FONDAZIONE
BRUNO KESSLER

# Implementation Plan for the Research Activity
# of the Fondazione Bruno Kessler
# for the Year 2012

Trento, December 2011

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# Introduction

As laid down by the Program Agreement between PAT and FBK for the 14th legislature, the proposal of the 2012 implementation plan must provide for the outline of activities for each internal unit and the general budget plan. For both aspects, the implementation plan refers to the contents of the "Research activities plan for the Program Agreement" (PA), for the five year period 2009-2013 that was turned in at the Province Government (PAT) in July 2009 and that provides an outline of the Foundation's medium term strategies.

The implementation plan for 2012 has been constructed in keeping with the AP's strategic guidelines in compliance with the above, on one hand, and four economic factors on the other: the start of T-Rise, the drop in external funding for projects, the drop in PAT funding on the PA and ties imposed by PAT on specific expenditure categories.

Regarding the research contents, we must distinguish the scientific and technological site activities (CIT, CMM, ECT*, CIRM) which confirm adherence to strategies laid down by the PA, from those of the human and social sciences site (ISIG, ISR and new activities) which are, on the contrary, expected to change direction, as specified in the dedicated section.

The advancement of T-Rise as a co-location center has led to a greater convergence between CIT's and UNITN's scientific strategies which will be implemented in 2012 also in innovation projects launched by T-Rise and reserved to the collaboration between companies and research. CIT's activity plan for 2012 confirms the excellent performance as far as competition among projects funded by the EU is concerned, thus maintaining a international credibility of prominence.

On the contrary, CMM is expected to undergo a phase of slight change, triggered by the arrival of a new director and decreased projects funding from external sources for 2012. This will entail the redefinition of some of the center's activities.

Despite this, the two research centers have greatly increased their synergy and in 2012 they will launch joint strategic projects; this is the major innovation with regards to the two research centers, which, in order to finance these multidisciplinary projects, will resize traditional activities, focusing resources and making strategic choices.

In keeping with the past, the ECT* center presents for 2012 activities included as full participants in the international scientific community, proving a point of reference at European level. From an institutional standpoint, the novelty in the science and technology site is represented by the transformation of CIRM from a simple activity into a FBK core center.

The Social sciences and humanities Site is expected to undergo in 2012 a true paradigm shift both in its research model and contents. The site is, as a matter of fact, has been thought of as a kind of multi-disciplinary department of humanities and social sciences, through which, on one hand, the Trentino region becomes able to attract prominent personalities in the relevant fields and, on the other hand, offers to talented young people and senior scholars the opportunity to invest s few years of their work, in a reciprocal exchange of knowledge and skills. Regarding its

contents, the Human and Social Sciences Site will become in the next four years a point of international reference on some topical issues due both to their importance on contemporary society from an ethics standpoint, and to their political and economic effects on the local communities. These are briefly grouped into two main areas:

− Improvement of citizens' wellbeing in a context of greater efficiency and responsibility in the public system
− Economic and social dynamics between cooperation and conflict

Regarding its relations with the local community, FBK will continue its virtuous relationship with its shareholders and its stakeholders, shifting from a more purely relational work that had been set in 2010, to the implementation of specific and concrete initiatives, which will contribute to improving the competitiveness of local companies and encourage the achievements of national and international networks, for a needed economic growth in the Trentino region.

Given that revenues from the private sector are made up of projects which result in the transfer of products for companies, and given that such resources tend to be declining due to the global crisis, FBK will work to ensure an adequate flow of funds from the private sector to ensure sustainable development at the Foundation. To ensure an economic return to the Foundation, in addition to the above, initiatives aimed at enhancing product research and supporting researchers in the definition of best practices in the selection of the most reliable partners will be planned.

Other novel projects for 2012 are represented by "special" projects such as:

a) OUTGOING-FBK project; The Foundation will offer a number of its researchers the possibility of a period of stay in a foreign university or research center to carry out a specific project. Each researcher may submit a project proposal in accordance with the host institution, the selection of the best projects will be done by a FBK Evaluation Committee.

b) RESTATE project; a program co-financed by FBK and the European Union within the Marie Curie actions, aims at promoting the mobility, at an European level, of highly qualified researchers by financing, through competition calls, up to 8 two-year scientific projects, proposed by experienced researchers of all nationalities, holding a PhD or equivalent experience. Compared to similar programs, RESTATE privileges scientific proposals which, besides being in line with FBK's research development strategies, aim at identifying innovative solutions to industrial problems

c) the participation of FBK in the VQR 2004-2010 assessment drill to be conducted by the National Agency for the Evaluation of University and Research (ANVUR), on behalf of the Ministry of Education, University and Research (MIUR). The drill is designed to assess the achievements of the national system of research, from 2004 to 2010, and concerns: the Italian universities (public and non-public), research institutes supervised by MIUR, other research organizations (such as FBK) who may apply for participation.

d) the continuation of the update of FBK's information system in order to make the most of their human capital.

After the internal reorganization approved by the Board of Directors in April 2011, the Administration and Research Support Services Division (CASSR) will continue, during 2012, the gradual convergence, together with the research part of FBK, toward common goals. In this regard, joint work groups will be created to address

specific problems related mainly to the definition of policies and tools for the enhancement of human capital and management of research contract s.

Regarding the aspect of funding for FBK's activities, the forecast for 2012 appears to mark a significant drop in funding from sources other than the PAT-FBK Program Agreement. Moreover, it must be said that FBK is also being affected by the global crisis; in fact the revenue forecast for 2012 is down, compared to the 2011 budget, to € 1.859K (-12.8%), as pointed out in table 1:

Table1. *Comparison revenues 2011-2012*

|  | 2011 | 2012 | diff | % diff |
|---|---|---|---|---|
| **Totale** | **14.466** | **12.608** | **-1.859** | **-12,85%** |
| CIT | 5.612 | 5.520 | -92 | -1.64% |
| CMM | 5.683 | 4.770 | -912 | -16.05% |
| ECT* | 2.012 | 657 | -1.355 | -67.33% |
| Other research activities | 188 | 203 | 15 | 7.98% |
| Other revenues | 972 | 1.457 | 485 | 49.89% |

For CMM, the reduction was due to a number of European projects that are about to expire and at the same time by the lack of new funded projects; the center has submitted several applications for funding of EU calls, the outcome of which will be formalized in mid-2012. The 2011 budget also contained estimates of revenue gain from projects that did not subsequently became concrete.

Regarding ECT *, we must say that revenues in 2011 were composed of two main items: i) revenues from the normal activities of the center and ii) revenues from the AURORA project, jointly funded by INFN and PAT. For 2012, the first remains constant, while the financing of Phase II of AURORA is not yet official. It should also be noted that should Phase II of the AURORA project not be launched, it will cause a lack of revenue but also decreased costs.

As for other revenues, it should be noted that, in 2012, the positive figure represented by the inclusion of the specific contribution arising from the energy efficiency improvement plan is partially mitigated by the reduced revenue from property tax expenses reimbursement, primarily by UNITN. In table 2 are the details relevant to revenue composition for CMM and CIT:

Table 2. *Comparison revenues CMM and CIT 2011-2012*

|  | 2011 | 2012 | diff | % diff |
|---|---|---|---|---|
| **CIT** | **5.612** | **5.520** | **-92** | **-1,64%** |
| EU Projects | 1.785 | 2.706 | 921 | 51,60% |
| Other External Revenues | 3.827 | 2.814 | -1.013 | -26,47% |
| **CMM** | **5.683** | **4.770** | **-912** | **-16,05%** |
| EU Projects | 1.079 | 747 | -332 | -30,81% |
| Other External Revenues | 4.604 | 4.024 | -580 | -12,59% |

We highlight the good situation of the Information Technology Center, which, while suffering a natural reduction of "Other External Sources" mainly due to the down-sizing of projects with companies, shows a terrific performance in the increasingly crowded competition on EU projects.

The financing of the Program Agreement by PAT will suffer a significant decrease in 2012 compared to 2011, due to the context of current conditions in the Trentino region. The implementation plan for 2012 sees in fact an Program Agreement funding for FBK Core (excluding subsidiaries in Program Agreement) amounting to € 31.432K against € 32.667K for 2011, with a cut of € 1.235K.

The distribution of funding from the Program Agreement within FBK occurred as a result of an internal bargaining between its Chairman, Secretary-General and Center Directors, which took into account the performances during 2011, difficulties in obtaining funding from external sources and proposals for strategic activities by the research centers. Table 3 shows the distribution of funding by the Program Agreement.

Table 3. *Comparison 2011-2012 PA*

|  | 2011 | 2012 | Diff | % diff |
|---|---|---|---|---|
| **FBK-core** | **32.667** | **31.432** | **-1.235** | **-3.78%** |
| CIT | 6.069 | 5.631 | -438 | -7.22% |
| CMM | 5.035 | 4.764 | -271 | -5.38% |
| ECT* | 512 | 493 | -20 | -3.82% |
| ISIG | 1.124 | 891 | -233 | -20.71% |
| ISR (with CSSR) | 781 | 307 | -474 | -60.75% |
| CIT Project | 0 | 238 | 238 | |
| Other research activities (1) | 1.961 | 1.154 | -807 | -41.15% |
| New initiatives (2) | 0 | 1.476 | 1.476 | |
| Chairman and Secretary General Offices | 781 | 752 | -30 | -3.78% |
| Admin. , Support services and Research valorization (3) | 7.639 | 7.214 | -425 | -5.56% |
| Operation and Overhead costs (4) | 6.106 | 5.834 | -272 | -4.45% |
| Structural investments (5) | 2.659 | 2.678 | 19 | 0.73% |

Notes:

(1)    comprises CNR , CIRM, SPIN-OFFs and , only for 2011, the MILAB project and the Haifa project

(2)    includes ANVUR, the WEB IRVAPP project new communication, RESTATE, Information system, studies and research, OUTGOING-FBK project

(3)    includes AIRT, Assessment Unit, University Special Project, FBK Special Project:

(4)    includes both operation costs (electricity, methane gas, porter's service, security, cleaning, tele-phone services) of the different sites (S. Croce, Povo, etc..), and the Foundation's overhead costs (performance bonus fund, insurance expenses, information networks management related costs, building maintenance costs, ….).

(5)    includes investments for laboratories and building plan activities

Given the lower contributions from the Program Agreement and external revenues, we will see a drop in overall costs which go from € 47.133K in 2011 to €44.040K for2012.

PAT has granted additional funding to the Program Agreement for 2012 for new projects (mainly the relaunch of the Human and Social Sciences Site) amounting to € 1.750K, which brings the overall contributions for FBK-core to:

Table 4. *Costs, revenue and PA 2012*

|  | Costs | Revenues | PA | % self-fin |
|---|---|---|---|---|
| **FBK-core + nuovi progetti** | **45.790** | **12.608** | **33.182** |  |
| **FBK-core without new projects** | **44.040** | **12.608** | **31.432** |  |
| CIT | 11.151 | 5.520 | 5.631 | 49.50% |
| CMM | 9.534 | 4.770 | 4.764 | 50.03% |
| ECT* | 1.150 | 657 | 493 | 57.16% |
| ISIG | 909 | 17 | 891 | 1.91% |
| ISR (with CSSR) | 351 | 44 | 307 | 12.57% |
| CIT project | 238 | 0 | 238 | 0.00% |
| Other research activities | 1.296 | 142 | 1.154 | 10.94% |
| New initiatives | 1.476 | 0 | 1.476 | 0.00% |
| Chairman and Secretary General Offices | 752 | 0 | 752 | 0.00% |
| Admin. , Support services and Research valorization | 7.239 | 25 | 7.214 | 0.35% |
| Operation and overhead costs | 6.596 | 762 | 5.834 | 11.55% |
| Structural investments | 3.348 | 670 | 2.678 | 20.00% |
| **New projects** | **1.750** | **0** | **1.750** |  |
| CMM project | 250 | 0 | 250 | 0,00% |
| New Human and Social Sciences Site | 1.500 | 0 | 1.500 | 0,00% |

Starting from 2012, in adherence to a development investment plan agreed with PAT, FBK will be involved in building operations for an amount of € 2.000K. These investments include the Povo site where the physical proximity between FBK and UNITN and shared urban connections and roads impose a global view of the entire sector, to be requalified as a scientific and technological research campus and which will include both FBK and UNITN buildings. The first investment will involve the first phase of construction of a new cafeteria that, in addition to meeting the needs of FBK staff (the current one is no longer adequate to accommodate the increased number of employees), it can also be partly used by UNITN faculty. The second investment will regard the preliminary stage for the creation of new spaces (laboratories and offices) for FBK research activities. Investments for 2012 can be summarized as follows:

Table 5. *Costs, revenues and PA 2012*

|  | Costs | Revenues | PA |
|---|---|---|---|
| **FBK Strategic investments** | **2.000** | **0** | **2.000** |
| **Strategic investments** | **2.000** | **0** | **2.000** |
| New cafeteria Povo | 1.500 | 0 | 1.500 |
| Povo site development | 500 | 0 | 500 |

Note that strategic investments (€ 2.000K) and part of the ordinary activity for a to-
tal of € 4.800K, are not funded directly by the PAT but are guaranteed by the use
of resources resulting from an ITC administrative surplus, i.e. funds that should
have already been assigned to FBK to liquidate a credit for the early years of the
Foundation, which had been considered of "difficult collectability." Access to these
funds by PAT demonstrates the predicament in which the whole system lies, and
calls us to a more rigorous policy of management for the Foundation.

During 2011, PAT issued some guidelines for FBK, and the other foundations and
system companies, aimed at containing spending on some specific items; these
guidelines were taken into account in the process of drafting the 2012 budget fore-
cast and in particular:

1    in fiscal years 2011, 2012 and 2013, the total expenditure on the Foundation
     staff (permanent, temporary and project collaborations) will not exceed the
     2010 one, with the exception of further expenses relevant to temporary re-
     searcher / technologist personnel increase related to the activation of new re-
     search projects

2    for researcher / technologist and technical-operational staff, the process for
     staff stabilization due to new permanent contracts shall not exceed 2 / 3 of to-
     tal staff (permanent, temporary and contract collaborations) expressed in
     terms of equivalent units and calculated with reference to the staff units on
     December 31, 2010

3    for administrative and support services staff, there shall not be any process of
     staff stabilization exceeding the number already granted by the provincial gov-
     ernment. Any hiring of temporary staff (temporary and project collaborations)
     will be accepted up to the maximum limit of 70% of the contracts ended for
     reasons other than stabilization

4    compared to the average of the total cost for 2008/2009 financial years, the
     Foundation shall cut by 50% the cost of external consultancy assignments,
     study and research charged on the program agreement and therefore different
     from those of competitive projects or special projects.

Table 6 provides a view by expenses categories which, by comparison with 2011,
also highlights the effects of PAT guidelines:

Table 6. *Comparison costs 2011-2012 by categories*

|                                    | 2011   | 2012   | Diff    | % diff   |
|------------------------------------|--------|--------|---------|----------|
| **FBK-Core**                       | **47.133** | **44.040** | **-3.093** | **-6.56%** |
| Personnel(a)                       | 25.762 | 24.953 | -809    | -3.14%   |
| Scientific equipment (b)           | 2.810  | 1.730  | -1.080  | -38.44%  |
| Strategic investments (c)          | 1.439  | 1.880  | 441     | 30.65%   |
| Other investments (d)              | 1.234  | 1.795  | 561     | 45.47%   |
| Travel expenses                    | 1.085  | 1.018  | -67     | -6.17%   |
| Material, maintenance, other (e)   | 6.746  | 4.478  | -2.268  | -33.62%  |
| Energy, water, etc.. (f)           | 2.639  | 2.588  | -51     | -1.93%   |
| MAP exempt collaborators           | 638    | 283    | -355    | -55.69%  |
| PhDs                               | 1.321  | 1.419  | 98      | 7.39%    |

| Cafeteria, other (g) | 1.815 | 1.944 | 130 | 7.15% |
|---|---|---|---|---|
| Other expenses (h) | 1.644 | 1.951 | 307 | 18.67% |

Notes:

*(a)   employees and collaborators; MAP exempt collaborators and PhDs*

*(b)   research equipment; works for the reorganization of offices; access gates management*

*(c)   works for laboratories and instrumentation*

*(d)   mainly in reference to: special maintenance: 1.167K€; subsidiaries (Say Service 64K€; Praticx 50K€; Okkam 33K€; Fabrica Ludens 45K€; CLS 50K€; Celct 66K€; New 55K€); books: 176K€*

*(e)   consumables: 801K€; conferences: 532K; additional endowments: 882K€, equipment upgrade and maintenance: 385K€; systems and buildings maintenance: 380K€; levies and taxes: 300K€*

*(f)   electricity: 835K€; Cleaning: 492K€; Methane gas 467K€; Security and porter's charges: 372K€; Telephone and internet services: 313K€*

*(g)   cafeteria: 529K€; consultants/services: 1.234K€;*

*(h)   project specific expenses: 1.951K€ mainly due to: CMM Project (250K€); CIT Project (238K€); Anvur (312K€); Studies and Research (210K€); RESTATE (190K€); IT Innovation (150K€).*

From the table you can notice a decrease, compared to 2011, in the cost of employees and collaborators (a) of 3.11% (-802K€); this positive result will have to be confirmed during the final accounting: to achieve this goal, FBK has adopted a tool that will help both the administration and the auditors to monitor the trend of personnel costs during the year. The sharp fall under scientific equipment (b) arises from two components: a reduction by the CMM and CIT centers on the normal equipment for the conduct of scientific activities, and not purchased equipment for ECT*'s AURORA project; the latter figure goes with the corresponding missed revenues for the AURORA project. This item (e) reveals a decrease, compared to 2011, of as much as 2,268K€ partly due to reduced project activities financed by the CMM (see declining revenues for CMM), and also to a substantial reduction of costs throughout FBK. You can also note that, despite the significant percentage reduction for total expenditure, the amount dedicated to PhD scholarships remains almost constant: a strong signal of the strenghening of the policy for the investment on UNITN doctoral students to make the synergy between the two institutions stronger.

In 2012, it will be important to define the role of UNITN and FBK subsidiary research institutions, created in recent years (Create-Net, Graphitech, Ceclt, Irvapp, Ahref). The relationship between them and the two main bodies should definitely be clarified, in terms of scientific and managerial indipendence and relationships with PAT; a clear decision that allows no interpretations, needs to be made among three possible options:

a)   the subsidiary institution becomes a part of FBK

b)   the subsidiary institution becomes completely independent

c    he relationship status remains unchanged but FBK obtains a real proxy on quality check of the research results of its subsidiaries.

In the first case, the subsidiary institution becomes an internal structure of FBK (center, research unit, other); the only legal status entity is FBK and everything refers to FBK's structure of governance and support. Strategies are defined by FBK's Board of Directors and FBK's Scientific Committee becomes their scientific reference. This makes it possible to define a common integrated scientific strategy decided within an agreement between FBK and UNITN according to the scheme of scientific clusters. We can thus also save resources by centralizing all services.

In the second case, the subsidiary institution becomes fully independent; UNITN and FBK cede their shares and leave any institution bodies. The institution does not fall any longer under the program agreement between PAT and FBK but defines its own program agreement with PAT. The role of scientific coordination and management governance is no longer carried out by FBK and UNITN but directly by the PAT

In the third case, following to an agreement between PAT, FBK and the subsidiaries, the PAT-FBK Program agreement needs to be amended so that FBK has the role described under c).

Since at present time the above definition has not yet been addressed, in 2012 FBK will find the above subsidiaries within its program agreement with PAT. Table 7 accounts for figures relating to the subsidiaries' PA only.

Table 7 - *Investee companies in PA*

|            | PA 2011 | PA 2012 |
|------------|--------:|--------:|
| **Total**  | **5,380** | **5,320** |
| Ahref      | 1,000   | 1,000   |
| Celct      | 270     | 210     |
| Irvapp     | 760     | 760     |
| Create-Net | 2,950   | 2,950   |
| Graphitech | 400     | 400     |

*The Secretary General*                    *The President of Fondazione Bruno Kessler*

Ing. Andrea Simoni                              Prof. Massimo Egidi

# SCIENCE AND TECHNOLOGY

CMM – Center for Materials and Microsystems

# Presentation

Director: Prof. Siddharth Saxena

## 1. Summary and vision

*Strengthening of CMM's Intellectual Property generation capacity to drive innovation and to build an international brand name beyond servicing national and international big players.*

CMM is a finely tuned institution serving the Industrial and Technical needs of Trentino, its neighbouring provinces and to some extent across Italy. It is also an engine for innovation and attracts the attention of European and International institutions as well as the big companies.

Brimming not only with potential and promise researchers and technical staff continuously make significant contributions in terms of new technologies, ideas for the future and business ventures on almost a daily basis. There are eleven units in CMM, each with its unique culture and technical background. These range from small biophysics and materials science based units to large infrastructure service and production oriented facilities like the clean-room or even a unique group on 3-D imaging of culturally and environmentally important locations world-over. Each requires a different type of management and support structure and offers very different kinds of deliverables. The strength and plurality of this diverse grouping becomes apparent when it comes together as a Centre to provide solutions to a wide range of customers coming from business, government and academic sectors. It also provides a coherent and integrated platform for collaboration, often catalyzing cooperation between, say government and industry, both locally and internationally. We are able to produce sensors for space-crafts and radio-telescopes or new coating materials for heavy industry as well as integrated imaging and bio-analysis systems for medical application and agro-business. Our scientists do aerial mapping of Trentino, hydroelectric plants to guard against stress damage and natural calamities and set up personalised and interactive devices for the public and school children in Art and Heritage museums.

Looking to the future we are gearing towards a step change in our internationalization while keeping our foot firmly in Trentino and indeed with a constant gaze towards Europe. It is essential that we are attuned to the exciting challenges and opportunities growing in the BRICK countries, namely Brazil, Russia, India, China and Kazakhstan. We have launched into industrial. This gives us a chance to train the future cadre of this emerging market and a competitive advantage in agro-business, nuclear and rare-metals and aerospace areas. We just appointed a young Cambridge researcher to work on a project between us and University in Cambridge (UK) and Princeton University (USA). This project is focusing on new materials and devices for electro-caloric cooling which can be integrated in VLSI

circuits to provide better power and computational efficiency through local heat management in next generation electronics.

## 2.   Objectives for 2012

Objectives for CMM are normalized with challenges and opportunities as follows:

Chanllenges:

–   Financial: Local and international financial crisis is causing severe difficulties in generating new contracts while we are also confronted by reduction and stagnation of the AdP income. This makes it difficult to ensure the critical mass of our main activities and drive growth.

–   Visibility: there is a difference between the Microsystems and Materials activities. The former has reached a good level in specific sectors, but still lacks outright international impact. The latter is still searching for a consolidated position despite the strong publication record etc.

–   In the last 2-4 years, several new research units have been launched. In some cases this led to efficient autonomy while the others have not established a reasonable footprint. There is good potential to align them both internally and internationally.

–   Due to the traditional 'organic' management practice and lack of understanding of international norms the internal competition is destructive rather than constructive. It is almost shocking that in the last four years cdA has failed to address and eradicate this.

To design a fruitful future one needs to consider how:

–   the excellence will be recognized at a more general level,

–   participation of individual researchers and Unit Heads in building and implementing the strategy,

–   to turn the crisis into an opportunity for growth,

Some central organizational changes must be implemented. The proposed changes must ensure:

–   The increase of the human capital and capacity (not number of people)

–   A more efficient managing model of the center ( deputy directors, advisors and board)

–   A clear commitment to applicable results (products for market)

–   A clear commitment to creating intellectual space for novel discoveries

To support a new Strategy thus following needs to be achieved:

–   the further growth of Microsystems capability

–   the visibility to Systems and foster their growth

–   the definition of Materials competences and their integration in central projects

–   Develop a better capability of Integration.

*Description of the changes (diagrammatic rendition further below)*

1.  Increasing of effective human capacity. There is a clear constrain that prevents acquisition of more people. Therefore, a rationalization of the blocks composing the center can facilitate harvesting of more time for research activities (increasing capacity without increasing personnel). This can be reached by reducing the number of units, but not by simply closing them down. The actual skilled leader will keep scientific leadership, having 100% of their time invested in research activities and cutting down duty for administrative commitment. Furthermore, reduction of barriers among units will allow a better exploitation of the working time and elimination of unnecessary duplications.

    The actual research units are going to be organized in three macro units, composed of researchers only and defined on the basis of specific scientific know-how:

    a.  new materials; major skill: new materials and interfaces properties

    b.  devices and microsystems; major skill: new devices, including devices with new functions

    c.  Systems; major skill: integration, systems approach.

    Each macro units will conduct strategic research projects, driven both bottom-up and top-down.

    On the other side, all the labs that at present are working also for the units, are going to be organized in a Facility, having the characteristics of offering high quality services and specific know how, continuously improved and kept up through research activities and equipment. Facility personnel can be made of researchers, technologist and technicians, depending on the task.
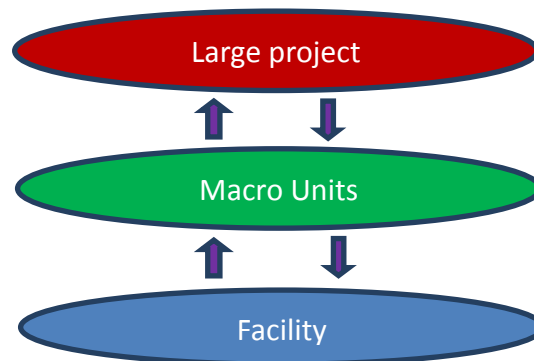


2.  Management model

a.  Each macro unit and facility has a responsible that reports to the director. Center is run by a board of 5 people (less in case of interim). Each macro units and facility has the autonomy to organize the research and/or service job to ensure high quality performances and objectives of the center.

b.  Following the research plan of FBK, supported by strategic commitment with UniTN and CNR especially in biological area, CMM must provide output in two

main applied fields: environmental (monitoring, energy transmission, storage and production) and biomedical. This turns out in large projects activation allowing the link among the macro units and finalized to the prototype level, viable for market introduction. Each large project will have a responsible, resource (human capacity) belonging to the macro units and integration tasks.
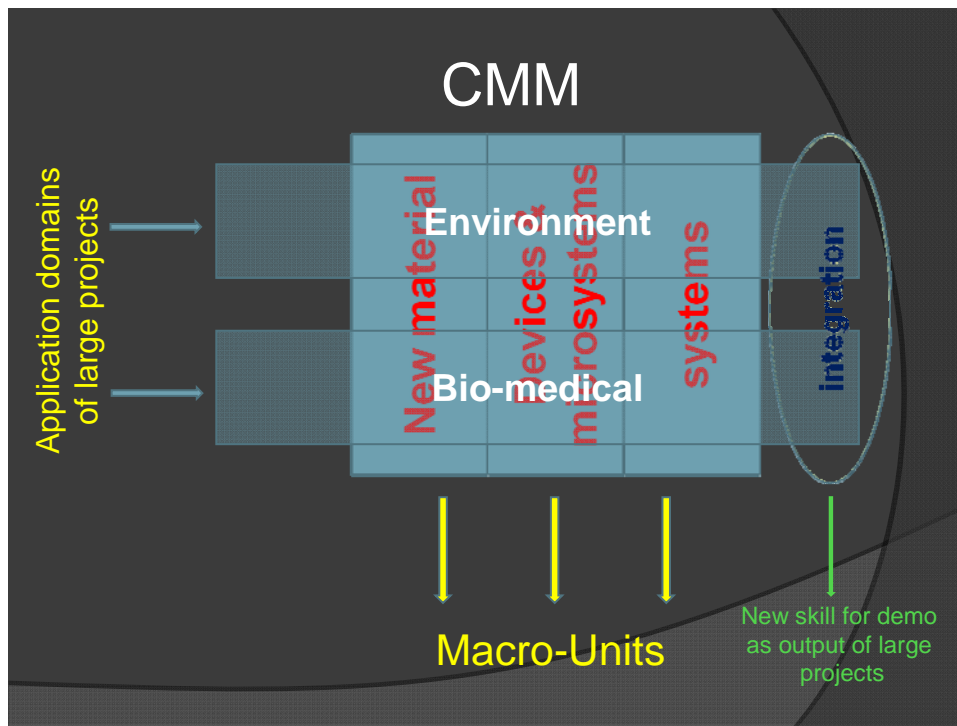


3. Applicable results. CMM must foster and exploit something unique on the national territory: the own ability to integrate different competences into a demonstrator/product. In this way CMM will fulfill:

   a. Better demonstration of its own capability
   b. Easier recognition of its know how
   c. Easier attraction of companies and governments
   d. Clearer innovation action
   e. Higher margin profit
   f. Generate its own high end Intellectual Property


**3.   Front Edge & New Initiatives**

*Description of two large strategic projects to be launched, one each in Environment and Biomedical areas, are to follow next. A third one on space applications is being prepared on the basis of MT Lab.*

*1.   Water splitting*

The growing awareness of issues related to climate change due to CO2 emissions and to energy system development sustainability has made the production of hydrogen fuel from sunlight and water one of the most important challenges in science today. The prospect of generating hydrogen from water as a substitute for fossil fuels has become a real possibility. However, large-scale direct photo-electrolysis of water under sunlight still faces many obstacles that prevent it from reaching its full potential. These technological barriers are caused by the lack of stable (corrosion resistant) and efficient light-absorption (suitable band gap) systems, the inherent semiconductor - redox energetics (difficulty to match the semiconductor band edge energies with the H2 and O2 reactions), and high catalyst cost as in the case of platinum and noble metals used in the standard systems.

This project aims to develop an innovative self-powered silicon-based microsystem for photocatalytic applications (PA). The advances in photovoltaics systems and the high efficiency achieved by modern PV cells have renewed interest in developing solar powered PA. This project will investigate the use of silicon and silicon nanostructures for water splitting applications. More precisely, a new concept of photo-electrochemical chemical (PEC) system design is proposed, based on an integration of silicon micro-structures to PEC cells, in a monolithic device for hydrogen generation by water splitting. Recent research in advanced materials has demonstrated the potential of these materials to significantly activate water reduction. Novel tandem catalyst systems will be selected as substitutes for the costly platinum group materials. Alternative and potentially inexpensive fabrication processes will be explored as well.

The present project is to be considered as a starting point of a wide program focusing on sustainable energy production and harvesting. However, it is extremely interesting to consider that this type of solar powered electrochemical system can open new and challenging scenarios for applications in other strategic fields. The key to achieve real progress beyond the state-of-the art relies on the combination and integration of different disciplines including nanotechnology, electro-chemistry, catalysis, photonics, microsystems, modeling and simulation. The complexity and the variety of disciplines of this research demands a strong combination of scientific backgrounds and can be efficiently exploited if accomplished under an international collaboration with the skills presents within the proposing team.

The proposal research team is particularly interested in extending the technical knowledge developed in optimizing the electrochemical properties of a Si-liquid junction to applications in water remediation. For example, because of the inertness of the semiconductor electrode against reduction, a PEC device with high specific surface area can constitute a viable and efficient system to reduce metallic ions that contaminate water. Likewise, other photochemically driven reactions can be investigated in future, such as the direct production of ozone for water purification applications.

Therefore, our proposed research program envisions developing a technology platform made up of microsystem building blocks that can be applied to multiple application domains, particularly in water purification, energy generation, and other solar-energy driven chemical processes.

Large project: project exploting new material properties (as related to new compound or new structure, including nano features) enabling new device/microsystems to be integrated in systems for environmental or biomedical application mainly.

*2.    Biomaterials and micro-scale technologies for health and biomedical systems*

Over the coming decades, the populations of many countries will age due to a decreasing birth rate and an increasing life expectancy. This, among many other aspects, will impact the healthcare system with certain disease appearing earlier in life while the older generation will require a higher quality of life. At the same time, the healthcare costs have been increasing due to the costs associated with healthcare development in a regulated social system and a higher patient expectations. In this context cost effective technologies and cutting-edge treatments are fundamental and are driving an increasing demand for new technologies in health and personalized medicine based on the realization of low cost, flexible devices and new nanomaterials for diagnosis and therapy. Nanomedicine has the goal to provide cost effective novel therapies and diagnostics using the expanding word of micro and nanotechnology. It investigates the physical, chemical and biological properties of materials at the nanometers scale enabling the development of tools improving diagnosis, treatment and follow-up of diseases.

In this context the research activity of the bionanotechnology team (Bio-MEMS, BioSInt and PAM-SE Units) at CMM will be focused over the next five years particularly on the development of research and medical diagnostic ("in vitro") tools. The main goal is to develop innovative solutions in the form of novel devices for preparation and analysis of biological samples, and, as long term aim, to add value to these devices through the development of integrated systems, addressing specific end-user requirements in diagnosis. In agreement with the European guidelines cancer is our selected disease area. Cancer is currently the second leading cause of death in Europe, while it shows probably the highest clinical complexity. Biomedicine stands the potential to provide an effective understanding of the complexity of the disease as it offers innovative diagnostic and therapeutic options. Especially in cancer, early diagnosis is of utmost importance. Late-stage metastatic cancer is difficult to cure and treatment leaves severe side-effects, and causes suffering for the patient. Diagnostic tests that allow measurement of a biomarker panel are necessary to catch the disease at on-set. Nanotechnology could enable the parallel in vitro measurements of many biomarkers at the same time, while keeping the test simple, sensitive, reliable, and inexpensive. In addition nanotechnology provides the tools to discover novel biomarkers, enhancing reliability and accuracy of diagnosis.

Main objectives will be the development of:

–   Portable point-of-care (POC) devices: differently from the progress up to now focused on central analytical labs, there is a trend towards the decentralization, i.e. simple diagnostics tests in the physician's office. Within the view of the development of POC devices sample preparation is a key challenge in particular going from micro to nano-scale.

– Devices for multi-parameter measurement: analysis offering to doctors a more comprehensive and personalized diagnosis.

This activity will be based on the collaborative work of researchers belonging to different Units within CMM having a background that covers competences on micro-technology, microfluidics, photonics, nanomaterials, biophysics and biology. The diverse expertise of the collaborative group fosters the development of integrated systems for these applications. Also, the research activity will be carried out in close collaboration with other technological partners such as ST-Microelectronics, Laboratory for nanofabrication of nanodevices (LaNN, Padova), Olivetti I-Jet and Polytechnic of Turin and with biological groups, mainly the Integrative Biology Centre (CIBIO) of Trento University, the IRCCS Burlo Garofolo-University of Trieste, University of Milano, University of Torino, CNR-Istituto di Tecnologie Biomediche.

Main running projects: A NAno on MIcro approach to a multispectral analysis system for protein essays (NAOMI); Advanced nanosystems for a new era in molecular oncology (NEWTON); Microchip-based solid-phase extraction of polysomal mRNA for translatome analysis.

In this area an important local partner is the CIBIO Centre of Trento University. FBK, CNR-IBF and CIBIO face together the strategic issue of the new technologies for nucleic acid sequencing for biomedical applications, by establishing a common, interdisciplinary laboratory: Laboratory for Sequence and Structure Analysis for Health (LSSAH). The aim is to concentrate resources and integrate expertise in molecular biology, bioinformatics and bionanotechnologies to face the challenge in the development of nanomedicine (that will have a strong social impact). The high-throughput sequencing technologies, also known as next-generation and deep sequencing (NGS), and the molecular imaging techniques are, nowadays, the focus of an unprecedented scientific revolution that could also be push by the Trentino research system. Thanks to these new technologies, the physiological and functional mechanisms of diseases can be now investigated quantitatively and at the highest achievable resolution of the cell structure.

Finally, we intend to apply our competencies to a different field of nanomedicine (molecular imaging) with the study and development of coated silicon and/or iron nanoparticles for cell imaging to gain a deeper understanding on different metabolic reactions and molecular mechanisms in normal and pathological cells. This research activity is part of a strategy among the University of Trento (Physics Department, Material Science Department), CNR (IBF and IFN) and FBK which aims to strengthen their activities in material science and technology by promoting closer relations among the research groups which are active in these fields. Main running projects: Smart nanoparticles for imaging, detection and therapy of cancer (NANOSMART); Functionalized silicon nanoparticles as luminescent labels for biomedical applications.

*3.   New Perspectives in International Grants, Networks and Partnerships*

(Cases of CMM-Princeton-Cambridge Projects, ICAM Network, Government of Kazakhstan, Uzbekistan Science Park and Mediterranean Nano Science Network and Maryland )

While the plans for the future adjustments are being drawn, since April 2010 CMM has been inserted into targeted actives based on my personal connections and initiatives, which have drawn on internal and external opportunities. A bright young Cambridge researcher being paid a tiny salary by CMM has capitalised on setting up collaboration where new materials for refrigeration and photo-magnetic applications are fabricated in *Princeton Physics and Chemistry departments*, devices and films from these materials then are being produced in CMM ( bringing together PAM and MT Lab together for the first time) and being tested in *Cambridge*, with a view set up some testing in CMM also. Two papers are already written and submitted on this topic and Princeton and Cambridge have born the costs of their side of the project themselves. We have new project at advance planning stages with University of Maryland.

*Opportunities from many emergent economies are growing and I have positioned CMM in two of these as a leading player details are as follows with potential grants of 5 Million Euros*:

Cambridge-Uzbekistan-CMM_FBK Initiative on organisation of the science park (MoU under negotiation)

For implementation of "Centre for High Technologies in Tashkent city, Republic of Uzbekistan"

This Memorandum of understanding (hereinafter "Memorandum") is concluded between:

Ministry for Foreign Economic Relations, Investments and Trade of the Republic of Uzbekistan, having the registered office at the address: 1, T. Shevchenko str., Tashkent, Uzbekistan,

Ministry of Finance of the Republic of Uzbekistan, having the registered office at the address: 5, Mustakillik sq., Tashkent, Uzbekistan,

Ministry of the Higher and Secondary Special Education of the Republic of Uzbekistan, having the registered office at the address: 96, 2-Chimbay str., Tashkent, Uzbekistan,

Academy of Sciences of the Republic of Uzbekistan, having the registered office at the address: 70, Academician Ya.Gulyamov str., Tashkent, Uzbekistan,

from Uzbek side,

Cambridge-Uzbekistan Initiative on organisation of the science park, Cambridge Central Asia Forum, Jesus College, University of Cambridge, Jesus Lane, Cambridge CB5 8BL, United Kingdom

from British side

Centre for Materials and Microsystems, Fondazione Bruno Kessler, 18 via Sommarive, Trento 38123, Italy

from Italian side

Article 1

1.1.   The main objectives of the Centre will be: Creating a platform for the innovative development of the Uzbek economy which will provide the institutional infrastructure for the synergetic utilisation of advanced scientific, technological and

business management processes and practices in accordance with HE President Karimov's declaration in support for growth of innovation and SME sector in Uzbekistan and utilise Cambridge's and CMM_FBK's long standing expertise in this area.

This will be achieved through actions below which are listed in the order of priority:

a. Creation of Analytical and Research Centre comprising of State-of-the-Art Analytical Equipment which are needed by Uzbek and International industry operating in the Republic of Uzbekistan to provide measurement and analytical services.

b. Creation of Business and Technology Transfer and Innovation Hub, similar to other such institutions in Cambridge, in order to provide Innovation environment, training, intellectual property consultancy and management support to new and existing technology businesses in Uzbekistan. This will allow Uzbekistan to acquire latest technologies from abroad and also showcase Uzbekistan's technological innovations at the international stage.

c. Create Training Innovation and Management Education Programmes in the form of Executive Education for Senior Managers and CEO's of Uzbekistan's state owned enterprise, heads of relevant government departments and ministries.

d. After a strict selection procedure carried out by project advisory team from Cambridge made up of senior Cambridge academics and CMM_FBK researchers lectures, seminars and practical studies in English will be delivered by teachers and scientists from Cambridge and CMM_FBK, to a limited and selected group as mentioned above, of postgraduate (Masters and PHD degree) students and young scientists of National University of Uzbekistan, Tashkent State Polytechnic University and other higher educational institutes of the Republic of Uzbekistan to deepen knowledge of chemistry, physics, biology, biochemistry, biophysics, Geology and Geophysics, all branches of engineering and computer sciences and other relevant areas of innovation and management. Selections of learners will be made after direct interviews either in person or through video link by Cambridge academics. Only those who have achieved a minimum of 7.00 IELTS score and an assessment examination will be allowed to participate in the academic lectures.

e. Furthering developments in the field of chemical, physical, biological, biochemical biophysical, geology and geophysics, all branches of engineering and computer sciences and other relevant areas. Conduct research activity with local and foreign enterprises, organizations, scientific and educational institutions.

f. Facilitating technology transfer from and to Uzbekistan

g. Facilitating the creation of new businesses and the innovative development of the Uzbek enterprises

1.2.   The Centre will conduct applied scientific research in the field of chemistry, physics, biology, biochemistry and biophysics, Geology and Geophysics subjects to achieve innovation and to fulfil the orders of any interested sector of economy and enterprises.

*Cavendish Laboratory, Cambridge-Centre for Materials and Microsystems_FBK, Trento-KazAtomProm, Astana Kazakhstan Joint Technology Initiative*

The project will exploit material and human resources in Kazakhstan, Cambridge and CMM_FBK to synergise technology transfer, innovation and other relevant expertise in Cambridge and Italy to jointly create new technology, bring new expertise to existing technical and industrial complexes in Kazakhstan and provide innovation, business and technology management training. This will be achieved by:

1.  Creating of joint laboratories in Kazakhstan, Cambridge and Trento

2.  Creating technology transfer platform

3.  Creation of companies to exploit and develop technologies

4.  Training of people through scholarships and research visitor positions

In the phase one we propose to start medium sized technology based on Nb and Ta and training initiatives and prepare feasibility studies for large-scale strategic projects. An example of such project would be Maglev of Superconducting Train. A country like Kazakhstan which has wealth of rare-earth metal resources needed for production of magnets and superconductors can have unusual and unique opportunity to develop this technology in Cooperation with Cambridge and CMM_FBK. From an economic and strategic point of view, Kazakhstan has a great need of transport of good at high speed from one end of the country to another. Conventional railways can only partly meet this challenge and the customs union maturing, such a need will increase dramatically.

We would like to propose the following medium term projects, lasting five years:

1.  MATERIALS AND INTERFACES ENGINEERING FOR SUPERCONDUCTIVE ELECTRONICS

2.  NOVEL TANTALUM OXIDE - BASED ELECTROCATALYST FOR PEM FUEL CELL APPLICATION

3.  TANTALUM OXIDE NANO-ARCHITECTURES FOR PHOTO CATALYSIS APPLIED TO WATER TREATMENT

4.  MAGNETIC REFRIGERATION USING RARE EARTH MAGNETS

5.  COMMERCIALISING ULTRA PURE RARE-EARTHS

6.  PRODUCTION OF TANTALATE AND LITHIUM NIOBATE CRYSTALS FOR THEIR APPLICATION IN OPTOELECTRONICS AND LASER TECHNICS.

7)  Beryllium materials and products.

*ICAM Network*

The Institute for Complex Adaptive Matter(ICAM-I2CAM) is a distributed experiment-based multi-institutional partnership whose purpose is to identify major new research themes in complex adaptive matter—the search for an understanding of emergent behavior in hard, soft, and living matter.

Established in March 1999, ICAM became, in April 2002, a Multidisciplinary Research Program of the University of California, with nine founding branches. In July, 2004, it received an award by NSF to establish the International Institute for Complex Adaptive Matter (I2CAM) as an integral part of ICAM to continue and ex-

pand ICAM's international scientific and educational activities. Since then ICAM-I2CAM has grown rapidly to its present constellation of branches: 31 in the US, 15 in Europe, 5 in Asia, 1 in Australia, 1 in the Middle East, 1 in South America and one European affiliate. Altogether, ICAM links 84 leading centers of complex materials research worldwide.

ICAM's integrated scientific and educational program includes exploratory workshops, symposia, fellowships, and research and educational networks. It has a well-developed communication, governance and advisory structure. Moreover, at each branch there is in turn an interdisciplinary grouping at the local level – from materials science, physics, chemistry, and biology, from theory and experiment. ICAM received early support from the Alfred P. Sloan Foundation, the David and Lucille Packard Foundation, the University of California Office of the President, Los Alamos National Laboratory, and the Richard Lounsbery Foundation. Its current activities are supported by the National Science Foundation, Los Alamos National Laboratory, the A.P. Sloan Foundation, the Trinity Capital Corporation and cost sharing contributions from its branch members.

## 4. Budget

|  | 2011 | 2012 |
|---|---|---|
| Expenses |  |  |
| Personnel | € 6.396,82 | € 6.320,46 |
| Travel | € 299,82 | € 271,35 |
| Equipment (HW/SW) | € 672,50 | € 332,00 |
| Other (e.g. subcontracting to external contractors) | € 3.348,24 | € 2.610,62 |
| Total Expenditure | € 10.717,38 | € 9.534,43 |
| Incomes |  |  |
| EU Projects (total amount financed by EU) | € 1.079,07 | € 746,56 |
| Other external incomes (industrial, PAT projects, etc.) | € 3.287,39 | € 2.182,99 |
| Projects to be finalized | € 1.316,14 | € 1.840,85 |
| Total Income | € 5.682,60 | € 4.770,41 |
| Financial Need (Total Income – Total Expenditure) | € 5.034,77 | € 4.764,02 |
| Self funding | 53,0% | 50,0% |

Note: Column 2011 is based on the unit's budget state as estimated at the date of document writing. Column 2012 is the budget planned for 2012

# BioMEMS – Bio MicroElectro-Mechanical System

Head of Unit: Leandro Lorenzelli

## 1. Summary and vision

*Scope and motivation for the activities carried out in the unit*

Starting from a background of expertises in microfabrication technology, microsystems and biotechnology, and according to the results produced during the previous years, the BioMEMS research unit will focus the efforts in 2012 on the two most promising areas of research conducted so far (i.e. Biodevices for cell analysis and Flexible electronics) where the impact in terms of innovation and publications is rapidly increasing. The scope of these activities is to develop microsystems enabling cell-based assays from cell culture to biochemical analysis and flexible devices for robotics and haptic interfaces applications. The knowledge accumulated in the past years on microsensors for environmental safety and security has led to the implementation of robust technologies for electrochemical, gas and flow sensors: this activity will be fully devoted to the exploitation of commercial contracts with companies and to implement this class of microdevices in application oriented systems.

*Positioning with respect to the state of the art and notable recent achievements of the unit*

*Microsystems enabling cell-based assays from cell culture to biochemical analysis.* The development of new microsystems for *in vitro* cell culture analysis (Lab on a Cell, microelectrode arrays, micro-bioreactors) can provide real time information about the biochemical behaviour of a cell, when exposed to specific pharmacology treatments, and models to predict the toxicological effects at systemic level. New microsystems for cell analysis might be able to guarantee a real time control of the cell conditions not only in whole cell populations, but also for single cells. Moreover, in biomedical field there is a wide interest in the possibility to genetically handle single cells for gene therapy application and to monitor lysates. This aspect guarantees a strong link between the research of microsystems for cell-based assays for cell culture and for biochemical analysis (e.g. DNA, RNA, proteins chip): microsystems for single cell analysis can provide a validation platform for the studies on genomics and post-genomics. The BIOMEMS unit's results in this field have been proposed to the scientific community and have received an award that stimulate further progresses in this activity.

*Flexible electronics.* Electronic systems that can be implemented on flexible substrates have received increasing attention in the last couple of decades. Thin devices possess properties like compliance, flexibility, conformability, elasticity, lightweight, etc. for a wide range of applications such as tactile sensors, flexible displays, electronic skin etc. Here, the overall size of the systems rather than the

minimum feature size of an individual circuit component represents the primary scaling metric. Concerning the positioning with respect to the state of the art, recent advances obtained at BioMEMS in the development of silicon based thin films make possible to fabricate high performance, flexible and foldable CMOS integrated devices. First results have been presented in scientific contexts in the area of Flexible and Organic Electronics. Fabricating flexible and stretchable sensing and electronic structures presents the challenge of processing and combining stiff and brittle device materials with highly compliant substrates for application areas like wearable electronics, electronic skin, prosthesis and many more.

*Vision about the most promising directions and activities to conduct in the future*

*Microsystems enabling cell-based assays from cell culture to biochemical analysis.* Innovative BioMEMS include the class of systems for diagnostics at cellular and molecular level, where the miniaturisation is generally considered the strategy to meet the requirements for efficient analysis and where further advances can be achieved by adopting a nano-microtechnological approach. In this aim, microsystems will provide essential interfaces between the macro world of human beings and the nano-world of molecules. The versatility offered by a multidisciplinary approach combining nano-microtechnology, nanomaterials and biology is the paradigm of a BioMEMS research unit with high-tech content. In this context, the activity aimed to improve the microsystems for investigating cell behaviour represents a key technology able to provide an in vitro platform to test the effectiveness of pharmacological treatments and to validate "on cell", the results of biochemical studies by vehiculating biomolecules (DNA, RNA, proteins and funtionalised nanoparticles) inside single cells.

*Flexible electronics.* Starting from a consolidated knowledge on the fabrication technologies for hybrid polymer/solid state based devices for tactile sensing, the vision is to extend the investigation to the realization of a technological platform for mass producible flexible and conformable smart systems. The availability of smart devices with conformable and flexible performances is still an open issues in many applications in robotics, in haptic interfaces and multifunctional microprobe for microsurgery. The aim is to implement sensors based on flexible polymeric materials fully compatible with both MEMS and IC processes.

*Unit composition*

|  | 2011 (as of Jan 1st) | 2012 (planned) |
| --- | --- | --- |
| Research directors | <NN> |  |
| Senior researchers* | 2* | 2* |
| Researchers | 4 | 4 |
| Technicians | 1 | 1 |
| PhD students | 0 | 1 |
| Total | 7 | 8 |
| Tenured (researchers/Technicians) | 5 (4/1) | 5 (4/1) |
| Tenure track | 0 | 0 |

Note: "Research directors" are level 1 researchers; "Senior researchers" are level 2 researchers. Category "Researchers" covers all other cases, including level 3 and 4 researchers, postdocs and other contractual forms used to enroll researchers.
(*) 1 BIOMEMS senior researcher participates for the 50% in the BioMEMS budget and activity and for the remaining 50% is in charge to Z2M srl company (FBK spin off). "Tenured" includes also a PAT technician.

*Top researchers by citations (max. 5)*

| Researcher | H-index | Citations (total) |
|---|---|---|
| Leandro Lorenzelli | 11 | 334 |
| Ravinder Dahiya (post Doc EU Marie Curie) | 5 | 104 |
| Andrea Adami | 5 | 70 |

## 2.   Recent publications

| Year | Jour. Papers (IF) | Q1 (%) | Conf. Papers | Patents | Books (authored) | Books (edited) | Chapters in Book |
|---|---|---|---|---|---|---|---|
| In print | 3 | 49 | 0 | 0 | 0 | 0 | 0 |
| 2011 | 6 | 53 | 15 | 0 | 0 | 0 | 0 |
| 2010 | 9 | 52 | 24 | 0 | 1 | 2 | 0 |
| 2009 | 6 | 83 | 10 | 2 | 0 | 0 | 0 |
| 2008 | 6 | 56 | 25 | 0 | 0 | 4 | 0 |

Note: The IF range of the main journals in the Microsystems/BioMEMS area is from 1 to 4. In order to ensure the best visibility, BIOMEMS has consolidated the presence in International scientific committees of conferences as Micro Nano Engineering (MNE), Eurosensors and CIMTEC by participating also as session and program chair.

Top 5 publications in the last 3 years (2009-2011):

−   L. Odorizzi, C. Ress, C. Collini, E. Morganti, L. Lorenzelli, N. Coppede`, A. B. Alabi, S. Iannotta, E. Cazzanelli, L. Vidalino, P. Macchi, "*An integrated platform for in vitro single-site cell electroporation: Controlled delivery and electrodes functionalization*", Sensors and Actuators B, publication date 06-17-2011 ISSN: 0925-4005 [UGOV: 39787].

−   Ravinder S. Dahiya, D. Cattin, A. Adami, C. Collini, L. Barboni, M. Valle, L. Lorenzelli, R. Oboe, G. Metta, F. Brunetti, "*Towards Tactile Sensing System on Chip for Robotic Applications*", IEEE Sensors Journal, vol. 11, n.12, 2011, pp. 3216–3226. [UGOV: 33385].

−   E. Morganti, C. Collini, R. Cunaccia, A. Gianfelice, L. Odorizzi, A. Adami, L. Lorenzelli, E. Jacchetti, A. Podesta`, C. Lenardi, P. Milani, "*A dielectrophoresis-based microdevice coated with ns-TiO2 for separation of particles and cells*", Microfluidics and Nanofluidics, vol. 10, n. 6, 2011, pp. 1211-1221. [UGOV: 23949].

−   Mattia Marelli, Giorgio Divitini, Cristian Collini, Luca Ravagnan, Gabriele Corbelli, Cristian Ghisleri, Antonella Gianfelice, Cristina Lenardi, Paolo Milani, Leandro Lorenzelli, "*Flexible and biocompatible microelectrode arrays fabricated by supersonic cluster beam deposition on SU-8*", Journal of Micromechanics and Microengineering , vol. 21, n. 4, 2011, [UGOV: 26009].

−   A. Adami, E. Morganti, L. Lorenzelli, L. Francioso, P. Siciliano, "*A novel approach to data analysis for semiconductor metal-oxide gas sensors in chromatographic systems*", Sensors and Actuators B, vol. 147, n.1, 2010, pp.1-4 [UGOV 6308].

## 3.  Objectives for 2012

**O1: Research on integrated systems for in-vitro cells assays and bioaffinity tests.** The BioMEMS research in the biomedical field is aimed at the study of:

- *Microfluidic-based microsystems for ensuring long term cell viability study in microgravity conditions.* The activity will require the design and fabrication of a microfluidic network for cell analysis in space laboratories for drug screening. In the framework of a project financed by ASI (Italian Space Agency), different solutions for MEMS-based micro-bioreactors for in vitro tests will be integrated on chip in order to study the drug concentration effects on cell growth and differentiation. In the final part of the activity, tests in microgravity conditions will be also performed in order to validate the suitability of the system for applications in space.

- *Lab on-chip in-vitro tests of cells in medical diagnostics by means of electrically-actuated nanoporation approaches.* With the results obtained during the previous year, the activity in the 2012 will be focussed on the final integration of the developed microsystems (Lab on Cell) for the study of the function of genes and proteins on in-vitro cell. In the present approach, the microsystems will include MEMS-based single cell-poration techniques based on specific modules for cell handling and separation, high density microelectrode array for cell stimulation, and microfluidics for cell transfection of specific biomarkers and functionalised nanoparticles. An important aspect will concern the collaboration with CIBIO (University of Trento) in all the experimental activities.

- *MEMS-based microcantilever arrays for bioaffinity studies.* The technologies involved deal with both ad hoc MEMS approaches for the realisation of thin suspended Silicon beams with tight thickness control, and the implementation of thin film cantilevers compatible with CMOS microelectronic processes. In this aim, the microcantilevers array realised during the 2011 will be finally characterised and tested. The microcantilever array working in the bending mode (i.e. in the stress-detection mode), suitable for operating in liquid phase, will be implemented in lab on chip architectures. In the 2012, the activity will be focussed on the validation with oligonucleotide probes of the final devices as label-free bioaffinity sensors.

*Research on flexible devices and electronics*

- *Flexible tactile sensing arrays.* The goal of this activity is the development of tactile sensing modules for the humanoid robot, its integration with robot and subsequent use in the robot control loop for exploration and manipulation tasks. After the realization of the first CMOS tactile sensors (with piezoelectric polymers, as sensing element at the gate of a FET device) on thin (10 um thick) silicon, the activity will be addressed to the implementation of the thin device in a flexible substrate.

- *Flexible Microelectrodes.* The activity deals with the improvement of a technology for microelecrodes arrays (MEAs) for cell stimulation on flexible substrates. The goal is to realize devices able to evaluate how surface conformability is reflected into cell growth and differentiation and biochemical signals.

- *Flexible nanowires.* The goal of the activity on flexible electronics (Flexsensotronics project) is to develop silicon based flexible electronic and sensing components. So far, silicon microstructures (e.g. microwires) have been successfully transferred to flexible substrates such as polyimide. As further development upon this key outcome, in the next year it is planned to develop electronic devices on flexible substrates using the silicon microwires. In fact, the discussion on the fabrication steps has already been initiated. Furthermore, the investigation will include transfer of silicon microstructures on other flexible substrates such as PET.

**O2: Fund raising.** The main actions for funds raising will be:

*Research on integrated systems for in-vitro cells assays and bioaffinity tests.*

- A EU/NIH project proposal on the development of bidirectional peripheral neural interfaces with electromagnetic stimulation for investigating the feasibility of a novel principle combining high selectivity, low invasiveness and resilience against physiological reactions;
- A EU project proposal on the development of microseparation systems for analyzing beverage samples for the simultaneous and rapid identification of chemical species.

*Research on flexible devices and electronics.*

- A ITN (Initial Training Network) EU project proposal on technologies for bendable, stretchable electronic skin aimed to develop the electronic skin patches with sensors and electronics spread over large areas

**O3: Any major objective agreed with the director.** During the 2012 the BIOMEMS research unit will collaborate with BIOSINT and SOI units in the FBK strategic project RNA by providing sensing technologies for label-free detection of RNAs and microfludic systems for in vitro tests. The technologies for sensing will be addressed to cantilever arrays for the detection of surface stress induced by immobilized biomolecules.

## 4.   Front Edge & New Initiatives

In tight collaboration with the PAM-SE research unit and according to the indications of the CMM Director, we started a research activity aimed to investigate the potential applications of graphene in the flexible-stretchable microelectronics sector. During the first period, the BioMEMS research unit will work with graphene purchased or fabricated through sub-contracting. This will allow to perform a feasibility study on the integration conditions of graphene into electronic devices. The two research units will take in charge the characterization of graphene from various points of view.

## 5.   Funding

| Acronym | Full name | Type | Duration | Total income [€] | Income 2012 [€] |
|---------|-----------|------|----------|------------------|------------------|
| NAOMI | A NAno-On-MIcro approach for a multi-spectral analysis of proteins | RL | 1/10/2008-30/09/2012 | 323638 | 60696 |
| T-BEST | Contratto di prestazione di servizio sul progetto T-B.E.S.T. finanziato a Far-Systems dalla PAT | PL | 15/1/2010-28/02/2012 | 200001 | 15226 |
| FLEXSENSO TRONICS | Flexible Sensors and Electronic Systems for Large Areas | RL | 15/05/2010 - 14/05/2013 | 148999 | 49757 |
| ROBOSKIN | Skin-based technologies and capabilities for safe, autonomous and interactive robot | EN | 24/02/2011 - 24/02/2012 | 15000 | 2260 |

Type: EU, PAT, Other public agency, Industrial.

Note: The Table have to be updated with the following project/contract approved or in a final stage of assessment.

ASTRALAB – "Miniaturised Multi-parameter Cell Analysis" ASI project, duration 1/09/2011-31/12/2012, Total income 2012 is 70000 Euro. This project has been included in the 2012 badget.

*ALENIA 2012 – "Flow sensors for space applications", Industrial contract for 2012 – in evaluation step, Total income 2012 is 60000 Euro.

*NARVALUS – Contract for mass production of an electroporation system", Industrial contract for 2012 –in evaluation step, Total incoming 2012 is 250.000 Euro.

(*) contracts waiting the final acceptance of bid. Only the 20% of the total incoming have been considered in the 2012 budget.

## 6.   Budget

|  | 2011 | 2012 |
|--|------|------|
| Expenses |  |  |
| Personnel | € 394,64 | € 400,17 |
| Travel | € 19,91 | € 19,00 |
| Equipment (HW/SW) | € 20,00 | € 13,00 |
| Other (e.g. subcontracting to external contractors) | € 112,12 | € 71,00 |
| Total Expenditure | € 546,67 | € 503,17 |
| Incomes |  |  |
| EU Projects (total amount financed by EU) | € 33,84 | € 0,00 |

| Other external incomes (industrial, PAT projects, etc.) | € 204,66 | € 116,05 |
|---|---|---|
| Projects to be finalized | € 45,77 | € 110,14 |
| Total Income | € 284,26 | € 226,19 |
| Financial Need (Total Income – Total Expenditure) | € 262,40 | € 276,98 |
| Self funding | 52,0% | 45,0% |

Note: Column 2011 is based on the unit's budget state as estimated at the date of document writing. Column 2012 is the budget planned for 2012

## 7.   Remarks

In 2012 will be requested a three years contract renewal for Elisa Morganti. Dr. E. Morganti has concluded on December 2011 the first three-year contract cycle at FBK.

# SOI – SMART OPTICAL SENSORS AND INTERFACES

Head of Unit: David Stoppa

## 1.    Summary and vision

The mission of Smart Optical Sensors and Interfaces - SOI - Research Unit is devoted to the integration on silicon by means of state-of-the-art CMOS technologies, of smart optical sensors and full custom read-out interfaces. The main objectives of the Unit are related to the design, fabrication, test and system integration of innovative and intelligent sensors with particular focus onto four main research topics: (i) single-photon time resolved image sensors, (ii) IR/THz multispectral imagers, (iii) energy aware sensors, (iv) read-out interfaces for above-IC or hybrid sensors. The main expertise build up by the Unit's researchers is in the field of high sensitivity optical detector architectures, which can be employed in different sensing device spanning from life science to ambient-assisted living and from safety and security to cultural heritage preservation. The skills in designing smart electronic interfaces, especially readout of arrays for multispectral sensors, have an important role in the research activity of SOI, as well as the competences developed in the field of low power imaging sensors for wireless camera networks. Most of these activities are driven both from scientific challenges, as those set by the international funding agencies like the EU, as well as from roadmaps set by the leading industries in the fields of Microsystems.

*SOI is recognized among the top five research groups worldwide* in the field of CMOS Single-Photon Avalanche Detectors as demonstrated by the publication score, the numerous review requests on this topic, the contributions to book chapter, and the involvement in top-conferences Technical Program Committees. During 2011 SOI was extensively involved into 3 FP7 European projects (SPADnet, Mutivis, Netcarity), one big project from PAT (NAoMI), and one bilateral Italian-Israel project (Bovis). A summary of the most relevant achievements in the last year is reported hereafter:

–    Three *dissemination events* have been successfully organized by SOI (RISA'11 International Workshop on Range Image Sensors, Physics and Applications of THz Winter School, IEEE PhD Research in Electronics and Microelectronics PRIME'11). More than 300 participants attended those events;

–    On the side of *scientific dissemination*: SOI sensors have been exploited in the field of biomedical imaging by experts in the field (e.g. Cambridge MRC Cancer Research Unit) and results published on relevant journals: J. of Biomedical Optics and Biomedical Optics Express. Moreover, new sensors designed by SOI in the field of 3D-imaging have been published on 3 reference IEEE journals;

–    All the planned results due within the EU-funded projects have been achieved and all the review meetings successfully passed: SOI developed a wafer-level

IR-THz ROIC for Mutivis, a QVGA Range Image sensor for Netcarity and designed two chips, a small- and a large-area CMOS detector for PET, in the framework of SPADnet project.

– There are also several *state-of-the-art scientific achievements*, among them the development of the first SPAD-based analog time-resolved imager having the highest fill factor ever reported on such a compact pixel pitch (IISW'11) and the first high-resolution 3D camera based on CMOS CIS technology (accepted at ISSCC'12); on the basis of those results a contract with PMD-technologies (leader in the market of 3D-TOF camera) is under discussion, and two EU project proposals for upcoming FP8 call under preparation. Other relevant results are the design of the first fully CMOS image sensor for THz detection and the demonstration of the first CMOS imager coupled to organic photodiodes, this latter being the result of a collaboration with Technische Universität München.

The vision of SOI for the next three to five years is therefore that of consolidating its expertise and recognition level on integrated optical sensing, with a focus on single-photon and multispectral imaging for biological and medical applications. The activity on 3D imagers has produced excellent results and has contributed to advance the state-of-the-art on these components. The technology developed so far could now enter a stage of market research for possible commercial exploitation. The future challenges pursued by the scientific community in the field of *Single-photon time-resolved imagers* are in the direction of increasing the number of pixels (megapixel sensor), reducing the pixel dimensions and increase the fill-factor. SOI Unit will explore new SPAD device structures and advanced pixel topology to realize a very compact pixel with in-pixel photon counting capability, which could potentially lead to the development of large SPAD array camera. In this context the on going projects NAOMI and SPADnet will support the activity for the next one to two years. Furthermore, new proposals will be submitted to upcoming calls to strengthen the research onto this topic.

On the side of *Multispectral imaging sensors*, the developments in the field of THz sensing will continue and follow different paths. One will be to continue the collaboration with our French partner CEA-LETI with the purpose of being recognized as reliable provider of readout circuits for their sensors with deep knowledge of the involved physical principles and technological constraints. The other path will be to continue the investigation of alternative techniques, which will enable FBK to take the lead in the development of fully CMOS THz sensors. In the field of *Energy aware sensors* the goal is to launch a new project aimed at developing a complete energy-autonomous vision system based on groundbreaking interdisciplinary technologies (energy-aware algorithm, custom vision sensor, 3D CMOS technology, ultra-low power RF technology, micropower energy harvesting).

*Unit composition*

|  | *2011 (as of Jan 1st)* | *2012 (planned)* |
|---|---|---|
| Senior researchers | 2 | 2 |
| Researchers (including postdocs, etc.) | 4 | 5 |
| Technologists | 3 * | 2 |
| PhD students | 3 | 4 |
| Total | 12 | 13 |
| Tenured | - | - |
| Tenure track | - | 1 |

Note: "Research directors" are level 1 researchers; "Senior researchers" are level 2 researchers. Category "Researchers" covers all other cases, including level 3 and 4 researchers, postdocs and other contractual forms used to enroll researchers.

*: 1 Technologist is actually a T3 staff person, the other 2 have a Cocopro and Consultant constracts respectively.

*Top researchers by citations (max. 5)*

| *Researcher* | *H-index* | *Citations (total)* |
|---|---|---|
| David Stoppa | 14 | 327 |
| Lucio Pancheri | 11 | 299 |
| Massimo Gottardi | 11 | 271 |
| Nicola Massari | 6 | 57 |
| Mattia Malfatti | 6 | 69 |

H-Index values and total citations have been extracted by using Harzing's Publish or Perish source with a manual screening of papers really belonging to SOI researchers. Total citations take into account only the number of citations that contribute to the H-index calculation.

## 2.  Recent publications

| Year | Jour. Papers (IF) | Q1 (%) | Conf. Papers | Patents | Books (authored) | Books (edited) | Chapters in Book |
|---|---|---|---|---|---|---|---|
| 2011 | 7 | 53 | 21 | 1 | 0 | 0 | 2 |
| 2010 | 9 | 33 | 31 | 2 | 0 | 1 | 1 |
| 2009 | 4 | 25 | 24 | 0 | 0 | 0 | 1 |

SOI and 3DOM were a single Unit in 2009 and during half of 2010: the number of publications in 2010 and 2009 is still referring to researchers which are now belonging to 3DOM Unit. By taking this into account it is clear that SOI dramatically improved in 2011 the number of publications per researcher. Moreover there has been an improvement in the quality (Q1 almost doubled) and an increased effort on book contributions.

Top 5 publications in the last 3 years (2009-2011).

− D. D.-U. Li, J. Arlt, D. Tyndall, R. Walker, J. Richardson, D. Stoppa, E. Charbon, R. K. Henderson, "Video-rate fluorescence lifetime imaging camera with CMOS single-photon avalanche diode arrays and high-speed imaging algorithm", JOURNAL OF BIOMEDICAL OPTICS, vol. 16, pp. 096012-1 – 096012-12, ISSN: 1083-3668, 2011, [uGov:50788]

−  M. Perenzoni, N. Massari, D. Stoppa, L. Pancheri, M. Malfatti, L. Gonzo, "A 160x120-Pixels Range Camera With In-Pixel Correlated Double Sampling and Fixed-Pattern Noise Correction", IEEE JOURNAL OF SOLID-STATE CIR-CUITS, vol. 46, n. 7, pp. 1672-1681, 2011, [uGov:38001]

−  D. Stoppa, N. Massari, L. Pancheri, M. Malfatti, M. Perenzoni, L. Gonzo, "A Range Image Sensor Based on 10-um Lock-In Pixels in 0.18-um CMOS Imag-ing Technology", IEEE JOURNAL OF SOLID-STATE CIRCUITS, vol. 46, n. 1, pp. 248-258, 2011, [uGov:28916]

−  Day-Uei Li, Jochen Arlt, Justin Richardson, Richard Walker, Alex Buts, David Stoppa, Edoardo Charbon, and Robert Henderson, "Real-time fluorescence lifetime imaging system with a 32 × 32 0.13um CMOS low dark-count single-photon avalanche diode array", OPTICS EXPRESS, vol. 18, n. 10, pp. 10257-10269, 2010, [uGov: 20769]

−  M. Gottardi, N. Massari, S.A. Jawed, "A 100uW 128x64 pixels contrast-based asynchronous binary vision sensor for sensor networks application ", IEEE JOURNAL OF SOLID-STATE CIRCUITS, vol. 44, n. 5, pp. 1582-1592, 2009, [uGov:8071]

## 3.  Objectives for 2012

### O1: Fund Raising

*Goals*: Two project proposals will be submitted to the upcoming ICT-FP8 Call (January 2012) to support further development in the fields of (i) single-photon de-tectors for biomedical imaging and of (ii) fully CMOS THz imager for security and surveillance applications. A third project proposal will be submitted to the FET-Proactive call to support the activity on Energy aware sensors, while a fourth pro-ject proposal will be sent to the upcoming ICT-FP8 Call (January 2012) to support the research activity in cooperation with SRS Unit in the field of SiPM+CMOS readout for PET applications;

*Plan*: Preliminary consortia have already been defined and the project proposals under preparation.

*Risks and outcome*: The targeted calls are very selective so the probability of suc-cess is estimated to be around 10%. However, if successful, even one of those projects could provide meaningful support to SOI research activities; *Success crite-ria*: at least one project granted.

### O2: Technology Transfer to Industry

*Goals*: Exploitation of SOI know-how developed in the last five years in the field of 3D-TOF cameras in cooperation with international companies in the worldwide market;

*Plan*: Keep on discussing with leading companies such as PMD-Technologies and MESA and define common research cooperation projects;

*Risks and outcome*: The risk linked to the funding search is limited because this kind of industrial cooperation projects requires reduced time effort for the contract preparation; if successful it would represent an important success for SOI and could stimulate further research on this topic;

*Success criteria*: obtain at least one contract for R&D activity linked to an industrial partner.

**O3: Internal Research** on Next Generation SPAD-based Image Sensor

*Goals*: Development of SPADs in deep-submicron CMOS technologies (130-180nm) and development of compact time-gated pixel structures (20-30um pitch).

*Plan*: Analyse available CMOS foundries and realise one or two test chips;

*Risks and outcome*: SOI already demonstrated the feasibility of good performance SPAD in 150-nm technology (unfortunately this technology is not available anymore), however SPAD design is strongly technology dependent so there is an intrinsic risk. This activity addresses the development of high spatial resolution single-photon cameras, which will open the way to numerous bio-imaging applications and valuable scientific dissemination;

*Success criteria*: obtain a fully working SPAD-based pixel in deep submicron CMOS technology.

**O4: Research activity** due within SPADnet project

*Goals*: Test and validation with gamma-source of the first chip prototype designed during the first year of the project and design of the second and final sensor. Development of a high-level simulator for the developed sensors;

*Plan*: Focus appropriate time-efforts of SOI researchers. Test on first sensor prototype from February to June, while design of the final sensor will last from March to October.

*Risks and outcome*: The sensors to be developed within SPADnet are quite complex and the target specifications extremely demanding. The risk is inherently medium/high but a lot of design efforts are dedicated to this project in order to mitigate the risk. If successful, the sensors developed within this project will generate high-level scientific dissemination (conferences, journals) and will open commercialization opportunities in the next future.

*Success criteria*: Fully working first chip trial and second tape out delivered on time.

**O5: Research activity** due within Naomi project

*Goals*: During year 2012, the technologies developed inside NAOMI project by different research groups (SOI, BioSINT, MEMS) will be refined and a final protein analysis system prototype will be improved and validated. On the side of THz detection, the objective is to demonstrate with real measurement the functionality of the different sensors for terahertz radiation developed during the project.

*Plan*: The different units involved in the final NAOMI system are now working towards improvement of the various parts and immediately implementing the improvements in the existing system. Validation experiments using real biological

fluids with protein concentrations of interest for the real applications will be used. Concerning THz detection, the plan is to contact universities across Italy and Europe having the proper equipment for terahertz measurements in order to properly characterize SOI sensors.

*Risks and outcome*: For the visible approach, the sensitivity of the system or the reliability of the developed components and measurement procedures might be inadequate for the proposed application. Concerning the THz, its technological development is a high risk activity due to the complexity of the devices: if one of the devices will be successful, the scientific results will be of high relevance.

*Success criteria*: a system prototype capable of analyzing low concentration of proteins in blood or serum, demonstrated with a preliminary validation using thrombin protein or VEGF and a successful measurement in THz domain.

### O6: Scientific Dissemination

*Goals*: Submission of four publications on high-profile international Journals and eight international conferences, organization of a scientific workshop, participation to top-quality conference TPC, editing of a book.

*Success criteria*: Publication of two papers and five conference proceedings.

### 4.    Front Edge & New Initiatives

In the next two/three years the main challenges for SOI research activities are the:
-    development of new generation detectors in the field of PET diagnostic: large area CMOS sensors with embedded, distributed intelligence and capable of chip-to-chip communication;
-    development of a new concept of photo-demodulator devices aimed at 3D TOF vision targeting an improvement of a factor of ten with respect to existing technologies in order to address low-power system for portable devices;

Other relevant initiatives, which will be pursued in 2012 are:
-    In 2011 SOI organized three scientific dissemination events (RISA'11 International Workshop on Range Image Sensors, Physics and Applications of THz Winter School, IEEE PhD Research in Electronics and Microelectronics PRIME'11) that have been very successful and contributed to the dissemination of SOI and FBK "brand" within the scientific and industrial community. During 2012 new initiatives will be defined in order to target one/two events by the end of 2012, early 2013.
-    More emphasis and effort will be put on the exploitation of SOI sensors by means of the development of system prototypes, evaluation boards, and a proper dissemination of the available technologies.
-    The synergy with other CMM Units will be strengthened by means of common research projects (at the moment under preparation) targeting: the development of high-performance hybrid sensors SiPM+CMOS in collaboration with SRS Unit, the validation of SOI detectors for proteins pre-screening in collaboration with M2B2 Unit, the combination of CMOS image sensors and MEMS

for medical imaging with BioMEMS Unit and finally the scientific dissemination in the field of 3D imaging with 3DOM Unit.

## 5.  Funding

| Acronym | Full name | Type | Duration | Total income | Income 2012 |
|---|---|---|---|---|---|
| NAoMI | Nano on Micro approach to a multispectral analytical system for protein assays | PAT "Big Project" | 1/10/2008-30/09/2012 | € 426052.00 | € 79903.00 |
| SPADnet | Fully Networked, Digital Components for Photonstarved Biomedical Imaging Systems | EU | 1/07/2010-31/12/2013 | € 335784.00 | € 95751.00 |
| MUTIVIS | Multispectral Terahertz, Infrared, Visible Imaging and Spectroscopy | EU | 22/05/2008-28/02/2012 | € 434464.00 | € 18600.00 |
| MILS | Miniaturized Imaging LiDAR System | ESA | 01/11/2011-31/10/2012 | € 36700.00 | € 36700.00 |
| *PMD | - | INDUSTRIAL | 01/01/2012-30/06/2012 | € 50000.00 | € 50000.00 |

Type: EU, PAT, Other public agency, Industrial.

* Contract Under definition

At present the key projects funding SOI are NAoMI and SPADnet. An industrial contract with PMD-Technology is under definition.

## 5.  Budget

|  | 2011 | 2012 |
|---|---|---|
| Expenses |  |  |
| Personnel | € 523,03 | € 494,51 |
| Travel | € 50,50 | € 40,80 |
| Equipment (HW/SW) | € 64,00 | € 58,00 |
| Other (e.g. subcontracting to external contractors) | € 349,85 | € 165,20 |
| Total Expenditure | € 987,38 | € 758,51 |
| Incomes |  |  |
| EU Projects (total amount financed by EU) | € 216,59 | € 179,35 |

| | | |
|---|---|---|
| Other external incomes (industrial, PAT projects, etc.) | € 283,48 | € 92,99 |
| Projects to be finalized | € 42,08 | € 70,69 |
| Total Income | € 542,15 | € 343,03 |
| Financial Need (Total Income – Total Expenditure) | € 445,24 | € 415,48 |
| Self funding | 54,9% | 45,2% |

Note: Column 2011 is based on the unit's budget state as estimated at the date of document writing. Column 2012 is the budget planned for 2012

## 7.   Remarks

Concerning the research activity, the Unit relies on state-of-the-art software packages for the design and simulation and, on commercial silicon foundries for the fabrication of the integrated devices. One critical aspect is to have access to professional IC design tools (e.g. Cadence and Mentor Graphics) at the price of academic licensing, otherwise the cost would become prohibitive.

Furthermore, in 2009 the test labs, i.e. FUNLAB and LASERLAB have been renewed with larger space allocation and new equipments; this allow for precise and accurate test procedures. An external support to properly train people, which is supposed to have access to LASERLAB, is also recommended to enhance the security of the researchers.

Finally, a specific need of the Unit is the improvement of competences on system integration; these skills and knowledge is more and more required within the collaborative projects and it is something that must be an in-house (in FBK) activity being of paramount importance a tight cooperation between designers and system integrators.

# MEMS – MICRO-ELECTRO-MECHANICAL-SYSTEMS

Head of Unit: Benno Margesin

## 1.    Summary and vision

The general scope of the activities of the MEMS Research Unit are the investigation and development of a few selected device typologies and related technologies that are both of high interest for science and industry and challenging to make. The later aspect is considered important in order not only to exploit and extend the knowledge of the group, but also a basic requirement for fruitful scientific research. In addition the use of the in house fabrication technology is considered as a key strategic element that gives the activity an potential advantage with respect to competing institutions on one side and more technological options on the other side.

The activity of the last three-four years essentially confirms this approach even if in detail some changes and additions to the activity of the group were necessary in order to guarantee continuity in the fund rising capability of the group.

The MEMS Unit is active on two main research topics: RF MEMS and bolometers, both cryogenic and room temperature.

The activity on RF MEMS dates back in the nineties were the first developments on low loss passive components started. In the last ten years the MEMS group was able to developed, mainly with in ESA contracts, a versatile technology platform for the fabrication of passive components, wide band micro switches and microwave and millimeter wave circuits for telecommunication, ground and satellite based and wireless applications. The RF MEMS switch technology albeit not fully developed has attracted many interests in academics and in the industry not only in Europe.

At the moment the Unit is active in 8 projects, two FP7 projects, 3 ESA contracts and 3 service contracts. Among the most recent achievements within this field are the important advance in lifetime of RF switches which is now in the range of 1 to 5 years of continuous actuation. This together with the demonstration of an active restoring mechanism allowed to proceed with phase 2 of the ESA contract on high reliability switches. In collaboration with the group of Prof. J. Hwang of the Lehigh University it has been shown that these switches are able to handle power levels up to 3 W. Finally it was possible to realize with the same process also dedicated test structures that are able to characterize the quality of the so called 0-level capping of the RF MEM switches developed with in a European FP7 project.

Research and development of bolometers in FBK again dates back in the early nineties. The activity originates from the development of cryogenic type bolometers of the implanted silicon type. Within a few years it was possible to develop and optimize devices suitable for basic research, in particular for the measurement of the mass of the electron anti-neutrino. This, more than ten year effort is now dedicated to the realization of an large experiment (over 200 detectors). In recent

years a new type of cryogenic bolometer has been also investigated. These kinetic inductance detectors, based on superconducting materials (niobium, aluminum) are potentially a good candidate for future large detector arrays, coupled to antennas for the detection of RF and THz radiation, that will be employed for the next generation satellites dedicated to CMB radiation polarization studies.

Recently it was possible to fabricate these devices in TiN, a potentially interesting material for these devices with high Q factors.

*Unit composition*

|  | *2011 (as of Jan 1$^{st}$)* | *2012 (planned)* |
|---|---|---|
| Research directors | 1 | 1 |
| Senior researchers | 2 | 2 |
| Researchers (including postdocs, etc.) | 6 | 6 |
| Technologists | - | - |
| PhD students | 2 | 2 |
| Total | 11 | 11 |
| Tenured | 3 | 3 |
| Tenure track | 1 | 1 |

Note: "Research directors" are level 1 researchers; "Senior researchers" are level 2 researchers. Category "Researchers" covers all other cases, including level 3 and 4 researchers, postdocs and other contractual forms used to enroll researchers.

*Top researchers by citations (max. 5)*

| *Researcher* | *H-index* | *Citations (total)* |
|---|---|---|
| Benno Margesin | 14 | 670 |
| Flavio Giacomozzi | 12 | 465 |
| Viviana Mulloni | 7 | 261 |
| Dan Vasilache | 5 | 74 |
| Alessandro Faes | 2 | 16 |

## 2.    Recent publications

| year | Jour. Papers (IF) | Q1 (%) | Conf. Papers | Patents | Books (authored) | Books (edited) | Chapters in Book |
|------|------|------|------|------|------|------|------|
| 2011 | 3 | 34 | 18 | 0 | 0 | 2 | 0 |
| 2010 | 11 | 45 | 20 | 0 | 1 | 3 | 1 |
| 2009 | 10 | 47 | 32 | 0 | 0 | 5 | 1 |

The Unit is publishing its research results at an approximately constant rate. Typically the work is presented first on conferences and through them in specialized Journals. This takes time and explains the low number of journal papers in 2011. Starting from last year an effort has been made to publish more on Journals and books, which is slowly showing some fruits especially regarding books.

Top 5 publications in the last 3 years (2009-2011):

−    M. A. Llamas, D. Girbau, M. Ribo', L. Pradell, F. Giacomozzi, S. Colpo, R*F-MEMS Uniplanar 180 Phase Switch Basedon a Multimodal Air-Bridged CPW Cross,* IEEE Transactions on Microwave Theory and Techniques, vol.59, n. 7, 2011, pp.1769—1777 [UGOV: 40192]

−    V. Mulloni, F. Giacomozzi, B. Margesin, *Controlling stress and stress gradient during the release process in gold suspended micro-structures*, Sensors and Actuators. A, Physical, vol. 162, n. 1, 2010, pp.93—99 [UGIV: 9768]

−    J. Iannacci, R. Gaddi, A. Gnudi, *Experimental Validation of Mixed Electromechanical and Electromagnetic Modeling of RF-MEMS Devices Within a Standard IC Simulation Environment,* JOURNAL OF MICROELECTROMECHANICAL SYSTEMS, vol. 19, n.3, 2010, pp.526—537 [UGOV: 8608]

−    M. A. Llamas, D. Girbau, M. Ribo', L. Pradell, A. La'zaro, F. Giacomozzi, B. Margesin, MEMS-Based 180 Phase Switch for Differential Radiometers, IEEE Transactions on Microwave Theory and Techniques, vol. 58, n. 5, 2010, pp.1264—1272 [UGOV: 7788

−    R. Marcelli, G. Papaioannu, S. Catoni, G. De Angelis, A. Lucibello, E. Proietti, B. Margesin, F. Giacomozzi, F. Deborgies, *Dielectric charging in microwave microelectromechanical Ohmic series and capacitive shunt switches*, Journal of Applied Physics, vol. 105, n, 11, 2009, pp.114514— [UGOV: 17829]

### 3. Objectives for 2012

**O1: Research on RF MEM Switches.** The main goals in the research on the RF MEM switch technology are the demonstration of the reliability of the devices and the technology and the development of a practical 0-level packaging technology in order to increase the manufacturability in the back end processing. The reliability issue is addressed mainly through the $2^{nd}$ phase of the ESA Redundancy project where innovative design solutions and process solutions are tested as well as specific test methods and protocols are been developed. The packaging is addressed by the development of two concepts, chip capping with quartz caps and thin film capping, both with specific advantages and with technical critical issues. Regarding the reliability the main risk is that of an insufficient lifetime. This is somewhat mitigated by the different approaches followed in parallel or can lead to a redefinition of the way to employ this technology. Regarding the 0-level packaging the risk is related to technical aspects and is partially mitigated by the two complementary approaches. The expected outcome is a reliable technology with tested design solutions both for switches and the chip capping. In particular this will be demonstrated on complex devices as there are phaseshifters and LC-tanks.

**O2: Research on Micromachined Cavity Filters.** The activity on the micromachined microwave filters has the goal to produce a narrow band filter with low footprint for microwave signals to be used on satellites. This is a complementary technology to the RF MEM switch platform. Next year it is planned to build the first demonstrators based on the techniques refined this year. The main risk is in a delay due to rework and refinements on the fabrication technology. The outcome of the activity will be two demonstrators in Ka band and in LS band with slightly different fabrication processes

**O3: Research on High Q MEM Resonators.** The goal of this research project is the development of a high Q MEM resonator to be used as a substitute of traditional quartz crystals, with higher performance in terms of stability and miniaturization. The activity for next year foresees the development of MEM resonator prototypes and their characterization as well as the development of an accurate lumped element simulation model. The risk of the activity relies mainly in the technology development and within this mainly in the hermetic packaging of the devices and the stabilization of the vacuum in the package through getters. Other critical aspects are related to the fabrication tolerances. The outcome will be sample resonance demonstrators in the 10 MHz and 100 MHz range with Q-factors as high as 500.

**O4: Research on bolometers.** The main goal will be the fabrication of KID arrays for the neutrino mass experiments and the X ray detection. The activity mainly requires the development of suitable metal films with the right transition temperature. The main risk is in the delays in the film preparation and sample characterization. The outcome will be working bolometer arrays.

**O5: Research on New Devices.** In order to give the Research Unit a larger footprint of projects the activity on interesting or "compatible" technologies will continue. Among these are the development of microthrusters, an activity

interesting for space applications and the development of microresonators for the energy harvesting based on the RF MEM switch platform. Both activities will profit from the 0-level capping development and the later also from the research on high Q resonators. These activity will be developed in the background in order to keep the interest of potential partners. The risk associated with this activity is negligible and the outcome will be demonstrators to be used either for basic research and for fostering funding requests.

## 4.    Front Edge & New Initiatives

The following front edge/new initiatives are foreseen for 2012:

*High Q MEM Resonators.* The development of high Q MEM resonators will be a completely new activity for the RU. The main scope is the development of a miniaturized high performance oscillator able to replace the traditional quartz crystals. 2012 will be devoted to the development of suitable MEMS resonators based on SOI silicon and high aspect ratio micromachining. Even if the group has a solid knowledge base on resonating micromachined structures (microphones) the application is completely new and challenging. In addition the application requires a hermetic packaging at 0-level, a field where the group has only preliminary and indirect knowledge.

*Micromachined filters.* Albeit the development of micromachined microwave filters is an ongoing activity the last year has shown that the process development is more tricky and complex than forecasted. Once the basic technology will be in place the optimization of the design will lead to new high performance filters that are on the edge of the state of the art.

*Exploratory devices.* The activity started during 2011 to explore selected device categories either to extend the technological capabilities of the group or to extend the applications of already developed technologies will continue. One device category of potential interest are the microthrusters for the precision positioning of nano satellites. This activity will be continued on a minimum effort base in order to foster the fund raising in this specific field. In a similar way the group will explore the feasibility of microresonators for energy harvesting based on the possibilities of the RF MEM switch technology platform.

All these new activities and developments have in common the development of basic technological capabilities like wafer bonding and wafer level encapsulation.

## 5.    Funding

| Acronym | Full name | Type | Duration | Total income | Income 2012 |
|---|---|---|---|---|---|
| MEMSPACK | Zero- and First-level Packaging of …. | EU | 1/6/2008-29/2/2012 | € 261.437,00 | € 11458.00 |
| NAoMi | NAoMi: Un'approccio Nano-on-micro per .. | RL | 1/10/2008-30/9/2012 | € 173.999,00 | € 32.632,00 |
| ESA MIGNON | Microwave Micro-Machined ….. | RI | 30/3/2009-29/3/2012 | € 160.001,00 | € 12.993,00 |

Type: EU, PAT, Other public agency, Industrial.

The Unit will be involved in 11 projects. Two of them will end within the first months of 2012 while 5 will end around mid 2012. In addition the Unit is in the negotiation phase for two ESA projects, MEMOS (High-Q MEMS Resonator for High-Performance Oscillators) and MEMTOS (Widely Tunable MEMS LC Tank for Wideband Oscillators) and a service project for the Indian company RCI.

## 6.    Budget

|  | 2011 | 2012 |
|---|---|---|
| Expenses |  |  |
| Personnel | € 560,75 | € 567,57 |
| Travel | € 21,23 | € 8,05 |
| Equipment (HW/SW) | € 10,00 | € 0,00 |
| Other (e.g. subcontracting to external contractors) | € 122,70 | € 70,37 |
| Total Expenditure | € 714,68 | € 645,99 |
| Incomes |  |  |
| EU Projects (total amount financed by EU) | € 82,27 | € 9,03 |
| Other external incomes (industrial, PAT projects, etc.) | € 179,25 | € 95,80 |
| Projects to be finalized | € 65,42 | € 205,88 |
| Total Income | € 326,94 | € 310,72 |
| Financial Need (Total Income – Total Expenditure) | € 387,75 | € 335,27 |
| Self funding | 45,7% | 48,1% |

Note: Column 2011 is based on the unit's budget state as estimated at the date of document writing. Column 2012 is the budget planned for 2012

## 7. Remarks

The actual staff of the MEMS Unit, consisting in 9 researchers and 2 PhD positions, is considered adequate to the expected work load of the 11 research projects foreseen for 2012. Thanks to the interdisciplinary mix of basic competences, including physics, chemistry and various engineering specialties, all needs of the Unit are covered even if 2011 has shown that some competence areas are understaffed. This is especially true for the electric characterization which has become more and more important for the group and which will need some enforcement in the future if the request of characterization and screening will persist.

In addition in 2012 a potential critical situation for the group is foreseen with the expiration of the contract to term of the process engineer of the group. As this position is particularly difficult to replace due to the unique nature of competences required in the day to day work in the clean room, acquired in years of training, an interruption of this contract will put the many activities of the group at risk, minimum of great delay, or make them temporarily impossible. For this reason a request has been made for stabilization of this position.

Finally due to the growing request of characterization, also in terms of reliability and environmental tests, and the need of a tighter control of the sample handling the Unit needs a small laboratory for its one where to perform these activities.

**MiNALab – Micro-Nano Analytical Laboratory**

Head of Unit: Massimo Bersani

## 1. Summary and vision

Mission of the MiNALab research unit is research and development (R&D) in the field of surface analytical techniques for material science. The activity is focused on surface science for both inorganic and soft materials at the micro and nano scale with a particularly strong background in secondary ion mass spectrometry. In the last two years a marked effort has been focused on analysis of bulk materials with x-ray based techniques.

Therefore the main objective is to structure and develop a research closely related to analytical instrumentation, but also focused on research topics related to surface science in collaboration with groups inside and outside FBK.

The unit specific objectives are:

- Realize and manage an analytical infrastructure being able to group equipment and competences present in FBK. In this way it will be possible to start a facility able to attract and link other resources and competences present on the local territory. Hence asset up and organise a technological platform for material analysis integrating inter-institute facilities between FBK and University. The networking TNLabs (www.tnlabs.eu) has been set up and tested in the 2011. The new facility registered a good impact in terms of requests, collaborations and topics improvement on both internal and external users

- Develop a research activity in some areas of surface science in order to improve the analytical methodologies and capabilities, set up networking and external collaboration; support the research activity of the other internal research units; push the analytical equipment improvement. The main research topics are in the fields of: Micro-nanoelectronics; nanomaterials for energy and surface protective coating applications; food-chemystry

- Support industries needing material characterization or involved in analytical equipment production through consulting service or innovation actions.

The state of art analytical instruments operative in the laboratories joint to the competences present in MiNALab by highly qualified personnel are the strength points of the unit. In details the competences can be summarize as following:

Long term analytical capabilities related to present instrument infrastructure. It comes from the historical mission and development of the group which has allowed to establish an important analytical infrastructure with a strong and diffuse expertise able to show the value and impact of research in surface science at a level of excellence

Data mining. This competence based on statistic multivariate methods was acquired and increased in the last five years. It allows to integrate the analytical result

and to obtain a more complete interpretation in particular on complex system. The effects are highlighted by a specific increase of publication quality and an extension of our analytical application fields

Analytical Instrumentation development, consequence of specific expertise on analytical needs and solutions ultra high vacuum project-design and software development. The main result in this activity field has been obtained with a company start up devoted to X-ray diffraction instrument manufacturing.

Accreditation and quality management. This competence closely connected to analytical activity and industrial relationships allows to obtain the accreditation following the norm UNI/ISO 17025.

These aspects allow to establish several local as well international collaborations scenario and receive funds for EU projects focused on characterization materials and analytical methodology development.

The main achievements are represented by:

Good level of publications.

Wide collaborations scenario.

Reference point for the research at international level; in fact we were choice as organisers of several international conferences. The last one was SIMS 18 in Riva del Garda (September 18-23 2011; http://www.simsxviii.org/).

Strong level of collaboration with other FBK units and Tn University groups.

Remarkable activity also in the industrial field as pointed out by financed project list (table 5)

The midterm strategy is structured in the following points:

•     Perform research, promote external collaborations and network links aimed to the improvement of the methodologies at the enhancement of analytical capabilities

•     Realize an manage an analytical infrastructure being able to group and to optimize equipment and competences present in FBK, linked to similar resources operating in the Province of Trento (www.tnlab.eu)

•     3D physical-chemical characterization at the nano scale

*Unit composition*

|  | 2011 (as of Jan 1<sup>st</sup>) | 2012 (planned) |
|---|---|---|
| Research directors | Massimo Bersani | Massimo Bersani |
| Senior researchers | Lia Vanzetti | Lia Vanzetti |
| Senior researchers | Roberto Canteri | Roberto Canteri |
| Senior researchers | Giancarlo Pepponi | Giancarlo Pepponi |
| Senior researchers | Salvatore Gennaro | Salvatore Gennaro |
| Researchers (including postdocs, etc.) | Mario Barozzi | Mario Barozzi |
| Researchers (including postdocs, etc.) | Mauro Bortolotti | Mauro Bortolotti |
| Researchers (including postdocs, etc.) | Corrado Deflorian | Corrado Deflorian |

| Researchers (including postdocs, etc.) | Rossana Dell'Anna | Rossana Dell'Anna |
|---|---|---|
| Researchers (including postdocs, etc.) | Damiano Giubertoni | Damiano Giubertoni |
| Researchers (including postdocs, etc.) | Erica Iacob | Erica Iacob |
| Researchers (including postdocs, etc.) | Florian Meirer | Florian Meirer |
| Technicians | Michele Fedrizzi | Michele Fedrizzi |
| PhD students | Evgeny Demenev | Evgeny Demenev |
| PhD students | | Fabio Brigidi |
| Total | 14 | 15 |
| Tenured | | |
| Tenure track | | |

Note: "Research directors" are level 1 researchers; "Senior researchers" are level 2 researchers. Category "Researchers" covers all other cases, including level 3 and 4 researchers, postdocs and other contractual forms used to enroll researchers.

*Top researchers by citations (max. 5)*

| Researcher | H-index | Citations (total) |
|---|---|---|
| Massimo Bersani | 13 | 483 |
| Giancarlo Pepponi | 12 | 355 |
| Lia Vanzetti | 20 | 1269 |
| Rossana Dell'Anna | 7 | 187 |
| Damiano Giubertoni | 11 | 344 |

## 2.    Recent publications

| year | Jour. Papers (IF) | Q1 (%) | Conf. Papers | Patents | Books (authored) | Books (edited) | Chapters in Book |
|---|---|---|---|---|---|---|---|
| 2011 | 13 | 46 | 1 | 0 | 0 | 0 | 0 |
| 2010 | 12 | 40 | 4 | 2 | 0 | 1 | 0 |
| 2009 | 14 | 41 | 19 | 0 | 0 | 0 | 1 |
| 2008 | 27 | 51 | 11 | 0 | 0 | 0 | 0 |

In the table are reported the main result achieved in terms of disseminations obtained by the Unit. The data related to 2011 are partial and before the end of the year at least two other papers, accepted for the publications, will increase the final score. One objective of 2012 is to increase the publications results in terms of number and quality.

Publications Table

| IF | Paper | U-GOV code |
|---|---|---|
| 6.602 | 2010 19951 journal-article<br><br>F. Meirer, A. Singh, G. Pepponi, C. Streli, T. Homma, P. Pianetta<br><br>Synchrotron radiation-induced total reflection X-ray fluorescence analysis<br><br>TRENDS IN ANALYTICAL CHEMISTRY ISSN: 0167-2940 | 19951 |
| 4.372 | 2011 25009 journal-article<br><br>Lara Lobo, Beatriz Fernandez, Rosario Pereiro, Nerea Bordel, Evgeny Demenev, Damiano Giubertoni, Massimo Bersani, Philipp Hoenicke, Burkhard Beckhoff, A. Sanz-Medel<br><br>Quantitative depth profiling of boron and arsenic ultra low energy implants by pulsed rf-GD-ToFMS<br><br>JOURNAL OF ANALYTICAL ATOMIC SPECTROMETRY ISSN: 0267-9477 | 25009 |
| 4.062 | 2009 19755 journal-article<br><br>H.R. Wenk, M. Armann, L. Burlini, K. Kunze, M. Bortolotti<br><br>Large strain shearing of halite: Experimental and theoretical evidence for dynamic texture changes<br><br>EARTH AND PLANETARY SCIENCE LETTERS ISSN: 0012-821X | 19755 |
| 3.841 | 2011 22909 journal-article<br><br>Alice Vezzaro, Andrea Boschetti, Rossana dell'Anna,Roberto Canteri, Mariano Dimauro, Angelo Ramina, Massimo Ferasin, Claudio Giulivo, Benedetto Ruperti<br><br>Influence of olive (cv Grignano) fruit ripening and oil extraction under different nitrogen regimes on volatile organic compound emissions studied by PTR-MS technique<br><br>ANALYTICAL AND BIOANALYTICAL CHEMISTRY ISSN: 1618-2642 | 22909 |
| 3.841 | 2010 13008 journal-article<br><br>Philipp Ho"nicke, Burkhard Beckhoff, Michael Kolbe, Damiano Giubertoni, Jaap van den Berg, Giancarlo Pepponi Depth profile characterization of ultra shallow junction implants<br><br>ANALYTICAL AND BIOANALYTICAL CHEMISTRY ISSN: 1618-2642 | 13008 |

In table 4 are reported the best 5 papers in terms of journal impact factor published in the last three years. The reported citations are representative of several activities performed inside MiNALab unit and pointed out the wide range of collaborations nowadays actives.

### 3.    Objectives for 2012

**O1: TNLabs**. Developing of the activity related to the analytical infrastructure in partnership with UniTN, organization. Elaboration of common activities and projects. The goal extending application and usability of analytical infrastructure and increase the common activities with UniTN. Define a new implementation strategy for the analytical infrastructure, in common with UniTN.

Risk: manage cost and efforts request to carry on this activity (can not to charge directly to a single unit).

**O2: Research on Food Chemistry**. Submission of new projects related to application of mass spectrometry on food chemistry. Improve and extend the collaboration with external partners. The goal is finalize the activity carried out in the 2011 with financed project and publications; joint a PhD student to improve MiNALab effort on this topic.

Risk: try to extend VOC's analyses to further topics in medical field.

**O3: Research on USJ**. Conclusion of PhD and post PhD activities on this research topic finalize the results by dissemination (Conference presentations and high level publication).

Risk: plan a new medium term strategy on this topic

**O4: Research on protective coating**. This activity is supported by NANOSTRATA and Zuani Project the main goal of 2012 is related to the realization of new and innovative x-ray instrumentation in collaboration with TNX start up.

Risk: find new funding possibilities in this topic

**O5: Publications**. Increase the rate of publications and communications obtained in the last 3 years

**O6: Accreditation.** Maintain and improve measurements accreditation under the International norm 17025 to obtain the third year confirmation.

Risk: not possible with further budget cuts

### 4.    Front Edge & New Initiatives

1    Elettra, Trieste, the Italian Synchrotron Radiation Lightsource wants to develop a micro beam X-Ray Fluorescence beamline. MiNALab has been contacted and asked to collaborate to develop an end station that can at best serve user needs.

Elettra also suggested that a greater involvement (including workforce as well as financial support) of FBK would be welcome and would allow the development of a better performing end station. Moreoever another end station could be built on the same beamline for surface science investigations by means of Grazing Incidence X-Ray Fluorescence Analysis.

FBK would then have access to the beamline for longer periods of time without going through the typical peer review process of proposals.

2    A project related to Micro- and nanoscale chemical characterization of fine and ultrafine airborne particulate matter - development and application of complementary methods has been submitted as a new complementary unit of research. If positive evaluated and financed this project will be form a new group inside MiNALab focused on environmental to characterize fine particulate matter (PM2.5 PM 0.1). A new field of application could be so joint on analytical infrastructure

## 5.    Funding

| Acronym | Full name | Type | Duration | Total income | Income 2012 |
|---|---|---|---|---|---|
| LIMA | Progetto ``248909 LIMA - Improve Photovoltaic efficiency by applying n | EU | 26/11/2009-31/12/2012 | 44679 | 14446 |
| ISIWebLIMS | Accordo di collaborazione scientifica finalizzata alla realizzazione d | RL | 1/3/2010-30/4/2016 | 0 | 0 |
| X-Bridge | Contratto di prestazione di servizio per la realizzazion di parte dell | PL | 1/5/2010-30/4/2012 | 129999 | 21518 |
| DART | Finanziamento progetto di ricerca: ``DART - Dopant profile and Activat | RL | 1/5/2010-30/4/2013 | 149000 | 49757 |
| NDA materiali innovativi | Accordo di confidenzialit/UTF-8::LATIN_SMALL_LETTER_A_WITH_GRAVE/ nel | PL | 17/6/2010-16/6/2013 | 0 | 0 |
| NANOSTRATA | Metodologie innovative di indagine nel settore dell'ingegneria delle s | RN | 30/9/2010-29/9/2012 | 218026 | 81424 |

| Analisi SIMS | Offerta per l/UTF-8::ACUTE_ACCENT/attivit/UTF-8::LATIN_SMALL_LETTER_A_ | PN | 23/11/2010-22/11/2013 | 15000 | 5009 |
|---|---|---|---|---|---|
| ARCO-P | Pestazione di servizio per il supporto alla realizzazione di parte del | PL | 1/2/2011-31/1/2013 | 150000 | 75103 |
| YES-AROMA | | OPA | 01/01/2012 | 11000 | 11000 |
| Zuani | | PL | 1/02/2011-31/01/2013 | | 81.236 |
| ERG | | PL | 01/01/2012 | 8935,32 | 8935,32 |
| iSiCPV | | PL | 01/11/2012-31/10/2014 | | 17.181,54 |
| Convenzione con TNX | | PL | 16/02/2009-1/01/2013 | | 47.357,08 |

## 6.   Budget

| | 2011 | 2012 |
|---|---|---|
| Expenses | | |
| Personnel | € 793,87 | € 785,18 |
| Travel | € 21,90 | € 20,50 |
| Equipment (HW/SW) | € 53,00 | € 45,00 |
| Other (e.g. subcontracting to external contractors | € 462,35 | € 225,55 |
| Total Expenditure | € 1.331,12 | € 1.076,23 |
| Incomes | | |
| EU Projects (total amount financed by EU) | € 14,28 | € 13,88 |
| Other external incomes (industrial, PAT projects, | € 191,22 | € 310,41 |
| Projects to be finalized | € 447,44 | € 37,12 |
| Total Income | € 652,93 | € 361,40 |
| Financial Need (Total Income – Total Expenditure | € 678,19 | € 714,83 |
| Self funding | 49,1% | 33,6% |

Note: Column 2011 is based on the unit's budget state as estimated at the date of document writing. Column 2012 is the budget planned for 2012.

# PAM-SE – PLASMA, ADVANCED MATERIALS AND SURFACE ENGINEERING

Head of Unit: Nadhira Bensaada Laidani

## 1. Summary and vision

*Scope and motivation for the activities carried out*

The strong background in the materials synthesis by low pressure plasma processes (RF sputtering and Plasma Enhanced Chemical Vapour Deposition) has found its largest application in multi-functional thin film growth, nanocomposite protective coatings, coatings for high-efficiency and low cost solar cells, nanostructures and surface manipulation for bio-medical applications.

The research activity in the field of energy points towards the synthesis of innovative materials such as transparent conductive oxides for application as transparent electrodes in thin film solar cells, as well as the exploration of new strategies for photovoltaic cells efficiency improvement. On the latter subject, the group is engaged in widening the range of solar radiation frequencies which can be exploited by silicon-based photovoltaic systems by photon management.

Another sector of the Unit research activity regards surface engineering, through functionalization and manipulation of nanostructures like metal nano-particles and carbon nanotubes. These structures could be integrated with macroscopic materials (as polymers) to achieve higher performances applicable for medical therapy and in innovative biosensors.

A significant part of the Unit activities are conducted in collaboration with other Units of CM&M centre, namely APP, REET, MT-Lab, Bio-MEMS, MinaLab and BioSint.

*Positioning with respect to the state of the art and recent achievements*

Several different requirements need to be satisfied in order to make photovoltaic cells be competitive with other energy generation systems and be manufactured on a large scale: the availability of less expensive materials than crystalline silicon commonly used in the PV cells, the necessity of using less quantity of semiconductor materials, improving the conversion efficiency or increasing the solar radiation absorbance of the materials composing the PV cells. The development of low cost and high quality transparent transparent conductive oxides (TCO), to be used as transparent electrodes in substitution of the expensive indium tin oxide is considered an important research topic for this class of cells.

By means of intrinsic and extrinsic doping conductive thin films are produced by the Unit. $TiO_2$ and ZnO conductive films are studied. One of our recent findings about the possibility of effectively controlling the surface work function of such conductive films constitutes a progress in the state-of-the art, as a major issue in the

application of TCO as electrodes resides in the electronic properties of their interface with the active part of the cell.

Another achievement of the Unit regards the synthesis of a working system for photon management, based on rare earth-doped $TiO_2$ and ZnO films. Adequate down-shifting from UV to near IR light is achieved. The $TiO_2$ based system tested onto a crystalline silicon solar cell give promising results, though needing further optimisation of its integration to the cell.

*Vision about the most promising directions and activities to conduct in the future*

The innovative materials synthesis for photovoltaics, in line with the on-going research axis can be further extended to the production of multifunctional materials. Combining photon management capability of our materials and their potential photo-activity can be a promising route to obtain more performant "chemical" solar systems. Improvements of the classical plasma-based processes will be necessary to achieve a breakthrough in these fields, these processes need to be integrated and/or assisted by new technologies, such as combined plasma-wet chemistry processes to produce and functionalize oxide nanostructures.

As for nanotechnology for surface engineering, the experience acquired in the engineering of nanoparticles for therapeutic purposes will be pursued ahead in collaboration with the local research centres, developing nanostructures with more sophisticated functionalities, such to allow detection, imaging and care of specific pathological tissues. High throughput surface treatment techniques based on a combinatorial approach will be mastered to develop active surfaces and materials of interest in the field of the biomedicine/biosensors.

*Unit composition and personnel citation report*

|  | 2011 (as of Jan 1st) | 2012 (planned) |
|---|---|---|
| Research directors |  |  |
| Senior researchers | 2 | 2 |
| Researchers (including postdocs, etc.) | 3 | 3 |
| Technologists | 1 | 1 |
| PhD students | 3 | 2 |
| Total | 9 | 8 |
| Tenured | - | - |
| Tenure track | - | - |

Note: "Research directors" are level 1 researchers; "Senior researchers" are level 2 researchers. Category "Researchers" covers all other cases, including level 3 and 4 researchers, postdocs and other contractual forms used to enroll researchers.

*Top researchers by citations (max. 5)*

| Researcher | H-index | Citations (total) |
|---|---|---|
| Nadhira LAIDANI | 13 (Web of Science) | 496 |
| Giorgio SPERANZA | 13 (Web of Science) | 503 |

## 2. Recent publications

| Model: Standard | | 07/11/2011 | | | | | |
|---|---|---|---|---|---|---|---|
| year | Jour. Papers (IF) | Q1 (%) | Conf. Papers | Patents | Books (authored) | Books (edited) | Chapters in Book |
| In print | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2011 | 9 | 22 | 2 | 0 | 0 | 0 | 0 |
| 2010 | 8 | 25 | 7 | 0 | 0 | 1 | 1 |
| 2009 | 13 | 42 | 5 | 0 | 0 | 0 | 0 |
| 2008 | 13 | 31 | 8 | 0 | 0 | 0 | 0 |

Top 5 publications in the last 3 years (2009-2011):

−   L. Minati, G. Speranza, I. Bernagozzi, S. Torrengo, A. Chiasera, M. Ferrari, *Luminescent short thiol-functionalized multi-wall carbon nanotubes,* in «DIAMOND AND RELATED MATERIALS», vol. 20 , 2011, pp. 1046-1049 [UGOV: 35784]

−   N. Laidani, R. Bartali, V. Micheli, G. Gottardi, P. Cheyssac, *Study of growth processes and mechanical properties of nanoscale multilayered C/C films,* in «SURFACE & COATINGS TECHNOLOGY», vol.206 , 2011 , pp. 654 -666 [UGOV: 47580]

−   L. Minati, G. Speranza, I. Bernagozzi, S. Torrengo, L. Toniutti, B. Rossi, M. Ferrari, A. Chiasera , *Investigation on the electronic and optical properties of short oxidized multi walled carbon nanotubes,* in «JOURNAL OF PHYSICAL CHEMISTRY. C, NANOMATERIALS AND INTERFACES», vol. 114, 2010, pp. 11068- 11073 vol. 114, [UGOV: 8308]

−   N. Laidani, P. Cheyssac, J. Perrière, R. Bartali, G. Gottardi, I. Luciu, V. Micheli, *Intrinsic defects and their influence on the chemical and optical properties of TiO2-x films,* in «JOURNAL OF PHYSICS. D, APPLIED PHYSICS», vol. 43, 2010, pp. 485402- 485413 [UGOV: 17089]

−   G. Speranza, L. Minati, A. Chiasera, A. Chiappini, Y. Jestin, M. Ferrari, G.C. Righini, *Structual investigation of photonic materials at the nano-level using XPS,* in «JOURNAL OF NON-CRYSTALLINE SOLIDS», vol. 355, n. 18 -21, 2009 , pp. 1157- 1159 [UGOV: 4819]

### 3.   Objectives for 2012

**O1: Research on Functionalized nanoparticles for biomedicine (NANOSMART PROJECT)**. An efficient drug delivery system will be searched through the production of PLCA-coated gold nanoparticles and the study of the drug delivery kinetics in *in vitro* experiments and further in *in vivo* experimenst at Ludwig Boltzman Institute,Vienne (LBI). The introduction of the drug inside the nanoparticle, the drug release kinetics and the chemical stability of the polymer-coated particle will constitute a significant part of the activity. The collaboration with DIMTI-Biotech (Trento Unv.), IMEM-CNR (Trento), Giorgiatech, Montpellier Univ. (France) and (LBI) will continue in the frame of the Nanosmart project.

**O2: Research on nano-oxide based systems for solar systems.** The research line of processing wide band gap oxides of the Unit will be extended to new application sectors. Multi-functional nano-structured oxide films will be produced in duplex plasma/wet chemistry processes. High aspect ratio structures will be searched for surface maximizing. The materials will be used for a combined solar photon management and photo-catalysis. Specific catalysts will be selected and their integration to the nano-oxide structures will be studied for hydrogen production. In another application sector, specific molecules will be chosen as target for photodegradation. The activity will be conducted in internal collaboration with CM&M Units and external collaboration with University P. & M. Curie of Paris.

**O3: Research on electrocaloric systems (activity agreed with the Director).** Multifunctional materials for energy storage and saving (duplex function of high-capacitors and electro-caloric systems) will constitute a new sector activity of the Unit, within a collaboration with the Centre Direction. The Unit will support the RF sputtering process to be applied for the highly-multilayered system production and the structural and chemical characterization of the samples by means of XPS, AES, XRD and AFM. This new research topic is constituting a common area of interest in the M&M Centre.

**O4: Research on Carbon-based systems.** The experience of the Unit related to carbon materials will be further directed towards new aspects such as the functionalization of diamond surface by means of UV irradiation and diamond characterization in view of waveguide application for THz region. This work will be done within the collaboration with IFN-CNR and University La Sapienza (Rome).

### 4.   Front Edge & New Initiatives

The main objective of the Unit for what concerns front edge activities is that to be of strong impact in two important sectors: *nanotechnology for energy* and *nanotechnology for surface engineering.*

Innovative materials synthesis in line with the on-going research axis for energy and the further exploration of new and highly strategic energy sectors, such as "*chemical solar cells*" for hydrogen production, and multifunctional materials for energy storage and saving (duplex function of high-capacitors and electro-caloric systems) are constituting a common area of interest in the M&M Centre. For these

new research topics, Unit PAM SE can be a platform for material research, in the next 3/5 years and beyond, in connection with the different research interest poles present in the M&M centre.

As for the *nanotechnology for surface engineering*, the ability to process materials of different natures will be important for the development of appealing devices from the technological point of view. High throughput surface treatment techniques based on a combinatorial approach will be mastered to develop active surfaces and materials of interest in the field of the biomedicine/biosensors and electro-chemical sensors. Grafting processes will be part of the Unit activity in surface development for the manipulation and separation of polysomial RNA (in collaboration with the BioSynt Unit in a new initiative).

The experience related to carbon will be further directed towards carbon nanostructures study such as *graphene*: a structure with extremely interesting electronic as well as mechanical properties (such as stretching capacity and flexibility), that altogether make it extremely attractive for different applications in nano-, transparent electronics and stretchable electronics. In fact, as a transparent electrode, a hot field for PAM SE, graphene is the most nascent nanomaterial investigated as such, with its exceptional in-plane electrical mobility. Such new topic for PAM SE will be shared with the CM&M Centre, BioMEMS Unit and potentially other Units.

## 5.  Funding

| Acronym | Full name | Type | Duration | Total income | Income 2012 |
|---------|-----------|------|----------|--------------|-------------|
| NANOSMART | Development of imaging for tumor therapy | PAT | 1/10/2010 30/9/2012 | 432 000.00 | 70 187.83 |
| ENVIPARK2 | Analytical support for industry | IND. | 2/8/2011 1/8/2012 | 16 222.00 | 16 222.00 |
| iSiCPV | R&D of technology and materials for innovative solar cell | NAT. | 1/11/2011 31/10/2014 | 35 662.00 | 35 662.00 |
| MADE-IN-ITALY | technological support | NAT. | 1/10/2010 30/9/2013 | | 21 184.32 |
| ARCO-P | technological support | PAT-LP06 | 1/2/2011 31/1/2013 | 60 000.00 | 30 041.00 |
| PRYSMIAN | Technological support | IND. | 1/1/2012 30/6/2012 | 20 000.00 | 20 000.00 |

## 6. Budget

|  | 2011 | 2012 |
|---|---|---|
| Expenses |  |  |
| Personnel | € 384,79 | € 340,42 |
| Travel | € 21,50 | € 21,50 |
| Equipment (HW/SW) | € 13,00 | € 18,00 |
| Other (e.g. subcontracting to external contractors) | € 99,90 | € 95,95 |
| Total Expenditure | € 519,19 | € 475,87 |
| Incomes |  |  |
| EU Projects (total amount financed by EU) | € 17,30 | € 0,00 |
| Other external incomes (industrial, PAT projects, etc.) | € 154,74 | € 140,21 |
| Projects to be finalized | € 42,30 | € 53,83 |
| Total Income | € 214,33 | € 194,04 |
| Financial Need (Total Income – Total Expenditure) | € 304,86 | € 281,83 |
| Self funding | 41,3% | 40,8% |

# APP – ADVANCED PHOTONICS AND PHOTOVOLTAICS

Head of Unit: Georg Pucker

## 1. Summary and vision

The Advanced Photonics and Photovoltaics unit (APP) performs research in the field of silicon photonics and photovoltaics. Silicon is the key material of both micro-electronic and photovoltaic industry. APP since several years is actively involved in: engineering the properties of silicon by controlling its dimension or strain on the nano-scale, and the integration and exploration of the material in solar cells or photonic-light-wave circuits (PLC). Aim of this concept is to obtain nanostructured silicon with properties, which are absent in bulk silicon (e.g. large non-linear refractive index, prevalent radiative recombination of carriers, etc.) to further widen the field of application for devices based on a relatively cheap and optimized technology. Our research is strongly interdisciplinary requiring expertise in the fields of nanotechnology, material science, optics, and photovoltaics.

Tiny silicon nano-crystals of dimensions of a few nanometer (so called silicon quantum dots) embedded in a dielectric matrix have electronic and optical properties differing considerable from bulk silicon and show strong photoluminescence due to the size reduction and localization of carriers. The band-gap of the material can be controlled by controlling the dimension of the dot. Even non-linear optical properties are considerably increased with respect to bulk silicon. Researchers of APP acquired strong competencies in the growth and optimization of the material and developed probably one of the best light emitting diodes based on silicon. Currently, we explore the properties of the dots for both applications in the fields of silicon photonics (all optical switching) and photovoltaics. In the EU project LIMA FP7 248909 (Improve Photovoltaic efficiency by applying novel effects at the limits of light to matter interaction) silicon-quantum dots are integrated together with metal nanoparticles on the front side of a solar cell and engineered to improve the cell efficiency maintaining at the same time the fabrication costs low.

Another approach of altering the properties of silicon is the application of straining materials, which induce a deformation of the unit cell, break the cubic symmetry and induce a non-linear power dependence in the material's optical suscebtibility. APP within a collaboration with the Nanoscience Laboratory of the Department of Physics, University of Trento, Italy and the Department of Information Engineering of the University of Brescia, Italy investigates this concept in the project STRESS for the realization of silicon waveguides with non-linear optical properties. Our results show that the non-linearity is of the same order of magnitude as the one for lithium niobate, one of the most widely used materials for the realization of electro-optical modulators.

Beside the excellence in engineering of the properties of silicon, APP has also strong competencies in the realization of planar-light-wave circuits. Especially in

the fabbrication and integration of different types of micro-meter sized resonators (discs, rings), which are fabricated either for fundamental physical studies in the field of opto-mechanics or for label-less sensors in biotechnology or medial applications.

APP started recently to realize quantum-wires in silicon for application in thermo-electrical devices. These devices allow to transform electrical power in head or vice versa and represent another application for nano-scale engineered silicon.

*Unit composition*

|  | *2011 (as of Jan 1$^{st}$)* | *2012 (planned)* |
|---|---|---|
| Research directors | 0 | 0 |
| Senior researchers | 1 | 1 |
| Researchers (including postdocs, etc.) | 2 | 2 |
| Technologists | 0 | 0 |
| PhD students | 0 | 1 |
| Total | 3 | 4 |
| Tenured |  |  |
| Tenure track |  |  |

*Top researchers by citations (max. 5)*

| *Researcher* | *H-index* | *Citations (total)* |
|---|---|---|
| G. Pucker | 18 | 723 |
| M. Ghulinyan | 14 | 547 |
| Y. Jestin | 9 | 205 |

Remark: H-INDEX from webofknowledge; number of citations without self-citations

## 2. Recent publications

| *Model: Standard* |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|
| *year* | *Jour. Papers (IF)* | *Q1 (%)* | *Conf. Papers* | *Patents* | *Books (authored)* | *Books (edited)* | *Chapters in Book* |
| In print | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2011 | 7 | 70 | 3 | 0 | 0 | 0 | 0 |
| 2010 | 3 | 67 | 4 | 0 | 0 | 0 | 0 |
| 2009 | 19 | 45 | 11 | 0 | 0 | 0 | 0 |
| 2008 | 9 | 67 | 7 | 0 | 0 | 0 | 0 |

APP is able to continuously publish in high ranked journals in the field of applied physics and optics (e.g.: Applied Physics Letters, Journal of Applied Physics, Optics Express, etc.). The number of publications shows fluctuations caused by the arrival of a new researcher in 2009 creating a temporary maximum in publications in 2009 due to co-authorship with his former center and by a pending patent deposited in 2010, which forced us to postpone the submission of a series of manuscripts.

Top 5 publications in the last 3 years (2009-2011):

−   Chiasera, Y. Dumeige, P. Fe'ron, M. Ferrari, Y. Jestin, G. Nunzi Conti, S. Pelli, S. Soria, G. C. Righini, *Spherical Whispering Gallery Mode Microresonators*, LASER & PHOTONICS REVIEWS, vol 4 n 3, 2010, pp 457-482 [ UGOV: 19598].

−   Pitanti, M. Ghulinyan, D. Navarro-Urrios, G. Pucker, L. Pavesi, *Probing the Spontaneous Emission Dynamics in Si-Nanocrystals-Based Microdisk Resonators*, PHYSICAL REVIEW LETTERS, vol 104, n 10, 2010, pp 103901 [ UGOV: 9217].

−   Z. Yuan, G. Pucker, A. Marconi, F. Sgrignuoli, A. Anopchenko, Y. Jestin, L. Ferrario, P. Bellutti, L. Pavesi, *Silicon nanocrystals as a photoluminescence down shifter for solar cells* SOLAR ENERGY MATERIALS AND SOLAR CELLS, vol 95, n 4, 2011, pp 1224-1227 [ UGOV: 32181].

−   Anopchenko, A. Marconi, M. Wang, G. Pucker, P. Bellutti, L. Pavesi, *Graded-size Si-quantum dot ensembles for efficient light emitting diodes*, APPLIED PHYSICS LETTERS, Vol 99, 2011, pp 181108 [UGOV 51205].

−   M. Ghulinyan, A. Pitanti, G. Pucker, L. Pavesi, *Whispering-gallery mode micro-kylix resonators*, OPTICS EXPRESS, vol 17, n 11, 2009, pp 9434-41. [UGOV: 9215].

## 3.   Objectives for 2012

**O1: Research on Si-quantum-structures for renewable energy.** APP will continue its research on silicon quantum dots for solar cells. An aspect of especial interest is the study of the optical behavior of silicon quantum dots under illumination conditions (high photon flux) encountered in concentration photovoltaics. In addition, growth processes for the fabrication of heavily doped silicon nanowires for thermo-electrical devices based on the Seebeck effect will be realized. The major risks are i) too strong quenching of photoluminescence under high concentration (the problem will be addressed by considering the optimum concentration factor of operation), ii) the growth of multilayer structures (needed for the Si-wire fabrication) could be hampered by large film stress (mitigation plan: use of different substrates and careful engineering of the film stress).

**O2: Optical bench for photoluminescence measurements.** APP plans to set-up an optical bench for a simple optical characterization of Si-quantum dots. The bench is needed for projects, in which no external partner is involved who can perform this type of experiments. Most of the equipment was bought in 2010-11 and

free space within the labs of CMM was already identified, therefor the operation is without major risks.

## 4.  Front Edge & New Initiatives

APP and BioSInt plan to collaborate closely on the development of label free sensing systems for biomolecules such as DNA, RNA, or proteins. These sensors based on whispering gallery resonators and planar light wave circuits have the potential to sense an extremely low quantity of molecules (pg/ mm$^2$). The collaboration picks up some encouraging results of the research started within the project Naomi FuPAT and will further increase the expertise of CMM in the development of sensors for applications in biology, biotechnology and medicine.

## 5.  Funding

| Acronym | Full name | Type | Duration | Total income | Income 2012 |
|---------|-----------|------|----------|--------------|-------------|
| LIMA | Project ``248909 LIMA - Improve Photovoltaic efficiency by applying novel effects at the limits of light to matter interaction" | EU | 1/1/2011-31/12/2011 | € 116367.00 | € 37624.00 |
| isiCPV | | MIUR | 01/11/2011-31/10/2014 | € 35591.,58 | - |
| ERG | | Industrial | 10 months within 2012 | € 81292.37 | - |

Type: EU, PAT, Other public agency, Industrial.

During the year 2011 2 projects in which APP was involved (STRESS, Oxi-Solar) ended. The projects will be replaced by 2 recent projects (isiCPV and ERG). APP in addition submitted 4 proposals (2 for regional and 2 for european Grants) and submission of at least another 2 proposals is planned to guarantee the project for 2013.

## 6. Budget

|  | 2011 | 2012 |
|---|---|---|
| Expenses |  |  |
| Personnel | € 193,63 | € 179,97 |
| Travel | € 9,60 | € 8,50 |
| Equipment (HW/SW) | € 0,50 | € 28,50 |
| Other (e.g. subcontracting to external contractors) | € 33,10 | € 37,30 |
| Total Expenditure | € 236,83 | € 254,27 |
| Incomes |  |  |
| EU Projects (total amount financed by EU) | € 43,24 | € 20,41 |
| Other external incomes (industrial, PAT projects, etc.) | € 62,41 | € 0,00 |
| Projects to be finalized | € 0,00 | € 109,77 |
| Total Income | € 105,64 | € 130,18 |
| Financial Need (Total Income – Total Expenditure) | € 131,18 | € 124,09 |
| Self funding | 44,6% | 51,2% |

Note: Column 2011 is based on the unit's budget state as estimated at the date of document writing. Column 2012 is the budget planned for 2012.

## BIOSINT – BIOFUNCTIONAL SURFACES AND INTERFACES

Head of Unit: Cecilia Pederzolli

### 1. Summary and vision

Since 2008, owing to the scientific reorganization of the CMM, the research activity of the BioSInt team has been part of a wider effort by the Center involving several research Units (Bio-MEMS, MiNALab, SOI, LISC, PAM-SE) to develop micro and nanostructure technologies for next generation medical devices (CMM-IRST *Programma Scientifico e Tecnologico 2009-2013, Nano–Micro Tecnologie per applicazioni biomedicali e BioNanoTecnologie/IT per le scienze della vita)*.

With the emergence of complex products, a paradigm change is occurring that demands devices with new built in biomaterial properties. Next generation medical devices will require enhanced properties in order to be even more effective. These enhanced properties may include the use of pharmacological agents, bioactive coatings, nano-textures, nano-engineered surfaces, reactive materials that control interactions in order to have desirable biological outcomes (*bio-functional surfaces and interfaces*). The methods for the introduction of biological functionalities on inorganic/organic materials and tailoring their surface properties to improve their bio-compatibility, constitutes a core activity on which the successful development of the next generation of biomedical devices is based. With this aim in mind and building on the surface science competencies already present in the Institute, an interdisciplinary group has gradually been developed with a twofold objective: 1) the study of the surface physico-chemical and morphological properties of material surfaces and their correlation with the interaction of biomolecules such as nucleic acids (DNA, RNA), proteins as well as animal and human cell lines (*biological surface science*); 2) the development of processes enabling controlled attachment of functional biomolecules, particularly the study of functionalization procedures aimed at the realization of biofunctional materials for biosensors, biochips and lab-on-chips applications. Apart from the difficulties over the last two years in retaining/replacing personnel, the research group is characterized by a highly multi-disciplinary character, comprising members with biological, physical and chemical competences and it has developed a strong background at the interface of these disciplines. This approach is generally considered of high value for the success of the research activity in biomedical technologies both because of the need for these diverse disciplines in developing biomedical devices and for the developed intellectual facility of these researchers to understand other important disciplines in this field such as engineering, biology and medicine. For the last few years the team has been carrying out applied research, also through joint activities and projects with start-up companies and industrial partners (i.e.Olivetti I-Jet, ST-Microelectronics), obtaining good recognition in the local and national scientific communities for its activity in bionanotechnology. During 2010 two patents were deposited while the number of publications in the period 2008- 2011 is 19 (+2 with-

out IF) with a cumulative Impact Factor of 77.105 (average value of 4.06 for paper). Now the research group is making an effort to obtain international recognition though scientific collaborations and projects funded by international agencies such as the EU community (1 submitted proposal and 2 in preparation under the FP7 program).

The vision for the future is to continue on the current course in the belief that the integration of new materials and micro-scale devices promises to lead to biomedical breakthroughs in both therapeutic and diagnostic applications. As already mentioned, biomaterials play an important role in the development of medical equipment, devices and implants, in research and clinical applications. Therefore, there is great interest in this research area among scientists in academic as well as in industrial companies. Finally, the BioSInt team activity is well placed in the CMM with respect to important infrastructures and competences in material science and engineering as well as opportunities for integration with local research groups (M. DallaSerra CNR-IBF, L. Pavesi UniTN Dep. Physics, A. Quattrone UniTN-CIBIO) resulting in novel competences in state-of-the-art areas such as molecular imaging and next generation sequencing systems, both considered key points for molecular diagnosis in the future. The key activities for the next 3/5 years: a) Materials, methods and devices for molecular diagnosis; b) Innovative systems for molecular imaging and biophotonic applications.

*Unit composition*

|  | *2011 (as of Jan 1st)* | *2012 (planned)* |
|---|---|---|
| Research directors |  |  |
| Senior researchers | Cecilia Pederzolli | Cecilia Pederzolli |
| Researchers (including postdocs, etc.) | Lorenzo Lunelli Laura Pasquardini Cristina Potrich | Lorenzo Lunelli Laura Pasquardini Cristina Potrich 1 post-doc |
| Technologists |  |  |
| PhD students | Lorenza Marocchi Prashant Pradhan | Lorenza Marocchi Prashant Pradhan 1 PhD student |
| Total | 6 | 8 |
| Tenured |  |  |
| Tenure track |  |  |

*Top researchers by citations (max. 5)*

| *Researcher* | *H-index* | *Citations (total)* |
|---|---|---|
| Cecilia Pederzolli | 14 | 689 |
| Cristina Potrich | 9 | 336 |

## 2. Recent publications

| year | Jour. Papers (IF) | Q1 (%) | Conf. Papers | Patents | Books (authored) | Books (edited) | Chapters in Book |
|------|------|------|------|------|------|------|------|
| In print | 2 | 75 | 0 | 0 | 0 | 0 | 1 |
| 2011 | 5 | 40 | 5 | 0 | 0 | 0 | 0 |
| 2010 | 4 | 75 | 13 | 2 | 0 | 0 | 0 |
| 2009 | 2 | 0 | 13 | 0 | 0 | 0 | 0 |
| 2008 | 6 | 50 | 7 | 0 | 0 | 0 | 0 |

After two years dedicated mostly to research activities which led to patent deposition within the Latemar consortium, the last year has been more fruitful in terms of the number of publications. However, the lack of financial support for travel has caused an appreciable decrease in conference participation.

Top 5 publications in the last 3 years (2009-2011):

− Praper, T.; Sonnen, A. F.-P.; Kladnik, A.; Andrighetti, A. O.; Viero, G.; Morris, K. J.; Volpi, E.; Lunelli, L.; Serra, M. D.; Froelich, C. J.; Gilbert, R. J. C. & Anderluh, G. (2011), *'Perforin activity at membranes leads to invaginations and vesicle formation'*, PNAS, in press [UGOV:51194]

− Pasquardini, L.; Potrich, C.; Quaglio, M.; Lamberti, A.; Guastella, S.; Lunelli, L.; Cocuzza, M.; Vanzetti, L.; Pirri, C. F. & Pederzolli, C. (2011), *'Solid phase DNA extraction on PDMS and direct amplification'*, Lab on a Chip, 11(23) 4029-4035 [UGOV:41989]

− Zanarini, S.; Vinante, M.; Pasquardini, L.; Sanginario, A.; Giorcelli, M.; Bianco, S.; Gerbaldi, C.; Nair, J. R.; Lunelli, L.; Vanzetti, L.; Paolucci, F.; Marcaccio, M.; Prodi, L.; Tagliaferro, A.; Pederzolli, C.; Demarchi, D. & Civera, P. (2011), *'Facile functionalization by pi-stacking of macroscopic substrates made of vertically aligned carbon nanotubes: Tracing reactive groups by electrochemiluminescence'*, Electrochimica Acta 56, 9269-9276 [UGOV:40590]

− Froner E., D'Amato E., Adamo R., Prtljaga N., Larcheri S., Pavesi L., Potrich C., Rigo A.,'*Deoxycholate as an efficient coating agent for hydrophilic silicon nanocrystals'*, Journal of Colloid and Interface Science 358, 86-92 [UGOV: 30849]

− Potrich, C.; Lunelli, L.; Forti, S.; Vozzi, D.; Pasquardini, L.; Vanzetti, L.; Panciatichi, C.; Anderle, M. & Pederzolli, C. (2010), *'Effect of Materials for Micro-electro-mechanical Systems on PCR Yield'*, European Biophysics Journal 39, 979-986 [UGOV:5040]

## 3. Objectives for 2012

**O1: Study of biomolecule-material interactions (Naomi, Netwon, RNA).** The investigation of the interactions between biomolecules (nucleic acids, proteins, li-

pids) and surfaces carrying different chemical, physical and morphological properties constitutes a fundamental aspect for the development of opportunely designed materials. The material surface properties determine its behavior when it comes in contact with biological fluids. A layer (or a multilayer) of biomolecules quickly covers the material surface causing in turn subsequent reactions with the complex mixture of molecules that are present in the surrounding. The truly biocompatible material doesn't exist and then depending on the final application each surface of the device must be treated with the appropriate set of surface processes. Within all the projects running in the Unit it will be crucial to perform the surface analysis of materials chosen for the chip realization and bioreactor development (silicon and derivatives, polymers) to estimate the biocompatibility extent and perhaps the best passivation treatment for the specific application.

**O2: Development of biofunctional surfaces for lab-on-chips in genomic analysis (Newton, RNA).** This task includes several activities with important objectives for the next year regarding DNA (genomic) and RNA (polysomal and miRNA) materials and devices for molecular diagnosis: 1) the development of tools for 3D cell micro-culture and for purification and analysis of nucleic acids, i.e. materials and structures aimed at the isolation of miRNA, small RNA and mutated DNA from cell fluids deriving 2D and 3D cell cultures; 2) material surfaces for genomic DNA isolation (using crude biological samples such as blood) and gene amplification (PCR reaction) from adherent DNA aimed to the optimization of the recently developed system from ST-Microelectronics (ST- Q3 real time PCR) integrating the DNA purification step. In addition, the RNA project will go on during 2012 following two directions: 1) the study of the interactions between polysomal cell fractions and surfaces with different chemistry and morphology; 2) development of a specific nanomaterial for the efficient isolation of mRNA under translation, suitable for integration in microdevices. The realization of functional surfaces able to specifically purify unmodified polysomes from cell lysates will constitute a fundamental step toward the realization of automated microdevices for polysome isolation. Part of the work will be also dedicated to a more advanced AFM use with the development of functional tips used to measure the strength of the interactions between ribosomes/polysomes and different chemical groups or biomolecules.

**O3: Study of surface functionalization processes (Naomi, RNA).** In order to achieve the scientific objectives of the ongoing projects and of the feasibility studies an effort will be applied to the study of surface modification methods: 1) microresonators (microsphere, microdisk) coating with a silane activating film and subsequently with DNA-aptamers molecules acting as highly specific receptor for thrombin and/or epidermal growth factor (bioaffinity sensor); 2) silicon nanocrystal coating for molecular imaging applications; 3) functionalization of microcantilevers made of silicon and gold for DNA hybridization detection; 4) plasma-based surface treatments for solid-phase RNA purification (combinatorial materials).

**O4: High resolution imaging using AFM (RNA).** AFM imaging of molecular assemblies will be carried out: 1) the structural determination of polysomes, that are supramolecular assemblies where the genetic code carried by ribonucleic acids

(mRNAs) is translated synthesizing proteins; 2) the imaging of the molecular structures of membrane proteins in contact with lipid bilayers deposited on flat surfaces.


## 4.   Front Edge & New Initiatives

FBK-CNR-UNITN joint laboratory: *Laboratory for Sequence and Structure Analysis for Health* (LSSAH)

In February 2012 the LSSAH laboratory will be ready and after one year of organizational activity (i.e. building of the infrastructure, buying instruments, etc.) the experimental activities will start establishing a common place where researchers belonging to different institution – UNITN-CIBIO, CNR-IBF, FBK-CMM, FBK-CIT – face together the strategic issue of the new technologies for nucleic acid sequencing for biomedical applications. The aim is to concentrate resources and integrate expertise in molecular biology, bioinformatics, molecular imaging and bionano-technologies to face the challenge in the development of nanomedicine (that will have a strong social impact). The high-throughput sequencing technologies, also known as next-generation and deep sequencing (NGS), and the molecular imaging techniques are, nowadays, the focus of an unprecedented scientific revolution that could also be push by the Trentino research system. Thanks to these new technologies, the physiological and functional mechanisms of diseases can be now investigated quantitatively and at the highest achievable resolution of the cell structure. A scientific document specifically dedicated to this initiative is in preparation.

Si-based lab-on-chip platform for label free sensing of biomolecules

The Units BioSInt and APP plan to collaborate closely on the development of label-free sensing systems for biomolecules such as DNA, RNA, or proteins. These sensors based on whispering gallery resonators and planar light wave circuits have the potential to sense an extremely low quantity of molecules ($pg/mm^2$). The collaboration is a prolongation of the research started within the Naomi project and will further increase the expertise of CMM in the development of sensors for applications in biology, biotechnology and medicine. In this contest an European proposal is in preparation with the collaboration of UNITN, ST-Microelectronics, Fraunhofer Institute of ENAS (Chemnitz D)and IBMT (Potsdam D), LETI and other entities.

MtLab and BioSInt collaboration: sharing of technician

Finally it is worth reporting an initiative aimed at optimizing efforts and resources within the Center. In 2009, the BioSInt team moved to a new lab (Biomolecular Sciences and Interfaces Laboratory, leader: C. Pederzolli) with a newly equipped and larger area (more than 200 m2), as a joint action with the Institute of Biophysics of CNR. These facilities benefit not only BioSInt Unit and the CNR-IBF but also other CMM material science Units (MiNALab, PAM-SE, CTP), Molecular Stamping, CIBIO and the Mach Foundation. Moreover, starting from 2012 the new laboratory area will become functional (adding about 150 m2). To face all the aspects related to the efficient management of the laboratory an agreement has been made with the coordinator of MTLab for sharing a skilled and trained technician.

## 5. Funding

| Acronym | Full name | Type | Duration | Total income | Income 2012 |
|---|---|---|---|---|---|
| Newton | Advanced nanosystems for a new era in molecular oncology | FIRB | 2012/2016 | **697.473** | **119.089,10** |
| Naomi | A NAno on MIcro approach to a multispectral analysis system for protein essays | PAT | 2009/2012 | **218.379,50** | **62.388,50** |
| RNA | Micro-tools for nucleic acids analyses in diagnostics | INTERNAL | 2009/2013 | **187.762** | **41.148,80** |

## 6. Budget

| | 2011 | 2012 |
|---|---|---|
| Expenses | | |
| Personnel | € 293,76 | € 306,21 |
| Travel | € 7,29 | € 12,00 |
| Equipment (HW/SW) | € 0,00 | € 0,00 |
| Other (e.g. subcontracting to external contractors) | € 86,50 | € 126,50 |
| Total Expenditure | € 387,55 | € 444,71 |
| Incomes | | |
| EU Projects (total amount financed by EU) | € 17,65 | € 0,00 |
| Other external incomes (industrial, PAT projects, etc.) | € 68,01 | € 62,39 |
| Projects to be finalized | € 0,00 | € 183,72 |
| Total Income | € 85,66 | € 246,11 |
| Financial Need (Total Income – Total Expenditure) | € 301,88 | € 198,61 |
| Self funding | 22,1% | 55,3% |

Note: Column 2011 is based on the unit's budget state as estimated at the date of document writing. Column 2012 is the budget planned for 2012

## 7.   Remarks

Since the implementation of the FBK strategic plan 2009-2013 the Unit has seen a gradual decrease in personnel: Stefania Forti - R3 (biologist), July 2009; Michele Vinante post-doc in chemistry, December 2010; Ramona Dallapiccola post-doc in electronic engineering, June 2011; Federica Piras post-doc in chemistry, June 2011. This situation is due to the low rate of incoming in relation to the high percentage of new research activities performed by the Unit in the period from 2008 up to now. Considering that it require time to gain the competences which form the basis of publication and recruitments of financial support in the new research activities the Unit has been requested to undertake (RNA project, joint laboratory CNR-FBK-UNITN), a more stable situation in terms of personnel would be desirable and provide a better and more efficient organization of our research activities over the long term. Also, the number of researchers in the Unit (core unit) should be more balanced between biological and biophysical competences and for this reason the stabilization of Laura Pasquardini is required (she is reaching the defined seniority in June 2012). The suitable/required number of personnel for the Unit is a core group comprising 4 researchers dedicated to material science plus a number of post-doc and PhD students (up to 5) depending on the incoming rate.

In this context the Unit needs to consolidate the available competences with a researcher having a solid background in biophysics, especially skilled in fluorescence techniques (such as confocal microscopy, two-photon microscopy), in spectroscopical methods especially suited for biological materials and in the synthesis of nanomaterial via wet-chemistry. In this regard Pasquardini is the most suitable candidate. Since 2001 she has been collaborating with FBK-CMM (and previously with Physics and Chemistry of Surfaces and Interfaces Division of the ITC-irst) on surface science topics applying her physics studies to biological problems: drug delivery systems against bacterial infections, carbon-based materials as biomaterials and/or components of biosensors, materials for DNA analysis, biosurfaces for biomarkers identification and detection. During her many years' experience she has constantly improved not only in terms of scientific competences but also in the various abilities that are essential for a distinguished researcher. These include the ability to effectively communicate results at meetings and conferences, to exercise initiative and judgment in carrying out research tasks, and to write papers at a level consistent with publication in highly regarded international journals. She also has good organizational and multi-tasking skills, and an excellent working relationship with others team members, which facilitates group coordination. Since January 2010 she has also been coordinating the "Biofunctional materials development and characterization" work package of Naomi project, a joint project on bionanotechnology involving four different research institutions. Finally, taking into consideration the criteria indicated by our director, Pasquardini has acquired mature professional experience as demonstrated by scientific results (i.e. patents) and publications; also, she is a researcher who has proven she is capable of working across the CMM Units: MiNALab, Bio-MEMS, SOI, LISC, PAM-SE.

# SRS – SILICON RADIATION SENSORS

Head of Unit: Claudio Piemonte

## 1. Summary and vision

*Scope and motivation for the activities carried out in the unit*

Semiconductor detectors are used in a large variety of fields in science and technology, including nuclear physics, elementary particle physics, optical and x-ray astronomy, medicine, and materials testing – and the number of applications is growing continually. The success of semiconductor detectors is due to several unique properties that are not available with other types of detectors. Among the various semiconductors, silicon is by far the most used both for its characteristics as well as for the highly developed technology and availability. FBK has a long successful tradition in this specific field. Furthermore, thanks to the in-house production facility it is a unique ideal environment to research and develop new radiation sensor concepts.

The SRS unit has unique capabilities of simulation, design, technology development and characterization of silicon radiation sensors. We can follow the entire development chain which is very attractive for companies and research institutes who need specific customized sensors.

*Positioning with respect to the state of the art and notable recent achievements of the unit*

The research content is focused in two areas:

- *Low-level light sensors.* The core activity is on the Silicon Photomultiplier (SiPM), which is one of the most interesting innovative technologies for low-level light detection. The fields of application are numerous: medicine, biology, material science, security and physics experiments. FBK is world-wide recognized as one of the main development centers for this tech. This is certified by the international collaborations and contacts: Philips, INFN, CERN, University of Pennsylvania, FermiLab, Siemens, and others. It is worth reminding that, in 2010, the SRS unit was the main actor in the incorporation of the spin-off company "AdvanSiD" having the scope of commercializing the first FBK generation of SiPMs.

- *High-energy radiation sensors.* This field includes a variety of detector technologies which are manufactured in fully depleted high resistivity silicon: pixel, micro-strip, drift and 3D detectors. For the first two types, FBK has a strong long-lasting competence and keeps on providing new customized solutions for different applications. The silicon drift detector type is a completely new technology for FBK which attracts a huge interest especially in spectroscopic instrumentation. At present, it is the most interesting R&D activity in this field since we have important collaborations both with industry and universities.

Results from the first 2 years of R&D are very encouraging and only part of them can be disclosed at this time.

*Vision about the most promising directions and activities to conduct in the future*

As evident from the previous paragraph, the SRS has two main R&D activities: the Silicon Photomultiplier and the Silicon Drift Detector. We intend to further develop and use most of our energies in these fields in the next coming years. We have created solid basis in terms of both technical competence and credibility worldwide. The FBK name is well recognized and respected in this context. Furthermore, both technologies find a wide range of high-tech applications, so we believe it is possible to find more collaborations and projects in the coming years.

*Unit composition*

|                                          | *2011 (as of Jan 1$^{st}$)* | *2012 (planned)* |
|------------------------------------------|-----------------------------|------------------|
| Research directors                       | 0                           | 0                |
| Senior researchers                       | 2                           | 2                |
| Researchers (including postdocs, etc.)   | 6                           | 6                |
| Technologists                            | 0                           | 0                |
| PhD students                             | 1                           | 1                |
| Total                                    | 9                           | 9                |
| Tenured                                  | 0                           | 0                |
| Tenure track                             | 0                           | 0                |

Note: "Research directors" are level 1 researchers; "Senior researchers" are level 2 researchers. Category "Researchers" covers all other cases, including level 3 and 4 researchers, postdocs and other contractual forms used to enroll researchers.

*Top researchers by citations (max. 5)*

| *Researcher*         | *H-index* | *Citations (total)* |
|----------------------|-----------|---------------------|
| Claudio Piemonte     | 14        | 808                 |
| Nicola Zorzi         | 11        | 561                 |
| Alberto Gola         | 6         | 115                 |
| Gabriele Giacomini   | 5         | 86                  |

Data from Scopus, http://www.scopus.com, 09/11/2001

## 2.   Recent publications

| year | *Jour. Papers (IF)* | *Q1 (%)* | *Conf. Papers* | *Patents* | *Books (authored)* | *Books (edited)* | *Chapters in Book* |
|------|---------------------|----------|----------------|-----------|--------------------|------------------|--------------------|
| 2011 | 12                  | 29       | 2              | 0         | 0                  | 0                | 0                  |

| 2010 | 13 | 15 | 8 | 1 | 0 | 0 | 0 |
| 2009 | 12 | 46 | 7 | 2 | 0 | 0 | 0 |
| 2008 | 11 | 36 | 7 | 1 | 0 | 0 | 0 |

Top 5 publications in the last 3 years (2009-2011):

− N. Serra, G. Giacomini, A. Piazza, C. Piemonte, A. Tarolli, N. Zorzi, *Experimental and TCAD Study of Breakdown Voltage Temperature Behavior in n+/p SiPMs*, in «IEEE TRANSACTIONS ON NUCLEAR SCIENCE», , pp. 1233- 1240 vol. 58, n. 3, 2011 [UGOV:35583]

− G. Collazuol, M.G. Bisogni, S. Marcatili, C. Piemonte, A. Del Guerra, *Studies of silicon photomultipliers at cryogenic temperatures*, in «NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH. SECTION A, ACCELERATORS, SPECTROMETERS, DETECTORS AND ASSOCIATED EQUIPMENT», , pp. 389- 392 vol. 628, n. 1, 2011 [UGOV:23209]

− G.-F. Dalla Betta, M. Boscardin, G. Darbo, C. Gemme, A. La Rosa, H. Pernegger, C. Piemonte, M. Povoli, S. Ronchin, A. Zoboli, N. Zorzi, *Development of 3D-DDTC pixel detectors for the ATLAS upgrade*, in «NUCLEAR INSTRUMENTS &amp; METHODS IN PHYSICS RESEARCH. SECTION A, ACCELERATORS, SPECTROMETERS, DETECTORS AND ASSOCIATED EQUIPMENT», , pp. S15- S23 vol. 636, n. S1, 2011 [UGOV:32780]

− Zoboli, M. Boscardin, L. Bosisio, G.-F. Dalla Betta, C. Piemonte, S. Ronchin, N. Zorzi, *Initial results from 3D-DDTC detectors on p-type substrates*, in «NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH. SECTION A, ACCELERATORS, SPECTROMETERS, DETECTORS AND ASSOCIATED EQUIPMENT», , pp. 521- 524 vol. 612, n. 3 2010 [UGOV:6508]

− G. Llosá, N. Belcari, M. G. Bisogni, G. Collazuol, S. Marcatili, P. Barrillon, C. de la Taille, S. Bondil-Blin, N. Dinu, M. Melchiorri, A. Tarolli, C. Piemonte, A. Del Guerra, *Energy, Timing and Position Resolution Studies With 16-Pixel Silicon Photomultiplier Matrices for Small Animal PET*, in «IEEE TRANSACTIONS ON NUCLEAR SCIENCE», , pp. 2586- 2593 vol. 56, n. 5 2009 [UGOV:6888]

## 3. Objectives for 2012

**O1: Research on Silicon Photomultipliers.** This activity is mainly related to the SUBLIMA project, whose aim is to improve the performance of the TOF-PET system developed in the previous project HyperImage. One of the main components determining the PET performance is the Silicon Photomultiplier.

We will work on: the improvement of the photo-detection efficiency in the UV/blue region of the EM spectrum; the noise reduction; and the development of read-out methods to improve the time-of-flight performance of our devices. Furthermore, we

will try to develop and produce first devices with back-side interconnection to improve the packaging of the device.

We have a very good understanding of our technology and all the capability/instrumentation to test new devices. However, in this research field, in which a single production requires at least 3-4 months, the risk of not meeting the objectives in the planned timeline is medium/high.

**O2: Research on Silicon Drift Detectors.** This activity is related to three projects: NexRay (with a private industry), SDD_ESA (an ESA project with Politecnico di Milano), XDXL (with INFN). In the first project, that started only 2 years ago, we are obtaining outstanding results (which cannot be published). The second started in 2010 and we are just finalizing the first characterization. The last project is a first development for future space experiments. It is clear that this technology can open new important gates for FBK.

The most important goal for the next year is to improve the performance in terms of leakage current. This parameter is important for each application. We are studying challenging gettering techniques to improve the already good results we have today. Concerning the risk, same considerations as above.

**O3: Fund raising.** An important goal for the next year it to find new projects to carry on the future activity. We plan to apply to 3 EU calls in the beginning of next year: 2 of them will deal with Silicon Photo-multipliers and 1 with Silicon Drift Detectors. Risk is high.

**O4: Innovation with AdvanSiD.** As mentioned above, in 2010 we created the spin-off company AdvanSiD with the scope of commercializing the first generation of SiPMs developed at FBK. The incorporation of AdvanSiD was an important success for the group. Now, one of the main goals is to reinforce a constructive collaborations between the company and FBK. AdvanSiD through its commercial network can spread the name FBK worldwide and transfer potential research collaborations to FBK. On the other side, FBK can transfer new technology evolutions closing the loop in the technology development.

### 4.   Front Edge & New Initiatives

*Front Edge Research*

Very large area Silicon Drift Detectors are the front edge research for the SRS research unit. More and more space physics experiments are interested in this sensor for the detection of the cosmic x-rays. A first concrete possibility to apply such technology could be the LOFT experiment in which several square meters of SDDs are required.

*New Initiatives*

The SRS research unit is committed in trying to strengthen the collaboration with some CMM research units. The first reason is to be more attractive as potential partners in industrial and research projects. The second important reason is to op-

timize the personell use sharing competencies between groups. In this sense we have two examples. The first is the strong collaboration between MTLab and SRS. Gabriele Giacomini form SRS is sharing its design competencies with MTLab while personnel from MTLAb is supporting SRS on the technological side (most important is on SDDs). The second collaboration is with the SOI research unit. This is a key combination since we join competencies to create a system made of the sensor plus the electronics. As an example, Alberto Gola of SRS group has developed a prototype of FLIM system using Single Photon Avalanche Diodes produced by FBK and an ASIC previously developed by SOI. The goal is to participate together in some future projects.

## 5. Funding

| Acronym | Full name | Type | Duration | Total income | Income 2012 |
|---------|-----------|------|----------|--------------|-------------|
| MEMS2 | Accordo di programma tra FBK e PAT per l'esecuzione del progetto MEMS2 | EL | 1-7-2009/30/6/2012 | 270000 | 44836 |
| SUBLIMA | SUB nanosecond Leverage In PET/MR ImAging | EU | 30-3-2010/31-8-2014 | 762314 | 172653 |
| Conv. Servizi | Convenzione di Servizi per definire i servizi offerti e le modalit/UTF | PL | 20-9-2010/19-9-2013 | 7501 | 2505 |
| Nexray | Annex 2 for Nexray Master Joint Development Agreement | PI | 26-11-2010/25-9-2012 | 100939 | 40526 |
| SDD_ESA | Silicon drift detectors for Gamma-Ray scintillators | RI | 1-4-2011/1-10-2012 | 125000 | 62500 |

Type: EU, PAT, Other public agency, Industrial.

Expected additional income during 2012 (about 40.000euro) is expected from contracts to be refined with INFN.

## 6.   Budget

|                                                              | 2011       | 2012       |
|--------------------------------------------------------------|------------|------------|
| Expenses                                                     |            |            |
| Personnel                                                    | € 461,92   | € 450,93   |
| Travel                                                       | € 38,00    | € 23,00    |
| Equipment (HW/SW)                                            | € 10,00    | € 5,00     |
| Other (e.g. subcontracting to external contractors)          | € 119,00   | € 110,00   |
| Total Expenditure                                            | € 628,92   | € 588,93   |
| Incomes                                                      |            |            |
| EU Projects (total amount financed by EU)                    | € 215,49   | € 187,52   |
| Other external incomes (industrial, PAT projects, etc.)      | € 285,52   | € 283,28   |
| Projects to be finalized                                     | € 0,00     | € 0,00     |
| Total Income                                                 | € 501,01   | € 470,81   |
| Financial Need (Total Income – Total Expenditure)            | € 127,91   | € 118,13   |
| Self funding                                                 | 79,7%      | 79,9%      |

Note: Column 2011 is based on the unit's budget state as estimated at the date of document writing. Column 2012 is the budget planned for 2012

## 7.   Remarks

The activity carried out by the Silicon Radiation Sensors Research Unit is unique in Italy. The main reason is that we have built a strong competence around an internal silicon foundry (MTLab) that can be accessed to provide new detector concepts and small productions. The group today is built around two senior scientist with permanent position. In total there are 9 people.

We think that the ratio between permanent and non permanent positions is too low to allow a good technological progress while keeping the core activity in house. In detail, 2 key positions are missing today. One is on the simulation and design side, while the second is on the functional characterization side. We are aware that it is impossible to acquire two stable positions in the near future for our group. A solution could be to share these positions with other groups belonging to CMM. Two groups that may be involved in this scheme are MTLab and SOI.

# MTLab - Microtechnologies Laboratory

Head of Unit: Pierluigi Bellutti

## 1. Summary and vision

*Scope and motivation for the activities carried out in the unit*

MTLab is a technologically updated Facility where R&D in Radiation Detectors and MEMS Areas, is carried out in collaboration with the Centre of Materials & Microsistems Research Units and with external (national and international) Partners.

MTLab is more and more attracting SME's looking for opportunities to introduce innovation in their products, working with a high quality, reliable and competent Partner.

MTLab offers high quality R&D environment and manufacturing Services, based on technological Platforms developed both independently or jointly with other Research Units of FBK. Besides, MTLab is actively engaged to transfer this technological Know-how into marketable products, supporting industrial production for medium quantity standard products.

*Positioning with respect to the state of the art and notable recent achievements of the unit*

Know how and equipments of MTLab belong to both the "MEMS world", and the Integrated Circuits (ICs) Silicon Technology. At national level, MTLab is still a unique MEMS Facility. Its ability to support also the development and production of high quality radiation sensor is placing the "facility systems" composed by MTLab and CMM Research Units as a worldwide recognized leader in these advanced Fields.

To mention just a few of the main achievements of MTlab, let cite the development of Silicon Drift Detectors Technology, together with SRS research Unit. This technology is the core of an active industrial contract (the largest private contract ever acquired in the recent 20 yearlong FBK history) with an Japanese multinational. The results are placing the FBK as one of the worldwide leaders in the sector. This result allowed MTLab and SRS to win an ESA tender together with the Politecnico of Milano. The most recent results are demonstrating the capability to meet the expected and challenging specs.

The second results is the development of a space–qualified phototransitor technology for the French Space agency, for ESA and ASI. At present MTLab of FBK has a unique potential as supplier at European level of such devices for space applications.

The last results to be mentioned is the achievement of a reliable technology for Si3D detectors, devices that will be included in the first upgrade of ATLAS experiment at CERN. To this purpose MTLab has already received a production contract.

*Vision about the most promising directions and activities to conduct in the future*

The MTLab proposed model of facility is growing year after year also because a new synergic interaction with CMM research units. Clear commitments of the Partners and optimized managements of the Partner's Role are the guidelines of new way how to operate.

One of the most exciting objectives MTLab is aiming at to take advantages from this new way of operation is to increase its present Leadership in space-related activities at european level. MTLab and CMM research Units have a number of projects completed or undergoing in developing and producing devices for space application with important international partners. This field shows several important features prospecting a very promising future for MTLab, supported by other Research Units. Space-related activities are fascinating, have high visibility, requires to develop sophisticated technologies, to manufacture small lots but to very high reliability and Quality standards, fosters technological fall-out because challenge established technological solution, is a well-funded niche market presently suffering of latent embargo problems. This Project could see the involvement of both Trento University, that has complementary space-related activities and some local microsystems manufacturers that could take advantage for strategic development of their interest.

*Unit composition*

|  | 2011 (as of Jan 1$^{st}$) | 2012 (planned) |
|---|---|---|
| Research directors | 1 | 1 |
| Senior researchers | 4 | 4 |
| Researchers (including postdocs, etc.) | 6 | 5 |
| Technologists | 2 | 3 |
| PhD students | 1 | 1 |
| Technicians | 15 | 15 |
| Total | 29 | 29 |
| Tenured | 23 | 24 |
| Tenure track |  |  |

Note: "Research directors" are level 1 researchers; "Senior researchers" are level 2 researchers. Category "Researchers" covers all other cases, including level 3 and 4 researchers, postdocs and other contractual forms used to enroll researchers.

*Top researchers by citations (max. 5)*

| Researcher | H-index | Citations (total) |
|---|---|---|
| Pierluigi Bellutti | 16 | 647 |
| Maurizio Boscardin | 13 | 683 |
| Sabina Ronchin | 13 | 625 |
| Antonino Picciotto | 7 | 130 |

H-index and Citations have been extracted by using Publish or Perish

## 2. Recent publications

| Year | Jour. Papers (IF) | Q1 (%) | Conf. Papers | Patents | Books (authored) | Books (edited) | Chapters in Book |
|------|-------------------|--------|--------------|---------|------------------|----------------|------------------|
| In print | 3 | 33 | 0 | 0 | 0 | 0 | 0 |
| 2011 | 12 | 32 | 4 | 0 | 0 | 0 | 0 |
| 2010 | 11 | 23 | 4 | 0 | 0 | 0 | 0 |
| 2009 | 15 | 47 | 10 | 1 | 0 | 0 | 0 |

Though MTLab personnel doesn't have as a priority goal to "produce" publications, collaboration with other research units and internal work are sometimes ending with paper publications. 32% of the papers published in 2009-2011 are related to activities not including other Centre Units.

Top 5 publications in the last 3 years (2009-2011):

−   Picciotto, D.Margarone, M.Crivellari, P.Bellutti, S.Colpo, L.Torrisi, J.Krasa, A.Velyhan, and J.Ullschmied, *Microfabrication of silicon hydrogenated thin targets for multi-MeV laser-driven proton acceleration*, In Print in APPLIED PHYSICS EXPRESS [UGOV: 51189]
−   Anopchenko, A. Marconi, M. Wang, G. Pucker, P. Bellutti, L. Pavesi, *Graded-size Si-quantum dot ensembles for efficient light emitting diodes*, In Print in APPLIED PHYSICS LETTERS [UGOV: 51205]
−   Z. Yuan, G. Pucker, A. Marconi, F. Sgrignuoli, A. Anopchenko, Y. Jestin, L. Ferrario, P. Bellutti, L. Pavesi, *Silicon nanocrystals as a photoluminescence down shifter for solar cells*, SOLAR ENERGY MATERIALS AND SOLAR CELLS, Vol 95, 2011, pp 1224-1227 [UGOV: 32181]
−   Borielli, M. Bonaldi, E. Serra, A. Bagolini, L. Conti, *Wideband mechanical response of high-Q silicon Double Paddle Oscillator,* JOURNAL OF MICRO-MECHANICS AND MICROENGINEERING, vol. 21, n 6, 2011, pp. 1-10 [UGOV: 31899]
−   D'Amico, C. Di Natale, E. Martinelli, A. Tibuzzi, B. Margesin, F. Giacomozzi, G. Soncini, C. Calaza, F. Ficorella, S. Iarossi, *A micromachined gold palladium Kelvin probe for hydrogen sensing,* SENSORS AND ACTUATORS. B, CHEMICAL, vol 142, n 2, 2009, pp 418-424 [UGOV: 17269]

## 3. Objectives for 2012

The following three main objectives for MTLab are all strongly product oriented, in a sense that they are either "ready to be used" or to be transferred in other plants for mass production. This follows the strategy of MTLab for approaching and promoting innovation.

**O1: R&D activities**. In 2012 R&D prevalent activities will be focused on:

- 1$^{st}$ year of iSiCPV (innovative silicon cell for concentration PV). The primary goal is a stabilization of the actual technology Platform to optimize uniformity and production yield. At present, in Italy, FBK is unique to provide this solution with production capabilities. A further goal is to develop testing capability for statistical evaluation of cell efficiency. For both tasks there are no particular risk of concern (please see section 7 Remarks).

- Phototransitors for European and Italian Space Agencies. These projects are performed in collaboration with Opto-I. MTLab is charged with developing the space qualified device technology. The challenge is to provide a technology withstanding the severe acceptance procedures focused on ageing and radiation damage. The project has been won after a two-year successful collaboration with the French space agency. The gained experience ensures an activity with very low risk level (please see section 7 Remarks).

- Silicon Drift Detectors. MTLab performs this activity with SRS research unit. There are two officially ongoing Contracts plus a projects being mainly a collaboration with INFN. One contract is with a Japanese Company for R&D and production of custom device. The second is with and Politecnico of Milano to develop a prototype of an X-ray detector for space application. Though at the beginning the risk, due to the complexity of the technology, was high, at present in both cases the results obtained till now show that MTLab is able to manage all the major issue and there are no major risks to be mentioned. The collaboration with INFN is quite interesting in perspective; in fact, in this case MTLab and SRS are working to be ready for a large production of SDD for the experiment "LOFT" selected for the assessment phase of the ESA M3 Cosmic Vision call (please see section 7 Remarks).

**O2: Production activities**. In 2012 main production activities will be the following:
- Production of SiPM to be supply to AdvanSiD srl within the service contract in place between AdvanSiD and FBK. Production includes also production lots carried out in the external silicon foundry (Semefab, Scotland-UK), where MTLab has transferred the first release of the SiPM technology during 2011 (please see section 7 Remarks).

- Si3D detectors. MTLab obtained a first stable release of this complicated technology and in 2012 will be committed to a first production Run. The objective is to provide detectors to ATLAS collaboration at CERN for implementing a first upgrade to be tested quite soon (please see section 7 Remarks).

- Production of Phototransitors and testing of Photoasics for Optoi Microelectronics. These activities are present in MTLab since many years under a long term agreement with the company and is one of the examples how MTlab interacts with local companies (please see section 7 Remarks).

**O3: MTLab Strengthening**. There are two main actions targeted at increasing the capabilities of MTLab. Both are aimed at increasing the ability of fund raising. They are:

- Steps towards 6" upgrades. In detail we plan to install the new set of furnaces and to buy and install 6" wet benches. After furnace installation we will be ready to upgrade the microfabrication line. This is planned to be realized in 2013 (please note that there will be a stop in the activities. Today it is estimated in two months)
- Quality assessment. To move toward a ISO 9001 certified Quality Management System is becoming mandatory for a successful approach to large international Companies, Projects and Institutions, space-qualified production and to more efficient MTLab operation. A relevant effort has been done in 2011. In 2012 we are going to complete the project and undergo to official certification process by the end of the year.

## 4.  Front Edge & New Initiatives

Beside the move toward becoming a reliable Partner for development and production of devices foe space application, MTLab is working since few years on innovative silicon solar cells for solar concentrators. Starting from the beginning of 2012 MTLab together with a local company (Optoi Microlectronics) and a national energy player (EdiPower) will participate to a new project funded by Ministero delle Sviluppo Economico. R&D on this specific topic is a major MTLab commitment for the next three years base on the firm belief that silicon have still lot to say in PV applications.

It is also worth reporting a couple of initiatives discussed with some of the CMM RU to optimize efforts and resources. The first is the integration of the specific design competence available in SRS unit in in MTLab projects. In the opposite sense, MTLab is supporting SRS unit in its R&D effort on challenging technologies such as SiPM and SDD. Finally, since skilled technicians are an asset for efficient management of a laboratory, considering the lab of BioSint unit is in shortage of this personnel, a MTLab skilled and clean room trained technician will support the Biosint Lab part-time.

## 5.  Funding

| Acronym | Full name | Type | Duration | Total income (€) | Income 2012 (€) |
|---------|-----------|------|----------|------------------|------------------|
| Memspack |  | EU | 1/6/2008-29/22/2012 | 41929 | 1838 |
| NAoMI |  | RL | 1/10/2008-30/9/2012 | 210000 | 39384 |
| MEMS2 | INFN-FBK | EN | 1/7/2009-30/6/2012 | 520000 | 86350 |
| MEMS2 | FBK-PaT | EL | 1/7/2009-30/6/2012 | 1530000 | 254000 |
| LIMA |  | EU | 26/11/2010-31/12/2012 | 58683 | 18973 |

| SUBLIMA | | EU | 30/3/2010-31/8/2014 | 382487 | 86628 |
|---|---|---|---|---|---|
| CONV.SE RVIZI | | PL | 20/9/2010-19/9/2013 | 7500 | 2500 |
| NEXRAY 11 | | PI | 26/11/2010-25/9/2012 | 249061 | 100000 |
| ESA OPTO | | RI | 1/42011-31/3/2013 | 90000 | 45000 |
| ESA_SDD | | RI | 1/4/2010-1/10/2012 | 125000 | 62500 |
| MISTICO | | RL | 1/6/2011-31/5/2013 | 5000 | 2500 |
| ATLAS 3D | | PI | 17/10/2011-31/01/2012 | 36389 | 125600 |

The list above must be updated with new recent acquired contracts. Their value increases the total income of about 600 K€.

## 6.   Budget

| | 2011 | 2012 |
|---|---|---|
| Expenses | | |
| Personnel | € 1.421,46 | € 1.441,47 |
| Travel | € 21,60 | € 28,50 |
| Equipment (HW/SW) | € 350,00 | € 70,00 |
| Other (e.g. subcontracting to external contractors) | € 1.165,80 | € 1.095,20 |
| Total Expenditure | € 2.958,86 | € 2.635,17 |
| Incomes | | |
| EU Projects (total amount financed by EU) | € 173,47 | € 97,50 |
| Other external incomes (industrial, PAT projects, etc.) | € 1.277,65 | € 592,06 |
| Projects to be finalized | € 25,70 | € 538,77 |
| Total Income | € 1.476,82 | € 1.228,33 |
| Financial Need (Total Income – Total Expenditure) | € 1.482,04 | € 1.406,84 |
| Self funding | 49,9% | 46,6% |

Note: Column 2011 is based on the unit's budget state as estimated at the date of document writing. Column 2012 is the budget planned for 2012

## 7.   Remarks

MTLab has to manage large labs with complex equipment with an approach quite close to a production environment. The large investments made over several years for the infrastructures, for training skilled people working with complex equipment, the need of investment based on concrete programs, the needs of budget for maintenance to keep well performing the tools, the success obtained approaching customers with a model where clear commitment, delivery time, production yield and professional management, are drawing a system that is quite unique.

Discussions with potential customer, whether from research and industrial Sectors, rely on MTLab reliability. To be reliable is not only a matter of personal effort within MTLab, but shall include the endorsement of the MTLab strategy within the team from the CMM Centre and up to the FBK Governance.

# REET – RENEWABLE ENERGIES AND ENVIRONMENTAL TECHNOLOGIES

Head of Unit: Alessandro Bozzoli

## 1.   Summary and Vision

*Scope and Motivation*

REET unit is working on the sectors of *Renewable Energies*, *Environmental Technologies* and *Modelization processes*. Its activities in the specific fields go from _basic research_ and *innovation* to *technology transfer* and *support to entrepreneurial sector* under the technological point of view. The core attitude of REET unit is the support to local initiatives, networking the actions of the SME and the entrepreneurial sector, developing in parallel an international approach to its general vision, including cooperations, international projects, international partnerships and PhD students.

A brief description of the Main Activities include:

− *basic research*: starting activities on the sector of *Wireless energy and Rectennas technologies*, *Thermal Fluid research* applied to Solar and Geothermal technologies, *Energy Conversion processes* (biofuels, energy multigeneration) based on specific experience and skills of REET unit in the different sectors of Electromagnetic interactions, of Modeling, of Renewable energies.

− *innovation*: the innovation is the actual main application sector of REET unit. In the *Energy sector*, REET unit has launched a series of pilot projects in different areas including solar multi cogeneration technologies, energy conversion from waste biomasses, solar cooling and heating technologies; in the sector of *Environmental technologies* new technologies for the safety systems in industrial machineries and processes.

− *technology transfer and support to entrepreneurial sector*: REET unit is working on a series of projects, demonstrators and prototypes on the energy and environmental sectors. The specific projects have the intent to provide added values to the partner companies, to which the results and technologies will be transferred. Some innovations of REET unit will be transferred directly to Start Up activities.

*State of the Art of the Unit*

REET unit activities are build up on three main sectors, which include all projects and programs: *Renewable energies*, *Physical modeling* and *Bio-Electromagnetism*. Additional actions are guided within the ambit of *Dissemination and Exploitation*, including *Technology Transfer and support to Entrepreneurial world*. During the last year, REET unit has improved the following activities at local and international level:

– *Renewable energies sector*: REET unit has worked on a *full energy vision*, developing since two years a work plan divided into three phases. The plan is focused on innovations on the specific field of distributed cogeneration and retrofittable technologies applied to small-medium sized dimension.

The below picture describes the general VISION of REET activities in the field of Renewable Energies:

| PHASE 1 PILOT PROJECTS on SPECIFIC THEMES | PHASE 2 TECHNOLOGY TRANSFER of RESULTS | PHASE 3 PROJECTS on INTEGRATED TECHNOLOGIES and HYBRID SYSTEMS |
|:---:|:---:|:---:|
| **2007 - 2012** | **2009 - 2013** | **2012 - 2015** |

At the present time the PHASE 1 is completely in progress for the pilot projects in different application fields, all coordinated by REET unit.

*SOLAR THERMAL/THERMODYNAMIC*: *DiGeSPo*, a FP7 funded European project (best project of the CALL Energy-2009-1) to obtain a micro cogenerating technology for domestic applications based on Concentrated Solar Power of small size and applied to a Heat Engine (Stirling).

*BIOMASSES*: *BioTec*, a local funded project by Fondazione CaRiTRo on Energy conversion processes by waste agricultural and forestry biomasses.

- *BioDomUs*, a funded project by the Province Energy Agency on a cogeneration of energy from small sized Stirling engine applied to a domestic pellet boiler.

- *Galef*, a funded project by the Province of Trento – law6, on a small scale Organic Rankine Cycle applied to fluid bed gasification process.

*SOLAR APPLIED TECHNOLOGIES*: *SolTec*, a funded project by the Province Energy Agency on a solar heating and cooling technology based on adsorption processes.

*GEOTHERMAL (low entalpy)*: *GEOITEA*, a funded project by the Province Energy Agency based on technology developments on ground probes and heat pumps.

*FUEL CELLS: EcoCell*, a funded project by the Italian Ministry for Environment and Territory on optimization of Direct Methanol Fuel Cells, reducing the cross – over effect.

*RESOURCE ASSESSMENT: BioPath*, a funded project by the European Commission on the Central Europe program, on a Biomass and solid biofules certification and traceability control system.

– *Physical modeling*: the second sector of REET is active mainly in all the projects, providing feedbacks and results for the optimal technology orientation and developments. Specific projects on Modelization has been run during this year (Hot Carpet project to optimize heat production for outdoor application like, markets, open space, ecc.).

*MISTICO project:* about Micro Sistems e Innovative Technologies for Solar Energy Cogeneration based on Plasmonic surface on PV layer with high optics concentration degree (more than 500:1) and micro fluidic cooling.

−    *Technology transfer and support to local companies*: the third sector of REET, is composed of a series of projects and initiatives actually running or in phase of development.

*EUROSTANDARD project*: about the development of a safety valve for natural gas infrastructures.

*STEINEX project*: about a safe technology for operators working on cutting-stone machines.

−    *Dissemination and Exploitation actions*: activities on scientific publishing for International Congresses and Journals, activities to build up start up activities. In specific participation to the networks of the ISES (world and European congresses), of WREN (world congresses) and the start up initiative of HT Solar in cooperation with AERMEC and IMAR companies.

−    *Education*: a series of educational activities have been performed, specifically the main are:

-    Course on Renewable Energies at the $2^{nd}$ level Master Course promoted by FBK together with the University of Trento.
-    Lectures at the Styrian Academy Summer School on Sustainable Regional Systems.

*Vision and Goals (3 to 5 years)*

The guiding Vision on Energy of REET unit starts from the consideration that no one technology or renewable energy system can support by itself the real and concrete realization of a energy-positive building. REET unit has worked on an ENERGY VISION for an integrated and hybrid system.

The realization of the plan should pass through a series of steps. The pilot projects on the specific themes and application areas, the technology transfer of consolidated technologies and the system integration and realization of hybrid technologies.

The whole plan is proceeding in the correct direction since two years and almost all the pilot projects has started or are starting at the present time. Some activities, as the solar cooling technology, are close to the second step, the technology transfer of results. Finally, all the pilot projects have been built looking forward to the third phase of hybrid technologies. In such way all the useful elements have been inserted within such projects. Some examples are the Technology Transfer Board for DiGeSPo project, where we have the intention to exploit, since now, the availability for a more complex hybrid system as an output of a pilot research oriented on the solar energy micro-cogeneration at distributed level.

The final objective is the realization of a FULL SYSTEM named the +*energy building*, able to produce in an integrated and feasible way thermal power for heating, cooling and hot sanitary water, electrical power and bio fuels from domestic wastes

and organic materials, to achieve at the best distributed scale of building, community or village.

*Unit composition*

|  | *2011 (as of Jan 1$^{st}$)* | *2012 (planned)* |
|---|---|---|
| Research directors | 1 | 1 |
| Senior researchers | 2 | 1 |
| Researchers (including postdocs, etc.) | 4 | 4 |
| Technologists | 1 | 1 |
| Techcnicians | 3 | 3 |
| PhD students | 2 | 1 |
| Total | 13 | 11 |
| Tenured | - | - |
| Tenure track | - | 3 |

Note: "Research directors" are level 1 researchers; "Senior researchers" are level 2 researchers. Category "Researchers" covers all other cases, including level 3 and 4 researchers, postdocs and other contractual forms used to enroll researchers.

*Top researchers by citations (max. 5)*

| *Researcher* | *H-index* | *Citations (total)* |
|---|---|---|
| Marco Cozzini | 12 | 509 |
| Rolando Pontalti | 8 | 137 |
| Alessandro Bozzoli | 7 | 132 |
| Alessandro Vaccari | 5 | 238 |
| Luigi Crema | 4 | 105 |

## 2.  Recent publications

| *Model:* | *Standard* | *08/11/2011* |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|
| *year* | *Jour. Papers* | *Jour. Papers (IF)* | *Q1 (%)* | *Conf. Papers* | *Patents* | *Books (auth.)* | *Books (edited)* | *Chapters in Book* |
| In print | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2011 | 1 | 0 | 0 | 4 | 0 | 0 | 0 | 0 |
| 2010 | 1 | 1 | 50 | 7 | 1 | 0 | 0 | 0 |
| 2009 | 1 | 0 | 0 | 3 | 0 | 0 | 0 | 0 |
| 2008 | 3 | 3 | 100 | 2 | 5 | 0 | 0 | 0 |

The number of publications starting from 2008 to 2011 is not so high depending to the approach adopted by the Research Unit, that has put efforts mainly on produc-

ing patents and prototypes, leaving publications in minor order of importance. Now, the results acquired in this 4 years enable the Unit to prepare a series of significant publications to be sent soon to important international journals and magazines.

Top 5 publications in the last 3 years (2009-2011):

−   L. Crema, F. Alberti, A. Bertaso, A. Bozzoli, *Development of a pellet boiler with Stirling engine for m-CHP domestic application,* Energy, Sustainability And Society – Springer Open Journal, November 15th, 2011, *in print*, [UGOV: 46396].
−   Vaccari, A. Cala' Lesina, L. Cristoforetti, R. Pontalti, *Parallel implementation of a 3D subgridding FDTD algorithm for large simulations*, Progress In Electromagnetics Research, Vol. 120, pp. 263-292, 2011, [UGOV: 43998].
−   Bozzoli, L. Crema, *FBK - REET Energy Vision and the Positive Energy Building*, International Symposium on best practices in Sustainable Innovation and Clean Technology, MIT, Cambridge (USA)), November 15th, 2010, [UGOV: 23009].
−   L. Crema, A. Bozzoli, E. Wackelgard, B. Rivolta, S. Hesse, M. Luminari, D. Hislop, B. Restall, *Distributed CHP Generation from small size concentrated Solar Power,* World Renewable Energy Congress XI 2010, Abu Dabi, 25 – 30 September, 2010, [UGOV: 12268].
−   L. Crema, A. Bozzoli, G. Cicolini, A. Zanetti, *A novel Retrofittable Solar Cooler/Heater based on Adsorption cycle for domestic application*, POLSKA ENERGETYKA SŁONECZNA, vol. 1-4/2009-1/2010, 2009 , pp. 43- 53, [UGOV: 12228].


## 3.   Objectives for 2012

**O1: Research on heat engines for micro cogeneration at medium low working temperatures.** The *goal* of the specific objective is to position REET as one leading Research Unit at international level on the specific context of m-CHP technologies. The objective is included in part of the research within DiGeSPo project. The engine under research will be ready by almost half of 2012 for testing and it will be the main objective of FBK within the same project. The success and *motivation* of such research will be strategic for a second generation of integrated and hybrid technologies, focus of future activities and projects. Furthermore, the success of such activity will be one essential element of strength even on the side of REET expertise on small scale energy technology application.

The *planned activities* lay on the European project and on a new proposal submitted by the Autumn of 2011 (SolTRAp Project).

The most *potential risk* is identified in the strict timetable to achieve the scientific results. Agreements with the European Commission has been taken to slightly postpone the expected output at the mid of 2012, while the demonstration activity could start during the summer period in Malta. Eventual bad performances of the prototype will require a re – scheduling and optimization steps required. *Expected*

*outcome* of such activity will be a core technology provided of a potential international impact, both for market application and for scientific results achieved.

**O2: Fund raising on energy storage technologies.** The *goal* of such activity will be the submission of proposals and the activation of grants within the theme of energy storages (particularly electrical ones), for stationary application at distributed level. In the specific context ISLe project will be re – tailored and re – submitted to specifically meets the requirements of the JTI – FCH platform. In parallel, REET has established a Memorandum of Understanding with the US Department of Energy Pacific Northwest National Laboratory. A strong motivation to launch activities in such context is specifically to improve and strengthen the mentioned international cooperation, both on the side of Nano composites and materials, on energy storage integrated technologies, on renewable energy storage technologies using sorption materials (thermal storage) and / or metal hydrides (electrical), particularly re-generable Sodium Borohydride cycles.

*Planned activities* for 2012 are the negotiation and launch of EDEN, FP7-JTI-FCH project. REET is awaiting for confirmation to enter negotiation. Such project will work on the context of Hydrogen high density storage solutions based on Mg-Metal Hydrides. Such technology may open a wide perspective of market application for storage technologies using hydrogen. Further activities are oriented in the submission of one to three proposals on this specific application area.

The *potential risk* is particularly for project proposal submission the approval stage. ISLe project has already been submitted twice. The latter, even after assurance by European Commission has not been approved yet. New attempts will be carried out. The *expected outcome* is to open a new big sector of REET on hydrogen and electrical storage technologies, and to impact at international level as one point of reference in the specific theme.

**O3: R&D activites to open the reet energy vision for +Energy Districts and Communities**. The *goal* of such activity will be activation of the second part of the REET Energy Vision oriented to +Energy Districts and Communities, so a list of potential projects where REET will contribute for the R&D and Innovation on such specific context, through pilot projects, technology transfer and integration of technologies.

A first *planned activity* will be the participation to a big European project (TRI-DISTRICT) proposed by Acciona within FP7-ENERGY-2012 call. FBK – REET will be one of the major partner of the Consortium.

A second local activity will be CONTEST project proposed to the local Energy Agency (APE), for the realization of a Stirling Dish technology with a size of 10 kWel and 10kWth per single unit.

Other activities will be launched during the 2012. There are scientific and strategic motivations on such plan for the international interest of distributed energy generation and related technologies included in the international Call.

*Potential risks* are the allocated resources and the efforts required for such new REET energy plan. Every required additional effort will be evaluated together with FBK management. The *expected outcome* is the acknowledgement of REET both

at local (as the leading Unit involved in the energy sector within the Province of Trento) and international level (as a leading developer in the specific context of distributed generation of energy).

## 4.    Front Edge & New Initiatives

FBK-REET is involved in a series of front edge technologies, all included in new initiatives already launched, starting and/or planned for 2012.

– HYDROGEN STORAGE: a new initiative is before the negotiation step (EDEN project) and new planned activities will be resubmitted on 2012, along the next call of JTI – FCH;

– DIRECT METHANOL FUEL CELLS: a project proposal has been identified between REET and US DoE PNNL. This new initiative requires a new call where obtain funds and financing. The new project aims at the development of a new membrane highly selective for the specific fuel cell using methanol as energy carrier;

– SMALL SCALE CONCENTRATED SOLAR TECHNOLOGIES: a new initiative has been launched within the call FP7-ENERGY-2012-1, proposed by FBK-REET and participated by relevant European partners such as ENEA, ACCIONA and others. By this initiative FBK – REET will be definitely recognized as a international development node on the specific topic;

– BIOMASS WHOLE CHAIN: FBK – REET is proposing to the local energy agency of the Province a context of development for the biomass industrial sector of the Province. Small chains, locally based in specific sustainable communities, utilizing at local level the identified resources. Such activity has been proposed together with Edmund Mach Foundation, CNR – IVALSA and the local community of Comano Municipality;

– LAND MANAGEMENT: FBK is developing together with most important local stakeholders at the local level of the Province of Trento and in cooperation with eseia (european sustainable energy innovation alliance) at European level, a plan for the development of a specific tool for the use of energy government institutions (from the municipal to the Regional levels) able to support the realization and implementation of Local/Regional Energy Plans.

– TOURISTRACK: It is an industrial research and innovation project presented by Electronic Service and FBK-REET on the PAT call law 6/99. The aim of this project is to research and improve the safety and localization of people and tourists who are engaged in outdoor activity, like hiking, climbing and other on surface activities, often in scenic or mountainous terrain. To achieve this goal the research will merge the state of art of localization and radio communication technologies with the know-how and best-practices adopted by rescue personnel in various context of operation. The final scope of the TourisTrack project is to develop a commercial platform, based on various TourisTrack personal devices, that can help to localize some people, in case of emergency, by the search and rescue personnel.

## 5.  Funding

| Acronym | Full name | Type | Duration | Total income | Income 2012 |
|---|---|---|---|---|---|
| DIGESPO | Distributed Chp Generation from Small Size Concentrated Solar Power | EU | 1/1/2009 31/12/2012 | € 828.370,00 | € 217.241,41 |
| GALEF | Sistema Ibrido GAsificatore a LEtto Fluido e Ciclo Rankine Organico (ORC) per Cogenerazione da Biomasse | INDUSTRIAL lg. 6/99 | 1/1/2011 31/12/2012 | € 100.000,00 | € 50.637,44 |
| ECOCELL | Celle a Combustibile Alimentate a Metanolo | MATTM Ministero Ambiente e T. | 1/7/2011 30/06/2013 | € 75.362.17 | € 41.440,41 |
| BIOPATH | Biomass and solid biofules certification and traceability control system | EU | 1/2/2011 31/10/2012 | € 60.000.00 | € 28.055,82 |
| MISTICO | Micro Sistemi e Tecnologie Innovative per Cogenerazione da energia solare | Fondazione CARITRO | 1/6/2011 31/05/2013 | € 40.000.00 | € 21.582,80 |
| TOURI-STRACK | Piattaforma Per La Ricerca E Soccorso In Montagna | INDUSTRIAL lg. 6/99 | 1/4/2012 31/03/2014 | € 300.000.00 | € 154.524,72 |
| CONTEST | Sistema Di Co-Generazione Energetica Da Solare A Concentrazione Mediante Tecnologia Stirling | PAT APE | 1/1/2012 31/12/2012 | € 300.000.00 | € 300.000.00 |

Type: EU, PAT, Other public agency, Industrial.

The funding plan for the 2012 showed before, follows a prudential criterion in order to avoid negative surprise during the year. Indeed, the total amount of the cost of the Unit is compensated by 85.428,96 € coming from AdP and by 60.000,00 € coming from new incomes to be acquired within the 2012. To support this prevision we would like to mention other project proposals already prepared and submitted like these: Metalsystem (Lg 6/99) income foreseen 238.500 €, EDEN (UE) income foreseen 395.450,00 €, PROCOPIR (Lg 6/99) income foreseen 250.000,00 €, CEEM (INTERREG) income foreseen 50.000,00 €, Formazione Aziende (Confindustria) income foreseen 60.000,00 €.

## 6. Budget

|                                                            | 2011        | 2012      |
|------------------------------------------------------------|-------------|-----------|
| Expenses                                                   |             |           |
| Personnel                                                  | € 611,66    | € 542,41  |
| Travel                                                     | € 26,30     | € 18,50   |
| Equipment (HW/SW)                                          | € 144,00    | € 84,00   |
| Other (e.g. subcontracting to external contractors)       | € 455,70    | € 314,00  |
| Total Expenditure                                          | € 1.237,66  | € 958,91  |
| Incomes                                                    |             |           |
| EU Projects (total amount financed by EU)                  | € 264,96    | € 245,30  |
| Other external incomes (industrial, PAT projects, etc.)    | € 233,75    | € 173,66  |
| Projects to be finalized                                   | € 647,45    | € 454,52  |
| Total Income                                               | € 1.146,16  | € 873,48  |
| Financial Need (Total Income – Total Expenditure)          | € 91,50     | € 85,43   |
| Self funding                                               | 92,6%       | 91,1%     |

Note: Column 2011 is based on the unit's budget state as estimated at the date of document writing. Column 2012 is the budget planned for 2012.

## 7. Remarks

The unit is cooperating internally and at local and international level with a series of Institutes and Companies:

− *internally* main cooperations are with the *Center for Information Technology* on the EIT KIC ICT initiative (*Trentino Rise*), and with some units from the *Center for Materials and Microsystems* on the energy technologies domain.

− *at local level*, REET unit is cooperating with all research and public institutions and the main companies at large and small - medium level (amongs them are UniTn, FEM, PAT, APE, Habitech, ITEA, Dolomiti Energia, Enervals, ELMA, Vescovi Stufe, Eurostandard, Steinex, Metalsistem, Electronic Service, CRF, Ceii, and others).

− *at national and international level*, REET unit has a wide cooperation from all over Europe and at International level (amongs them are US DOE Pacific Nothwest National Laboratory, Uppsala University, TU Graz, TU Hamburg, University of Twente, Politecnico di Milano, Massachusetts Institute of Technology, Narva Lichtquellen, Consejo Superior de Investigaciones Científicas, Laboratório Nacional de Energia e Geologia, Acciona, Aermec SpA, IMAR SpA, and others).

Due to the high number of themes where the activities of REET are oriented, *the efforts of the unit require an integration in terms of expertise and employees.* The unit is trying to establish a link with the local University to activate some thesis program at Bachelor or Master Degree levels.

REET is planning the development of a *highly advanced laboratory on the development and characterization of energy materials* (fluids, energy carriers, solids, …). Partly this laboratory had been already built, partially it requires further steps of development. The map of the planned actions and required efforts will be prepared soon.

# 3DOM – 3D OPTICAL METROLOGY

Head of Unit: Fabio Remondino

## 1.    Summary and vision

Recently the surveying, monitoring and protection of our environment, cities, territory and heritages (natural and cultural) has received more interest and consideration. Geomatics, as the science responsible of acquiring, processing, storing and delivering geographic and spatially referenced (3D) information, is gathering more and more power as discipline for environment mapping and heritage documentation. Geomatics researchers can rely on photogrammetry and remote sensing as optical image-based techniques for the extraction of metric and semantic information from images or on active sensors, like laser scanners, radar or structured light systems. All these available platforms, sensors and technologies set the scene for new approaches, methodologies and perspectives for large sites recording, modeling, studying and protection. The 3DOM unit is inserted in these problematic and research issues, with a primarily mission to research and develop newly and advanced methodologies for 3D surveying and modeling in the fields of landscape and terrain monitoring, cultural heritage documentation, environmental changes, deformation analyses, heat loos, cartography and mapping, geology, archaeology, architecture, virtual reality, etc.

3DOM rises from the experience acquired in the course of the past years within the SOI research unit in the 3D surveying and modeling field, developing and characterize recording passive and active sensors and creating new 3D modeling methodology for many geo-referenced applications. At local level there are no other entities or groups with such potentialities and background. At international level few research groups are the same level of the 3DOM unit from a surveying and 3D modeling point of view and the achievements shown in the publications and project results are quite significant. Thus 3DOM is aiming at becoming the leader for all the issues related to 3D geo-informatics research activities. Being a reference point for all the geo-problems and geo-applications in Trentino will  help to fill the existing gap in this sector.

Although it is still a young and small figure in FBK, the group cohesion is good and we are also seeking transversal and join activities with the other FBK research units and external partners.

*Unit composition*

|  | *2011 (as of Jan 1st)* | *2012 (planned)* |
|---|---|---|
| Research directors |  |  |
| Senior researchers | Fabio Remondino | Fabio Remondino |
| Researchers | Giorgio    Agugiaro, | Giorgio  Agugiaro, |

| (including postdocs, etc.) | Fabio Menna, Francesco Nex, Belen Jimenez, Erica Nocerino | Fabio Menna, Francesco Nex, Belen Jimenez, Erica Nocerino |
|---|---|---|
| Technologists | Alessandro Rizzi | Alessandro Rizzi |
| PhD students | Giorgio Baratti | Giorgio Baratti |
| Total | 7 | 7 |
| Tenured | | |
| Tenure track | | |

Note: "Research directors" are level 1 researchers; "Senior researchers" are level 2 researchers. Category "Researchers" covers all other cases, including level 3 and 4 researchers, postdocs and other contractual forms used to enroll researchers.

*Top researchers by citations (max. 5)*

| Researcher | H-index | Citations (total) |
|---|---|---|
| Fabio Remondino | 14 | 1008 |

*Font: Publish or Perish*

## 2.  Recent publications

| year | *Jour. Papers (IF)* | *Q1 (%)* | *Conf. Papers* | *Patents* | *Books (authored)* | *Books (edited)* | *Chapters in Book* |
|---|---|---|---|---|---|---|---|
| In print | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| 2011 | 1 | 0 | 15 | 0 | 0 | 0 | 1 |
| 2010 | 2 | 0 | 7 | 0 | 0 | 1 | 1 |
| 2009 | 0 | 0 | 14 | 0 | 0 | 0 | 0 |
| 2008 | 1 | 100 | 5 | 1 | 0 | 0 | 0 |
| 2007 | 0 | 0 | 8 | 0 | 0 | 0 | 0 |
| 2006 | 0 | 0 | 3 | 0 | 0 | 0 | 0 |

Top 5 publications in the last 3 years (2009-2011):

− F. Remondino, A. Rizzi, L. Barazzetti, M. Scaioni, F. Fassi, R. Brumana, A. Pelagotti,2011: Review of geometric and radiometric analyses of paintings. PHOTOGRAMMETRIC RECORD Journal, U-GOV 53191

− F. Remondino, Heritage Recording and 3D Modeling with Photogrammetry and 3D Scanning. REMOTE SENSING Journal, U-GOV 52587

− F. Remondino, A. Rizzi, S. Girardi, F.M. Petti, M. Avanzini, 2010: 3D Ichnology - Recovering digital 3D models of dinosaur footprints. PHOTOGRAMMETRIC RECORD Journal, U-GOV 20830

- F. Remondino, A. Rizzi, 2010: Reality-based 3D documentation of natural and cultural heritage sites -Techniques, problems and examples. APPLIED GEOMATICS Journal, U-GOV 20849
- F. Remondino, S. Girardi, A. Rizzi, L. Gonzo, 2009: 3D Modeling of complex and detailed Cultural Heritage using multi-resolution data. ACM JOURNAL ON COMPUTING AND CULTURAL HERITAGE, U-GOV 8654

## 3. Objectives for 2012

- Establish more relations and collaborative works within CMM due to the fact that 3D is a transversal topic and it might be applied to all research fields
- Develop new 3D recording methodologies, new data integration strategies and new 3D data visualization procedures
- Fund raising to decrease the AdP
- Long term period project with Asian and UK partners following Director's contacts

## 4. Front Edge & New Initiatives

- New exhibition on the Etruscan project in Stockholm (Sweden) from February till August
- Publication of the book on Range-Imaging Cameras, co-edited with D.Stoppa

## 5. Funding

| Acronym | Full name | Type | Duration | Total income | Income 2012 |
|---------|-----------|------|----------|--------------|-------------|
| 3D-ICON | 3D Digitization of Icons of European Architectural and Archaeological Heritage | EU | 1/3/2012 - 28/2/2014 | € 167.500 | € 34.406 |
| 3M | 3D Modeling, mapping and monitoring | PAT | 17/5/2010 - 16/5/2013 | € 450.000 | € 129.527 |
| CIEM | 3D Cartographic information extraction and management | PAT | 1/3/2011 - 28/2/2014 | € 146.500 | € 45.580 |
| APSAT | Ambiente e Paesaggi dei Siti d'Altura del Trentino | PAT | 1/10/2008 - 30/09/2012 | € 332.500 | € 57.042 |
| MEM3D | Ricostruzioni 3D di un secolo di cambiamenti sul territorio trentino | CARITRO | 01/09/2011 - 28/02/2012 | € 14.000 | € |

| X-Bridge | x-bridge | L6 PAT | 20/05/2010 - 20/05/2012 | € 375.000 | € 7.443 |
| 3DSolar Web | 3D Solar Web | l6 PAT | 24 mesi | € 44.000 | € 22.000 |
| Nuvola | 3D Modeling of Fuksas cloud | industrial | 6 mesi | € 20.000 | € 20.000 |

Type: EU, PAT, Other public agency, Industrial.

## 6. Budget

|  | 2011 | 2012 |
| --- | --- | --- |
| Expenses |  |  |
| Personnel | € 243,65 | € 306,03 |
| Travel | € 21,00 | € 39,00 |
| Equipment (HW/SW) | € 3,00 | € 7,50 |
| Other (e.g. subcontracting to external contractors) | € 55,81 | € 14,05 |
| Total Expenditure | € 323,46 | € 366,58 |
| Incomes |  |  |
| EU Projects (total amount financed by EU) | € 0,00 | € 0,00 |
| Other external incomes (industrial, PAT projects, etc.) | € 319,67 | € 264,59 |
| Projects to be finalized | € 0,00 | € 76,41 |
| Total Income | € 319,67 | € 341,00 |
| Financial Need (Total Income – Total Expenditure) | € 3,79 | € 25,58 |
| Self funding | 98,8% | 93,0% |

Note: Column 2011 is based on the unit's budget state as estimated at the date of document writing. Column 2012 is the budget planned for 2012

# LISC – INTERDISCIPLINARY LABORATORY FOR COMPUTATIONAL SCIENCE

Head of Unit: Maurizio Dapor

## 1. Summary and vision

LISC was established as the result of a long-standing collaboration between the members of the former Computational and Theoretical Physics (CTP) group of the Center of Materials and Microsystems of FBK, ECT*, and scientists from the Physics Department of the University of Trento. This laboratory is an endorsement of the high academic quality of the research performed by the CTP group. LISC provides a common ground where computational scientists coming from different fields could find the opportunity to exchange ideas and expertise in numerical techniques, in order to produce world-class research. Presently, the principal research lines under active development at LISC include – but are not limited to –: electronic structure of condensed matter systems, with particular emphasis on computer simulations of various kinds of core electron spectroscopies; simulation of biomolecular systems, such as protein folding and DNA adsorption on functionalized surfaces; nuclear and subnuclear physics; simulation and design of micro and nano devices, such as silicon-based opto-mechanical resonators used to detect quantum mechanical effects. LISC members are actively collaborating with scientists form world leading institutions such as the University College London, the Swiss Federal Institute of Technology (ETH), and the National Institute of Standards and Technology of the United States of America. There are of course collaborations between members of LISC and scientists of the other CMM research units on the topics of biophysics (Biosint: Cecilia Pederzolli) and materials analysis (MINALab: Massimo Bersani).

The scientific output of LISC consists principally of papers published on international peer reviewed journals. In the past 3½ years, the cumulative impact factor of papers coauthored by the 6 members of LISC has reached ~140, which is more than 15% of the total output of FBK during the same period, that is ~850. Members of LISC have also been involved in research projects who have been granted ~380.000 EUR in the past 3½ years.

*Unit composition*

|  | *2011 (as of Jan 1st)* | *2012 (planned)* |
|---|---|---|
| Research directors | 0 | 0 |
| Senior researchers | 3 | 3 |
| Researchers (including postdocs, etc.) | 3 | 3 |
| Technologists | 0 | 0 |
| PhD students | 1 | 1 |
| Total | 7 | 7 |

| Tenured | 3 | 3 |
|---|---|---|
| Tenure track | 0 | 0 |

Note: "Research directors" are level 1 researchers; "Senior researchers" are level 2 researchers. Category "Researchers" covers all other cases, including level 3 and 4 researchers, postdocs and other contractual forms used to enroll researchers.

Top researchers by citations (max. 5)

| Researcher | H-index | Citations (total) |
|---|---|---|
| Lucia Calliari | 13 | 608 |
| Maurizio Dapor | 13 | 558 |
| Giovanni Garberoglio | 11 | 546 |
| Simone Taioli | 7 | 141 |
| Enrico Serra | 3 | 29 |

## 2. Recent publications

| year | Jour. Papers (IF) | Q1 (%) | Conf. Papers | Books (authored) |
|---|---|---|---|---|
| 2011 | 20 | 59 | 1 | 1 |
| 2010 | 14 | 38 | 1 | 0 |
| 2009 | 13 | 36 | 0 | 0 |
| 2008 | 10 | 40 | 3 | 1 |

Top 5 publications in the last 3 years (2009-2011):

− S. Beccara, P. Faccioli, M. Sega, F. Pederiva, G. Garberoglio, H. Orland, *Dominant folding pathways of a peptide chain from ab initio quantum-mechanical simulations,* in «THE JOURNAL OF CHEMICAL PHYSICS», vol. 134, 2011, pp. 024501 [ UGOV: 25909]

− G. Garberoglio, J. K. Johnson, *Hydrogen Isotope Separation in Carbon Nanotubes: Calculation of Coupled Rotational and Translational States at High Densities,* in «ACS NANO», vol. 4, 2010, pp. 1703-1715 [ UGOV: 7722]

− Simone Taioli, Stefano Simonucci, Lucia Calliari, Maurizio Dapor, *Electron spectroscopies and inelastic processes in nanoclusters and solids: Theory and experiment,* in «PHYSICS REPORTS», vol. 493, 2010, pp. 237-319 [ UGOV: 9948]

− Simone Taioli, Stefano Simonucci, Lucia Calliari, Massimiliano Filippi, Maurizio Dapor, *Mixed ab initio quantum mechanical and Monte Carlo calculations of secondary emission from SiO2 nanoclusters,* in «PHYSICAL REVIEW. B, CONDENSED MATTER AND MATERIALS PHYSICS», vol. 79, 2009, p. 085432 [ UGOV: 4528]

–   S. Simonucci, G. Garberoglio, S. Taioli, *Finite-range effects in dilute Fermi gases at unitarity,* in «PHYSICAL REVIEW A», vol. 84, 2011, p. 043639 [ UGOV: 52382]

### 3.    Objectives for 2012

**O1: Computer Simulation of Biomolecules.** This activity concerns the study of two kinds of biopolymers. The first case is related to extend a model for DNA adsorption on functionalized surfaces which is used in connection with experimental activities going on in the Biosint Lab. Secondly we will contribute to the activities in protein folding simulation carried on at LISC in collaboration with Dr Pietro Faccioli of the University of Trento.

**O2: Computer Simulation Electronic Spectra for Materials Analysis.** Goal of the activity is to understand REEL spectra and, in particular, how they are affected by surfaces and interfaces. Monte Carlo simulation of spectra acquired at different electron energies will be the main approach in this regard. It is expected that these spectra and their evolution with electron energy could be simulated with good reproduction of all their features (overall intensity, relative intensity of surface and bulk features, single and multiple losses).

**O3: Computer Simulation of Quantum Fluids.** This research will proceed along two principal directions. We will continue our collaboration with NIST about the calculation of the virial coefficients of quantum gases. Moreover, we will tighten our collaboration with Dr Stefano Simonucci of the University of Camerino about the development of efficient simulation codes for calculating properties of degenerate quantum gases using the Bogolioubov-de Gennes approach. This methodology can be applied to the study of superconducting systems.

**O4: Computer Simulation of Structural and Dynamical Properties of Metal-Organic Frameworks.** There is a growing body of evidence suggesting that framework flexibility is a crucial ingredient in any reliable model of gas transport in metal-organic frameworks. We will combine ab-initio simulations and classical models to investigate the principal effects due to framework flexibility on the diffusion of molecules within metal-organic materials.

**O5: Mistico Project.** Context of the project is the micro cogeneration of electrical and thermal energy. Partners within FBK are REET and MTLab units, while the University of Padova is a further partner. LISC activity is focused on investigating the possible role of so-called plasmonic structures (metallic features of size in the order of 100nm) at enhancing the efficiency of photovoltaic cells. Plasmonic features deposited on the front end of a silicon solar cell are characterized with respect to morphology and composition. Numerical simulations of their effects on the efficiency of solar cells are compared to measured efficiency values.

**O6: High-Q Resonators.** Reduction of inhomogeneous losses in micro-optomechanical mirrors with high reflectivity coating to develop promising architectures for controlling the quantum states of light and matter, and for exploring the boundary between quantum and classical mechanics. Analysis of dissipation of new die-

lectric materials for coatings in mirrors for third generation interferometric gravitational wave detectors and analysis of non-equilibrium phenomena due to thermal gradient in high-Q resonators. Those study are done in a national and international context.

**O7: Modeling and Simulating Deposition of Rubber Strips.** Development of a java software for modeling and simulating the deposition process of rubber strips on a carcass for retreating tyre by controlling the head of an application machine in a strip winding process. Machine sell by Marangoni Meccanica to tires manufactures: Bridgestone, Good Year and Pirelli. Simulation with finite element method of mechanical structures for tyre industry.

## 4.    Front Edge & New Initiatives

LISC is planning to further advance towards its goals, that is to employ state of the art numerical methods to produce cutting edge research and, therefore, improve its visibility on both the international and the local scene. LISC aims at being a reference center for harnessing and developing computational techniques for scientific and technological research. In particular, LISC will establish itself as the leading reference place for scientific computing, supporting the various research institutions in the Trento area. LISC will also strengthen its collaborations with local research groups in theoretical physics and material science. A significant effort will be devoted to promote the use of numerical techniques in the local industrial sector. Computational science will be promoted among students of science and engineering as a modern and effective tool to understand physical phenomena and exploit them in technological applications. The best and most motivated students will be offered the opportunity to specialize in scientific computing both at the level of Master Degree or during their Ph.D. studies. In all of these activities a multidisciplinary approach will be encouraged.

## 5.    Funding

| Acronym | Full name | Type | Duration | Total income | Income 2012 |
|---------|-----------|------|----------|--------------|-------------|
| SOLTECO | Solare termodinamico in concentrazione | RL | 2/5/2011-30/4/2013 | € 18,300.00 | € 9,175.00 |
| MISTICO | Micro Sistemi e Tecnologie Innovative per COgenerazione da Energia Solare | RL | 1/6/2011-31/5/2013 | € 40,000.00 | € 20,027.00 |
| PICS | Quantum Calculation of the Second Virial Coefficients of Hydrogen and its isotopes | EI | 5/8/2011-31/5/2012 | € 5,652.00 | € 2,854.00 |

Type: EU, PAT, Other public agency, Industrial.

## 6.    Budget

|                                                                    | 2011      | 2012      |
|--------------------------------------------------------------------|-----------|-----------|
| Expenses                                                           |           |           |
| Personnel                                                          | € 347,47  | € 338,41  |
| Travel                                                             | € 16,00   | € 14,00   |
| Equipment (HW/SW)                                                  | € 5,00    | € 3,00    |
| Other (e.g. subcontracting to external contractors)               | € 34,40   | € 46,30   |
| Total Expenditure                                                  | € 402,87  | € 401,71  |
| Incomes                                                            |           |           |
| EU Projects (total amount financed by EU)                          | € 0,00    | € 0,00    |
| Other external incomes (industrial, PAT projects, etc.)            | € 27,03   | € 45,12   |
| Projects to be finalized                                           | € 0,00    | € 0,00    |
| Total Income                                                       | € 27,03   | € 45,12   |
| Financial Need (Total Income – Total Expenditure)                  | € 375,85  | € 356,59  |
| Self funding                                                       | 6,7%      | 11,2%     |

Note: Column 2011 is based on the unit's budget state as estimated at the date of document writing. Column 2012 is the budget planned for 2012.

CIT – Center for Information Technology

# Presentation

Director: Ing. Paolo Traverso

## Executive Summary

The Mission of the FBK Centre for Information Technology – IRST (FBK-ICT) is to conduct *high quality research that provides practical and experimental evidence of its added value to market and society*. The Position of FBK-ICT in the international scientific arena is therefore clear: A place where (even theoretical and foundational) research is always backed up by experimental evaluation, system implementation, user validation, industrial and social applications. People and their know how are the key asset of FBK-ICT: about 190 people, including 90 researchers, 40 technologists, and 60 PhD students. Sixteen researchers have h-index> 20 (six of them with h-index > 30). Technologists have an important role: They are project managers, software architects, analysts, and developers, most of them with industrial background and competences in application domains. We plan to increase the number of PhD students up to 100 in three years.

In 2012, we intend to maintain the level of scientific results and publications, as well as – according to our mission – the participation in international contests, competitions, and grand challenges. We plan to maintain fund raising at the level of the last 3 years, with a stable income from external projects positioned around 45%-50% of our costs. This trend is confirmed in the budget for 2012, with an expected income higher than 5.5 Million Euro (with almost 3 Million Euro from European Projects), and 50% of self funding.

We expect to further realize the Vision promoted in 2010: *"ICT for the Quality of Life in a Smart Territory"* where Territorial Labs, i.e., living labs extended to the whole territory, play an important role. Along this line, we plan to further enhance our experimentations in the *"smart homes for ambient assisted living"* in the apartments of the Public Housing Body of the Province of Trento; the evaluation by over 500 end users of the *"personal health record system"*, which will be extended to deal with chronic diseases; the *"smart tunnel"* actually in operation with novel WSN techniques in one of the tunnels of Trentino; the *MoKi* system for process modeling for regional public administration, which is currently in use in seven Italian regions. A further plan is to let our Territorial Labs to play an important role in education by providing unique hands-on experience to students of Masters, PhD courses and/or summer/winter schools.

We plan to continue our participation in projects in collaboration with companies and in projects with a social impact. Moreover, we plan to exploit our participation to the EIT ICT Labs (http://eit.ictlabs.eu/) through Trento RISE - the association between FBK and the University of Trento - to attract key international companies to co-locate their research labs in physical proximity to FBK, and launch joint projects with them. Those projects will be characterized by impact on the local territory, in-

ternational market opportunities, significant co-investment by co-located companies, significant involvement of SME from the territory, clear exploitation plans and IPR policies, specific need for FBK research contribution. Joint PhDs with the co-located companies are another important ingredient of our strategy.

Finally, through Trento RISE, we plan to contribute to the definition and implementation of a new model of integration between FBK-ICT, the ICT department of the University of Trento, and other research centres in Trento, through the participation of our research units in inter-institutional research groups (research areas) that besides sharing information and promoting synergies, produce and carry out common strategies, placing themselves in a position to better compete at the international level. The integration process will be supported by joint strategic research projects, addressing new scientific challenges through the cross-fertilization among different research groups.

We see Trento RISE as a key instrument to achieve the goals to attract and launch projects with key companies, as well as experimenting with a new model of integration of research, still maintaining our own FBK independence, unique characteristics, specific strengths, and strategies.


**Vision: ICT for Quality of Life**

Quality of life is nowadays widely recognized as the key concept for societal and individual development, as it holistically refers to the level of general well-being of both. It is a broad concept that goes far beyond the classical emphasis on the economical richness and the material resources available to people and countries. Indicators for quality of life range from economical ones to aspects such as health and social welfare, environmental conditions and sustainable development, citizens' education, cultural level and participation in political life. Europe has been offering its citizens a high quality of life for decades and is highly competitive not only with respect to other highly developed areas (e.g., USA, Japan) but also with respect to the emerging economies (e.g., Brazil, India, China and Asia in general). Trentino is regarded as a territory with a high quality of life, thanks to, e.g., its economic well-being, the quality of its public services, the widespread awareness of social issues, its cultural heritage resources, safe living condition, international connections, quality of education and respect for the environment. While this position is nowadays put at risk by the economic crisis, a further effort in enabling quality of life can turn the current situation into a strong socio-economic competitive advantage, by exporting services, infrastructures and know-how enabling quality of life to become a key response to the challenges of economic crisis.

ICT is the key enabler of Quality of Life, thanks to the dramatic evolution of ICT in recent years. ICT has indeed evolved from a "centralized" technology which was mainly used for business applications and specific tasks within (large) organizations to a fully "decentralized" and pervasive technology. From the mainframe, ICT has moved to devices like PCs, Smartphones, iPads and is now giving concreteness to the idea of smart spaces, where most of the objects we use in our everyday life are active elements connected to the network. We are moving towards an

ICT that is anywhere, anytime and for anybody, an ICT that is pervasive to all different sectors, like services, media, eGovernment, social nets, welfare, health, well being, culture, education, creativity, environment monitoring and management, mobility, tourism, energy, agriculture, food, etc. ICT has evolved from targeting scientific or business applications to being the factor that most significantly shapes individual and societal habits, moving from being the enabling technology for different sectors to becoming itself a global challenge. Along this evolution, ICT infrastructures and new-generation services have the potential of directly impacting on the individual and societal quality of life.

We will focus research on developing ICT technologies and services for enhancing the Quality of Life. This objective will be pursued through the concept of Territorial Labs, as an evolution and extension of the Experience and Living Labs. In 2012, we plan to make Territorial Labs to contribute to the three dimensions of Research, Education and Business, namely:

- *Research*: Territorial Labs allow for testing novel technologies in realistic settings and experimenting with user-related issues, quality of experience, acceptability, adoption, impact on everyday life

- *Education*: Territorial Labs can provide hands-on experience for students in Masters and PhD courses and/or during summer/winter schools

- *Business*: Territorial Labs can provide market tests, comparison among alternative business models, assessment of the impact on organizations

From the Scientific point of view, we address the challenge to develop ICT technologies and services for enhancing the Quality of Life in Territorial Labs by focusing research in three main areas of computer science: Engineering, Content, and Interaction:

- *Engineering*, i.e., the specification, design, implementation, validation, and maintenance of computer systems.

- *Content*, i.e., the organization, management, elaboration, and extraction of information and knowledge from both structured and unstructured data

- *Interaction*, i.e., the study of computer systems that interact both with humans and with the environment

**Engineering:** Software system engineering is playing an increasingly critical role for the success of ICT applications and more generally for the success of many economic, social and cultural activities, which almost always involve software applications. Indeed, choosing adequate engineering techniques, adopting technologies that can be seamlessly integrated with the organization and procedures, and pushing software technologies that facilitate innovation are essential keys for the success (or, vice versa, the failure) of companies, for the quality and usability of publicly available services and, overall, for improving the quality of life of people.

Nonetheless, the engineering of complex software systems has not yet reached an adequate maturity level. This is testified by the large number of software projects that fail, do not meet deadlines or costs, and release unreliable and unstable products – which, in turn, miss the requirements of final users. And these challenges are becoming even more and more compelling for an ICT that is anywhere, anytime and for anybody, an ICT that is becoming the factor that most significantly

shapes individual and societal habits, an ICT that is becoming itself a global challenge.

We address key limitations in the current approaches to software system engineering: Existing techniques focus mainly on software that keeps being: "static", i.e., it cannot easily adapt and evolve to face the changes in requirements, context and technology that, unavoidably, take place during the life-cycle of a software system; or "centralized", i.e., it has difficulty managing the integration of loosely-coupled, independent, autonomous components such as all the services available on the Web; or "not adequately reliable and secure", especially when the software and the system where it operates are highly complex and malfunctions have critical implications.

**Content:** A key element for ICT to impact on the individual and societal quality of life is the ability to deal with, manage, organize, interpret, understand the huge amount of structured and unstructured data that is generated and distributed nowadays by an ICT that is anywhere, anytime and for anybody. The challenge here is the organization, management, elaboration, and extraction of information and knowledge from this huge amount of multimedia data. The objective is to transform data into *content*, i.e. *information and knowledge useful for people*.

Besides traditional content conveyed through popular communication channels (e.g. television, Internet), in the form of audio, video and text, new types of information are rapidly emerging, ranging from intensive streams of scientific and business data (e.g. molecular, sensory, and financial data) to semi-structured information that is increasingly tagging much of the content put on the Web. Such bulks of information represent a formidable challenge for research and innovation and an enormous potential for many sectors of society.

Some of the challenging objectives for this area of research are the following: sensory data could be aggregated and interpreted in order to explain or predict environmental changes; general or sectorial news coming from every corner of the world could be transcribed, translated, interpreted and organized for the benefit of many organizations and individuals; metadata on the Web could be organized and linked together to significantly improve information search; finally, semantic tags of data, produced manually or automatically, could lead to a deeper understanding of content as well as to the inference of new knowledge.

**Interaction:** The impressive development of information technology in the last few years - from smart phones, to iPads, "intelligent" appliances, and smart objects - is creating the basis for a new idea of interaction among people and ICT devices. ICT can be really for everyone only if information and communication technologies are designed to be able to adapt to the users and evolve together with them; in some cases they need to "disappear" in the periphery of users' attention still providing an uninterrupted support to people's activities. They should foster and support interaction and collaboration among people rather than isolate individuals. Finally, technologies should evolve from standalone devices toward an eco-system of services. This challenge requires a multi-disciplinary approach which combines scientific and technological skills with competences from social and cognitive sciences; the ultimate goal being the design of systems able to interact in robust and appropriate

ways with users, be they individuals or groups. This technical and scientific en-deavour requires addressing several issues:

−  The improvement of core level technologies for audio/visual analysis of com-plex natural scenes;

−  The investigation of new multimodal perceptual components able to efficiently combine and integrate information from different sensors;

−  The development of socially intelligent components able to understand events and actions in the real world, as well as the emotions and moods of the people involved in the interaction;
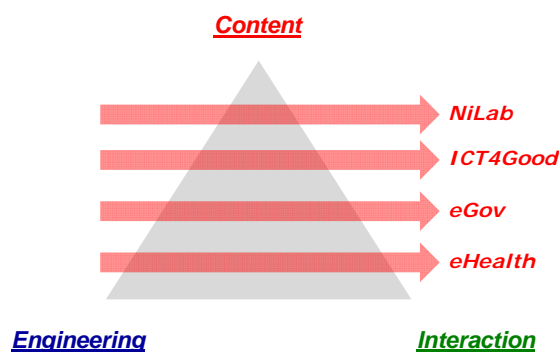
The design of new types of interaction of which the user may also be unaware. In-direct and persuasive communication and pro-active initiative are important as-pects of these technologies though they need to be carefully designed to consider ethical issues.

A new approach is required to design how people interact with these new technol-ogies. ICT can really enable quality of life if we build a *"person centric ICT"*, where human beings are in the center of the design process considering their needs, their values and their practices. ICT should move *from a technology for the users to a technology for the person.*

**Organization**

Research at FBK-ICT is organized into Research Units, i.e., groups that include both senior and young researchers, post docs, PhD students and Technicians. Each research unit refers to a field of the scientific community, and its leader (the head of unit) is internationally recognized in the field. Research units are shown in the diagram below, where each group is "positioned" in a triangle depending on their competence in the three areas of engineering, interaction, and content[1].

Beyond research units, four fur-ther units address domains that are intrinsically transversal to different research areas, e.g., the application units working on eHealth and eGovernment, the unit on ICT4Good - targeting how ICT can address problems of societies with low ICT pene-tration - and the research unit on Neuroinformatics (NiLab) co-located with the Center for Mind



and Brain at the University of Trento**.** Application Units have the competence on a specific domain and the goal to collaborate with and involve research units in ap-

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[1]  The spatial positioning of the unit is simply indicative.

plied projects. As an example, the eGovernment unit has involved the Data and Knowledge Management Unit in the project for the dematerialization of the public administration, and is going to involve the Service Oriented Application Unit in future projects. The eHealth unit has involved the Security and Trust Unit in the project for the experimentation of the personal health record system, and is going to involve researchers with competences in Human Language Technology in future projects.

From the organizational point of view, in 2012, the explorative projects will be integrated within existing units. The project on *Social Network* will find its natural integration with the activities devoted to Social Informatics of the "Intelligent Interaction and Interfaces" Unit, while the explorative project *"FreeIT",* exploring the theme of free software will be integrated in the eGovernement Unit, focusing on the topic of "Open Data". The Unit "Technologies of Vision" will be led by a new "young" researcher, Oswald Lanz, who contributed substantially to one of the main lines of research of the unit.

## People

The tables below show the number of people in FBK-ICT in 2011 and the expected figures for 2012. The number of people who area employed will remain essentially stable, while PhD students tend to increase. Given the experimental nature of our research, we have several technologists, including software programmers, designers, analysts, software architects, and project managers.

| People | 2011 | 2012 | | Researchers | 2011 | 2012 |
|---|---|---|---|---|---|---|
| Researchers | 89 | 91 | | Senior Researchers | 10 | 12 |
| Technologists | 43 | 39 | | Researchers | 19 | 17 |
| PhD Students | 50 | 59 | | Junior Researchers | 60 | 62 |
| Total | 182 | 189 | | Researchers: Total | 89 | 91 |
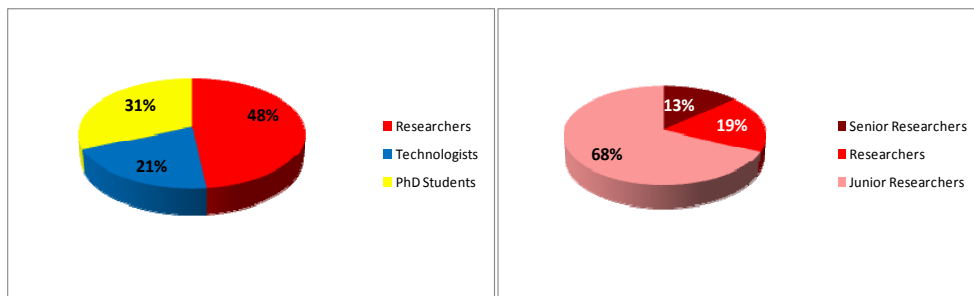
**Publications**

The researchers at FBK-ICT include 16 researchers with h-index > 20[2], 6 of them with h-index > 30. More in detail, according to Google Scholar, at the time of the writing of this report (October 2011), the average h-index of unit leaders is above 20 (23 at the moment). A detailed list of the top 20 researchers according their h-index is reported in the following table.

|                     | h-index |  |                      | h-index |
|---------------------|---------|--|----------------------|---------|
| Marco Pistore       | 35      |  | Marcello Federico    | 22      |
| Luciano Serafini    | 34      |  | Alessandro Armando   | 22      |
| Alessandro Cimatti  | 33      |  | Oliviero Stock       | 22      |
| Paolo Traverso      | 33      |  | Fabio Pianesi        | 21      |
| Bernardo Magnini    | 32      |  | Piergiorgio Bertoli  | 21      |
| Paolo Tonella       | 32      |  | Maurizio Omologo     | 21      |
| Carlo Strapparava   | 24      |  | Silvio Ranise        | 19      |
| Marco Roveri        | 23      |  | Paolo Avesani        | 19      |
| Anna Perini         | 23      |  | Massimo Zancanaro    | 19      |
| Amy L. Murphy       | 23      |  | Piergiorgio Svaizer  | 18      |

In the following diagram we report the number of peer-reviewed publications in the last four years. They include international journal articles, international conference proceedings, books (published as authors, editors, as well as chapters in books), and reviews. We also report the number of publications by type. All of this is reported according to the "standard model", which considers publications of people affiliated to FBK-ICT in the corresponding year.
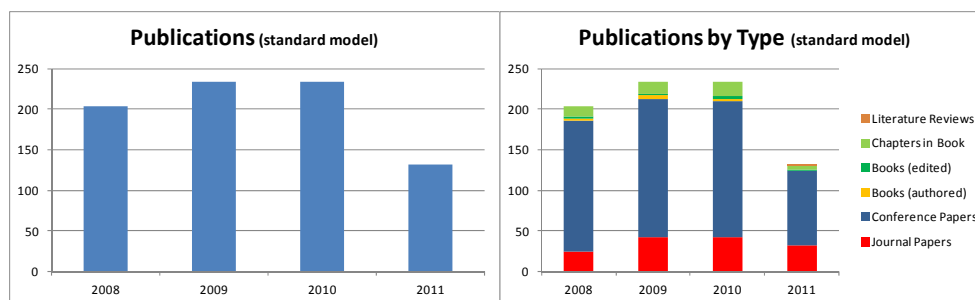


The decrease of the number of publications in 2011 can be attributed to the fact that data have been collected at the end of September and to the usual delay in the data entering. As usual in our scientific community, most of our publications are in conference and journal papers. Concerning journal papers, we detail below their numbers according to the standard model.

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[2]    According to google scholar (Publish or Perish)
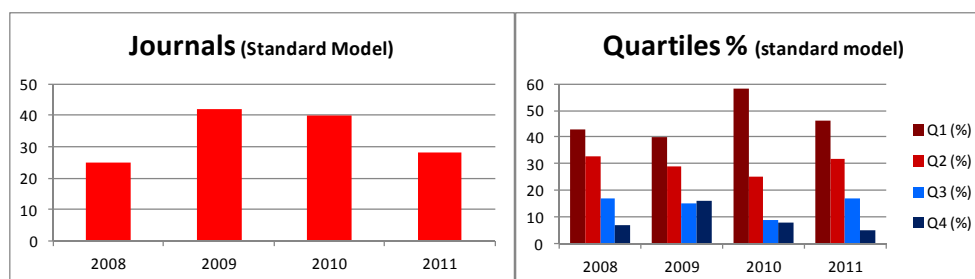
The diagram shows that, since 2008, the number has increased and stabilized around 40 in 2009 and 2010. Some decrease in the number of journal papers can be noticed in 2011, again probably due to the usual delay in data collection. Since our journal publications have 3 authors on average, we have a mean number of about 1.3 journals per researcher per year. As to the quality of published journal papers, which is much more important than the number, the percentage of papers in top journals - those with impact factor in the top 25% quartile (Q1) – has been increasing in recent years, while those in the lowest quartile is decreasing.

In the next diagrams, we report the number of conference papers together with their classification according to the ERA ranking. The percentage of papers in top conferences (ERA A papers) has increased while that of lower quality papers (ERA C papers) has decreased, with no papers in ERA D. In conclusion, the decreasing trend concerning quantity has been more than compensated by the increasing trend concerning quality.



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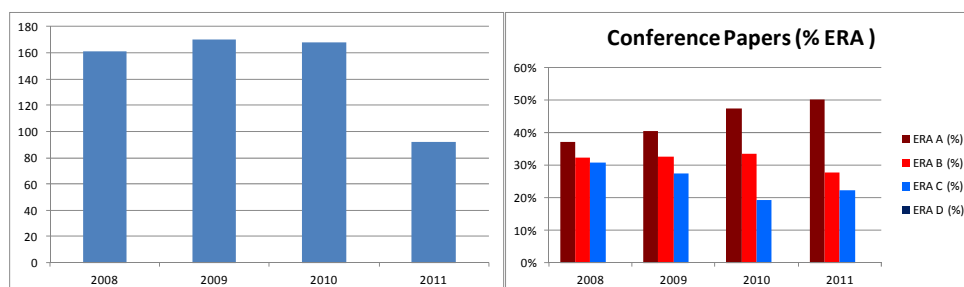
## Budget & Fund Raising

We report below the budget distribution for 2011 and the forecast budget for year 2012[3].

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|  | **2011** | **2012** |
|---|---|---|
| **Expenses** | **11.680.836** | **11.151.117** |
| Personnel | 8.299.741 | 8.305.540 |
| Travel | 553.900 | 567.690 |
| Equipment (Hw/Sw) | 164.000 | 133.600 |
| PhD | 831.054 | 1.033.820 |
| Other (e.g. subcontracting) | 1.832.141 | 1.110.467 |
| **Income** | **5.611.927** | **5.520.095** |
| EU Projects | 1.785.191 | 2.705.815 |
| Other External Incomes | 3.826.736 | 2.814.280 |
| **Financial Need** | **6.068.909** | **5.631.021** |
| **% Self Funding** | **48%** | **50%** |

The row **Income** refers to funds acquired from research agencies on a competitive basis (e.g., the European Commission) and from the public and private sectors (e.g., projects for private companies and project for public bodies, like, e.g., the health care system). The row Financial Need refers to the fund from the Autonomous Province of Trento, which are used to co-fund projects acquired by research agencies (e.g., FP7 European Projects), to fund research that is not committed to external projects, and to invest in different kinds of initiatives – e.g., the evaluation of a technology for the launch of a spin offs, investment in territorial labs etc. The sum of these two sources gives the total cost of the center, reported in the row "Expenses". The row "% Self Funding" indicates the % of the amount of money that comes from external projects over the total cost. In 2012 we slightly increase the percentage of self funding, while we reduce the financial need of about 440.000 Euros.

The acquisition of external funds is an important factor for the economical sustainability of the center. In the next figures we report some data about fund acquisitions in recent years.

| Contract Type | Value in Euros | Number | Avg Value |
|---|---|---|---|
| Grant | **19.141.473** | **57** | **335.815** |
| Development | **3.375.021** | **63** | **53.572** |
| Collaborations | **2.992.310** | **55** | **54.406** |
| Service | **244.050** | **82** | **2.976** |
| **Total** | **25.752.854** | **257** | **100.206** |
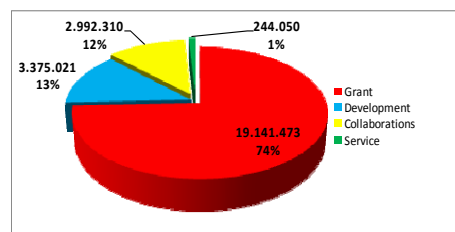


The table above reports the external funds acquired the period 2006-2011[4] classified by type of contract. Most of the external project acquisitions come from com-

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petitive grants at the international and national level, while we have a rather limited amount of income and projects based on development of systems for third parties. Collaborations represent income from joint projects (e.g. with companies). We have a very small amount of funds for services to companies and public bodies. In conclusion, the by far large majority of income are from competitive research grants.

The next diagram reports the value of external projects acquisition in years 2006-2011. In this case, for the year 2011, we show the amount of income of projects currently (in October 2011) under negotiation. Most of the amount due to projects under negotiation is due to FP7 European Projects. Indeed, the total amount of projects under negotiation is 3.314.826 Euros, with 3.073.038 Euros due to FP7 European Projects. It is well known that European Projects under negotiation are de facto approved, modulo a minimal budget variation. We can therefore conclude that 2008 and 2011 are the two years during which FBK-ICT has its best project acquisition phase, while the years in between have been years where project acquisition decreased due to the high amount of funds already available.
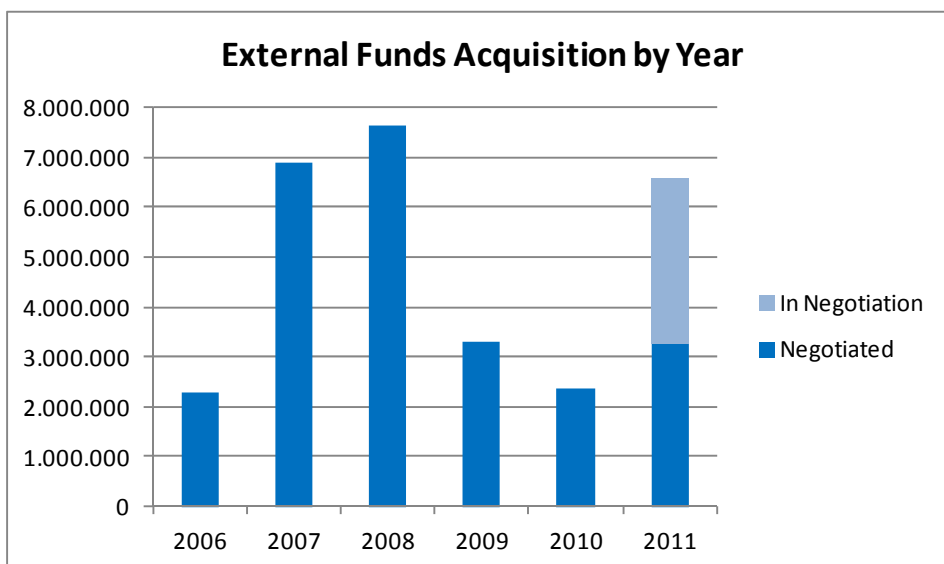


The next table includes the project proposals under evaluation in 2011 – a total amount of proposals for 7.541.429 Euros. Differently from what happens to projects under negotiation, proposals are not granted to be approved. In previous years, the statistics report a rather high success rate, around 30% (the global rate, e.g., for European Projects, is around 5-10%). If this rate was confirmed, we would get more than **2.200.000 Euros** of further funds, thus leading to the maximum amount of fund raising in recent years.

**Fund Raising by Year including Proposals Under Evaluation**
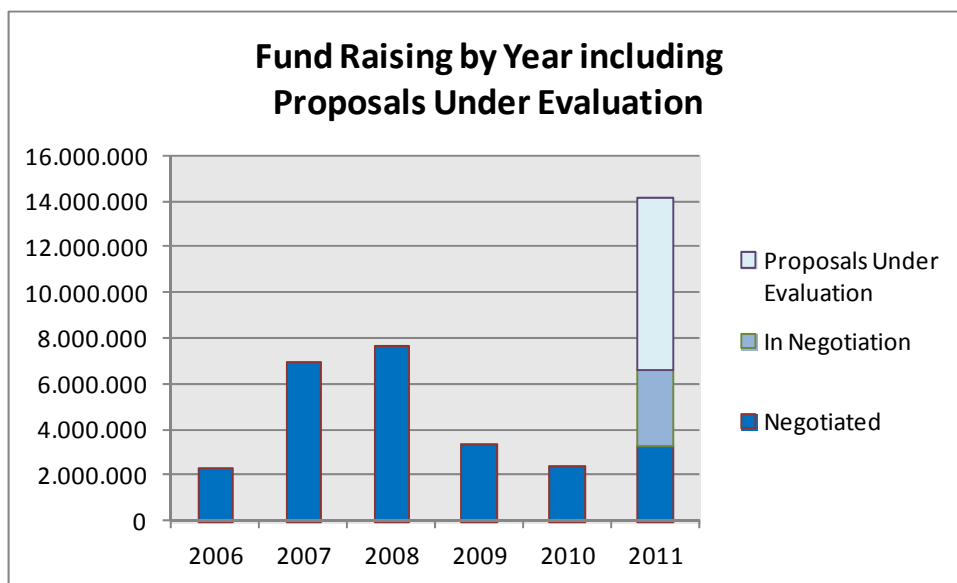
In the following diagram we show fund raising per year according to its provenance, with Europe being the area contributing most of the amount (mainly projects funded by the European Commission in the Framework Programs).

**Fund Raising by Geographical Area**
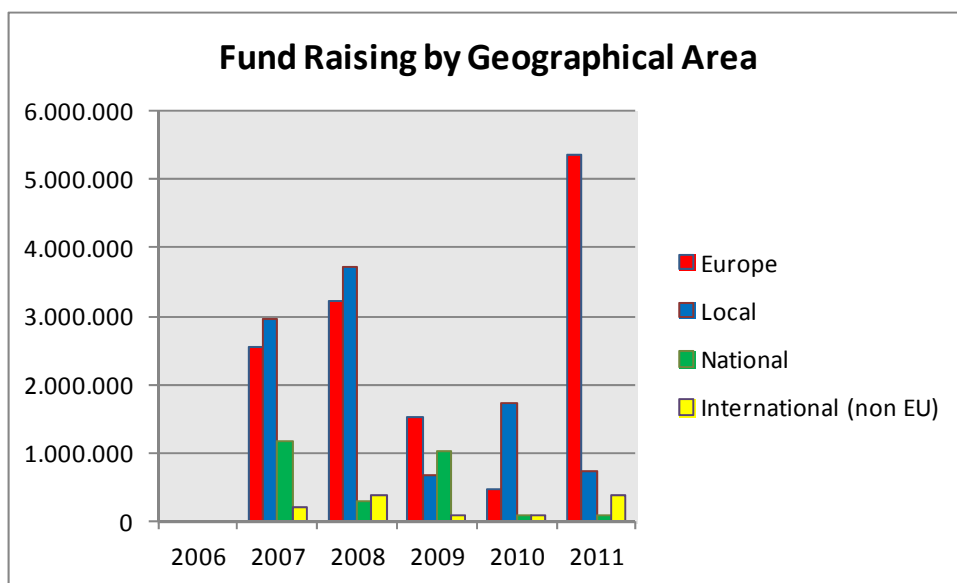
We report below the portfolio per year, i.e. the total amount of funds by projects that are active year by year[5].

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[5]     The diagram does not take into account projects in negotiation
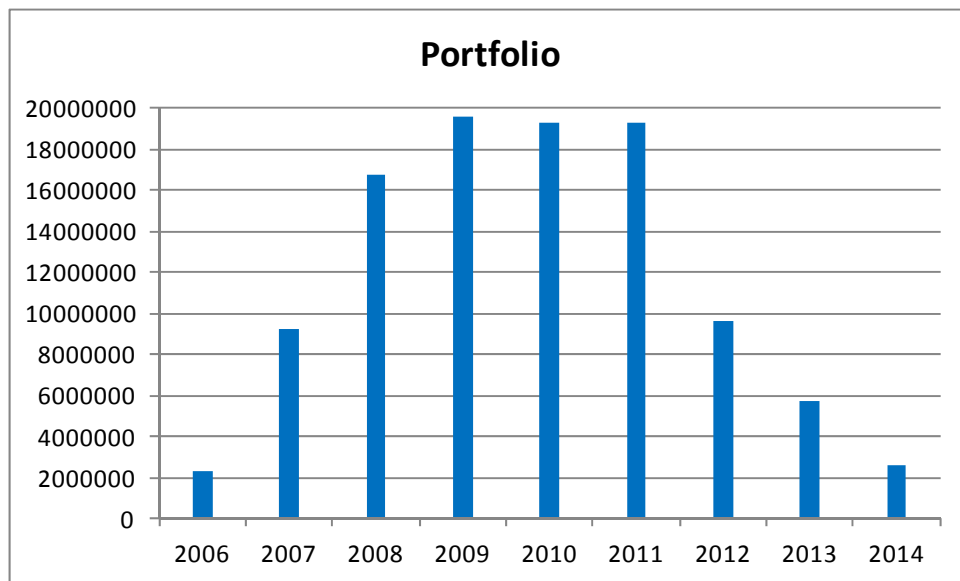
**Portfolio**



The portfolio of projects in 2011 is close to 20 Million Euros, and if we consider also projects under negotiation it gets to 22.637.195 Euros. Another good sign for our future sustainability.

**Relations with Trento RISE**

Trento RISE, the Trento Research, Innovation, and Education System, is the association between FBK and the University of Trento which participates in the EIT ICT Labs (http://eit.ictlabs.eu/), the European Institute of Innovation and Technology in ICT. Trento RISE is both the right stimulus and the right instrument for FBK-ICT to achieve a number of long planned goals. Trento RISE is part of an international network that comprises key European players (Ericsson, Nokia, Philips, SAP, Siemens, Alcatel, Orange, Deutsche Telecom) and Italian ICT companies (Telecom Italia, Engineering, STMicroelectronics, FIAT). We plan to exploit this network of key research and business players in the following ways:

−    This outstanding industrial network is ideal for our goal to attract key international companies to co-locate their research labs in physical proximity to FBK research labs, and launch joint projects with them. International key players are needed in order to push innovation and results towards the global market, to transfer the results of the local experimentations in Territorial Labs to other regions, as well as to create market for local SMEs they will collaborate with.

−    Trento RISE's network will also be used to support the creation of new business by means of new spin offs that target the international (rather than merely the local or national) market. Existing FBK spin offs will also be able to take advantage of this international business network.

−    We plan to open our local territorial labs to this network to create new international technology transfer opportunities, to push innovation and results towards the global market, and to transfer the results of the local experimentations in Territorial Labs to other regions. Territorial Labs like the "*smart home for ambient assisted*

*living",* the "*personal health record system*" currently in use by 500 people in Trentino, the "*smart tunnel"* with novel WSN techniques in one of the tunnels of Trentino, could be opened to the international EIT ICT Labs network.

−    The EIT ICT Labs international network will open us the way to launch Innovation Projects with co-located companies, i.e., projects whose aim is to bring research to the market and to impact in the society. These projects will be characterized by some major requirements: impact in the local territory, international market opportunities, significant co-investment by the co-located companies, involvement of SME in the territory, clear plan to market and IPR policy, clear need for research and plan to bring research results to market. By leveraging public funds from the local government, the co-investment and leadership of co-located companies and the strong involvement of research centres (among which FBK is going to play a major role), Innovation Projects will stimulate the transition to market of research results and provide an ideal framework for SMEs rooted in the territory to get involved in joint projects with international players, with important advantages for the local Territory. Domains currently under consideration for Innovation Projects are:

−    *Tourism*: the main idea is to integrate and exploit the recent Web 2.0 approach     based on social networks and the recent Web 3.0 approach based on user-centric (mobile) services in different phases (e.g., during, and after) the participation of tourists, and tour operators to major touristic events and attraction, e.g., ski events.

−    *Smart city & mobility*: the objective is to enable smart city services based on a sensor-based infrastructure which allows for the management of public lights, intelligent parking systems, display information at bus stops, integrated e-ticketing service, intelligent traffic management, etc.

−    *Tele-assistance and personal health record system*: The main goal is to deliver an advanced tele-assistance service that leverages innovative ICT to extend and improve the traditional human-based tele-assistance business model by reducing the operational costs while increasing the quality of the service. A major ingredient is the exploitation of smart technologies that can understand the environmental context and the users' behaviors.

Further areas of impact that are being considered for innovation projects are the area of *"culture fruition"*, *"environment monitoring and management", "energy efficiency".* FBK will contribute to the realization of these scenarios by contributing its research skills, its expertise in research-to-market transition and its own network of companies, stakeholders and users.

Moreover, FBK can exploit Trento RISE as a powerful instrument to influence the strategy in education, and to aim at a more entrepreneurial approach to education. This can be done especially in the context of the EIT ICT Labs, which also aims at a similar radical change in the way education is organized, with a higher and higher integration with research and business. We plan to extend the current use of Territorial Labs to provide hands-on experiences for students in Masters and PhD courses and/or during summer/winter schools. Further objectives are: The launch of PhD students co-advised by research and companies, i.e. PhD students who will be co-advised by FBK researchers and people from co-located companies; The set

up of a Doctoral Training Center as a place where PhD students work with companies in a entrepreneurial environment

Finally, Trento RISE provides the ideal context to set up cross-institutional research groups, i.e., groups of researchers from different institutions, with common scientific competences and background, each maintaining its original affiliation. Beyond sharing information and ideas, these groups will be able to set up and deploy common scientific strategies and increase the international impact of our research. Far from subtracting (human) resources to FBK, the model of integration among institutions promoted by Trento RISE has the aim to lift up the whole research system in Trentino to one of the very few top hub in Europe and the World.

## Remarks and Conclusions

FBK-ICT 2012 plan of activities aims at maintaining the scientific performances of recent years, and at consolidating our positioning in the international research panorama, by maintaining and possibly increasing the quality of publications, the level of participation in international contests and competitions, the level of involvement in industrial and social projects, as well as the level of fund raising mainly in international competitive research grants.

Moreover, the plan aims at extending our strategy on Territorial Labs in different directions: by reinforcing the experimentations (see, e.g., the case of the experimentation of the personal health record system that will be extended to citizens with critical diseases); by using Territorial labs as hands-on experience for students in education courses; by opening them to the EIT ICT Labs international network to push innovation and results towards the global market and to other regions, as well as to attract experimentations by international key players in the Territory.

We also plan to re-enforce our collaborations with key international companies by exploiting the EIT ICT Labs international network, by co-locating their research labs in physical proximity to FBK, and by launching joint innovation projects with them. We plan for a set of joint PhD students who will be co-advised by researchers and companies on topics of common interest.

Finally, we plan to contribute to the set up of Inter-Institutional Research Groups, as a new model of integration between ICT research centres in Trento, as a first step towards the ambitious goal of making Trento one of the very few top research hubs in Europe and in the World.

We believe these actions are a concrete way to address new issues and trends, including those raised by the recent economical crisis: the focus of resources in few top level research centers; the need for a better and more stable link between high education and research; the compelling need for research to create market and social value. Far from representing the final solution, the plan for 2012 consistently goes towards targeting a new model of integration among research centers in Trento, a stronger active involvement on high education (PhD programs, Master Programs, etc.), the establishment of systematic collaborations with large international companies that intend to invest in research and education, and the set up of innovation projects that can have an impact to market and society.

# ES – EMBEDDED SYSTEMS

Head of Unit: Alessandro Cimatti

## 1. Summary and vision

Embedded Systems are computer-based systems connected to some physical environment by means of sensors and actuators. They are pervasive in everyday life, in sectors including automotive, railways, space, industrial control, ambient assisted living, biomedical devices, and others. Embedded systems are often required to carry out complex and often critical tasks autonomously. The Unit carries out activities in the field of Embedded Systems, along three main directions: advanced design methods, required to support the production of correct and reliable embedded systems; architectures for autonomous control, required to realize systems able to carry out complex tasks in de-structured environments without direct human intervention; protocols for distributed embedded systems, with particular reference to wireless sensor networks, to ease the task of programming and to maximize the available resources.

These activities all span from research to technology transfer, and rely on the development of software tools providing strong experimental support and competitive advantage. The unit carries out research with a strong emphasis on practical applications, and is currently participating in various projects. It has a strong interest in training students. The unit is active in many research fields, including formal verification, automated reasoning, planning, diagnosis, wireless sensor networks.

The unit develops several tools including the NuSMV and Kratos model checkers, the MathSAT SMT solver, and has a testbed for the evaluation of Wireless Sensor Networks. The unit has been actively applying the developed technologies in various projects, and has been awarded several project by the European Space Agency. There are several active collaborations, e.g. with the University of Trento on the development of the MathSAT solver, on wireless sensor networks, and on the organization of . The unit has a solid funding history, and produces high-ranked research.

The most promising research direction in formal verification is to increase the scalability of automated algorithms using the power of SMT solvers. This has strong applications in testing and certification. The using will work to finalize tool support for a new flow for safety assessment, a standard procedure for the design of safety critical systems. The flow is being currently evaluated by a major avionic company, and is likely to result in an innovative technology. The most interesting direction in the field of wireless sensor networks is the investigation and development of the ReinsMAC communication protocol for reliable WSN applications.

*Unit composition*

|                                              | *2011 (as of Jan 1$^{st}$)* | *2012 (planned)* |
| -------------------------------------------- | -------------------------- | ---------------- |
| Research directors                           | 1                          | 1                |
| Senior researchers                           | 1                          | 2                |
| Researchers (including postdocs, etc.)       | 7                          | 4                |
| Technologists                                | 9                          | 5                |
| PhD students                                 | 3                          | 5                |
| Total                                        | 21                         | 17               |
| Tenured                                      | 6                          | 7                |
| Tenure track                                 | 1                          | 0                |

Note: "Research directors" are level 1 researchers; "Senior researchers" are level 2 researchers. Category "Researchers" covers all other cases, including level 3 and 4 researchers, postdocs and other contractual forms used to enroll researchers.

*Top 5 researchers by H-index*

| *Researcher*        | *H-index* |
| ------------------- | --------- |
| Alessandro Cimatti  | 33        |
| Amy Lynn Murphy     | 23        |
| Marco Roveri        | 23        |
| Marco Bozzano       | 17        |
| Alberto Griggio     | 9         |

## 2.    Recent publications

| year | *Jour. Papers* | *Jour. Papers (IF)* | *Q1 (%)* | *Q2 (%)* | *Conf. Papers* | *ERA A* | *ERA B* | *Books (author)* | *Books (edited)* | *Chapters in Book* |
| ---- | -------------- | ------------------- | -------- | -------- | -------------- | ------- | ------- | ---------------- | ---------------- | ------------------ |
| 2011 | 4 | 3 | 17 | 83  | 9  | 7 | 1 |   |   |   |
| 2010 | 4 | 4 | 42 | 58  | 16 | 7 | 1 | 1 | 1 | 1 |
| 2009 | 2 | 2 | 0  | 25  | 20 | 6 | 5 |   | 2 |   |
| 2008 | 1 | 1 | 0  | 100 | 16 | 4 | 3 |   | 1 | 1 |

The unit has a positive trend in the publication of journal articles. The conference papers are of high quality. The paper "Is There Light at the Ends of the Tunnel? Wireless Sensor Networks for Adaptive Lighting in Road Tunnels" won the Best Paper Award at IPSN'11 (SPOTS track). The paper "Boosting Lazy Abstraction for SystemC with Partial Order Reduction" received the EASST Best Paper Award at the TACAS 2011 conference. The paper "Applying SMT in symbolic execution of microcode", by Anders Franzén, Alessandro Cimatti, Alexander Nadel, Roberto

Sebastiani, Jonathan Shalev, received the best paper award at FMCAD 2010, for work carried out in collaboration with the University of Trento. The paper describes the deployment of the MathSAT solver into an industrial setting, i.e. Intel's microcode development flow.

Top 5 publications in the last 3 years (2009-2011):

−   Matteo Ceriotti, Michele Corrà, Leandro D'Orazio, Roberto Doriguzzi, Daniele Facchin, Stefan Guna, Gian Paolo Jesi, Renato Lo Cigno, Luca Mottola, Amy L. Murphy, Massimo Pescalli, Gian Pietro Picco, Denis Pregnolato, Carloalberto Torghele: Is there light at the ends of the tunnel? Wireless sensor networks for adaptive lighting in road tunnels. IPSN 2011: 187-198. *Best paper award.*
−   Alessandro Cimatti, Sergio Mover, Stefano Tonetta: Efficient Scenario Verification for Hybrid Automata. CAV 2011.
−   Alessandro Cimatti, Iman Narasamdya, Marco Roveri: Boosting Lazy Abstraction for SystemC with Partial Order Reduction. TACAS 2011. *Best paper award.*
−   Marco Bozzano, Alessandro Cimatti, Marco Roveri, Andrei Tchaltsev: A Comprehensive Approach to On-Board Autonomy Verification and Validation. IJCAI 2011: 2398-2403
−   Alessandro Cimatti, Alberto Griggio, Roberto Sebastiani: Efficient generation of Craig interpolants in Satisfiability Modulo Theories. ACM Trans. Comput. Log. 12(1): 7 (2010)

### 3.   Objectives for 2012

**O1: research on WNS**. This objective has two facets. The first one is to port the middleware for WSN programming, originally developed under TinyOS, to the Standard ZigBee stack. This activity is being carried out within the with RockFall Defense and Algorab. The second one is to continue the investigation and development of the ReinsMAC communication protocol for reliable WSN applications.

**O2: fund raising**. The objective for 2012 is to increase the funding with long term initiatives (e.g. three-years EU projects), and to acquire research projects in the area of WSN.

**O3: formal verification empowerment**. A key factor in verification is the scalability of automated techniques. The objective is to obtain significant speed ups (an order of magnitude on large problems) in the verification capabilities of the NuSMV verification tool. This will be achieved with the interconnection between NuSMV and MathSAT, and with the adoption of techniques based on the novel IC3 paradigm. The technology will be publicly released, and additional case studies will be solicited from the user base.

**O4: safety assessment flow.** The objective is to finalize a strong tool support for a new flow for safety assessment, a standard procedure for the design of safety critical systems. We believe that the flow, being currently evaluated by a major avionic company, has major market potential, and is likely to result in an innovative tech-

nology. The activity will include scouting of the marked, and an analysis of the implications on the various verification flows.

**O5: organization of the SAT conference and school.** The unit will increase its visibility by organizing, jointly with the University of Trento, the 15th edition of the International Conference on Theory and Applications of Satisfiability Testing (SAT). Furthermore, it will organize the second edition of the International SAT/SMT Solver Summer School. In the previous year the school was held at MIT and attracted almost 200 participants.

## 4. Funding

The unit has a solid funding history, with multiple sources of income, including industrial project, EU-funded activities, local projects, and post-doc grants.

| Acronym | Type | Start | End | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | Total |
|---------|------|-------|-----|------|------|------|------|------|------|-------|
| OMCARE | RI | 16 4 2007 | 15 10 2009 | 33637 | 26468 | | | | | 60105 |
| ANACONDA | RL | 6 8 2007 | 5 8 2010 | 50091 | 49954 | 29699 | | | | 129744 |
| S3MS | EU | 1 9 2007 | 15 5 2008 | 35089 | | | | | | 35089 |
| TRITON | EL | 1 9 2007 | 31 8 2010 | 50091 | 49954 | 33257 | | | | 133302 |
| VELOS | PN | 1 9 2007 | 31 3 2011 | 10633 | 10604 | 10604 | 2615 | | | 34456 |
| COCONUT | EU | 10 12 2007 | 30 6 2010 | 143255 | 142864 | 70845 | | | | 356964 |
| ETCS | RI | 1 1 2008 | 31 1 2009 | 162258 | 13743 | | | | | 176001 |
| COMPASS | RI | 1 2 2008 | 28 3 2011 | 56124 | 61150 | 61150 | 14576 | | | 193000 |
| EMTELOS | RL | 2 5 2008 | 1 5 2011 | 33425 | 50000 | 50000 | 16575 | | | 150000 |
| ACUBE | RL | 1 10 2008 | 30 9 2012 | 25254 | 100192 | 100192 | 100192 | 75212 | | 401042 |
| MISSA | EU | 15 12 2008 | 30 6 2011 | 8345 | 179175 | 179175 | 88851 | | | 455546 |
| ALES0 | PN | 1 4 2009 | 28 2 2010 | | 44708 | 9592 | | | | 54300 |
| ADAPTATION | RL | 15 5 2010 | 14 5 2013 | | | 31404 | 49621 | 49757 | 18217 | 148999 |
| IRONCAP | PI | 14 7 2010 | 13 7 2012 | | | | 38400 | 88200 | 3600 | 130200 |
| ALES1 | PN | 1 11 2010 | 31 10 2011 | | 8356 | 41644 | | | | 50000 |
| ROCKFALL | PL | 1 4 2011 | 14 4 2012 | | | | 34158 | 13042 | | 47200 |
| pSafeCer | RI | 1 4 2011 | 31 3 2013 | | | | 29187 | 38845 | 9552 | 77584 |
| AUTOGEF | RI | 6 10 2011 | 31 12 2012 | | | 19205 | 80795 | | | 100000 |
| TOTAL | | | | 608202 | 728812 | 584274 | 435024 | 345851 | 31369 | 2733532 |

In 2012, the unit has several projects funded by the European Space Agency, an ARTEMIS project, a Marie Curie grant supporting Alberto Griggio, and an industrial contract sponsored by Legge VI project. Three other projects, with durations between 2012 and 2015, are currently under negotiation, for a total amount of over €450.000 of income.

| Acronym | Full name | Type | Duration | Total income | Income 2012 |
|---------|-----------|------|----------|--------------|-------------|
| ACUBE | | RL | 1/10/2008-31/9/2012 | 401042 | 66360 |
| IRONCAP | | PI | 1/1/2011-31/12/2011 | 130000 | 88609 |
| ROCKFALL | | PL | 1/1/2011-31/12/2011 | 47200 | 6363 |
| AUTOGEF | | RI | 1/1/2011-31/12/2011 | 10000 | 81244 |
| ADAPTATION | | RL | 1/1/2011-31/12/2011 | 149000 | 49667 |
| CONET | | EU | 1/1/2011-31/12/2011 | 13400 | 6220 |
| pSAFECER | | RI | 1/1/2011-31/12/2011 | 77584 | 55000 |
| FOREVER | | RI | 1/1/2011-31/12/2011 | 140000 | 114500 |
| TOTAL | | | 1/1/2011-31/12/2011 | 968226 | 467963 |

## 5. Budget

| | 2011 | 2012 |
|---|------|------|
| Expenses | | |
| Personnel | € 705,02 | € 608,40 |
| Travel | € 51,75 | € 62,80 |
| Equipment (HW/SW) | € 0,00 | € 8,50 |
| Other (e.g. subcontracting to external contractors) | € 79,95 | € 116,00 |
| Total Expenditure | € 836,72 | € 795,70 |
| Incomes | | |
| EU Projects (total amount financed by EU) | € 99,73 | € 61,22 |
| Other external incomes (industrial, PAT projects, etc.) | € 293,87 | € 292,24 |
| Projects to be finalized | € 116,45 | € 114,50 |
| Total Income | € 510,05 | € 467,96 |
| Financial Need (Total Income – Total Expenditure) | € 326,67 | € 327,73 |
| Self funding | 61,0% | 58,8% |

Note: Column 2011 is based on the unit's budget state as estimated at the date of document writing. Column 2012 is the budget planned for 2012.

## SE – SOFTWARE ENGINEERING

Head of Unit: Paolo Tonella

## 1.    Summary and vision

The environment in which future software systems will operate is highly demanding, in terms of: (1) scale (consisting of a large system of systems and including legacy systems); (2) adaptation and self-adaptation (run time conditions might require autonomic changes and modifications); (3) observability (only the interface is often available for third party services and components); (4) internet-centric (applications run in an open, distributed, asynchronous environment, highly exposed to security threats and attacks). The quality of these software systems depends critically on the quality of the requirements and the effectiveness and efficiency of testing. The main activities planned for the next year descend from this vision and include research on requirements modeling; adaptive requirements; software evolution; testing of future internet applications; automated failure reproduction; security testing. Such activities are expected to have a strong technological impact, thanks to the projects ongoing within the SE unit and to the research tools being developed in such projects.

For what concerns the research in the area of requirements, we will focus on complex socio-technical systems, with the goal of investigating: *(i) Requirements prioritization*: here we will focus on the definition and evaluation of algorithms based on machine learning and search based techniques to prioritize requirements, involving stakeholders' feedback and considering the constraints from the domain and the requirements change; *(ii) Norm compliance*: compliance is particularly relevant when new systems have to be integrated into complex social settings where laws and strategies, as well as requirements, continuously change; *(iii) Multi-methods analysis for requirements evolution*: extending recent work on integrating User-Centered Design and Goal-Oriented requirements methodologies, this research aims at specifying a set of guidelines for modeling and validating an evolved set of requirements; we plan to submit an FP7 Call 8 STREP project on this (among the consortium's partners are: University of Twente, The Netherlands, and Universidad Politecnica de Valencia, Spain); *(iv) Requirements at runtime:* the goal of this research is to enable the software to manage a requirements set, which includes users' goals and preferences, at run-time. This has been pointed out as a core step towards realizing self-adaptive software in recent research agendas.

For what concerns the research in the area of testing, we will focus on *(i) Web testing*, within the FITTEST project; *(ii) Failure reproduction*, a novel research line to be explored in collaboration with the Georgia Institute of Technology; *(iii) Security testing*, continuing the work on search based generation of security test cases and exploits. While our approach to security is substantially different from that of the ST unit at FBK, relying on test case generation rather than formal methods, we think there is the potential for collaboration and joint research, which we intend to ex-

plore. Automated test case generation and fault localization during debugging have been investigated for a long time. However, the problem of collecting a minimal amount of field data to enable in-lab reproduction of field failures has received comparatively much less attention. We plan to investigate a combination of dynamic symbolic execution and search based heuristics with the purpose of reproducing field failures in the testing lab. Given the huge importance of avoiding catastrophic field failures for software companies, we think the potential impact of the results of this research line is enormous. We plan to submit an FP7 Call 8 STREP project proposal on this topic (among the others, the principal investigators include A. Zeller, M. Pezzè, M. Harman).

*Unit composition*

|  | 2011 (as of Jan 1$^{st}$) | 2012 (planned) |
| --- | --- | --- |
| Research directors | 1 | 1 |
| Senior researchers | 1 | 1 |
| Researchers (including postdocs, etc.) | 6 | 5 |
| Technologists | 1 | 1 |
| PhD students | 5 | 5 |
| Total | 14 | 13 |
| Tenured | 5 | 5 |
| Tenure track | 0 | 0 |

Note: "Research directors" are level 1 researchers; "Senior researchers" are level 2 researchers. Category "Researchers" covers all other cases, including level 3 and 4 researchers, postdocs and other contractual forms used to enroll researchers.

*Top researchers by citations (max. 5)*

| Researcher | H-index | Citations (total) |
| --- | --- | --- |
| Paolo Tonella | 32 | 3411 |
| Anna Perini | 23 | 2736 |
| Angelo Susi | 13 | 673 |
| Mariano Ceccato | 12 | 707 |
| Alessandro Marchetto | 10 | 405 |

Note: H-index and citations have been obtained from Publish or Perish, by manually checking only the publications that contribute to the H-index. Hence, the total citation count may include extra publications that have not been manually verified.

## 2.   Recent publications

| year | Jour. papers | Jour. papers (IF) | Top jour. (*) | Q1 % | Q2 % | Q3 % | Q4 % | Conf. papers | ERA A | ERA B | ERA C | ERA D | Books (authored) | Books (edited) | Chapter in Book |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2011 | 8 | 6 | 0 | 61 | 22 | 0 | 17 | 12 | 3 | 1 | 4 | 0 | 0 | 0 | 0 |
| 2010 | 8 | 4 | 0 | 25 | 0 | 50 | 25 | 24 | 9 | 2 | 2 | 0 | 0 | 3 | 0 |
| 2009 | 11 | 7 | 0 | 36 | 36 | 0 | 28 | 27 | 8 | 2 | 7 | 0 | 0 | 1 | 0 |
| 2008 | 5 | 1 | 0 | 0 | 0 | 100 | 0 | 35 | 7 | 5 | 13 | 0 | 0 | 3 | 0 |
| 2011 | 8 | 6 | 0 | 61 | 22 | 0 | 17 | 12 | 3 | 1 | 4 | 0 | 0 | 0 | 0 |
| 2010 | 8 | 4 | 0 | 25 | 0 | 50 | 25 | 24 | 9 | 2 | 2 | 0 | 0 | 3 | 0 |
| 2009 | 10 | 7 | 0 | 36 | 36 | 0 | 28 | 27 | 8 | 2 | 7 | 0 | 0 | 1 | 0 |
| 2008 | 5 | 1 | 0 | 0 | 0 | 100 | 0 | 33 | 6 | 4 | 13 | 0 | 0 | 3 | 0 |
| 2007 | 4 | 2 | 0 | 0 | 0 | 100 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 2006 | 5 | 4 | 1 | 37 | 13 | 25 | 25 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| 2005 | 6 | 3 | 0 | 33 | 0 | 33 | 34 | 13 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| 2004 | 3 | 2 | 0 | 25 | 25 | 50 | 0 | 16 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |

Table provided by the Research Assessment unit. Top of table: Standard model; bottom: Dowry.

(*) For a definition of "top journal" see http://researchassessment.fbk.eu/very_best_journals.

Although incomplete at the date of document writing, data for 2011 indicate a quite good performance in terms of quality of the publications, as compared to the previous years (see top quartile and IF journal publications).

Top 5 publications in the last 3 years (2009-2011):

−   F. Palma, A. Susi, P. Tonella, *Using an SMT solver for interactive requirements prioritization*, in Proc. of the 19th ACM SIGSOFT Symposium on the Foundations of Software Engineering (FSE), Szeged, Hungary, pp. 48-58, 2011. [UGOV: 44582]

−   Filippo Ricca, Massimiliano Di Penta, Marco Torchiano, Paolo Tonella, Mariano Ceccato, *How Developers' Experience and Ability Influence Web Application Comprehension Tasks Supported by UML Stereotypes: a Series of Four Experiments*, in «IEEE TRANSACTIONS ON SOFTWARE ENGINEERING», vol. 36, n. 1, pp. 96-118, 2010. [UGOV: 6650]

−   Shin Yoo, Mark Harman, Paolo Tonella, Angelo Susi, *Clustering Test Cases to Achieve Effective and Scalable Prioritisation Incorporating Expert Knowledge*, in Proc. of the Int. Symp. on Software Analysis and Testing (ISSTA), ACM, pp. 201-211, Chicago, USA, 2009. [UGOV: 4968]

−   Cu Nguyen, Simon Miles, Anna Perini, Paolo Tonella, Mark Harman, Michael Luck, *Evolutionary Testing of Autonomous Software Agents,* in Proc. of the

Eighth International Conference on Autonomous Agents and Multiagent Systems (AAMAS), vol. 1, pp. 521-528, Budapest, Hungary, 2009. [UGOV: 4713]

–  Mirko Morandini, Loris Penserini, Anna Perini, *Operational semantics of goal models in adaptive agents*, in Proc. of the Eighth International Conference on Autonomous Agents and Multiagent Systems (AAMAS), vol. 1, pp. 129-136, 2009. [UGOV: 4675]

## 3. Objectives for 2012

**O1: Requirements at Run-time**. We intend to define a theoretical framework, which includes a taxonomy of requirements changes based on well known core concepts that define the requirements problem; a set of actions for modifying requirements and associated rules to deduce effects of changes on other requirements of the initial set, and on the associated solution (i.e. requirements analysis). A proof of concept implementation will be realized for the case of service-based application. This research brings attention on other open problems, such as "on-line" requirements elicitation and analysis, which define the core topic for an FP7 Call 8 STREP project proposal we plan to submit (among the consortium's partners are: Universitat Politecnica de Catalunya (UPC), Barcelona, Spain, and University of Zurich, Switzerland).

**O2: FITTEST project**. The overall goal of FITTEST is automated test case generation for future internet applications based on models inferred from observations (i.e., execution logs). The contribution of the SE unit to the FITTEST project in 2012 will be focused on two main topics: (1) automated oracle learning; (2) event sequence derivation from models for automated test case generation. To achieve the first goal we plan to conduct several comparative experiments aimed at assessing the relative strength of different, alternative oracle learning algorithms under investigation. For the second goal the integrated testing environment of FIT-TEST will be empowered with the capability of deriving test sequences from finite state models of future internet applications. We expect to publish the scientific results of this research and to contribute to the project's demonstrator that will be presented at the review meeting of the second year of the project.

**O3: Security testing.** Even after fully testing the main functionalities of a piece of software, small bugs could still remain on secondary features that occur just on rare and strange conditions. Even if rare and small, when bugs lead to security problems, consequences can be dramatic (sensitive data disclosure, denial of service, revenue loss). A structured approach to security testing is required for all the publicly exposed web applications. We intend to support developers trying to understand and fix complex and strange conditions, that are connected to security relevant bugs. The identification of candidate vulnerabilities is the first step toward our long-term objective: (automatic) definition of a security test suite. In 2012 our goal will be to investigate advanced algorithms to improve code coverage of the generated test cases and we plan to study the role of the security oracle for validating our test cases. The expected outcome is not just an advancement in the state of the art, but also new methodologies and tools to support developers in delivering

more secure systems. Moreover, we formed a consortium to submit an FP7 Call 8 STREP project proposal about secure code execution. In 2012 we plan also to explore the possibility of collaborating on joint research projects with the ST unit at FBK.

**O4: Made-in-Italy project**. The overall goal of the project is to realize a prototype of an "add-on" module at the top of an existing building, in a foreign country. This "Made-in-Italy top" will provide functions alternative to the classic building "coat", in terms of energy saving and management, and will be designed according to architectural design principles that make it fit environmental constraints and "Made-in Italy" characteristics. Together with the building module the project will deliver a Technology Platform (for logistics and information processing) and dedicated management tools. The contribution of the SE unit to the project is to define the requirements and to coordinate the development of a prototype of the software platform that will support information and data exchange in the critical phases of the Made-in-Italy top design and construction.

## 4.   Front Edge & New Initiatives

The SE units plans to submit some project proposals to FP7 call 8, with deadline January 17, 2012, in the area of requirements engineering, automated failure reproduction and tamper-resistant software.

The SE unit will organize the 28th IEEE International Conference on Software Maintenance (ICSM) 2012 in Riva del Garda between September 23 and 30. Paolo Tonella will be General Chair of the event; Angelo Susi will be General Chair of the co-located event SSBSE; Mariano Ceccato will be Program Chair of the co-located event SCAM.

## 5.   Funding

| Acronym | Full name | Type | Duration | Total income | Income 2012 |
|---------|-----------|------|----------|--------------|-------------|
| FITTEST | Future Internet Testing | EU | 1/9/2010-31/8/2013 | € 387,184 | € 138,450 |
| IBT | Informatica Bancaria Trentina | Industrial | 1/5/2006-31/12/2012 | € 465,000 | € 15,000 |
| CERN | European Organization for Nuclear Research | Other | 1/1/2010-31/12/2012 | € 48,000 | € 11,318 |
| Made-in-Italy | Architettura della performance | Other | 1/11/2011-31/10/2014 | € 51,223 | € 30,640 |
| Ipse | Interoperabilita' europea e nazionale delle | Other | 1/10/2011-31/3/2012 | € 18,643 | € 9,321 |

| | | | | | |
|---|---|---|---|---|---|
| | soluzioni di fascicolo sanitario elettronico | | | | |
| FESTA | Female empower-ment in science and technology academia | EU | 1/1/2012- 31/12/2014 | € 21,771 | € 7,257 |

The most important project, FITTEST, is in the area of automated software testing. The SE unit aims at acquiring additional projects to further increase the level of self-funding, especially in the area of requirements engineering, in which several quite successful projects have been carried out in the past, among which A-CUBE and ETCS.

## 6.   Budget

| | 2011 | 2012 |
|---|---|---|
| Expenses | | |
| Personnel | € 588,86 | € 487,78 |
| Travel | € 32,50 | € 41,50 |
| Equipment (HW/SW) | € 2,50 | € 4,20 |
| Other (e.g. subcontracting to external contractors) | € 241,00 | € 125,12 |
| Total Expenditure | € 864,86 | € 658,60 |
| Incomes | | |
| EU Projects (total amount financed by EU) | € 139,32 | € 139,93 |
| Other external incomes (industrial, PAT projects, etc.) | € 212,85 | € 32,75 |
| Projects to be finalized | € 90,00 | € 76,82 |
| Total Income | € 442,17 | € 249,50 |
| Financial Need (Total Income – Total Expenditure) | € 422,69 | € 409,10 |
| Self funding | 51,1% | 37,9% |

Note: Column 2011 is based on the unit's budget state as estimated at the date of document writing. Column 2012 is the budget planned for 2012.

It should be remarked that expenses and income for 2011 include the cost and revenue of the International Conference on Requirements Engineering, organized in Trento by the SE unit (Anna Perini and Angelo Susi). The conference budget, with cost and revenue equated, was 163,000 EUR.

## 7.    Remarks

The decrease in the level of self-funding between 2011 and 2012 is due to the end of the IBT project, which was renovated for 2012 with a small budget, covering just maintenance and support for tool usage in IBT. In 2012 the SE unit will work toward the acquisition of new external funding, both at the European and local level, especially in the area of requirements.

# SOA – SERVICE ORIENTED APPLICATIONS

Head of Unit: Marco Pistore

## 1.    Summary and vision

The goal of the Service Oriented Applications (SOA) unit is to investigate theories, methodologies and tools for the engineering and management of software applications based on the "service oriented computing" paradigm. This paradigm defines a new approach to software development that is gaining more and more impact in the ICT marketplace, namely the realization of new applications through the composition and customization of software "services", i.e., of self-contained computational elements that have been designed to be re-usable. The adoption of the service oriented paradigm is considered one of the key elements of the "industrial" revolution of software: as a major architectural shift, it has been compared to the one that occurred in the late 80's beginning of the 90's when mainframe architectures were gradually replaced by client/server architecture[1]. The key advantage promised by the service oriented paradigm is the capability to reduce the development and maintenance cost of software applications (also through the adoption of cloud computing solutions) without loosing control of the quality and lifecycle management of these applications.

In the last years, the SOA Unit has consolidated its leading position among the European research groups in the area of service oriented computing, as confirmed, for instance, by the participation to the steering committee of S-Cube, the European network of excellence in this area, and by the invitation of the head of unit to serve as expert for the preparation of the FP8 strategy in the area of Services in the Future Internet[2]. The most relevant contribution of the Unit to the research community has been the ASTRO framework (http://www.astroproject.org), a toolset that provides advanced techniques for supporting design and execution of service oriented applications. With more than 60 publications and an h-index of 20, ASTRO collects and integrates the results of almost 10 years of research, undertaken both in research projects and in technology transfer projects with industry. In 2009, the SOA Unit has also launched a spin-off, SAYservice (http://www.sayservice.it), with the goal of bringing to the market the solutions developed by the Unit in the last years and implemented within the ASTRO framework.

In year 2012, the Unit will continue its research on techniques for supporting design and execution of service oriented applications, focusing in particular on the problem of adaptation of such applications, one of the most significant and chal-

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[1]  Pierre Audoin Consultants SAS. "The European Software Industry. Economic and Social Impact of Software & Software-Based Services". 2009. http://cordis.europa.eu/fp7/ict/ssai/docs/study-sw-report-final.pdf

[2]  See http://cordis.europa.eu/fp7/ict/ssai/fp8-expertmeeting_en.html

lenging open problems of service oriented computing (see objective O1 in Section 3). It will also work to launch an initiative on the territory of the Province of Trento, aiming at the creation of an instance of the "Internet of Services" (see objective O2 in Section 3). By "Internet of Services" we mean an evolution of today's Internet, so that not only data, information and content, but also the applications are available in the net, as easy to use services accessible both from PCs and from mobile devices. This possibility to access to service, which will be able to respond in a capillary way to the needs of the users, will trigger a radical transformation not only in the way software applications are designed and implemented, but also in the way they are perceived, similarly to how Internet has transformed the access to information and content. The creation of an "Internet of Services" in Trentino will make the territory a lab not only for future Internet technologies, but also for investigating and assessing business models and social impacts of this transformation.

*Unit composition*

|                                          | *2011 (as of Jan 1$^{st}$)* | *2012 (planned)* |
|------------------------------------------|----------------------------|------------------|
| Research directors                       | 1                          | 1                |
| Senior researchers                       | -                          | -                |
| Researchers (including postdocs, etc.)   | 4                          | 4                |
| Technologists                            | 2                          | 1                |
| PhD students                             | 4                          | 4                |
| Total                                    | 11                         | 10               |
| Tenured                                  | 3                          | 3                |
| Tenure track                             | -                          | 1                |

Note: "Research directors" are level 1 researchers; "Senior researchers" are level 2 researchers. Category "Researchers" covers all other cases, including level 3 and 4 researchers, postdocs and other contractual forms used to enroll researchers.

*Top researchers by citations (max. 5)*

| *Researcher*        | *H-index* | *Citations (total)* |
|---------------------|-----------|---------------------|
| Marco Pistore       | 35        | ~ 5100              |
| Antonio Bucchiarone | 11        | ~ 410               |
| Annapaola Marconi   | 10        | ~ 470               |

## 2. Recent publications

| Year | Jour. Papers | Jour. Papers (IF) | Top Journal | Q1 (%) | Q2 (%) | Q3 (%) | Q4 (%) | Conf. Papers | ERA A | ERA B | ERA C | ERA D | Patents | Books (authored) | Books (edited) | Chapters in Book | Literature Reviews | Transl. (book) | Transl. (essay) | Transl. (article) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| In print | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2011 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| 2010 | 2 | 1 | 0 | 100 | 0 | 0 | 0 | 11 | 2 | 3 | 0 | 0 | 0 | 1 | 5 | 0 | 0 | 0 | 0 | 0 |
| 2009 | 3 | 3 | 0 | 67 | 33 | 0 | 0 | 14 | 5 | 1 | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| 2008 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 1 | 0 | 2 | 0 | 0 | 1 | 3 | 0 | 0 | 0 | 0 | 0 |

The SOA Unit publishes regularly in the most important conferences and workshops in the area of web services and service oriented computing (ICSOC, ServiceWave, ICWS, SOCA, EDOCS, WSFM).

The results and vision of the Unit also appears as chapters in strategic books aiming at shaping the research in the service oriented computing and future Internet areas, such as "At Your Service: Service-Oriented Computing from an EU Perspective" and "Towards the Future Internet – A European Research perspective".

Journal papers of years 2009 and 2010 are on the theoretical foundation of the results of the Unit, and appeared in top journals on AI (see table below). The Unit is now targeting publications on the application of these theoretical results in the area of service oriented computing, in journals on web, information systems and software engineering. The journal paper currently in print (see first publication in the table below) is an instance of this strategy.

Top 5 publications in the last 3 years (2009-2011):

– Stephen Lane, Antonino Bucchiarone and Ita Richardson: *SOAdapt: A Process Reference Model for Developing Adaptable Service-Based Applications*. Information and Software Technology (2011). To appear.

– Piergiorgio Bertoli, Marco Pistore, Paolo Traverso: *Automated composition of Web services via planning in asynchronous domains*. Artif. Intell. 174(3-4): 316-361 (2010) [UGOV: 5366]

– Marco Pistore, Paolo Traverso, Massimo Paolucci, Matthias Wagner: *From Software Services to a Future Internet of Services*. Future Internet Assembly 2009: 183-192 [UGOV: 4655]

– Ugur Kuter, Dana S. Nau, Marco Pistore, Paolo Traverso: *Task decomposition on abstract states, for planning under nondeterminism*. Artif. Intell. 173(5-6): 669-695 (2009) [UGOV: 24769]

– Jörg Hoffmann, Piergiorgio Bertoli, Malte Helmert, Marco Pistore: *Message-

*Based Web Service Composition, Integrity Constraints, and Planning under Uncertainty: A New Connection.* J. Artif. Intell. Res. (JAIR) 35: 49-117 (2009) [UGOV: 24609]

## 3.   Objectives for 2012

**O1: Research on Adaptation of Service Oriented Applications.** One of the key advantages of the service oriented paradigm is the capability to reduce the development and maintenance cost of software applications without losing the control of their quality and the capability of managing their lifecycle. This capability depends also on the capability of service oriented applications to adapt, i.e., to modify their behavior and to evolve in order to satisfy new requirements and to fit new situations. During the last years, the Unit has been working on the problem of adaptation of such applications, contributing to different research projects (S-Cube, Allow, SLA@SOI), and producing different approaches, methodologies and tools to support adaptation. During year 2012, the SOA Unit intends to consolidate these results, to produce an integrated approach for adaptation of service oriented applications, and to implement it within the ASTRO framework. This approach will also serve as the basis for the launch of new research and industrial projects. Given the results already achieved and the state of the art, no specific risks are foreseen for this objective.

**O2: Launch of Internet of Services in Trentino**. The long term goal is to create in the Province of Trento an instance of the "Internet of services" vision discussed in Section 1. The objective is to realize a "critical mass" of services covering all the different systems that contribute to a smart territory. These services need to be integrated and easily accessible through the net, so that who lives or works in the territory (citizen, workers, tourists, companies, and so on) can turn to the network in order to find and access to the services he/she needs. The expected result is to start a mechanism similar to the one that, years ago, has triggered the explosion of the Web, and has lead to nowadays situation where, whenever we need some information, we can turn to the Web confident to find what we look for. For 2012, the objectives are to do a first step towards this goal, by developing and deploying a service platform that supports the "Internet of services" vision, and to run the first experiments on this platform. The most critical aspect is the capability to define the collaborations on the territory that are necessary to expose services on this platform and to start building the foreseen critical mass of services.

**O3: Unit Sustainability**. During the last years, the SOA Unit has always been working on a significant number of projects, which have been able to guarantee a high self-funding rate. Also in year 2011, the Unit has been working on 6 projects – 3 EU research projects plus 3 industrial projects. 5 of these 6 projects are now ended, and the last one will end on February 2012. In order to guarantee the mid-term sustainability of the Unit, a serious project acquisition campaign has been lunched, and will continue in year 2012. The objective is to reach in 2012 a self-funding rate in line with the average of the units of CIT, and to increase this rate for the following years. The main risk is in the unpredictability of the outcome of project applications; to mitigate this risk, different funding sources will be targeted – ranging from EU research projects to collaborations with local industries.

### 4.  Front Edge & New Initiatives

In year 2012, the SOA Unit will launch the Internet of Services initiative already described in Sections 1 and 3. This is a front edge initiative, which aims at creating in Trentino a lab for experimenting with novel technologies and well as with new business and social models enabled by the Internet of Services vision.

In addition to this, the Unit is still committed to the launch of the SAYservice spin-off, which is now entering in the 3rd year of its activity.

### 5.  Funding

| Acronym | Full name | Type | Duration | Total income | Income 2012 |
|---------|-----------|------|----------|--------------|-------------|
| S-Cube | Software Services and Systems Network – FP7 NoE | EU | 1/3/2008 – 29/2/2012 | € 501,300 | € 39,400 |
| SayService | Activities for SayService | Industrial | 28/8/2009 – 27/8/2012 | € 190,000 | € 38,000 |
| Smart Campus | Smart Campus | TRise | 1/1/2012 – 31/12/2012 | € 100,000 | € 100,000 |

### 6.  Budget

| | 2011 | 2012 |
|---|------|------|
| Expenses | | |
| Personnel | € 552,60 | € 419,87 |
| Travel | € 58,50 | € 29,50 |
| Equipment (HW/SW) | € 10,00 | € 8,00 |
| Other (e.g. subcontracting to external contractors) | € 96,16 | € 65,40 |
| Total Expenditure | € 717,26 | € 522,77 |
| Incomes | | |
| EU Projects (total amount financed by EU) | € 341,93 | € 39,40 |
| Other external incomes (industrial, PAT projects, etc.) | € 149,18 | € 31,66 |
| Projects to be finalized | € 0,00 | € 200,00 |
| Total Income | € 491,11 | € 271,06 |
| Financial Need (Total Income – Total Expenditure) | € 226,15 | € 251,71 |
| Self funding | 68,5% | 51,9% |

Note: Column 2011 is based on the unit's budget state as estimated at the date of document writing. Column 2012 is the budget planned for 2012.

# DKM – DATA AND KNOWLEDGE MANAGEMENT

Head of Unit: Luciano Serafini

## 1. Summary and vision

Knowledge is becoming an important asset in information technology for the following two main reasons: From the one hand, the web, and the semantic web, made available a *huge amount of content data*, under a multitude of forms spamming from completely unstructured (i.e., with no explicit semantics) information like natural language text, images, video, to well structured data (i.e., with explicit semantic) like, databases, linked data, RDF repositories and ontologies. On the other hand, the increased level of complexity, sophistication, and pervasiveness of the information technology in our everyday life, imposes to have flexible applications capable to smoothly adapt to many possible unpredicted situations. The consequence of this is that more and more applications require an *explicit, and as much complete as possible, representation of "the world"* in which they are suppose to operate. Such a representation should be machine understandable and will constitute the "store of meanings" to be attached to the object manipulated by the application.

The main vision of DKM research is shown in the following picture.
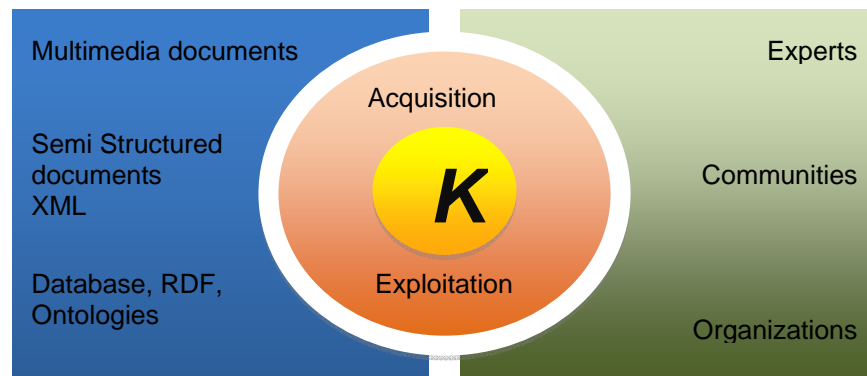


Fig 1. *Knowledge acquisition, representation, and exploitation*

The core research of the DKM unit is on knowledge representation, knowledge integration and reasoning. However, to apply the developed methodologies, we dedicate a substantial effort in developing techniques for the acquisition of knowledge about complex domains from electronic resources and from humans. Context and State of the Art (current)

In the last ten years, general approaches and tools for knowledge acquisition, representation, integration and services, have seen a tremendous improvement towards mature systems which can be applicable and integrable in real world complex applications. For knowledge acquisition, on the one side, we can find

knowledge/ontology editors, like for instance Protégé, that support the manual editing of complex ontologies, on the other hand there is a number of tools for automatic content extraction, as for instance TextPro and Gate, that allow the automatic extraction of key concepts lists, basic facts, and other semi-structured material that represent an important pre-processed material for knowledge/ontology construction and population. However, using this tools and combining them for an effective knowledge acquisition process is far to be a pure standard application activity. The state of the art ontology editors are designed for knowledge engineers, which have a specific competence in logical modeling. Such tools do not provide sufficient support for assisting knowledge experts to input their knowledge about a certain domain in some informal (or semi formal) manner. On the other side, despite the state of the art tools for automatic knowledge mining from multimedia content are of great help in an early knowledge engineering phase, it's not easy to integrate them with other tools in order to create a full and integrated production chain for knowledge.

In the area of knowledge representation and reasoning, also the state of the art is quite advance, and provide off-the-shelf theories and tools for storing large knowledge base and doing complex reasoning. They spam from large RDF triple stores, like Sesame, Joseke, 3Store, etc. (see http://simile.mit.edu/reports/stores/for a survey), to complex logical reasoners, such as Pellet, FACT++, OWLim, … (for Description Logics) and, Prover9/Mace4, SPASS, Vampire … (for full first order logic). In the middle we can find system like CYC which is at the same time, a huge knowledge repository and a reasoner. Despite being great tools, the application of these tools has been limited to reason in well formalized environments (like program verification) but they are rarely applied to situation which are more open and not so well defined such as the processing of content of a multimedia document. Furthermore, all these approaches are well designed for crisp knowledge (mainly represented in some family of first order logic), while there is no much work done in integrating logical knowledge with statistical knowledge, which is now available by the huge quantity of data.

Semantic services is an important research area because it justify all the effort done in knowledge acquisition, representation and integration. The goal of knowledge services is the one to make available knowledge in all the other application in a proper format. This span in semantic look up, semantic enrichment of content, verification, etc. This is a very wide area and it is impossible to give a precise state of the art, but in general we can see that there are a plethora of services each of which is designed for some specific application. General knowledge services are limited to standard reasoning services like satisfiability and logical consequence. However, in order to effectively exploit knowledge in application of content extraction or in application of knowledge management we need more sophisticated general services, like for instance semantic enrichment, abductive reasoning, explanation, etc.

*Unit composition*

|                                        | *2011 (as of Jan 1st)* | *2012 (planned)* |
|----------------------------------------|------------------------|------------------|
| Research directors                     | 1                      | 1                |
| Senior researchers                     | 1                      | 1                |
| Researchers (including postdocs, etc.) | 6                      | 6                |
| Technologists                          | 1                      | 1                |
| PhD students                           | 5                      | 6                |
| Total                                  | 14                     | 15               |
| Tenured                                | 3                      | 4                |
| Tenure track                           | 1                      | 1                |

Note: "Research directors" are level 1 researchers; "Senior researchers" are level 2 researchers. Category "Researchers" covers all other cases, including level 3 and 4 researchers, postdocs and other contractual forms used to enroll researchers.

*Top researchers by citations (max. 5)*

| *Researcher*               | *H-index* | *Citations (total)* |
|----------------------------|-----------|---------------------|
| Luciano Serafini           | 34        | 4886                |
| Chiara Ghidini             | 16        | 1388                |
| Volha Bryl                 | 10        | 162                 |
| Marco Rospocher            | 7         | 117                 |
| Chiara Di Francescomarino  | 4         | 52                  |

## 2.  Recent publications

| year | Jour. Papers | Jour. Papers (IF) | Conf. Papers | Books (authored) | Books (edited) | Chapters in Book |
|------|--------------|-------------------|--------------|------------------|----------------|------------------|
| 2011 | 2 | 2 | 6  | 0 | 1 | 1 |
| 2010 | 2 | 1 | 12 | 0 | 3 | 0 |
| 2009 | 2 | 0 | 15 | 0 | 3 | 0 |
| 2008 | 3 | 2 | 20 | 2 | 2 | 0 |

Top 5 publications in the last 3 years (2009-2011):

− C. Ghidini, C. D. Francescomarino, M. Rospocher, P. Tonella, and L. Serafini. Semantics based aspect oriented management of exceptional flows in business processes. *IEEE Transactions on Systems, Man, and Cybernetics, Part C: Applications and Reviews*, On-line first 2011. ISSN: 10946977 DOI: 10.1109/TSMCC.2011.2138133

− M. Fisher and C. Ghidini. Executable specifications of resource-bounded agents. *Journal of Autonomous Agents and Multi-Agent Systems*, 21(3):368–396, August 2010. DOI: 10.1007/s10458-009-9105-x

− M. Homola and L. Serafini. Augmenting Subsumption Propagation in Distributed Description Logics. *Applied Artificial Intelligence*, 24(1-2):137-174, January 2010. DOI: 10.1080/08839510903448650

− C. di Francescomarino, C. Ghidini, M. Rospocher, L. Serafini, and P. Tonella. Semantically-aided business process modeling. In *8th International Semantic Web Conference (ISWC 2009)*, volume 5823/2009 of Lecture Notes in Computer Science, pages 114–129, Westfields Conference Center, Washington, DC. USA, 25-29 October 2009. Springer Berlin / Heidelberg. DOI: 10.1007/978-3-642-04930-9_8

− V. Bryl, C. Giuliano, L. Serafini, K. Tymoshenko. Supporting natural language processing with background knowledge: coreference resolution case. In *9th International Semantic Web Conference (ISWC2010)*, volume 6496 of Lecture Notes in Computer Science, pages 80-95, Shanghi, China. DOI: 10.1007/978-3-642-17746-0_6

### 3. Objectives for 2012

From the high level perspective DKM has three main groups of objective.

The first group of objectives, labeled with "**research**" concern to the production of top-level research and publish them in the most relevant conferences, are KR, ESWC, ISWC, DL2012, AAAI2012, FOIS, BPM, FOIS. EKAW and ECAI, and on the most important international journals, which are JWS, JAI, IJAO, ...

**O1: Research: Collaborative Knowledge Engineering:** The construction of a formal model for a specific domain is one of the most challenging barrier for the application of KR&R techniques in real world situations. The development of methodologies, algorithms, and tools to support experts in formalization of their knowledge enables the implementation of knowledge intensive application. For the 2012 we plan the following activities:

a. Integrated modeling of processes and ontologies:

b. Modeling templates, i.e., wizards for knowledge acquisition and feedback

c. Natural language processing and resources for knowledge engineering

d. Multi-lingua knowledge engineering

e. Evaluation of modeling methodologiestools in a real case study (ProDe and or, SuperProf x eValue)

This type of research requires a considerable effort in tailoring the methodologies and tools to realistic cases with the consequential risk leaving few resources for scientific production and investigation.

**O2: Research: Contextual Knowledge Representation and Reasoning: Re**al world knowledge based systems need to represent context dependent knowledge. Starting from our long tradition in research on Contextual Logic, we are interested in researching, theories, reasoning algorithms, and prototypes for the collection, representation, and exploitation of contextual knowledge. The detailed plan is structured in the following tasks:

f.  Logic of contexts for the semantic web

g.  Query answering on contextual knowledge

h.  Contextual knowledge reasoning and other services

i.  Evaluation on a realistic case study to be defined

Big risk of having inapplicable theories To mitigate this risk, particular attention will be paid to evaluate the proposed solutions (taks d)

**O3: Research: Representation and Reasoning about process and ontologies:** Often knowledge intensive applications such as (Decision support systems, knowledge management systems, workflow monitoring systems, etc.) need to have a formal model that integrates "declarative knowledge" (often expressed in an ontology, with "procedural knowledge" (often expressed in a set of process models).

j.  Definition of a integrated semantic for BPMN processes and Ontologies

k.  Integration of procedural and factual knowledge with real process

a.  Evaluation of the theory on a real world case study (ProMo project)

This is a novel and highly risky research. For part a) there is no specific recovery strategy, for part b) if part a) fail we will apply state of the art approaches.

**O4: Research: Integration of logical and Statistical reasoning.** During the COPILOSK joint research project we run concrete experiments in the area of NLP showing that injecting logical background knowledge in machine learning algorithm, provide a concrete advantage of the performance. During the last three years we matured an important know-how in the combination of statistical and logical reasoning, and we intend to exploit such an investment for the next years. We plan four main activities:

l.  Improving NL processing and NL resources by using background logical knowledge

m.  Using background knowledge for event detection in texts

n.  Interpretation of mobile phone records with the help of Background Knowledge

o.  Study of a general model for the combination of logical and statistical knowledge.

The third action is highly risky, however it is not on a critical path.

The second group of objectives concerns the proposal/participation to proposals of research projects. We will focus on proposals which requires a sufficient amount of research to justify the contribution of DKM.

**O5: Fund Raising: EU proposal** in the area of integration of logical and statistical knowledge or in the area of knowledge engineering

**O6: Fund Raising: Participation/Coordination of Research/Industrial Proposals of TerntoRise**

**O7: Fund Raising: Participation to a Proposal for FESR**

The next groups of objectives, concerns the improvement of the connections between the DKM group and the international research community of the DKM research areas.

**O8: Networking: Proposal for hosting ISWC 2014:** We are currently evaluating the possibility of proposing Trento as conference site for the 13th edition of the International Semantic Web Conference.

**O9: Networking: Workshop organizations:** in the area of knowledge engineering and/or in the area of contextual reasoning

**O10: Networking: Active participation to the actitivies of EIT and TentoRise**

**O11: Networking: Extend the network of external collaborators**

The third group of objectives concern the capability of exploiting our know how and our research products to impact on the society. This class objectives might involve the participation to projects with local/national public and private organizations.

**O12: Innovation: MoKi** In this activity we will collaborate with SayService for the transformation of MoKi from Prototype to final product and it's integration in the process monitoring platform.

**O13: Innovation: Modeling Activities for Real Case:** Participation to some of the modeling projects to private of public organizations.

**O14: Semantic Decision Support Systems to support teaching offers creation**: collaboration with private company (Edizioni Erickson)

The final group of objective concerns with the project activities

**O15: Projects: Pescado**

**O16: Projects: ProMo**

**O17: Projects: OrganicLingua**

**O18: Projects: SuperProf x E-value**

**O19: Projects: ProDe**

## 4.   Funding

| Acronym | Full name | Type | Duration | Total income | Income 2012 |
|---|---|---|---|---|---|
| PESCADO | | EU | 1/1/10-31/12/12 | 274499.77 | 89815.80 |
| ORGANICLINGUA | | EU | 1/3/11-28/2/14 | 224979.89 | 102875.92 |
| PROMO | | FESR | 1/1/12-30/6/13 | 48.219,00 | 76.798,00 |
| SUPERPROF | | PRIVATE | 1/7/11-31/5/12 | 55000.00 | 55000.00 |

## 5.   Budget

| | 2011 | 2012 |
|---|---|---|
| Expenses | | |
| Personnel | € 522,44 | € 465,27 |
| Travel | € 38,50 | € 51,50 |
| Equipment (HW/SW) | € 5,00 | € 11,70 |
| Other (e.g. subcontracting to external contractors) | € 112,00 | € 158,90 |
| Total Expenditure | € 677,94 | € 687,37 |
| Incomes | | |
| EU Projects (total amount financed by EU) | € 92,63 | € 195,58 |
| Other external incomes (industrial, PAT projects, etc.) | € 112,21 | € 0,00 |
| Projects to be finalized | € 54,91 | € 103,22 |
| Total Income | € 259,74 | € 298,80 |
| Financial Need (Total Income – Total Expenditure) | € 418,19 | € 388,57 |
| Self funding | 38,3% | 43,5% |

Note: Column 2011 is based on the unit's budget state as estimated at the date of document writing. Column 2012 is the budget planned for 2012.

# HLT – HUMAN LANGUAGE TECHNOLOGY

Heads of Unit: Marcello Federico and Bernardo Magnini

## 1.    Summary and vision

Human Language Technology is a multi-disciplinary research unit that addresses the automatic processing of human language for a range of tasks. In particular, our research unit will focus on:

−    Automatic speech recognition (ASR), that is the conversion of a speech signal into a readable text
−    Machine translation (MT), translation of speech or text from one language into another
−    Content processing (CP), that includes the extraction, integration and retrieval of information from texts

HLT draws on several disciplines, such as Computational Linguistics or Natural Language Processing, Speech Processing, Information Retrieval, Machine Learning, Pattern Recognition, etc.

The HLT unit has been developing state-of-the-art technology in all the main research areas it operates in. The group has performed consistently well in several international evaluations, and is currently engaged in international projects for open source software development (e.g. the Moses platform for statistical machine translation). Research on speech recognition also meets the highest standards, and has reached the application market in several occasions. Moreover, people of the unit are key-players of many international initiatives around evaluation and benchmarking. The unit also provides technological support and high-level services in order to optimize the internal research activities, namely a shared and efficient computing environment, software tools, up to the creation and management of large scale linguistic resources.

Concerning promising future directions for our research areas, we expect important developments in the application of MT into the professional translation market, in the deployment of ASR on multimedia and multilingual content, and in the applications of semantic technologies in several scenarios. During 2012, the unit will be engaged in a research activities addressing the integration of statistical MT and computer assisted translation, the dominant technology in the professional translation market. Other activities will cope with the develop of advanced MT and ASR web services for large scale multimedia content transcription and translation. In parallel, research work on improving the robustness and portability of ASR across many languages will be pursued in a large integrated project. Finally, we plan several activities in the Content Extraction area, including the developing of an open source platform for textual inferences, which will be initiated in the new EU project Excitement, advanced technologies for linking textual information to open linked data on the web, and state of art research in event extraction.

Finally, besides the involvement in research projects, the unit will also participate in an international open source infrastructure around the Moses MT platform, in a large network shaping future research in multi-lingual language processing in Europe, and finally in several industrial projects fostering the technology transfer to local SMEs.

*Unit composition*

|  | *2011 (as of Jan 1ˢᵗ)* | *2012 (planned)* |
|---|---|---|
| Research directors | 2 | 2 |
| Senior researchers | 8 | 8 |
| Researchers (including postdocs, etc.) | 5 | 10 |
| Technologists | 4 | 6 |
| PhD students | 9 | 11 |
| Total | 28 | 37 |
| Tenured | 19 | 19 |
| Tenure track | 0 | 1 |

Note: "Research directors" are level 1 researchers; "Senior researchers" are level 2 researchers. Category "Researchers" covers all other cases, including level 3 and 4 researchers, postdocs and other contractual forms used to enroll researchers.

*Top 5 researchers by H-index*

| *Researcher* | *H-index* |
|---|---|
| Magnini | 32 |
| Strapparava | 24 |
| Federico | 22 |
| Giuliani | 17 |
| Cettolo | 17 |

## 2.  Recent publications

| year | Jour. Pap. | pers(IF) | Top Jour. | Q1 (%) | Q2 (%) | Q3 (%) | Q4 (%) | Conf. Papers | ERA A | ERA B | ERA C | Books (aut) | Books (ed) | Chap in Book | Lit Rev. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2011 | 1 | 1 | 0 | 100 | 0 | 0 | 0 | 31 | 6 | 3 | 0 | 0 | 0 | 0 | 1 |
| 2010 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 50 | 6 | 3 | 0 | 0 | 2 | 2 | 0 |
| 2009 | 5 | 3 | 0 | 33 | 17 | 17 | 33 | 46 | 7 | 5 | 7 | 1 | 0 | 0 | 0 |
| 2008 | 9 | 5 | 1 | 60 | 20 | 20 | 0 | 37 | 6 | 5 | 3 | 0 | 2 | 0 | 0 |

In the last few years we have seen an increase of PhD students which also reflected in more publication at top conferences. Indeed, the provided selection is mostly made of papers authored by PhD students. Given the increase of funded research projects, one of our goals for 2012 is to increase the quality of publications by senior researchers.

Top 5 publications in the last 3 years (2009-2011):

- Yashar Mehdad, Matteo Negri, and Marcello Federico, "Using Bilingual Parallel Corpora for Cross-Lingual Textual Entailment", ACL/HLT 2011.
- Matteo Negri, Luisa Bentivogli, Yashar Mehdad, Danilo Giampiccolo and Alessandro Marchetti, "Divide and Conquer: Crowdsourcing the Creation of Cross-Lingual Textual Entailment Corpora", EMNLP 2011.
- Nicola Bertoldi, Mauro Cettolo, Marcello Federico,Statistical Machine Translation of Texts with Misspelled Words, Proc. of NAACL-HLT 2010, Los Angeles, CA, USA.
- 4.E. Cabrio, B. Magnini, Toward Qualitative Evaluation of Textual Entailment Systems,Proc. of COLING 2010,Beijing, China.
- Volha Bryl, Claudio Giuliano, Luciano Serafini, Kateryna Tymoshenko, Supporting natural language processing with background knowledge: coreference resolution case, 2010, (9th International Semantic Web Conference (ISWC2010)

### 3. Objectives for 2012

**O1: Research on adaptive MT.** This objective aims to improve robustness and performance of statistical MT under two main operating conditions: the computer assisted translation framework and MT of multimedia content. Our motivations are, respectively, to improve productivity of human translators, by combining the use of translation memories and MT, to reduce maintenance cost of MT technology, and to better cope with many of today's digital media's relentlessly changing streams of information, across different topics, styles, and genres. Research will address modeling aspects of language, such domain, style, and topic, statistical adaptation techniques, on-line learning methods, as well exploitation of context information and user feedback. Activities will be conducted under new European projects (MateCat, EU-BRIDGE) and undergoing phd theses. The expected outcomes include the creation of benchmarks replicating different operating conditions, new evaluation protocols suited to measure impact of adaptation, and of course new methods that will enrich functionality of our current statistical MT technology. Potential risks are the lack of impact on some of the pursued investigations, either in terms of performance or computational inefficiency of the method.

**O2: Research on cross-lingual semantic matching.** The goal is to bridge semantics and machine translation into a common framework targeting cross-lingual inference. Focusing on different applications (e.g. content-synchronization, MT evaluation), the research activity will explore semantic-aware matching techniques going beyond current word alignment methods. To this aim, we will focus on algorithms combining lexical, syntactic, and semantic features to: i) automatically identi-

fy and distinguish between "semantic equivalence" and "implication" relations between portions of texts in different languages, and ii) estimate confidence probabilities for the discovered relations. Along this direction, the main conditions of success are: i) the availability of annotated data for training and evaluation, ii) the availability of linguistic processors (e.g. named entity taggers, parsers) for the language of interests, and iii) their adaptation to adhere with common I/O formats. The expected outcomes include the creation of reusable data collections, and the development of effective solutions for the challenges posed by ongoing (CoSyne, T4ME) and future projects.

**O3: Development of open source for MT.** This objective aims at increasing the community of users (and developers) of the MT-related open-source software (Moses, IRSTLM), whose implementation we are involved in currently or in the upcoming projects, and enhancing them in term of effectiveness, efficiency, usability, etc., thanks to the feedback of the public and the aid and hints of skilled developers. Most effort will be devoted to support the objective O1 ("Research on Adaptive MT"); selected solutions for online learning, incremental training, adaptive MT, etc. will be implemented and possibly embedded into Moses and IRSTLM. Moreover, standards and APIs to interface SMT engine, translation memory, and CAT editor will be defined and implemented. Finally, we will continue developing IRSTLM, which is transversal to many software for most NLP tasks (ASR, MT, TE, etc.), focusing on increasing parallelization and enabling thread-safety. We also plan to ease the interaction between developers and users of IRSTLM, improving the website and setting a light bug tracker system. Activities will be mainly conducted under new European projects (MateCat, MosesCore). Outcomes of this objective are basically open-source software modules, standalone or embedded in existing toolkits, which increase training efficiency, translation performance and improve professional productivity in the MT area. As this objective is substantially dependent on O1 outcome, the risk consists in a delayed implementation of such software modules.

**O4: Research on multi-lingual ASR.** This objective aims to enlarge the number of spoken languages we can process with our ASR; our main motivation is to improve our knowledge of linguistic phenomena that occur in different languages, and as a byproduct we can increase our ability to attract projects and investors. To do this in an efficient way we plan to collect and organize for each language the data needed (speech, text, phonetic lexica), to refine and update a common framework, which is under development since a couple of years. In particular we plan to perform research in the following areas: handling of morphological and agglutinative phenomena, automatic bootstrap and refinement of phonetic lexica, use of raw data (e.g. untranscribed speech, web data). Activities will be carried out under new European projects (TOSCA-MT, EU-BRIDGE). The main risk is to address this issue as a list of language specific activities, without being able to reuse the same modules for various languages, partially missing the goal of building a general framework.

**O5: Core technology enhancements for ASR.** This goal aims to improve robustness and performance of the FBK technology for automatic transcription under two

operative conditions: offline transcription and real time content processing. Research and development activities will focus on audio partitioning, language identification, harvesting and selection of acoustic training data, acoustic and language model adaptation. Activities will be conducted under new European projects (EU-BRIDGE, TOSCA-MP) and a PhD thesis. The expected outcomes include better transcription performance, robustness under a variety of conditions, new functionality and creation of reusable corpora of data. Potential risks are related to the lack performance, computational inefficiency, and reduced degree of novelties of the investigated methods.

**O6: Technology transfer.** The objective of technology transfer is to make available for industrial exploitation the technology developed in FBK laboratories, so as to give it the added value of having a positive impact on local economy. The real-world application of FBK software is an excellent testbed for verifying robustness and efficiency of techniques and algorithms, besides being a stimulating source of practical challenges to cope with. Technology transfer for ASR technology is mainly pursued through a collaboration with the PerVoice spin-off company, actually licensee of the transcription system. In the next year, FBK will be involved in the new publicly funded project WikiVoice with PerVoice, whose aim is to provide easy access to a transcription facility, with a special attention to customizability. PerVoice has the capability of carrying out most of the activities needed for completion of the project, and relies on FBK for support on specific topics, such as control of the quality of a recorded signal, integration of convenient modalities for model adaptation, and migration of significant portions of the decoding algorithms to a multi-core architecture on specialized devices. Beside this project, in 2012 there will be the Stealth project lead by GST, aimed at supporting the adoption of the FBK technology in the dictation systems distributed by the company. Also in this case, the involvement of FBK consists mainly in consulting over specific topics, that are somewhat related to areas also present in WikiVoice, namely: control of audio recording for speaker enrollment, integration of software modules into the overall architecture of the GST system, and user profiling. The main benefit expected from these activities is a improved exploitation of the FBK technology. GST, for example, is a leading distributor of dictation technology in the medical field, and counts thousands of installations. If the FBK recognition engine could be distributed by this company, the visibility of FBK could greatly increase. However, the intention behind this project has already been stated by GST a couple of times in the past, without ever being brought to conclusion. So it may happen that also this time the actual commercial exploitation will not succeed.

**O7: Research on textual inferences**. The general goal of this objective is to advance research on textual inferences, particularly textual entailment. As for 2012, we have the following goals: (i) develop an open source platform textual inferences as part of the work-plan of the new EXCITEMENT project, and taking advantage of the previous experience of the EDITS platform; (ii) set the basis of a research on inferences by presupposition, anchored on verbal behavior as defined in the Corpus Pattern Analysis approach, which has been adopted in the BCROCE project; (iii) consolidate the work on text simplification, carried on in the context of the Ter-

ence project, setting up a software component able to judge the degree of readability of Italian texts.

**O8: Research on event extraction and reasoning**. This activity aims at producing state of art resources and software components for the automatic recognition and reasoning on events expressed in text. The following goals will be target during 2012: (i) the recognition and normalization of temporal expressions and the annotation of events and event relations, according to the TimeML annotation format; (ii) the automatic porting to Italian of the event patterns developed for English under the Corpus Pattern Analysis, as adopted in the context of the BCROCE project; (iii) the development of tools for the recognition of event frames described in the FrameNet resource, particularly taking advantage of background knowledge (e.g. Wikipedia).

**O9: Research on entity and relation extraction**. In this area we carry on activities related to a number of topics in the field of Information Extraction on which the research unit has already developed an expertise in the past: (i) Entity Extraction both on written texts and on transcriptions of speech; (ii) Relation Extraction both on newspaper articles and on biomedical texts exploiting techniques based on supervised ML; (iii) we will explore the use of weakly supervised ML techniques for addressing a larger number of relations with respect to the one addressable by supervised techniques (the so called Open IE); (iv) Linking entities and terms in text to the LOD, using DBpedia as semantic mediator. This activity fuses IE and WSD techniques. Moreover, we will take further advantage of the KnowledgeStore technology developed in the context of the LiveMemories project funded by PAT; (v) exploiting key-concept and relation extraction techniques for ontology extension and evaluation (joint work with DKM).

**O10: Research on language resources.** This objective addresses research on development, maintenance, use and distribution of language resources. We plan the following main goals for 2012: (i) collaboration to the development of META-SHARE, an open source platform for sharing language resources, carried on in the context of the T4ME Network of Excellence; (ii) definition of annotation schemes of datasets for textual entailment recognition, both monolingual (Excitement project) and multilingual (Cosyne and Semeval 2012). These activities are carried on in collaboration with Celct. (iii) systematic use of crowd-sourcing services (CrowdFlower) for internal data annotation and evaluation of language technologies. This goal includes the creation of datasets for the development and evaluation of both automatic transcription systems and machine translation systems (Tosca project). (iv) Networking and dissemination activities will mainly focus on maintaining relationships with other institutions (e.g. "white papers" for the T4ME project), distributing resources, disseminating results, organising events and evaluation campaigns. (v) developing cognitively-motivated linguistic resources to be used in scenarios involving various kind of disabilities, in collaboration with Cimec.

**O11: Research on emotional language.** This activity focuses on the automatic recognition of emotional features of language and on their exploitation for concrete applicative scenarios. This research is conducted in the context of the Google Award assigned to the HLT group during 2011.

## 4. Funding

In 2012, the unit will be significantly involved in European and industrial projects, especially in the MT and ASR areas. In particular, six new European projects have been acquired, one of which as coordinator and one as scientific coordinator.

| Acronym | Type | Duration | Total income | Income 2012 |
|---|---|---|---|---|
| EuromatrixPlus | EU-Strep | 1-Mar-2009 | € 429,703.00 | € 15,000.00 |
| Pescado | EU-Strep | 1-Jan-2010 | € 158,000.00 | € 79,000.00 |
| T4ME | EU-NoE | 1-Feb-2010 | € 381,000.00 | € 115,000.00 |
| Cosyne | EU-Strep | 1-Mar-2010 | € 354,192.00 | € 112,000.00 |
| Terence | EU-Strep | 1-Oct-2010 | € 66,200.00 | € 24,101.00 |
| Tosca MP | EU-Strep | 1-Oct-2011 | € 393,823.00 | € 185,000.00 |
| MateCat | EU-Strep | 1-Nov-2011 | € 952,000.00 | € 273,000.00 |
| Excitement | EU-Strep | 1-Jan-2012 | € 674,970.00 | € 230,000.00 |
| Dirha | EU-Strep | 1-Jan-2012 | € 72,000.00 | € 22,000.00 |
| MosesCore | EU-CSA | 1-Mar-2012 | € 97,000.00 | € 20,000.00 |
| EuBridge | EU-IP | 1-Feb-2012 | € 985,000.00 | € 240,000.00 |
| BCroce | PAT-PostDoc | 23-May 2011 | € 195,000.00 | € 64,000.00 |
| Celct | AdP | | € 198,000.00 | € 66,000.00 |
| Google | Google | 1-Aug-2011 | € 36,500.00 | € 30,000.00 |
| SCMS | Fesr | 1-Dec-2011 | € 40,000.00 | € 25,000.00 |
| Stealth | Legge 6 | 1-Dec-2011 | € 70,000.00 | € 36,500.00 |
| WikiVoice | Legge 6 | 1-Dec-2011 | € 95,000.00 | € 58,000.00 |
| Fesr Shine | Fesr | 1-Jan-2012 | € 46,000.00 | € 23,000.00 |

## 5. Budget

| | 2011 | 2012 |
|---|---|---|
| Expenses | | |
| Personnel | € 1.362,51 | € 1.618,26 |
| Travel | € 107,50 | € 133,89 |
| Equipment (HW/SW) | € 27,00 | € 12,00 |
| Other (e.g. subcontracting to external contractors) | € 332,17 | € 278,12 |
| Total Expenditure | € 1.829,18 | € 2.042,27 |
| Incomes | | |
| EU Projects (total amount financed by EU) | € 468,88 | € 800,95 |

| | | |
|---|---|---|
| Other external incomes (industrial, PAT projects, etc.) | € 571,92 | € 176,35 |
| Projects to be finalized | € 0,00 | € 633,08 |
| Total Income | € 1.040,80 | € 1.610,38 |
| Financial Need (Total Income – Total Expenditure) | € 788,38 | € 431,89 |
| Self funding | 56,9% | 78,9% |

Note: Column 2011 is based on the unit's budget state as estimated at the date of document writing. Column 2012 is the budget planned for 2012.

# MPBA – PREDICTIVE MODELS FOR BIOMEDICINE AND ENVIRONMENT

Head of Unit: Cesare Furlanello

## 1.    Summary and vision

The scientific challenge of the MPBA unit is to create models and computational tools that can connect the newest high-throughput data in human and environmental health together. An unprecedented volume of data is being generated in life sciences at the interface between different disciplines and at different scales. The strongest impact is certainly due to the whole-genome biotechnologies such as Next Generation Sequencing (NGS), giving high resolution data that are changing the foundations of molecular biology and biomedicine. Innovative sources of digital information about spatial and temporal patterns of environmental and exposure features are increasingly being collected, again at incredibly high resolution. This advance gives the potential to reveal how the environment reshapes individual health trajectories since the very first phases of life. Environment can act as a switch on biological functions by both inducing transient or permanent epigenetic effects on DNA as well as on the "microbiome" system of genes from trillions bacteria that live in symbiosis with the human body. All these new data are strongly changing our knowledge on complex diseases (e.g. cancer and neural pathologies) and of infectious diseases. However, there is a critical need for computational platforms and predictive methods that can identify complex patterns on millions of variables or samples while operating on multiple scales, from the new omics cell biology to environmental systems. Also, there is an urgent need for interdisciplinary contribution from mathematics and computational sciences.

In 2012, the MPBA unit will consolidate its capability of proposing computational platforms for the bioinformatics and geoinformatics analysis of Terabyte-size datasets, enabling machine learning and scientific computing as core components in interdisciplinary studies. To develop mathematical and computational models of the global spread of epidemics, e.g. influenza, knowledge about human mobility at the global and local scale and social interaction models will be integrated. Simulations based on virtual societies will be enabled to improve reliability of model predictions and evaluation of intervention measures at the global scale. To complete the framework, the unit will consolidate its know-how in geospatial technologies to link space-time environmental and socio-economic patterns to health data (GeoICT). As characteristic strategy of this Unit, the new technical knowledge will be acquired by developing high-throughput platforms in interdisciplinary research collaboration and it will be translated into innovation and applicative projects, to enhance self-funding and ethical impact.

In bioinformatics, the unit has a solid position given by the partnership in two of the most relevant Next Generation Sequencing initiatives worldwide, i.e. the Fantom5 project with OMICS RIKEN Yokohama and the SEQC initiative with the USA Food and Drug Administration. In machine learning, MPBA develops and distributes the

MLPY package, currently the 4/334 most downloaded solution from the Machine Learning Open Source Software (MLOSS) international repository. In 2012 a new network approach will be introduced that will expand visibility in machine learning also in international collaboration. In epidemic modeling, the Unit developed the largest scale individual based model of influenza transmission, covering the whole Europe. In collaboration with leading worldwide groups (Imperial College MRC Centre, Indiana Univ. Center for Complex Networks and Systems Research), MPBA has studied the effects of human mobility and demographic structure on the spread of 2009 H1N1 influenza pandemic, to be further developed within a ERC project with Bocconi university in 2012. In Geoinformatics, MPBA has developed one of the largest installed WebGIS Geoserver infrastructures worldwide, with applications to landscape epidemiology (cancer mapping and exposure due to industrial sites) and environmental health research on the impacts of climate change on Alpine agriculture. In 2012, MPBA will complete the handling to PAT of the IET platform, which will provide an innovative on-line maps and statistical analysis of integrated socio-economic and environmental data to several hundreds of technical users, decision makers and citizens in Trentino.

The innovation derived by the platforms will be transferred within application oriented initiatives in collaboration with the regional health system, University of Trento and Fondazione Mach. Finally, MPBA will confirm in 2012 the commitment in dissemination of science to young people by organizing the 12th FBK WebValley summer school - International edition.

*Unit composition*

|                                          | *2011 (as of Jan 1ˢᵗ)* | *2012 (planned)* |
|------------------------------------------|------------------------|------------------|
| Research directors                       | 1                      | 1                |
| Senior researchers                       | 2                      | 2                |
| Researchers (including postdocs, etc.)   | 12                     | 12               |
| Technologists                            | 6.5                    | 7                |
| PhD students                             | 6                      | 5                |
| Total                                    | 27.5                   | 27               |
| Tenured                                  | 3                      | 4                |
| Tenure track                             | 2                      | 1                |

Note: In 2012, two postdoc positions included in this table will be funded by external agencies (ERC through Univ Bocconi Milano, ECDC through Univ. of Pisa). Technologists are in FTE, resulting from 10 scientific programmers and data specialists. An international visit funded by the ASI/CONAE initiative will be also implemented in 2012.

*Top researchers by citations (max. 5)*

| *Researcher* | *H-index* | *Citations (total)* |
|--------------|-----------|---------------------|
| Furlanello   | 17        | 1006                |

| Merler | 15 | 843 |
|---|---|---|
| Jurman | 11 | 516 |
| Ajelli | 8 | 165 |
| Chierici | 4 | 58 |

## 2.   Recent publications

| Year | Jour. Papers | Jour. Papers (IF) | Top Journal (*) | Q1 (%) | Q2 (%) | Q3 (%) | Q4 (%) | Conf. Papers |
|---|---|---|---|---|---|---|---|---|
| 2011 | 13 | 13 | 1 | 54 | 33 | 13 | 0 | 2 |
| 2010 | 13 | 12 | 2 | 78 | 14 | 8 | 0 | 1 |
| 2009 | 6 | 6 | 1 | 50 | 50 | 0 | 0 | 1 |
| 2008 | 7 | 5 | 1 | 62 | 38 | 0 | 0 | 0 |

COMMENT: Scientific production has additionally led to 8 technical publications on the arXiv Open Source archive and 5 book chapters. For 2012, given the interdisciplinary mission, the Unit will confirm a focus at publishing preferentially on ISI-indexed journals in Q1, aiming with medium-high ISI impact factor. Further care will be aimed at publishing within international networks of collaborations. The prize for best Science PhD thesis at has been awarded to P. Poletti by Trento University in Nov. 2011.

Top 5 publications in the last 3 years (2009-2011):

− J.P.A. Ioannidis, D.B. Allison, C.A. Ball, I. Coulibaly, X. Cui, A.C. Culhane, M. Falchi, C. Furlanello, L. Game, G. Jurman, T. Mehta, J. Mangion, M. Nitzberg, G.P. Page, E. Petretto, V. van Noort. Repeatability of published microarray gene expression analyses. Nature Genetics, 41(2):499-505, 2009. [IF: 34.284][UGOV:5310]

− Li et al. The MAQC-II Project: A comprehensive study of common practices for the development and validation of microarray-based predictive models. Nature Biotechnology, 28(8):827-838, 2010. [IF 31.085][UGOV:10568]

− S. Merler and M. Ajelli. The role of population heterogeneity and human mobility in the spread of pandemic influenza. Proceedings of the Royal Society B, 277: 557-565, 2010. [IF: 5.064][UGOV:5296]

− K. Miclaus, M. Chierici, C. Lambert, L. Zhang, S. Vega, H. Hong, S. Yin, C. Furlanello, R. Wolfinger, F. Goodsaid. Variability in GWAS Analysis: the Impact of Genotype Calling Algorithm Inconsistencies. The Pharmacogenomics Journal, 10, 324-335, 2010. [IF: 4.306][UGOV:10648]

− S. Merler, M. Ajelli, A. Pugliese, N.M. Ferguson. Determinants of the spatiotemporal dynamics of the 2009 H1N1 pandemic in Europe: implications for real-time modelling. PLoS Computational Biology 7(9), 2011. [IF: 5.515] [UGOV:40780]

### 3.   Objectives for 2012

With this plan, MPBA aims at a further step towards the integration of Statistical Machine Learning, Bioinformatics and Epidemiological Models, developing state-of-art platforms and upscaling systems in the high performance and cloud computing framework. Activities for the 2012 will be structured in 3 main pillar objectives (FGM, EpiMod, GeoICT), the last including innovation and dissemination actions.

### O1.  Bioinformatics for Functional Genomic Modeling (FGM)

- Biological Networks: Development of a new pipeline implementing the "network medicine approach" by combining graph structural analysis and predictors for a new type of profiling in terms of molecular and signalling pathways. The pipeline will include methods for network stability analysis.

- NGS-pipelines: further development of a complete system of NGS pipelines for RNA-seq, Variant identification, Metagenomics with implementation on the FBK-KORE cluster. Development of the bioinformatics services for the LSSAH laboratory and for the collaboration with FEM. Studies on large scale test public data, replication of genome resequencing on public and original data (oncogenomics and neurogenomics). Analysis of sources of variability on up to 5 large scale studies within the FDA-SEQC initiative: platform and tissue dependent biases, with focus on transcriptome, study designs and standards, toxicology aspects.

- FANTOM5: Development of machine learning methods coupled to NGS algorithms for the analysis of ultra-high throughput CAGE data, with focus on new algorithms for promoter identification and profiling methods for complex tissue time-dependent expression.

- FP7 HIPERDART: biomarker identification of NGS and colorectal microarrays from ICO Barcelona, review of profiling on public datasets, analysis of signals from SunS process.

- MLPY: new release of the machine learning core algorithms and preprocessing methods, graphical user interfaces.

### O2.  Epidemic Modeling (EpiMod):

- The mechanisms regulating the global spread of infectious diseases, e.g. influenza, are still poorly known. Understanding the complex interplay between climatic factors, human mobility and social interaction at the global scale would contribute to greatly improve basic knowledge, model predictive power and planning of response measures. We plan to investigate to what extent complex human social interactions affect the global transmission of infectious diseases and the effectiveness of mitigation/containment measures. We expect to partly explain the observed heterogeneity in transmission of infectious diseases (e.g. influenza and childhood diseases) and to develop more reliable models to give insight into optimal control (e.g. reactive school closure, post-exposure prophylaxis).

### O3.  Geoinformatics (GeoICT):

- ENVIROCHANGE: Completion and test of the ENVIRO platform, with geographical web services and support to scientific reproducibility for the study of vulnerability to climate change of the agricultural environment in Trentino.

- IET 2012: Activity with PAT and Informatica Trentina for complete migration in production mode into a virtualized cloud computing environment of the IET interactive interfaces for on-line data analysis, interconnection of geographical and statistical data by web services.

- SOLARWEB: development of an industrial prototype for a WebGIS managed estimation of solar budget (PV estimates) on high resolution DTM, in combination with airborne stereo photogrammetry for 3D building structure extraction.

- RiskMapping: WebGIS infrastructures and statistical services for predictive risk modeling of traffic accidents (MITRIS), cancer epidemiology (CancerAtlas), victimization analysis (eSecurity), ski accidents (SicurSki).

- TranSafeAlp: WebGIS tools for the improvement of the transregional management efficiency of Alpine transport security.

- Dissemination & Innovation: implementation of the mobile scientific computing project for high school students; Organization of the WebValley 2012 International Summer Camp.

### 4.  Front Edge & New Initiatives

The participation in the FDA led project SEQC and to the consortium funded and organized by the OMICS RIKEN Centre (Yokohama, Japan) will allow to be part of top initiatives in the field of computational biology, with the opportunity of discoveries in the fields of toxicology and of basic biology. The SEQC project can also be considered a "Grand Challenge", as the datasets will be analyzed in parallel to other collaborating Data Analysis Teams. Collaborative initiatives will be implemented with University of Trento, Fondazione Mach and EURAC Bolzano to develop a local network for the development of computational biotechnologies. A new initiative for modeling the spreading patterns of mobile phone viruses will aim to improve preparedness as a response to malicious malware attacks. The effects of human mobility on the spread of infections on Bluetooth devices has been already studied but here we aim at studying the effects of local outbreaks, which may be amplified by spatial population density patterns and concentration of individuals in schools and workplaces, on the speed of epidemic spread. An explorative initiative will be launched for a spinoff company on the GeoICT area developing the results of the ENVIROCHANGE project in the context of exposure mapping.

## 5.   Funding

| Acronym | Full name | Type | Duration | Total income | Income 2012 |
|---|---|---|---|---|---|
| HIPERDART | Development of High Performance Diagnostic Array Replication Technology | EU | 2009-12 | 279084 | 188020 |
| TranSafeAlp | Connecting Transport regional networks to Security and emergency Advanced Strategy Frameworks of European and Alpine regions decisional platforms. | EU | 2011-12 | 205200 | 169826 |
| ENVIROCHANGE | Global change and sustainable management of agriculture in highly developed mountain environment | PAT | 2008-12 | 567035 | 56005 |
| EPIWORK | Developing the Framework for an Epidemic Forecast Infrastructure | EU | 2009-13 | 242700 | 65862 |
| CancerAtlas | ICT Methods predictive of cancer risk from environmental factors | PAT | 2011-12 | 75000 | 22970 |
| SOLARWeb | Web, Geoinformatics and 3D analysis for the estimation of Photovoltaic production | Industrial | 2012-13 | 36000 | 22000 |
| IET2012 | Economic-territorial Interface | Industrial | 2012 | 70000 | 18000 |
| INAIL | Development of a WebGIS system supporting Environmental planning of industrial sites | Other | 2011-12 | 33000 | 18540 |
| VZV3 | Vaccine Preventable Disease Modelling in the European Union and EEA/EFTA Countries: Forecasting the Effects of Introducing a New Vaccine in a National/Regional Program | EU | 2011-12 | 26449 | 12312 |
| CCM | Development and management of a situation room and a rapid response evaluation network Support to the national Center for Disease Control | Other | 2010-12 | 140000 | 5000 |

A grant by Fondazione Tumori for 2012-13 has been approved on Nov 4 (15000 Euro). An internal grant of 30 000Eur will be assigned as for a collaboration with Univ. of Trento and Polizia di Stato for a pilot project on security. A pilot initiative for SkiSafety models will be externally co-funded by 10000 Euro (Industrial Project). Further support for travels and personnel will be provided by an ERC-Junior investigator grant.

## 6.  Budget

|  | 2011 | 2012 |
|---|---|---|
| Expenses |  |  |
| Personnel | € 827,48 | € 712,63 |
| Travel | € 38,25 | € 40,00 |
| Equipment (HW/SW) | € 9,00 | € 21,50 |
| Other (e.g. subcontracting to external contractors) | € 111,86 | € 143,90 |
| Total Expenditure | € 986,59 | € 918,03 |
| Incomes |  |  |
| EU Projects (total amount financed by EU) | € 202,80 | € 310,16 |
| Other external incomes (industrial, PAT projects, etc.) | € 482,05 | € 234,42 |
| Projects to be finalized | € 45,55 | € 52,31 |
| Total Income | € 730,40 | € 596,89 |
| Financial Need (Total Income – Total Expenditure) | € 256,20 | € 321,14 |
| Self funding | 74,0% | 65,0% |

Note: Column 2011 is based on the unit's budget state as estimated at the date of document writing. Column 2012 is the budget planned for 2012.

## 7.  Remarks

All current MPBA members are affiliated to FBK as employees, but only 3 have tenure. Within 2013, two postdocs are expected to complete their tenure track but still the ratio of non/tenured researchers will remain low and post-doc funding will increasingly depend on external fellowships. The Unit includes 8 junior scientific programmers of expertise ranging between 6 months and 4 years, all students at the IT or TLC degrees. Most of them were brilliant students at WebValley: they are now developing an increasingly key role in the Unit, with the potential of playing a pivotal role in new spinoff initiatives. A strategic consolidation of the high performance computing and storage resources is needed for all the three pillar objectives, in particular to support the international initiatives in bioinformatics.

# TeV – Technologies of Vision

Head of Unit: Oswald Lanz

## 1.  Summary and vision

TeV is conducting research in the field of computer vision and image analysis, currently with focus on 3D content creation from a mobile device using on-board camera, and video analytics for non-invasive monitoring, activity analysis and anomaly detection. We invest on novel methods that support the integration of context (domain knowledge, user models, geo-location and environment data, textual information from social networks) and complementary sensing (GPS, inertial sensor, acoustic and 3D sensing), allow for adaptation in a dynamic environment (to changing illumination conditions, available computing and sensing resources, application and user demand), and have potentials to scale to real world tasks. These objectives are in line with current trends in the community, and are recognized to be key aspects in the realization of next generation vision technologies with strong innovation potential.

TeV has acquired relevant competences over the last years to carry out such research. Important scientific results have been obtained in the area of object tracking in the past, and scientific objectives have then focused on overcoming limitations that have emerged during tests carried out in applicative projects and pilot sites. Moreover, underlying technology (SmarTrack – people tracking) is patented, and a live demonstrator is constantly available and continuously updated through the integration of novel results. Our second technology in this field (SCOCA – monitoring road intersections) has reached a good maturity as demonstrated in several field tests. During the last year a statistical approach to activity discovery and anomaly detection - known to be more effective in crowded scenes (e.g. far-field traffic monitoring) – was also investigated. This has led to another important scientific contribution at the state-of-the-art, with a paper accepted for oral presentation (3.5% acceptance rate) at the major conference (CVPR) of the field. Activities in the area of mobile vision for augmented reality began just recently, but have reached an exceptional result in terms of fund raising and established partnership with major industrial players: the new VENTURI FP7 project is coordinated by a member of the unit, and, for what regards TeV efforts, has the ambitious goal of enabling immersive information presentation in next generation mobile platforms through embedded real time video processing. Furthermore, to create impact on the territory, several collaborations with local companies have been established: GeoMedia project (Interplay Software – landmark tracking in video taken by a handheld camera), Risolvi project (DeltamaxAutomazione – industrial quality inspection), BvTech project (video analytics), Café project (Interplay Software and Cartagena – UAV environment monitoring), PAT-Servizio Infrastrutture Stradali e Ferroviarie (analytics based on commercial car plate recognition system).

We see VENTURI as a great opportunity to increase the units competences in embedded mobile vision. Through the collaboration with main industrial players (Sony Ericson, ST-Microelectronics) we have access to next generation platforms while they are being developed, and it should be in their interest to give valuable feedback to tailor research activities on aspects with innovation potential.

*Unit composition*

|  | *2011 (as of Jan 1$^{st}$)* | *2012 (planned)* |
|---|---|---|
| Research directors | - | - |
| Senior researchers | 1 | 1 |
| Researchers (including postdocs, etc.) | 6 | 6 |
| Technologists | 3 | 3 |
| PhD students | 3 | 3 |
| Total | 13 | 13 |
| Tenured | 6 | 6 |
| Tenure track | - | 1 |

Note: "Research directors" are level 1 researchers; "Senior researchers" are level 2 researchers. Category "Researchers" covers all other cases, including level 3 and 4 researchers, postdocs and other contractual forms used to enroll researchers.

*Top researchers by citations (max. 5)*

| *Researcher* | *H-index* | *Citations (total)* |
|---|---|---|
| Stefano Messelodi | 10 | 410 |
| Carla Maria Modena | 8 | 495 |
| Oswald Lanz | 8 | 242 |

## 2. Recent publications

| *Year 2011* | *Journal papers* | *with IF* | *Quartile* | *Conference papers* | *ERA A* | *ERA B* | *Chapters in Book* |
|---|---|---|---|---|---|---|---|
| Published | 2 | 1 | Q3 | 10 | 1 | 3 | 1 |
| In press | 2 | 2 | Q2/Q3 | | | | |

Top 5 publications in the last 3 years (2009-2011):

− S. Messelodi, C.M. Modena, *Scene Text Recognition and Tracking to Identify Athletes in Sport Videos*. Multimedia Tools and Applications, Special Issue on Automated Information Extraction in Media Production, Online First [UGOV: 46398]

− M. Lecca, S. Messelodi, *Linking the von Kries Model to Wien's Law for the esti-mation of an Illuminant Invariant Image,* Pattern Recognition Letters, Online First [UGOV: 46580]

− G. Zen, E. Ricci, *Earth Mover's Prototypes: a Convex Learning Approach for Discovering Activity Patterns in Dynamic Scenes*, Computer Vision and Pattern Recognition - CVPR 2011, Colorado Springs, CO, USA, June 21-23, 2011, pp. 3225-3232 [UGOV: 34785]

− Brutti, O. Lanz, *A joint particle filter to track the position and head orientation of people using audio visual cue*, European Signal Processing Conference - EUSIPCO 2010, Aalborg, Denmark, August 23-27, 2010 [UGOV: 11168]

− S. Messelodi, C.M. Modena, M. Zanin, F.G.B. De Natale, F. Granelli, E. Betterle, A. Guarise, *Intelligent Extended Floating Car Data Collection*, Expert Systems with Applications, Vol. 36, Iss. 3, Part 1, pp. 4213-4227, April 2009 [UGOV: 4254]

## 3. Objectives for 2012

**O1: 3D content creation from a mobile platform**. In line with the VENTURI FP7 project objectives, we endeavor to (i) create multi-resolution 3D content from a mobile device using on-board camera in conjunction with sensors such as GPS, compass, accelerometers and gyroscopes, (ii) begin experiments to adaptively and intelligently inject 3D models into the environment for the purposes of visual aug-mentation, bearing in mind occlusions, lighting and context, and (iii) create a tool to detect and measure flat surfaces in the environment that could potentially be used as ad-hoc interactive surfaces. To reach such goal, in 2012 we plan to (i) apply knowledge gained from other projects and SOTA literature to create versions of al-gorithms suitable for the mobile platform based on form-factor limitation (e.g. SLAM for mobile), (ii) utilization of on-board sensors to reinforce visual tracking using a dead-reckoning approach when visual blurring occurs, (iii) help to create fully syn-chronized data-sets to generate material for testing and development, and (vi) ex-plore the possibility of utilizing a 'Kinect' type of 3D sensor attached to the VEN-TURI development boards to see whether this approach could be feasible. As the mobile development platform is not yet available, it is very difficult to understand whether it will be possible to fulfill the real-time requirements imposed by the goals. Also, the group to-date has little experience in producing code for the Android plat-form, it may take longer than expected to learn how to use the development board that we will receive, thus causing a delay. The APIs required to create a seamless integrated prototype have not yet been clearly defined which could reveal problems or delays when this stage is approached. Expected outcomes of these activities are an integrated cross-project prototype demonstrator, and various algorithms for the mobile platform that could be re-used by other projects. The data-set acquired for development and testing, or a subset of it, will be shared to the community.

**O2: Adaptive and scalable tracking**. As a result of several installations in real environments a number of issues have been identified that need to be addressed to upgrade the SmarTrack lab demonstrator to a deployable technology. In re-

sponse of that, the unit will investigate on theoretically grounded solutions addressing (i) robustness to uneven and time-varying illumination, (ii) scalability to large environments, (iii) target acquisition in non-collaborative context, (iv) automatic calibration and tuning. Foreseen activities focus on finalizing the extension of belief propagation to learn distortion functions from sparse and sequential observations and its application to achieve (i); strategies for selective, polling-based sensing and distributed processing to leverage (ii); target model adaptation driven by continuous detection and integration of complementary sensing for (iii), and parameter tuning methods that use humans as calibration patterns for (iv). We invest on methodology, abstracting from the modality where possible, such that results may be mapped to other domains (e.g. to acoustic sensing). (i) and (ii) involve theoretical investigations with associated risks, but as such they may apply well beyond original objectives. Together with (iii), these activities aim at minimizing constraints on the environments SmarTrack can operate on, and we intend to evaluate their impact under realistic conditions, e.g. in the FBK foyer and ACUBE project pilot sites. Target of activity (iv) is to develop a lightweight portable demonstrator of SmarTrack (e.g. using a laptop and 2 Kinect devices) which may be set up in short time with minimal manual intervention.

**O3: Fund raising**. To maintain and possibly further increase self-funding over the next years (raised from about 30% in 2010 to over 50% in 2011) we continue to look for EU funding opportunities (currently two EU proposals are under preparation), and to expand our network with potential partners. Given the healthy state of the unit's self-funding, we invest in opportunities that allow us to maintain a good balance of and focus on the units scientific objectives.

**O4: Exploitation**. The unit will continue to investigate on technology transfer opportunities. It is TeV's intent to support a former member of the group in creating a start-up on traffic monitoring technologies (video and plate recognition analytics for flow analysis). With regard to SmarTrack (people tracking), we are in contact with two industrial partners to complement with hardware and event detection competences that are needed to get to a product addressing real customer needs. VENTURI will be used for possible exploitation of Marmota technology (outdoor photo labeling).

### 4.   Front Edge & New Initiatives

Recently we established contact with two recognized research groups (QMUL, IDIAP) with shared research interests, with the goal of investigating funding opportunities for a joint initiative. This allowed us to joint an already established project proposal consortium with a contribution on large scale video analytics as a component for large-scale intelligent information management. Besides this, we believe that enforcing partnership with them is an opportunity to grow and to increase our scientific visibility. We also look forward to opportunities to network with EIT ICT Labs partners, and proactively to Trento-RISE initiatives, in particular to the recently established research areas to consolidate local collaborations.

## 5.   Funding

| Acronym | Full name | Type | Duration | Total income | Income 2012 |
|---------|-----------|------|----------|--------------|-------------|
| VENTURI |  | EU | 01/10/2011 30/09/2014 | € 530,260.00 | € 221,975.00 |
| BVTECH |  | IND | 01/07/2011 31/12/2012 | € 50,000.00 | € 38,000.00 |
| RISOLVI |  | IND | 01/07/2011 31/12/2013 | € 91,000.00 | € 50,000.00 |
| GEOMEDIA |  | IND | 01/04/2011 30/06/2012 | € 32,000.00 | € 10,000.00 |
| CAFÉ |  | IND | 01/01/2012 31/12/2013 | € 70,000.00 | € 35,000.00 |
|  |  |  | TOTAL | € 773,260.00 | € 354,975.00 |

## 6.   Budget

|  | 2011 | 2012 |
|---|------|------|
| Expenses |  |  |
| Personnel | € 536,89 | € 546,92 |
| Travel | € 14,50 | € 22,50 |
| Equipment (HW/SW) | € 8,50 | € 13,50 |
| Other (e.g. subcontracting to external contractors) | € 51,30 | € 68,20 |
| Total Expenditure | € 611,19 | € 651,12 |
| Incomes |  |  |
| EU Projects (total amount financed by EU) | € 6,80 | € 221,97 |
| Other external incomes (industrial, PAT projects, etc.) | € 43,58 | € 10,00 |
| Projects to be finalized | € 151,09 | € 123,00 |
| Total Income | € 201,47 | € 354,97 |
| Financial Need (Total Income – Total Expenditure) | € 409,72 | € 296,15 |
| Self funding | 33,0% | 54,5% |

Note: Column 2011 is based on the unit's budget state as estimated at the date of document writing. Column 2012 is the budget planned for 2012.

## I3 – INTELLIGENT INTERFACES AND INTERACTION

Head of Unit: Massimo Zancanaro

## 1.   Summary and vision

The i3 research unit focuses on designing interaction modalities for cutting-edge IT using a highly interdisciplinary approach borrowed from social sciences. The research objectives are at the same time technological—that is, developing innovative technologies—and social—that is, investigating how people use and benefit from these technologies.

Last year, the specific technologies investigated were active surfaces and automatic human behavior analysis. The focus this year will be mainly on the latter with the more precise objectives of (i) improving the development of an engine for short-range interaction which composes and analyses data from sensors and infers psychological traits and specific behaviors; (ii) improving the skills of analysis for behavioral and psychological traits both for individual and small groups in a co-located setting and by also considering the social network data as part of the context and (iii) developing interaction strategies for direct/indirect and peripheral/attentive communication.

The emphasis will be to investigate interactive experiences aimed at improving the quality of human interactions mediated by computers. Accordingly to the i3 core competencies and skills, the approach used will be *research by design* and the relevant dimensions we want to investigate for the design and assessment of the new prototypes include *situational and personal awareness*, *engagement*, *empowerment, efficacy of communication (persuasion)* and *quality of experience.* Furthermore, we will continue to investigate stochastic models of behavior and psychological traits using machine learning techniques *and data mining* on large dataset of social networks data and social activities. This approach is in line and constitutes a progress from the achievements of last years, including the work on empowerment of teachers and children on the autism spectrum in the COSPATIAL project, the work on the *Augmented Café Table* developed in the HITCH project (Zancanaro et al. 2011), the work conducted in the PERSI project together with Media Lab, and in general the prototypes developed in NETCARITY, in particular the *Goodmorning Mirror* as well as the work on social dynamics in Wikipedia, such as the construction of collective memories of recent events or social networks of communication

The line of research proposed can be framed in the scientific community of *intelligent interfaces* whose main conferences are *ACM Intelligent User Interfaces* (IUI), *ACM International Conference on Multimedia Interaction*, *ACM Multimedia* and *User Models and User Adapted Interaction* (UMAP). Researchers of the unit are in the program committee of all these conferences. For 2010, the head of unity was the area chair for a special track on interfaces for *ACM Multimedia*. Furthermore, the wider and more general area of Human-Computer Interaction is in the area of

interest for dissemination of results, in particular the prestigious *ACM CHI* conference in which we had some publications in the last few years. Finally, we will aim at targeting the scientific communities of Ubiquitous Computing and the more recent trends on social computing.

The most promising directions for the next future include the use of peripheral visual communication to influence behavior (from local context and from activities in social networks) and the visualization of data from automatic behavior analysis to communicate information about behaviors of individual and groups in a quick and robust way. Beside building prototypes on applicative scenarios, collection and distribution of multimodal corpora will continue to be a key activity for the group.

*Unit composition*

|  | 2011 (as of Jan 1st) | 2012 (planned) |
|---|---|---|
| Research directors | 1 | 1 |
| Senior researchers | 0 | 0 |
| Researchers (including postdocs, etc.) | 5 | 7 |
| Technologists | 4 | 4 |
| PhD students | 1 | 3 |
| Total | 11 | 15 |
| Tenured | 6 | 7 |
| Tenure track | 0 | 0 |

Note 1: "Research directors" are level 1 researchers; "Senior researchers" are level 2 researchers. Category "Researchers" covers all other cases, including level 3 and 4 researchers, postdocs and other contractual forms used to enroll researchers.

Note 2: the personnel for 2012 also includes the personnel formerly assigned to the SONET exploratory project.

*Top researchers by citations (max. 5)*

| Researcher | H-index | Citations (total) |
|---|---|---|
| Massimo Zancanaro | 19 | ~1200 |
| Paolo Massa | 14 | ~1100 |
| Elena Not | 11 | ~470 |
| Ornella Mich | 9 | ~631 |
| Nadia Mana | 9 | ~310 |

## 2. Recent publications

| Year | Jour. Papers | Jour. Papers (IF) | Top Journal (*) | Q1 (%) | Q2 (%) | Q3 (%) | Q4 (%) | Conf. Papers | ERA A | ERA B | ERA C | ERA D | Patents | Books (authored) | Books (edited) | Chapters in Book | Literature Reviews | Transl. (book) | Transl. (essay) | Transl. (article) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| In print | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 1 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 2011 | 2 | 1 | 0 | 0 | 0 | 100 | 0 | 11 | 6 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2010 | 3 | 2 | 0 | 0 | 100 | 0 | 0 | 22 | 4 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2009 | 6 | 1 | 1 | 100 | 0 | 0 | 0 | 11 | 5 | 1 | 0 | 0 | 3 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 2008 | 1 | 1 | 0 | 0 | 50 | 50 | 0 | 12 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| Year | Jour. Papers | Jour. Papers (IF) | Top Journal (*) | Q1 (%) | Q2 (%) | Q3 (%) | Q4 (%) | Conf. Papers | ERA A | ERA B | ERA C | ERA D | Patents | Books (authored) | Books (edited) | Chapters in Book | Literature Reviews | Transl. (book) | Transl. (essay) | Transl. (article) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| In print | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 1 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 2011 | 2 | 1 | 0 | 0 | 0 | 100 | 0 | 11 | 6 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2010 | 2 | 1 | 0 | 0 | 0 | 100 | 0 | 11 | 6 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2009 | 2 | 1 | 0 | 0 | 0 | 100 | 0 | 11 | 6 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2008 | 2 | 1 | 0 | 0 | 0 | 100 | 0 | 11 | 6 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Note: the publications reported in table 3 does not include SONET publications; furthermore two papers in major conferences to be held in late November and a journal paper accepted by not yet published are not reported.

Top 5 publications in the last 3 years (2009-2011):

- Lepri B., Mana N., Cappelletti A., Pianesi F., Zancanaro M. What Is Happening Now? - Detection of Activities of Daily Living from Simple Visual Features. Personal and Ubiquitous Computing. March, 2010. [IF 1.544]
- Pianesi F., Graziola I., Zancanaro M. Goren-Bar D. The Motivational and Control Structure Underlying the Acceptance of Adaptive Museum Guides - An Empirical Study. Interacting with Computers. 2009 Volume 21, Issue 3: 186-200. [IF 1.192]
- Giusti L., Zancanaro M., Gal E., Weiss P.L. Dimensions of collaboration on a tabletop interface for children with autism spectrum disorder. In Proceedings of the CHI'11, 2011 annual conference on Human factors in computing systems. Vancouver, Canada, May 2011
- Leonardi C., Mennecozzi C., Not E., Pianesi F., Gennai F., Cristoforetti A. Zancanaro M. Knocking on Elders' Door Investigating the Functional and Emotional Geography of their Domestic Space. In Proceedings of ACM CHI 2009. April 2009, Boston, Mass.
- Staiano J., Lepri B., Subramanian R., Pianesi F., Sebe N.. Automatic Modeling of

Personality States in Small Group Interactions. In Proceedings of ACM International Conference on Multimedia (ACM-MM) 2011, Scottsdale, AZ

## 3. Objectives for 2012

**O1: [Research on Automatic human behavior analysis] deployment of Behavior Recognizer for Short-Range Interaction.** This objective consists in the implementation of a software tool which integrates a number of sensors able to track human behavior in a restricted area. This tool will be used for rapid prototyping of interactive system to investigate new modalities of interaction (see objective O2). It will support collecting different streams of data coming from different sensors, their integration and synchronization, storage (for subsequent construction of empirical models) and post-processing. For the latter, it will include the possibility of applying advanced filtering and prediction from previously compiled empirical models (possibly integrating a general purpose tool such as Octave).

The key performance indicators for this activity are measured in terms of the number of sensors actually managed by the tool, the relative difficulty of integrating new sensors, the robustness and the possibility of being easily distributable. The major milestone will be the actual availability of the tool at the end of the year.

**O2: Research on Interaction based on Automatic human behavior analysis Framework for peripheral/Attentive persuasive interaction (to be submitted to a major journal).** The framework consists in a number of experiences and tools to visualize information in contextual-aware systems. These visualizations are meant to be on the peripheral of the human attention until the system explicitly has a goal to move them in the focus. The case of attentive interfaces with meaningful representations for non-technical users will also be addressed as a special case. Different modalities will be explored, including speech, audio (such as music) and light. Different communication strategies will be employed, in particular those aimed at addressing the central route of persuasion (direct and argumentative messages) and those aimed at addressing the so called peripheral route (subtle, indirect and emotionally-charged messages).

Key performance indicators for this activity include the completeness of the framework in terms of number of rules and modalities employed. The actual evaluation of (part) of the framework will depend on the scenarios required by the new projects. In case the new projects experience a substantial delay, we will set up lab studies for some relevant dimensions of the framework. The main expected outcome for the task is a journal paper submitted to a major journal on intelligent user interfaces or ubiquitous computing.

**O3: [Research on Automatic human behavior analysis] modeling of social behavior of large groups on Wikipedia.** This objective is related to finalizing the activities carried out in 2011 about modeling of behavior of groups of users on Wikipedia.

Key performance indicators for this activity include the spectrum of different aspects of behaviors analyzed, such as differentiating activities of users on Wikipedia based on gender and analyzing the social processes of creation and maintenance

of collective memories of current events. The main expected outcome for the task are several papers submitted to major conferences or journals.

This objective also comprises the integration of these activities and line of research in an integrated way with the core focus of the unit about automatic human behavior analysis of small groups involved in short-range interactions. With this regard, a key performance indicator is the level of integration reached at the end of 2012.

**O3: [FUND RAISING CALL 8] PROPOSALS FOR CALL8.** This objective consists in the proposal writing for the Call 8 of the IST FP7. One or two proposals will be submitted for projects that, if funded, will support the group on the objectives O1 and O2. At present, a consortium for the preparation of a proposal of an interactive desk that implements an intelligent tutoring system able to reproduce the emotional intelligence of a smart teacher is under preparation with FBK as a coordinator. A follow-up of COSPATIAL is also under discussion.

**O4: [fund raising call 8] proposals for call9.** This objective consists in the proposal writing for the Call 8 of the IST FP7. One consortium for a proposal for an IP in the museum scenario (under the coordination by Engineering SPA) is already active. Further proposals will be elaborated depending on the outcomes of Call 8.

## 4.    Front Edge & New Initiatives

No front edge or new initiatives are envisaged for 2012.

## 5.    Funding

| Acronym | Full name | Type | Duration | Total income | Income 2012 |
|---------|-----------|------|----------|--------------|-------------|
| PERSI | Public Enhanced Reasoning for Social Influence | PAT/EU | 3 years, ends in june 2013 | €180.000 | €60.000 |
| Trip@dvice | Trip@dvice | L6 | 1 year, ends in december 2012 | €30.000 | €30.000 |
| FESTA | Female Emerging in Science and Technology Academia | EU | 5 years from 2012 | - | €27.000 |
| COSPATIAL | Communication and Social Participation: Collaborative Technologies for Interaction And Learning | EU | 3 years, ends in January 2012 (a non-cost extension is under evaluation) | €560.000 | €22.000 |

Beside the funding already secured listed above, the unit has opened a number of proposal.

−    the unit has been quite active in the EIT-ITC Labs activities proposals in May 2012: although the KIC budget is not yet finalized, we have raised more than 90k for catalysts activities closed to the unit expertise.

− we are actively involved in the definition of the TrentoRISE proposal for the Trentino Territorial Lab and the PERTE research project. Paolo Massa will allocate part of his time for the coordination of the Social Informatics research area.
− a proposal to be funded by Confcommercio (with an expected income of around 140k in 15 months FBK) is going to be finalized
− a FET pre-proposal was submitted in late October

Furthermore, the discussion for two proposals to be submitted at the upcoming call 8 (January 2011) and possibly two more for call 9 (May 2011) have already started.

## 6. Budget

|  | 2011 | 2012 |
|---|---|---|
| Expenses |  |  |
| Personnel | € 535,90 | € 590,57 |
| Travel | € 43,00 | € 12,00 |
| Equipment (HW/SW) | € 10,00 | € 6,00 |
| Other (e.g. subcontracting to external tractors) | € 72,00 | € 73,50 |
| Total Expenditure | € 660,90 | € 682,07 |
| Incomes |  |  |
| EU Projects (total amount financed b | € 230,18 | € 22,66 |
| Other external incomes (industrial, P projects, etc.) | € 268,98 | € 117,00 |
| Projects to be finalized | € 0,94 | € 0,00 |
| Total Income | € 500,09 | € 139,66 |
| Financial Need (Total Income – Total penditure) | € 160,81 | € 542,41 |
| Self funding | 75,7% | 20,5% |

Note1: Column 2011 is based on the unit's budget state as estimated at the date of document writing. Column 2012 is the budget planned for 2012

Note2: PhDs have been included in other costs (18k for 1 Phd in 2011 and 50k for 3 Phds in 2012).

Note3: The costs for 2012 also include the costs of the personnel formerly assigned to the SONET exploratory project.

## 7. Remarks

For 2012, the personnel of the SONET research project joins the i3 research unit. The two groups have started to elaborate a common vision but it is expected that the process of fully integrating the two streams of research will take most of next year.

# SHINE – Speech-acoustic scene analysis and interpretation

Head of Unit: Maurizio Omologo

## 1.    Summary and vision

The *SHINE* research unit deals with advanced techniques of audio signal processing and interpretation, with a particular focus on speech signals acquired by multi-microphone systems. Main activities concern *Distant-speech Interaction* in real noisy and reverberant environments and, more generally, *Acoustic Scene Analysis* in indoor contexts. Other pioneering activities are conducted on *Musical Scene Analysis* and on *Microphone array and loudspeaker array processing for Immersive Reality.*

Speech interaction with distant microphones is an important step towards the development of easy-to-use voice interfaces in an increasing number of possible applications (e.g., smart home). Except for rather controlled real scenarios, with this type of interaction present automatic speech recognition (ASR) systems still exhibit lack of robustness and flexibility and, as a result, an unacceptable variability in their performance.

The approach adopted under SHINE consists in combining acoustic scene analysis and ASR technologies, in order to interpret from different perspectives the acoustic information diffused in the environment and picked up by a multi-microphone acquisition system. *Sound source location and tracking*, *acoustic event detection and classification*, *source separation, speech enhancement*, *distant speaker identification*, represent some of the tasks that are addressed with the purpose of deriving a detailed scene description to be eventually used by speech recognition, understanding and spoken dialogue management components. All of these tasks are normally tackled under real-world conditions, including the presence of two or more competitive speakers and noise sources.

Another field recently addressed by SHINE is musical scene analysis, whose main objective is the extraction of relevant cues from an audio stream, which can enable effective solutions of music information retrieval. Many analogies with basic problems usually addressed for distant-speech interaction suggested few years ago to concentrate a PhD on this topic, which started by addressing automatic chord detection and beat tracking tasks.

Over the last 20 years, the unit has progressively accumulated expertise and skill in scientific and technological fields related to microphone array processing and distant-speech recognition, and acquired a good visibility in the related scientific communities. Nowadays, at international level several research teams are concentrating increasing efforts and resources on these topics, due to real applications and new markets which are envisaged. Beside publications in major international conferences and journals, a relevant achievement of SHINE during the last five years refers to DICIT, an EC project coordinated by FBK (2006-2009), under which

a prototype was realized that enables voice control of TV and related devices in a smart-home environment speaking at distance of 3-4 meters from the microphones. Another context to mention is the EC SCENIC project, under which a relevant scientific progress has been obtained recently for what regards a deep comprehension of environmental acoustics.

During the last five years, the scientific impact of SHINE unit in contributions regarding source separation and chord detection has also been considerably strengthened, with a deeper understanding of key concepts, design of original algorithms, and a strong involvement in evaluation activities and competitions which positioned our group among the best ones at international level (see SISEC and MIREX campaigns).

The immediate trend is to investigate on the most challenging topics, and open issues, and to further increase the visibility of the group at international level in the addressed fields. At the same time, we believe that the most mature technologies available in the unit are ready for a technology transfer.

Since January 2012, the unit will be strongly committed in coordinating the DIRHA FP7 EC project, under which progress at basic research level is envisaged for most of the above-mentioned scientific areas, given as reference a smart-home application scenario. Challenges and complexity addressed by the project are multi-fold, but basically related to the opportunity for the user to interact with the system in different rooms, even while other speakers, noise and interfering sources are active.

Smart-home will also represent one of the application fields to investigate under a FESR project, together with a small local enterprise (i.e., DomoticArea S.p.A.); the other application scenario for this FESR regards the use of distant-speech recognition technologies in a surgery operation room (for command-and-control as well as for dictation of short reports during an operation), which will be investigated with UniHospital S.p.A.. With these two companies, and other possible investors, the creation of a spin-off is also being examined.

As for musical scene analysis, we plan to continue with a post-doc and a PhD student, if possible addressing other topics which can lead in the near future to the development of a first application of music information retrieval (e.g., including cover song identification).

A long-term goal for the team is the realization of immersive communication systems embedding microphone and loudspeaker arrays with SHINE technologies and combining it with technologies for vision.

*Unit composition*

|                                           | 2011 (as of Jan 1$^{st}$) | 2012 (planned) |
| ----------------------------------------- | ------------------------- | -------------- |
| Research directors                        | 1                         | 1              |
| Senior researchers                        | -                         | -              |
| Researchers (including postdocs, etc.)    | 5                         | 7              |
| Technologists                             | 1                         | 1              |

| PhD students | 4 | 6 |
|---|---|---|
| Total | 11 | 15 |
| Tenured | 4 | 4 |
| Tenure track | 1 | 1 |

Note: "Research directors" are level 1 researchers; "Senior researchers" are level 2 researchers. Category "Researchers" covers all other cases, including level 3 and 4 researchers, post-docs and other contractual forms used to enroll researchers.

*Top researchers by citations (max. 5)*

| *Researcher* | *H-index* | *Citations (total)* |
|---|---|---|
| Maurizio Omologo | 21 | 1919 |
| Piergiorgio Svaizer | 18 | 1425 |
| Marco Matassoni | 11 | 515 |
| Alessio Brutti | 8 | 217 |
| Francesco Nesta | 7 | 90 |

## 2.  Recent publications

| Year | Jour. Papers | Jour. Papers (IF) | Top Journal (*) | Q1 (%) | Q2 (%) | Q3 (%) | Q4 (%) | Conf. Papers | ERA A | ERA B | ERA C | ERA D | Patents | Books (authored) | Books (edited) | Chapters in Book | Literature Reviews | Transl. (book) | Transl. (essay) | Transl. (article) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| In print | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2011 | 1 | 1 | 0 | 50 | 50 | 0 | 0 | 13 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2010 | 4 | 3 | 0 | 33 | 33 | 0 | 34 | 7 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 2009 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 0 | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 2008 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Top 5 publications in the last 3 years (2009-2011):

−  F. Nesta, P. Svaizer, M. Omologo, Convolutive BSS of short mixtures by ICA recursively regularized across frequencies, IEEE Transactions on Audio, Speech and Language Processing, March 2011 [UGOV: 12018]

−  F. Nesta, M. Omologo, Generalized State Coherence Transform for multidimensional TDOA estimation of multiple sources, IEEE Transactions on Audio, Speech and Language Processing, 2011 [UGOV: code to be assigned].

−  Brutti, M. Omologo, P. Svaizer, Multiple Source Localization based on Acoustic Map De-Emphasis, EURASIP Journal on Audio, Speech, and Music Processing, vol. 2010 [UGOV: 23829].

−   F. Nesta, T. S. Wada, and B. H. Juang, Batch-Online Semi-Blind Source Separa-
    tion Applied to Multi-Channel Acoustic Echo Cancellation, IEEE Transactions on
    Audio, Speech and Language Processing, March 2011 [UGOV: 12019].

−   A. Brutti, L. Cristoforetti, W. Kellermann, L. Marquardt and M. Omologo, WOZ
    Acoustic Data Collection For Interactive TV, Language Resources and Evaluation
    Journal, January 2010 [UGOV: 8408].

## 3.    Objectives for 2012

**O1: DIRHA**. The activities under DIRHA include coordination, management, as
well as research and development on a wide range of tasks, as detailed in the
Technical Annex of the project. During 2012, research efforts will focus on: blind
and semi-blind source separation techniques for speech enhancement, acoustic
echo cancellation, and ASR; acoustic event detection and localization in a multi-
room environment; baseline of ASR and speaker identification systems. It is also
foreseen the development of related showcases. The unit will then be particularly
active in actions regarding analysis of user requirements, definition of technology
evaluation procedures, acoustic data collection, simulated corpora, development of
experimental tasks, and other supporting activities for the execution of the project.
In particular, dissemination actions include the realization and maintenance of the
project web site. Milestones and deliverables of the project are other outcomes.

**O2: FESR**. The SHINE unit is committed for the development of distant-speech in-
put and voice control solutions, based on pre-existing s.o.a. technologies, in the
contexts of smart-home and surgery room. The activities of 2012 include: the anal-
ysis of user requirements; the definition of the hardware framework; the collection
of real-world data; the design and development of front-end and off-line distant-
speech recognition system for the surgery room; the design and development of a
front-end suitable for the smart-home application. A tight cooperation with the two
above-mentioned industries is foreseen; the HLT unit will also be involved in the
activities conducted for UniHospital. The outcomes of this activity include both re-
ports for project deliverables and software components.

**O3: Pumalab**. This collaboration with the TeV unit will continue with activities re-
garding: Joint audio-video processing for scene analysis; new methodologies for
automatic calibration of video and audio sensors.

**O4: Other relevant topics**. Other research activities of the unit, not included in the
previous two Objectives, are summarized in the following:

-   Progress in chord detection, beat tracking, key detection, and other basic
    tasks, with the purpose of creating during the second half of the year a first
    experiment of cover song identification. This will probably represent a direction
    to continue with a new PhD student.

-   Basic research on sparseness and model-based methods for underdeter-
    mined source separation and localization. This will probably represent the field
    addressed by Mahmoud Fakhry in his PhD track.

- Modeling of sound propagation in enclosures. Following the work previously conducted under EC SCENIC project, investigation will regard possible connections between study of Room Impulse Responses, geometric models, channel identification and speech dereverberation. The activity can also have impact under DIRHA.
- Far-field speaker identification and verification and relationship with acoustics of an enclosure, e.g., early reflections, reverberation tail (PhD thesis goal of Saameh Golzadeh).
- Confidence measures and acoustic scene analysis for robust distant-speech interaction (PhD thesis goal of Cristina Guerrero).
- Dynamic acoustic modeling for robust distant-speech recognition (PhD thesis goal of Abdul Mohammed Waheed).

## 4.  Front Edge & New Initiatives

Most of the issues reported under O4 can be classified as front-edge activities. The current policy of the unit is, in fact, to explore novel research topics in a more risky way through PhD theses, to conduct research and development activities under the EC DIRHA project, while innovation and technology transfer is addressed under the FESR project. A spin-off targeting reengineering and porting some of the most mature technologies towards the market is a missing "brick", maybe to create during 2012.

It is finally worth noting that the team is proactively working in the context of TrentoRise with the purpose of creating new opportunities for cooperation and for development of inter-disciplinary actions with other FBK-CIT teams, University of Trento, and under EIT framework, in particular for what regards multi-dimensional and multi-modal signal processing and interpretation (in the fields of scene analysis and reconstruction, multimedia archives, human behaviour analysis) and of distant-speech recognition.

## 5.  Funding

| Acronym | Full name | Type | Duration | Total income | Income 2012 |
|---------|-----------|------|----------|--------------|-------------|
| DIRHA | Distant-speech Interaction for Robust Home Applications | EU | 1/1/2012-31/12/2014 | €800000.00 | €232726.13 |
| UNIHOSPI-TAL,DOMOTI CAREA | Tecnologie di riconoscimento vocale a distanza dai microfoni in sanità e domotica1/1 | FESR | 1/1/2011-31/10/2013 | €150000.00 | €88508.50 |

## 6.   Budget

|                                                                  | 2011       | 2012       |
|------------------------------------------------------------------|------------|------------|
| Expenses                                                         |            |            |
| Personnel                                                        | € 460,63   | € 553,02   |
| Travel                                                           | € 15,00    | € 24,00    |
| Equipment (HW/SW)                                                | € 4,00     | € 11,00    |
| Other (e.g. subcontracting to external contractors)             | € 92,00    | € 101,50   |
| Total Expenditure                                                | € 571,63   | € 689,52   |
| Incomes                                                          |            |            |
| EU Projects (total amount financed by EU)                        | € 105,62   | € 0,00     |
| Other external incomes (industrial, PAT projects, etc.)          | € 82,64    | € 88,51    |
| Projects to be finalized                                         | € 0,00     | € 232,73   |
| Total Income                                                     | € 188,25   | € 321,23   |
| Financial Need (Total Income – Total Expenditure)               | € 383,38   | € 368,28   |
| Self funding                                                     | 32,9%      | 46,6%      |

Note: Column 2011 is based on the unit's budget state as estimated at the date of document writing. Column 2012 is the budget planned for 2012.

# WED – WEB OF DATA

Head of Unit: Giovanni Tummarello

## 1. Summary and vision

The Web of Data (or Web 3.0 or Semantic web) is the collective effort to augment the existing web by exposing the raw data underneath the pages, with the ultimate goal to enable automatic intelligent data discovery, integration and reuse by agents and search engines. In 2011 the Web of Data can be said to have exploded in numbers thanks to the launch of the Schema.org initiative (by Google, Yahoo and Microsoft), the strengthening of the LOD movement, and the general strengthening of the open Data Movement – also clearly fuelled by the economic crisis making more and more unacceptable that publicly funded works (e.g. datasets) are not made publicly reusable. This explosion, in number, make it even more appealing the research and develop infrastructures which can turn this information into actual value either in terms of new opportunities or in terms of savings with respect to previous practices. The Web of Data (WeD) units performs:

- *Research on scalable infrastructures*: to add value and exploit data published online in interoperable formats such as RDF, RDFa and Microformats. This involves research in *semantic information retrieval, cluster semantic data processing, cluster semantic databases, pragmatic, large scale mechanisms for semantic entity reconciliation and most recently scalable data workflows making dynamic use of cloud resources* ultimately delivering "Data as a Service" to empower data intelligence in applications.

- *Research and studies*: on mechanisms for fostering use of the above "Data as a service" by dramatically lowering implementation barriers via augmenting existing applications and scenarios. This happens via *collaborative widget platforms* (Sindice Site Services), via integration with HTL technologies (e.g. wiki machine + Web of Data powered "recommendations and search engines), via the study of *mechanisms that create closed loops that verify and augment the quality of open data* (data developer tools, assisted query writing tools, data inspection tools).

- *Innovation and knowledge transfer*: WeD technological platform is the base of Spinoffs, notably the SpazioDati set to be created end of 2011/early 2012, licensed IP (IP from WeD to be licensed by the Sindice ltd company). Technology transfer happens via collaborations with local bodies, companies and projects *(e.g. Informatica Trentina, Netwise, Statistical office, Telecom Italia Labs, Trentino Open Data, Livememories) which have led in 2011 to commercial bids, pilot study programs, awareness creating initiatives and funded proposal submission.*

-

*Unit composition*

|                                         | *2011 (as of Jan 1$^{st}$)* | *2012 (planned)* |
|-----------------------------------------|-----------------------------|------------------|
| Research directors                      | 1                           | 1                |
| Senior researchers                      |                             |                  |
| Researchers (including postdocs, etc.)  |                             |                  |
| Technologists                           | 2                           | 2                |
| PhD students                            | 0                           | 1                |
| Total                                   | 3                           | 4                |
| Tenured                                 |                             |                  |
| Tenure track                            |                             |                  |

Note: "Research directors" are level 1 researchers; "Senior researchers" are level 2 researchers. Category "Researchers" covers all other cases, including level 3 and 4 researchers, postdocs and other contractual forms used to enroll researchers.

*Top researchers by citations (max. 5)*

| *Researcher*        | *H-index* | *Citations (total)* |
|---------------------|-----------|---------------------|
| Giovanni Tummarello | 14        | 839                 |
| Michele Mostarda    | 3         | 17                  |

## 2.    Recent publications

| *year* | *Jour. Papers* | *Jour. Papers (IF)* | *Top Journal (\*)* | *Q1 (%)* | *Q2 (%)* | *Q3 (%)* | *Q4 (%)* | *Conf. Papers* | *ERA A* | *ERA B* |
|--------|----------------|---------------------|--------------------|----------|----------|----------|----------|----------------|---------|---------|
| 2011   | 1              | 1                   | 0                  | 0        | 0        | 0        | 0        | 1              | 0       | 1       |
| 2010   | 1              | 1                   | 0                  | 100      | 0        | 0        | 0        | 5              | 1       | 0       |
| 2009   | 0              | 0                   | 0                  | 0        | 0        | 0        | 0        | 0              | 0       | 0       |
| 2008   | 0              | 0                   | 0                  | 0        | 0        | 0        | 0        | 0              | 0       | 0       |

Note: 2011 journal publication added (currently not on the system)

Top 5 publications in the last 3 years (2009-2011):

−  2011: R. Delbru, S. Campinas, G. Tummarello. "Searching Web Data: an Entity Retrieval and High-Performance Indexing Model. Accepted". In Journal of Web Semantics, 2011. [not in UGOV yet]

−  2011: S.Campinas, R.Delbru, G.Tummarello, "SkipBlock: Self-Indexing for Block-Based Inverted List", 33rd European Conference on Information Retrieval ECIR 2011 [UGOV: 31190]

− 2010: Giovanni Tummarello, R. Cyganiak, M. Catasta, S. Danielczyk, R. Delbru, S. Decker ``Sig.ma: Live views on the Web of Data'' Journal of Web Semantics: Science, Services and Agents on the World Wide Web [UGOV 31189]

− 2010: G. Tummarello, R. Cyganiak, M. Catasta, S. Danielczyk, R. Delbru, S. Decker, "Sig.ma: Live views on the Web of Data". Demo Track - World Wide Web Conference 2010" [UGOV: 24892]

− 2010: R. Delbru, N. Toupikov, M. Catasta, G. Tummarello, S. Decker, "Hierarchical Link Analysis for Ranking Web". Data Extended Semantic Web Technology Conference (ESWC) 2010 [UGOV: 24891]

## 3.    Objectives for 2012

**O1. Demonstration of value of Sindice technologies also in enterprise use cases:** During 2011 we received strong indications that the technology which we now demonstrate to be able to cope with very large streams of web data is of high interest in enterprise data. The theme is "Real Time Semantic Data Warehousing". *The goal* is to use Cloud computing as a key enabler to combine the value of large scale data warehousing with the benefit and flexibility of semantic "pay as you go" data integration. *Activities* will see design, implementation and industry evaluation with partners which have already been selected thanks to our international cooperation in the LION2 project. *Risks* include not being able to outperform traditional technologies in terms of overall ease of use and capabilities, these will be mitigated by a close, steering feedback with our partners over their use cases.

**O2. Open use of "Contextual DataSpaces" as an enabler to Web of Data use cases.** Acting on the feedback received so far for our flagship Web data infrastructure Sindice *the goal* will be to allow researchers and developers alike to create customized integration dataspaces powered by live web data. *The Activities* will see the deployment of the infrastructure designed in O1) with the addition of a social layer and interaction mechanism to foster reuse of intermediate datasets and data cleansing efforts. Risks include not being able to communicate well the concept to the end user and creating too much (data and resource expensive!) fragmentation in the way people do their dataspaces. Again this will be mitigated by an agile process which will favor early releases and feedback.

**O3. Innovation and knowledge transfer:** The goal is to gather real needs and research feedback from the Spinoffs and other knowledge transfer partners. The activities will include collaborating closely with the SpazioDati and Sindice spinoff and others to gather real needs and feedback which can be turned into general lessons and new directions. Several public and private sector interactions are already planned for 2012 as the Open Data theme becomes recognized as more and more strategic. Risks include being dragged too much into commercial or implementation details, but these will be limited by careful scientific opportunity/value analysis.

## 4.    Front Edge & New Initiatives

In 2012 the WeD unit will have a role in the execution of the Venturi FP7 project in conjunction with the group at TeV. This will investigate on the theme of providing streams of relevant objects to the Venturi envision augmented reality platform. This activity will be performed by creating new experimental services, specifically developed for the purpose of the project but also in a way to act as "trials" for the technologies developed as main unit objective, specifically objective o1 and o2.

In 2012 we will be also starting a local FBK "cloud computing for semantic data processing" laboratory – initially composed by relatively small cluster of machines - which will be running experimental cloud software with the goal of acting as on the fly infrastructure and platform providers for semantic data warehousing.

## 5.    Funding

| Acronym | Full name | Type | Duration | Total income | Income 2012 |
|---------|-----------|------|----------|--------------|-------------|
| Venturi | Venturi | EU | 2011-2014 | 150k | 50k |

## 6.    Budget

|                                                          | 2011       | 2012       |
|----------------------------------------------------------|------------|------------|
| Expenses                                                 |            |            |
| Personnel                                                | € 200,42   | € 153,58   |
| Travel                                                   | € 12,00    | € 5,00     |
| Equipment (HW/SW)                                        | € 2,50     | € 2,00     |
| Other (e.g. subcontracting to external contractors)      | € 23,00    | € 34,20    |
| Total Expenditure                                        | € 237,92   | € 194,78   |
| Incomes                                                  |            |            |
| EU Projects (total amount financed by EU)                | € 0,00     | € 50,81    |
| Other external incomes (industrial, PAT projects, etc.)  | € 0,00     | € 0,00     |
| Projects to be finalized                                 | € 0,00     | € 0,00     |
| Total Income                                             | € 0,00     | € 50,81    |
| Financial Need (Total Income – Total Expenditure)        | € 237,92   | € 143,97   |
| Self funding                                             | 0,0%       | 26,1%      |

Note: Column 2011 is based on the unit's budget state as estimated at the date of document writing. Column 2012 is the budget planned for 2012.

# ST – SECURITY AND TRUST

Head of Unit: Alessandro Armando

## 1. Summary and vision

The ST Research Unit focuses on the development of cutting-edge automated reasoning techniques with the ultimate objective to build a new generation of push-button, security analysis and provisioning tools supporting the development of security-critical IT applications. The unit, started on April 2010, is pursuing the following research lines:

*Formal modeling and automatic security analysis of browser-based protocols.* Browser-based protocols play a key role in the Internet of Services as they facilitate access to and/or secure the composition of web applications. The unit is developing a model checker for security-sensitive, browser-based protocols and is applying it on real-world protocols. In doing so the unit has discovered an important authentication flaw in the prototypical browser-based Single Sign-On (SSO) use case of the SAML standard. In response to this finding OASIS has approved an errata to the standard (http://tools.oasis-open.org/issues/browse/SECURITY-12?page=com.atlassian.jira.plugin.system.issuetabpanels:comment-tabpanel&focusedCommentId=25914#action_25914). The unit has also contributed to the discovery of two vulnerabilities in the SSO protocol implemented in an earlier version of Novell Access Manager (http://www.novell.com/support/php/search.do?cmd=displayKC&docType=kc&externalId=7008342&sliceId=1&docTypeID=DT_TID_1_1&dialogID=225524659&stateId=0%200%2020225520905).

*Symbolic model checking of access control policies.* The unit is also developing a novel symbolic model checking procedure for the automatic analysis of a varieties of access control policies, ranging from Administrative Role-Based Access Control Policies (ARBAC) to access control policies used in business processes.

*Efficient solvers for the User-Authorization Query (UAQ) problem.* The UAQ problem is the problem to determine a minimal (maximal, resp.) set of roles to activate in a given session in order to achieve a given set of permissions while satisfying a given set of authorization constraints (e.g. mutual exclusion of roles). This is an important problem in the enforcement of role-based access control policies. We are developing automated techniques for solving the UAQ problem and experiments indicate that our technique scales significantly better than those available in the literature.

Given the important results obtained so far in 2012 we will continue developing the above research lines with the goal of attain both top-quality research results and acquire fundings to sustain and further expand our work in this setting.

The unit has also played a prominent role in the foundation of the Trento RISE research area on Information Security, Privacy and Trust (InfoSEC). The head of the

unit, Alessandro Armando is chair of the InfoSEC research area. The participation of personnel of the ST unit in InfoSEC will improve the positioning and visibility of the unit both internationally (e.g. within the EIT) and locally (e.g. within Italy and Trentino). The initiative has already led some results: the unit has actively participated in the preparation of four project proposals for the *EIT ICT Labs Activities for 2012*.

*Unit composition*

|                                        | *2011 (as of Jan 1st)* | *2012 (planned)* |
|----------------------------------------|:---:|:---:|
| Research directors                     | 1 | 1 |
| Senior researchers                     | 1 | 1 |
| Researchers (including postdocs, etc.) | 1 | 1 |
| Technologists                          | 0 | 0 |
| PhD students                           | 1 | 2 |
| Total                                  | 4 | 5 |
| Tenured                                | 0 | 0 |
| Tenure track                           | 1 | 1 |

Note: "Research directors" are level 1 researchers; "Senior researchers" are level 2 researchers. Category "Researchers" covers all other cases, including level 3 and 4 researchers, postdocs and other contractual forms used to enroll researchers.

*Top 5 researchers by H-index*

| *Researcher* | *H-index* |
|--------------|:---:|
| Alessandro Armando | 22 |
| Silvio Ranise | 19 |
| Roberto Carbone | 4 |

## 2.   Recent publications

The following table summarizes the scientific publications produced by the members of the ST unit in the last 5 years. The figures indicate that the unit has been able not only to start the new research lines outlined in Section 1, but also to quickly produce new high-quality results and publish them.

| year | Jour. Papers | Jour. Papers (IF) | Conf. Papers | Books (edited) | Chapters in Book |
|:---:|:---:|:---:|:---:|:---:|:---:|
| 2011 | 3 | 0 | 7 | 1 | 0 |
| 2010 | 2 | 1 | 7 | 0 | 1 |
| 2009 | 4 | 1 | 6 | 1 | 0 |
| 2008 | 2 | 0 | 2 | 0 | 1 |
| 2007 | 1 | 1 | 7 | 0 | 0 |

Top 5 publications in the last 3 years (2009-2011):

– Armando, E. Giunchiglia, M. Maratea and S. E. Ponta. An Action-based Approach to the Formal Specification and Automatic Analysis of Business Processes under Authorization Constraints. To appear on the Journal of Computer and System Sciences. http://dx.doi.org/10.1016/j.jcss.2011.02.015Criteri e distribuzione premio 2011

– Armando, M. P. Bonacina, S. Ranise, and S. Schulz. New results on rewrite-based satisfiability procedures. ACM Transactions on Computational Logic (TOCL), vol. 10, no. 1, 2009.

– Armando, J. Mantovani and L. Platania. Bounded Model Checking of Software using SMT Solvers instead of SAT Solvers. International Journal on Software Tools for Technology Transfer (STTT), volume 11, issue 1, pp. 69-83, 2009.

– M. Barletta, S. Ranise, and L. Vigano. A Declarative Two-level Framework to Specify and Verify Workflow and Authorization Policies in Service Oriented Architetures. In Journal of Service Oriented Computing and Applications, vol. 5, nr. 1, 2011.

– F. Alberti, A. Armando and S. Ranise. Efficient Symbolic Automated Analysis of Administrative Attribute-based RBAC-Policies. In Proceedings of the 6th ACM Symposium on Information, Computer and Communications Security (ASIACCS'11), Hong Kong, March 22-24, 2011.

## 3.  Objectives for 2012

The objectives for 2012 are aligned with the directives posed by the Director of the Centre in the document "Criteri e distribuzione premio 2011" for the ST unit: "Per il futuro la sfida per la costruzione di un gruppo forte deve continuare anche con l'acquisizione di progetti europei e azioni di impatto sul mercato." ("For the future the challenge for building a strong group must continue also with the acquisition of EU projects and actions impacting on the *market.")* We will tackle the challenge by targeting the following objectives:

**O1: Research.** The unit will continue developing the three research lines outlined in Section 1. More publications are expected (2 papers are currently under review by top-quality journals in computer security and 2 more will be submitted early next year). In the light of the results obtained so far we consider *moderate* the risk associated to the achievement of this objective.

**O2: Funding.** Seeking funding to sustain and expand the unit is a top priority. To this end the unit is currently leading the preparation of a proposal for an *European Industrial Doctorate* on "Information Security, Privacy and Trust" with SAP Research. If successful the project will provide funding for the recruitment of 5 PhD students. Due to the competitive nature of EU projects we rate *high* the risk associated to this objective.

**O3: Scouting new talents.** There are a number of promising and important research topics that the unit cannot currently tackle because of its limited size. Scouting new talents is thus another top priority for the unit. To this end we plan to invite young researchers, possibly with an international research record, to visit our

unit with the ultimate objective to find a candidate with an outstanding profile to recruit. Since we are seeking a candidate with an outstanding profile and the competition for your researchers in the area of Computer Security is fierce, we consider high the risk associated to this objective.

## 5.    Funding

The unit is currently funded by the SIAM project as summarized in the following tables:

| Acronym | Title | Type | Status | Start | End | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | Total |
|---------|-------|------|--------|-------|-----|------|------|------|------|------|------|------|-------|
| SIAM | o progetto di ricerca: SIAM | RL | awarded | 1 4 2010 | 31 3 2013 | 0 | 0 | 106638 | 141538 | 141925 | 34900 | 0 | 425001 |

| Acronym | Full Name | Type | Duration | Total Income | Income 2012 |
|---------|-----------|------|----------|--------------|-------------|
| Siam | analisi automatica della sicurezza dei sistemi per la gestione delle identità e degli accessi | cofund | 1/4/2010-31/3/2013 | 425,000 | 148,952 |

## 6.    Budget

|                                                      | 2011      | 2012      |
|------------------------------------------------------|-----------|-----------|
| Expenses                                             |           |           |
| Personnel                                            | € 224,43  | € 232,44  |
| Travel                                               | € 7,00    | € 10,00   |
| Equipment (HW/SW)                                    | € 6,00    | € 3,00    |
| Other (e.g. subcontracting to external contractors)  | € 15,40   | € 27,82   |
| Total Expenditure                                    | € 252,83  | € 273,26  |
| Incomes                                              |           |           |
| EU Projects (total amount financed by EU)            | € 0,00    | € 0,00    |
| Other external incomes (industrial, PAT projects, etc.) | € 182,69 | € 148,67 |
| Projects to be finalized                             | € 0,00    | € 0,00    |
| Total Income                                         | € 182,69  | € 148,67  |
| Financial Need (Total Income – Total Expenditure)    | € 70,13   | € 124,59  |
| Self funding                                         | 72,3%     | 54,4%     |

Note: Column 2011 is based on the unit's budget state as estimated at the date of document writing. Column 2012 is the budget planned for 2012.

## ICT4G – INFORMATION AND COMMUNICATION TECHNOLOGIES

Head of Unit: Adolfo Villafiorita

## 1.    Summary and vision

The goal of the ICT4G, which started operating in 2010, is looking at novel ways of using technology to preserve and improve people's life in areas characterized by a low penetration of ICT. Notice that by low ICT penetration, we not only refer to developing countries (where the penetration is remarkably low) but also to societies with significant and tangible gaps that could be effectively addressed by the usage of new technologies. On top of the research interest, two significant side effects are the "pro-bono" impact on marginalized societies and the possibility of opening opportunities in a market of great interest for the years to come.

The unit is focusing its effort on the implementation of the Maputo Living Lab (MLL), for which it has secured funding for about 800.000 Euros for the years 2011-2013. Main goals of MLL are the development of a "marketplace" of ideas to collect requirements and propose initiatives, the development of mobile applications to be experimented in rural areas, joint collaborations between Italian industries and Mozambican industries, and securing additional funding for the sustainability of the initiative. The Summer School of ICT, held in Maputo in November 2011, is a step to strengthen collaborations with Universities in Mozambique and, in the longer term, to create the reference Summer School in Southern Africa in the areas of ICT4D, web and mobile application development. On top of the Maputo Living Lab, for 2012 we are planning to enlarge our network of collaborations, concretizing some joint initiatives in Ethiopia with the Computer Science Department of the University of Addis Ababa and Adama University.

Concerning research directions, the unit is implementing and experimenting solutions to foster development through social collaboration. The longer term problem we are trying to tackle is understanding what mechanisms and what tools can best mobilize and support the implementation of global-scale changes. The approach we take is bottom up, developing and experimenting solutions in specific applicative domains. The domains we are currently focusing on are: a) sharing information about market prices to improve the conditions at which small farmers in developing countries can sell their products and b) creating "trade" places to reduce the waste of food. A second line of research is understanding factors and approaches that allow to systematically address sustainability aspects in the software development process. This is another significant issue to address problems related to long-term sustainability of ICT4D solutions.

*Unit composition*

|  | *2011 (as of Jan 1st)* | *2012 (planned)* |
|---|---|---|
| Research directors |  | 1 |
| Senior researchers | 1 |  |
| Researchers (including postdocs, etc.) | 1 | 1 |
| Technologists |  | 1 |
| PhD students | 3 + 1 (*) | 5 + 1 (*) |
| Total | 6 | 9 |
| Tenured | 1 | 1 |
| Tenure track |  | 1 (**) |

Note: "Research directors" are level 1 researchers; "Senior researchers" are level 2 researchers. Category "Researchers" covers all other cases, including level 3 and 4 researchers, postdocs and other contractual forms used to enroll researchers.

(*) One resource paid by the University of Bolzano.

(**) the resource on tenure track is expected to be tenured in 2012

OTHER REMARKS. The numbers above do not include the following resources:

- 1 collaborator @ 20% of time
- 1 student @ 20% of time
- 3 MSc students (planned graduation March 2012)

*Top researchers by citations (max. 5)*

| *Researcher* | *H-index* | *Citations (total)* |
|---|---|---|
| Adolfo Villafiorita | 12 | 436 |
| Komminist Weldemariam | 5 | 60 |

## 2.  Recent publications

*Editor*

−   R. Popescu-Zeletin, I. A. Rai, K. Jonas, and A. Villafiorita, editors. E-Infrastructures and E-Services on Developing Countries: Second International ICST Conference, AFRICOMM 2010, Cape Town, South Africa. LNICST, Springer, October 2011.

*Journals*

−   Komminist Sisai Weldemariam, Adolfo Villafiorita Monteleone, Procedural Security Analysis: A Methodological Approach. In «THE JOURNAL OF SYSTEMS AND SOFTWARE»,vol. 84, n. 7,2011, pp. 1114-1129

−   Komminist Sisai Weldemariam, Richard A. Kemmerer, Adolfo Villafiorita, Formal Specification and Verification of an e-voting System: An experience Re-

port. In «THE JOURNAL OF SYSTEMS AND SOFTWARE»,vol. 84 , n. 10,2011, pp. 1618-1637

*Book Chapters*

− Luca Cernuzzi, Magalí González, Marco Ronchetti, Adolfo Villafiorita, Komminist Weldemariam, Experiences in e-Governance from an ICT4G Perspective: Case Studies and Lesson Learned,. In Dr. Danilo Piaggesi, Dr. Kristian J. Sund and Dr. Walter Castelnovo (eds.),Global Strategy and Practice of e-Governance: Examples from Around the World,Washington D.C.,IGI Global ,2011,pp. 407-423

*Conferences and Workshop*

− Birhanu Eshete, Adolfo Villafiorita, Komminist Weldemariam,Malicious Website Detection: Effectiveness and Efficiency Issues. IEEE Computer Society, 2011, pp. 121-124 (Proceedings of the 1st SysSec Workshop in conjunction with the Eighth Conference on Detection of Intrusions and Malware & Vulnerability Assessment ,Amsterdam, The Netherlands).

− Birhanu Eshete, Adolfo Villafiorita, Komminist Weldemariam, Early Detection of Security Misconfiguration Vulnerabilities in Web Applications. IEEE Computer Society, 2011, Proceedings of the Sixth International Conference on Availability, Reliability and Security (ARES 2011).

− Ali Fawzi Najm Al-Shammari, Komminist Weldemariam, Adolfo Villafiorita, Sergio Tessaris, Vote Verification through Open Standard: A Roadmap. IEEE Computer Society, Proceedings of the Workshop on Requirements Engineering for E-voting System (REVOTE), in conjunction with the RE2011, Trento, Italy 2011.

− Aaron Ciaghi, Komminist Weldemariam, Adolfo Villafiorita, Law Modeling with Ontological Support and BPMN: a Case Study. 2011 International Conference on Technical and Legal Aspects of the e-Society, Gosier, Guadeloupe, France, February 23-28, 2011.

− Komminist Sisai Weldemariam, Adolfo Villafiorita, A Formal Methodology for Procedural Security Assessment. 2011, pp. 146-171, International Conference on Digital Society, Gosier, Guadeloupe, France, February 23-28, 2011.

− Valentino Sartori, Birhanu Mekuria Eshete, Adolfo Villafiorita, Measuring the Impact of Different Metrics on Software Quality: a Case Study in the Open Source Domain. 2011, pp. 172-177, International Conference on Digital Society, Gosier, Guadeloupe, France, February 23-28, 2011.

− Aaron Ciaghi, Adolfo Villafiorita, Lourino Chemane, Macueve Gertrudes, Stimulating Development Through Transnational Living Labs: the Italo-Mozambican Vision. IST-Africa 2011 Conference Proceedings, 2011, IST-Africa 2011,Gabarone, Botswana, 11 - 13 May, 2011.

Top Publications in the period 2009-2011:

− Komminist Weldemariam, Richard A. Kemmerer, Adolfo Villafiorita: Formal analysis of an electronic voting system: An experience report. Journal of Systems and Software 84(10): 1618-1637 (2011)

− Komminist Weldemariam, Adolfo Villafiorita: Procedural security analysis: A methodological approach. Journal of Systems and Software 84(7): 1114-1129 (2011)

− Adolfo Villafiorita, Komminist Weldemariam, Roberto Tiella: Development, formal verification, and evaluation of an E-voting system with VVPAT. IEEE Transactions on Information Forensics and Security 4(4): 651-661 (2009)

− M. Bozzano and A. Villafiorita. Design and Safety Assessment of Critical Systems - A formal methods perspective. CRC Press (Taylor and Francis), an Auerbach Book, 2010.

The unit is still capitalizing work the area of e-voting and collaborations with other Universities such as the University of California, Santa Barbara (UCSB) and Politecnico di Milano. Some publications in the area of ICT4D demonstrate some first achievements in the area.


## 3.    Objectives for 2012

The objectives for 2012 are related to consolidating the position of the unit. In particular we envisage the following goals:

**O1: Concrete impact with the MLL.** Some of the way in which this goal can be concretized include: development and experimentation of a solution in Mozambique; some initial areas of investigation include applications for rural areas such as vaccination reminder systems and information systems in agriculture. Consolidation of the MLL initiative by finding external financial resources to sustain the MLL over the third year. Consolidation of the Summer School of ICT, laying out the foundation to make it become a major event in Mozambique/Southern Africa.

**O2: Diversification of the financial resources.** The unit depends uniquely on the MLL as the main source of financing. Even though incomes are significative, the unit needs to diversify income source to guarantee a sound and robust financial management after 2013.

The unit additionally setting the following internal goals to further consolidate its positioning:

**O3: Consolidation of collaborations with Addis Ababa Computer Science Department (AAU-CS), with the School of Engineering and Information Technology at Adama University (Ethiopia) and with the Eduardo Mondlane University.** In Ethiopia we intend to work with AAU-CS on common development projects, setting up a living lab (either self financed or sustained by international donors). With the School of Engineering and Information Technology at Adama University we intend to work on the definition of a Master Program in Computer Science. The school has incomes from major German foundations (e.g., from the

German Academic Exchange Service - DAAD) and other international donors for establishing the Masters program in Adama (Ethiopia).

**O4: Consolidation of the unit in the RHoK (Random Hacks of Kindness) network**. This will be achieved with the organization of two RHoK hachathons in 2012. Although getting in the network is relatively easy, the actual goals is increasing our role and credibility, by ensuring a good participation and, more importantly, by consolidating the development of the solutions started during the hackhaton. The participation to the network is relevant for the visibility it offers, to have a chance to actually contribute and as a place to exchange ideas to address emergencies and foster development.

**O5: Consolidation in the research network,** with particular reference to eAgriculture, with two visits to be performed by Komminist Weldemariam and Aaron Ciaghi in top research centers (e.g. Georgia Tech, USA and Rhodes University, South Africa).

Finally, as the critical mass of the unit has increased recently, it will be necessary to give further structure to the group moving to a situation in which there is more organization and specialization of resources.

## 4.   Front Edge & New Initiatives

The recent publication of a work in the area of metrics for laws at conference in the area (Jurix 2011) has opened up the opportunity for the group to further investigate the area and consolidate the position.

In 2012, the unit will consolidate its analysis of the Italian body of laws (which is available on the Internet at http://ict4g.org/) and work on the development of an interactive tool to analyze the laws made available through the Normativa website.

Financing opportunities for this line of activity will be investigated in 2012. Some opportunities rely on collaborations with NGOs in the areas of eTransparency.

## 5.   Funding

| Acronym | Full name | Type | Duration | Total income | Income 2012 |
|---------|-----------|------|----------|--------------|-------------|
| MLL | Maputo Living Lab | PAT | 2011-2013 | 803000 | 265000 |

As highlighted in Section 3, although the MLL is providing a significant financing, diversification of the sources of income is an important step in further strengthening the unit.

## 6.   Budget

|  | 2011 | 2012 |
|---|---|---|
| Expenses |  |  |
| Personnel | € 203,19 | € 216,35 |
| Travel | € 22,40 | € 19,00 |
| Equipment (HW/SW) | € 23,80 | € 4,00 |
| Other (e.g. subcontracting to external con-tractors) | € 308,00 | € 343,58 |
| Total Expenditure | € 557,39 | € 582,93 |
| Incomes |  |  |
| EU Projects (total amount financed by EU) | € 0,00 | € 0,00 |
| Other external incomes (industrial, PAT projects, etc.) | € 0,00 | € 294,87 |
| Projects to be finalized | € 295,90 | € 0,00 |
| Total Income | € 295,90 | € 294,87 |
| Financial Need (Total Income – Total Ex-penditure) | € 261,49 | € 288,06 |
| Self funding | 53,1% | 50,6% |

Note: Column 2011 is based on the unit's budget state as estimated at the date of document writing. Column 2012 is the budget planned for 2012

## NILAB – NEUROINFORMATICS LABORATORY

Head of Unit: Paolo Avesani

## 1. Summary and vision

NILab is a laboratory devoted to neuroinformatics raised as a joint initiative of Fondazione Bruno Kessler and University of Trento. The laboratory is located in Mattarello at the Center for Mind and Brain Sciences (CIMeC). Neuroinformatics is mainly concerned with the data analysis and data management for neuroscience. Currently the activities of NILab are focused on computational methods for brain data interpretation.

The main effort of NILab is devoted to research. The goal is to advance the computational methods for brain data interpretation. More in detail the orientation is to investigate how machine learning approaches might provide competitive advantages in neuroscience investigations. The ambition is to cover the wide range of heterogeneous sources of brain data that are managed at CIMeC as fMRI, DW-MRI, MEG, EEG, TMS.

The research agenda includes three main challenges that are recognized as the most prominent by the scientific community: multivariate brain mapping, real-time brain decoding, functional and structural brain connectivity. The first challenge is concerned with the design of computational methods for whole brain multi-voxels pattern analysis; the second challenge aims to deliver a learning model to perform brain decoding in real-time, creating the premise for an adaptive protocol of stimuli; the third challenge is dealing with the issue of joint analysis of functional and structural data that should become viable using a relational learning approach.

The open challenge is to devise an effective multidisciplinary collaboration with the researchers working at CIMeC on a broad scope of areas as cognitive neuroscience, social neuroscience, neuroeconomics. Special attention is devoted to the collaboration with CERIN, a research institute on health care devoted to cognitive rehabilitation. The ultimate goal is to deliver computational methods that might be beneficial for the diagnosis or the treatment of patients.

The research activities of the next year will involve collaborations with James Haxby, Darmouth, USA; Eleftherios Garyfallidis, University of Cambridge, UK; Giorgio Coricelli, CNRS, Lyon, France; Gabriele Miceli, CERIN, Italy; Larry Manevitz, University of Haifa, Israel.

*Unit composition*

|                     | *2011 (as of Jan 1st)* | *2012 (planned)* |
|---------------------|------------------------|------------------|
| Research directors  |                        | 1                |
| Senior researchers  | 1                      |                  |

| | | |
|---|---|---|
| Researchers (including postdocs, etc.) | 2 | 2 |
| Technologists | | |
| PhD students | 3 | 3 |
| Total | 6 | 6 |
| Tenured | 2 | 3 |
| Tenure track | 1 | |

Note: "Research directors" are level 1 researchers; "Senior researchers" are level 2 researchers. Category "Researchers" covers all other cases, including level 3 and 4 researchers, postdocs and other contractual forms used to enroll researchers.

*Top researchers by citations (max. 5)*

| Researcher | H-index | Citations (total) |
|---|---|---|
| Paolo Avesani | 19 | 1616 |
| Diego Sona | 9 | 248 |
| Emanuele Olivetti | 6 | 145 |

## 2. Recent publications

| year | Jour. Papers | Jour. Papers (IF) | Top Journal (*) | Q1 (%) | Q2 (%) | Q3 (%) | Q4 (%) | Conf. Papers | ERA A | ERA B | ERA C | ERA D | Books (authored) | Books (edited) | Chapters in Book | Literature Reviews | Transl. (book) | Transl. (essay) | Transl. (article) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2011 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2010 | 1 | 1 | 0 | 33 | 67 | 0 | 0 | 4 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 2009 | 2 | 1 | 0 | 0 | 0 | 100 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| 2008 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

The data reported in the table don't include two publications currently in press on international journals with impact factor. Neuroinformatics is a relatively recent discipline that stands in between computer science and neuroscience. There is still an emerging effort to aggregate the community around a reference international event. For this reason the conferences covering the topics of neuroinformatics are not yet indexed by initiatives like ERA. It is worthwhile to remark that the activity of NILab started from scratch on 2008 and for this reason the publication rate is low despite its growing rate.

Top 5 publications in the last 3 years (2009-2011):

− Emanuele Olivetti, Sriharsha Veeramachaneni, Ewa Nowakowska, *Bayesian hypothesis testing for pattern discrimination in brain decoding*, in «PATTERN RECOGNITION», vol. 45 (in press) [UGOV: 39992]

− Emanuele Olivetti, Paolo Avesani, 2011, Supervised Segmentation of Fiber Tracts, Springer, (International Workshop on Similarity-Based Pattern

Analysis and Recognition, da 09/28/2011 a 09/30/2011 Venice, Italy) Lecture Notes in Computer Science (LNCS) [UGOV: 39993]

– Paolo Avesani, Hananel Hazan, Ester Koilis, Larry Manevitz, Diego Sona, 2011, Learning BOLD Response in fMRI by Reservoir Computing, pp. 57- 60 (IEEE International Workshop on Pattern Recognition in NeuroImaging, 16- 18 May 2011 Seoul, Korea) [UGOV: 34397]

– Diego Sona, Emanuele Olivetti, Paolo Avesani, Sriharsha Veeramachaneni, 2009, Learning to Interpret Cognitive States from fMRI Brain Images, in F. Masulli, Alessio Micheli, Alessandro Sperduti (eds.), Computational Intelligence and Bioengineering, IOS Press, Amsterdam, pp. 21- 3 [UGOV: 3454]

– Michael Hanke, Yaroslav Halchenko, Per Sederberg, Emanuele Olivetti, Ingo Freund, Jochem Rieger, Christoph Herrmann, James Haxby, Stephen Hanson, Stefan Pollmann, 2009 PyMVPA: A Unifying Approach to the Analysis of Neuroscientific Data, in «FRONTIERS IN NEUROINFORMA-TICS» [UGOV: 4556]

## 3. Objectives for 2012

The definition of objectives for 2012 follows two main concerns: the research contributions and the non scientific achievements. The former is organized along four main topics:

O1: **Methods for Brain Decoding**] Development of a method to support the task of brain induction in neuroscience studies based on machine learning. Brain decoding is becoming a strategic task not only in neurocognitive investigations but also in clinical diagnosis. Our goal is to improve the encoding of the classification problem and to approach the issues of learning a model from a non homogeneous sampling of data. We plan to conclude an ongoing work by submitting a paper to an international journal and to submit some new preliminary results to an international conference.

O2: **Methods for Brain Induction**] Development of a method to support the task of brain induction in neuroscience studies based on machine learning. In cognitive neuroscience the ultimate goal is to perform hypothesis testing. The literature lacks of methods to properly test hypothesis upon the results of a classifier, overall when few data are available. Our goal is to contribute to the best practice by defining sound methods for multivariate pattern analysis in neuroimaging. The plan is to submit some intermediate results to an international conference.

O3: **Methods for Brain Mapping**] Development of a method to support the task of brain mapping in neuroscience studies based on machine learning. The challenge is to develop computational method for detecting neural correlates without the restriction of prior assumptions on haemodynamic response for fMRI. Our goal is to develop a model-free method that should allow for brain mapping in clinical studies where it is difficult to rely on default haemodynamic response. We plan to submit a paper to an international journal as progress of our previous research effort.

O4: **Methods for Brain Connectivity**] Development of a method to support the task of fiber tracts segmentation based on machine learning for studies of structural brain connectivity. Manual annotation of tracts is a complex and time consuming task. Currently available methods support only an unsupervised segmentation of main tracts. Our goal is to develop a supervised learning approach to enable the segmentation of the tracts of interests. We plan to submit a paper to an international journal.

Concerning the non scientific activities our effort will be focused on:

O5: **Impact on Local Community**] We are establishing a collaboration with the Department of Neurology and Neurosurgery of the Hospital of S.Chiara in Trento. The main purpose is to contribute to the current effort of improving the clinical research activity of APSS. We plan to work both on methods and tools. From the point of view of research we will approach the issue of building brain maps for longitudinal studies that are taking place in a joint project of NILab, LNIF and APSS. In addition we are promoting a pilot study to support the remote data analysis of clinical studies. This second effort is in collaboration with EnginSoft.

O6: **Fund raising**] The objective is to approach the issue of sustainability of the research activities of the laboratory. After the bootstrapping of the laboratory we need to begin to spend the scientific reputation acquired in the last years by a more robust action of fund raising. We plan to pursue research grants for PhD scholarships or Postdoc. An additional line of action is to join project devoted to support the clinical studies.

## 4.  Front Edge & New Initiatives

During the next three years we are planning to promote a preferential relationship with the Italian Institute of Technology, more in details with the Department of Computer Imaging. The competences developed at NILab are of interest for the research on neuroscience and brain technologies that are taking place at IIT. As a preliminary action, a workshop will be organized to illustrate the research that are being carried on in the two laboratories. The next action will be the definition of a program for student visiting. The final objective is to work on a definition of a joint research project and to apply for funds. For this purpose one of the tenured researcher of the laboratory is taking a temporary leave and is currently a visiting scientist at IIT.

## 5.  Funding

| Acronym | Full name | Type | Duration | Total income | Income 2012 |
|---------|-----------|------|----------|--------------|-------------|
|         | Integrazione di metodiche di neuroimaging avanzato e di assessment neuropsicologico per la | PAT | 1/1/2012-31/12/2013 | € 3.000,00 | € 3.000,00 |

| | valutazione del recupero funzionale dopo interven- to neurochirurgico | | | | |
|---|---|---|---|---|---|

Fund raising is critic for neuroinformatics. The European Framework Programme doesn't cover this discipline that is mainly funded by national programme. Countries as Germany, France, Sweden and United Kingdom have a very rich research program on neuroscience and neuroinformatics. The International Neuroinformatics Coordinating Facilities (INCF), the international reference agency for the scientific research in neuroinformatics, doesn't manage research grant since the premise is that research activity is funded at the national level. Italy doesn't provide any resource for neuroinformatics.

The funded project on clinical study is a collaboration with APSS. The budgets for projects in health care are quite small. The choice to join this project is mainly concerned with the objective of increasing the impact of our research on local community by supporting advances in clinical studies of APSS. Other minor sources of funding are represented by travel grants. We have been awarded with two on 2011.

We have three project proposals currently under evaluation, respectively at the european level, at the national level and at the local level. In collaboration to the University of Oslo, Norway, and the University of Goettingen and the University of California Santa Barbara we have submitted the project proposal TILLIT to the FET EU Program., an interdisciplinary between computer science, brain science and economics. A further project proposal has been submitted to the Ministry of Foreign Affairs in collaboration with the University of Haifa: DAFF - Data-driven Analysis for fMRI Data in Clinical Studies via Machine Learning Tools. Notification of evaluation is expected at the end of the year. Before the end of the year we should conclude the negotiation of a project with the Department of Innovation of PAT. The project is concerned with a cloud-based service to support the data analysis of neurological and neurosurgery studies that are taking place at the Hospital S. Chiara. The project is a joint initiative with CIMeC, DISI, Create0Net and the APSS.

Some other initiatives are already taking place and will be submitted at the beginning of the next year, January 2012. The first is a project proposal for a FESR call. The consortium includes EnginSoft and the DISI of University of Trento. The focus is scientific computing for clinical studies in neuroscience. The second proposal is concerned with the Marie Curie Actions for Innovative Doctoral Programme. There is a joint effort with the ICT PhD School of DISI and the COBRAS PhD School of CIMeC to apply for PhD scholarships.

## 6.  Budget

The 90% of the budget is composed by the cost of personnel and for the PhD scholarships. The investment on hardware in 2012 has been reduced after the acquisition of several blades as part of Kore, the scientific computing facility of FBK. Furthermore the cost of upgrading the current workstations will be charged to

CIMeC, as part of the formal agreement that is going to be renewed at the end of the current year. The budget for travels is according to the objectives declared in the plan.

|  | 2011 | 2012 |
|---|---|---|
| Expenses | | |
| Personnel | € 228,45 | € 229,74 |
| Travel | € 12,00 | € 8,00 |
| Equipment (HW/SW) | € 4,50 | € 2,50 |
| Other (e.g. subcontracting to external contractors) | € 64,90 | € 63,90 |
| Total Expenditure | € 309,85 | € 304,14 |
| Incomes | | |
| EU Projects (total amount financed by EU) | € 0,00 | € 0,00 |
| Other external incomes (industrial, PAT projects, etc.) | € 30,00 | € 0,00 |
| Projects to be finalized | € 0,00 | € 0,00 |
| Total Income | € 30,00 | € 0,00 |
| Financial Need (Total Income – Total Expenditure) | € 279,85 | € 304,14 |
| Self funding | 9,7% | 0,0% |

Note: Column 2011 is based on the unit's budget state as estimated at the date of document writing. Column 2012 is the budget planned for 2012.

## 7. Remarks

The formal agreement to sustain NILab as joint initiatives of FBK and the University of Trento is going to be renewed at the beginning of 2012. Some parts of this workplan might be modified according to the contents of the new upcoming agreement.

**E-HEALTH**

Head of Unit: Stefano Forti

## 1.    Summary and vision

Industrialized countries are facing new challenges in the health care sector due to the percentage growth of the elderly population, the increase in chronic pathologies, the growing request for high quality health care services and their increased costs, and citizens' demand to be more involved and play an active role in the their own care. In this context e-Health research and innovation unit aims at the promotion of innovation at local and national level in the domain of health and healthcare through scientific projects aimed at introducing in the daily life of citizens and in the clinical practice innovative e-health services, involving public and private stakeholders of healthcare domain. This scope is achieved by a multidisciplinary group conducting research on methods and models for the design, implementation and evaluation of prototypic applications and ICT-based innovative services that support the management and sharing of data, information and knowledge in healthcare domain. These aims are achieved through the adoption of a "living lab approach" that considers real-life contexts as the privileged loci of both analysis and experimentation. The activities of applied research and innovation focus on:

– the support of personal health (and wellbeing) information management in everyday life through the design of citizen-controlled digital platforms to enable collecting, accessing, managing and sharing with care providers and caregivers health-related data;

– the support of collaboration among healthcare professionals in technologically dense health settings (e.g. hospital departments) through the introduction of ICTs aimed at facilitating information sharing and knowledge dissemination;

– evaluation of applications in laboratory and on-the-field (also of systems adopted in real clinical settings but not designed in the unit).

With respect to the state of art in this field, our aim is to expand the notion of "living lab" moving from a conception where it is considered as the "space where innovation is tested" to take into account the social, organizational and institutional aspects that play a role in the success or failure of a new ICT. In this respect, the unit activities' are characterized by a prolonged commitment to each project in order to assess the long term effects on the field of the deployment of new ICTs.

In the last year we have deployed a citizen-controlled platform that allows the management personal health information management. The tool is currently being tested by 500 people and the experimental phase has ended with a decision to move to production, in charge of the local healthcare authority.

In the near future two main challenges need to be addressed in the field of healthcare provision. On the one had ethical and economic issues push toward favoring the citizens empowerment, providing them the tools to interact with clini-

cians, support family members and take autonomous decisions regarding their health. On the other hand the provision of a evidence-based, cost effective, high quality care in healthcare organization push toward what is called the 'hospital of the future' in which different ICT devices seamlessly connected and embedded into the environment effectively help and support healthcare professionals in the provision of the best care and the integrated patient management between primary (GPs) and secondary care. In this framework our unit will be active in two distinct living labs set up to investigate three cases of chronic condition management (TreC) and new ICTs to support information management activities in a hospital setting (eOnco). The work will be conducted taking advantage of the distinct expertise in the fields of knowledge management in medicine, socio-organizational analysis and participatory design techniques.

*Unit composition*

|  | *2011 (as of Jan 1ˢᵗ)* | *2012 (planned)* |
|---|---|---|
| Research directors | 0 | 0 |
| Senior researchers | 1 | 1 |
| Researchers (including postdocs, etc.) | 2 | 2 |
| Technologist directors | 1 | 1 |
| Senior Technologists | 0 | 0 |
| Technologists | 6 | 4 |
| PhD students | 1 | 0 |
| Technicians | 1 | 1 |
| Total | **12** | 9 |
| Tenured | 0 | 0 |
| Tenure track | 0 | 0 |

Note: "Research directors" are level 1 researchers; "Senior researchers" are level 2 researchers. Category "Researchers" covers all other cases, including level 3 and 4 researchers, postdocs and other contractual forms used to enroll researchers.

*Top 5 researchers by H-index*

| *Researcher* | *H-index* |
|---|---|
| Claudio Eccher | 10 |
| Enrico Maria Piras | 2 |
| Elena Cardillo | 2 |

## 2.    Recent publications

| Year | Jour. Papers | Jour. Papers (IF) | Top Journal (*) | Q1 (%) | Q2 (%) | Q3 (%) | Q4 (%) | Conf. Papers | ERA A | ERA B | ERA C | ERA D | Patents | Books (authored) | Books (edited) | Chapters in Book | Literature Reviews | Transl. (book) | Transl. (essay) | Transl. (article) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| In print | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2011 | 3 | 2 | 0 | 0 | 0 | 100 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 |
| 2010 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 |
| 2009 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 0 | 2 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 2008 | 1 | 1 | 0 | 100 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |

Top 5 publications in the last 3 years (2009-2011):

−    Chiara Cantaloni, Eugenia R. Tonini, Claudio Eccher, Luca Morelli, Elena Leo-nardi, Emma Bragantini, Daniela Aldovini, Silvia Fasanella, Antonella Ferro, Daniela Cazzolli, Gabriella Berlanda, Paolo Dalla Palma, Mattia Barbareschi, Diagnostic Value of Automated Her2 Evaluation in Breast Cancer : A Study on 272 Equivocal (score 2+) Her2 Immunoreactive Cases Using an FDA Appro-ved System, in «APPLIED IMMUNOHISTOCHEMISTRY AND MOLECULAR MORPHOLOGY», vol. Epub ahead of print, 2011

−    Piras, E.M., A. Zanutto. 2011. Emotions and Personal Health Information Management: some Implications for Design. A. Moen, S.K. Andersen, J. Aarts, P. Hurlen, eds. User centered networked care. IOS Press, 63-67.

−    Piras, E.M., A. Zanutto. 2010. Prescriptions, X-rays and Grocery Lists. Design-ing a Personal Health Record to Support (The Invisible Work Of) Health Infor-mation Management in the Household. Computer Supported Cooperative Work 19(6) 585-613.

−    Claudio Eccher, Andreas Seyfang, Antonella Ferro, Silvia Miksch, Updating a Protocol-based Decision-Support System's Knowledge Base: a Breast Cancer Case Study, in David Riano, Annette ten Teije, Silvia Miksch, Mor Peleg (eds.), Knowledge Representation for Health-Care ECAI 2010 Workshop KR4HC 2010, Lisbon, Portugal, August 17, 2010, Revised Selected Papers, (Lecture Notes in Computer Science), Berlin, Heidelberg,Springer Verlag, 2011, pp. 126-138

−    E. Cardillo, L. Serafini, A.Tamilin: A Methodology for Knowledge Acquisition in Consumer-oriented Healthcare. In Knowledge Discovery, Knowledge Engi-neering and Knowledge Management, CCIS, vol.128, part 3, pp. 249-261. Springer Heidelberg, 2011

## 3.    Objectives for 2012

For the future, the objectives of the applied unit are on three directions. First, an greater involvement of the other FBK research units in innovation projects, especially to propose more advanced solutions (this objective can be reached in the near future, once Trec basic infrastructure is built, deployed and tested). Second, actions to support the export of outcomes outside the local territory, mainly at national level. Third, actions devoted for positioning the activities of eHealth unit in the international and European context (i.e EU projects).

**O1: Research on chronic disease management (TreC).** We aim at deploying and evaluating a shared module of TreC (Cartella Clinica del Cittadino) to allow patients to keep track and share in real time some parameters and information among the network of care and test the application in contexts with different complexities in terms disease management, level of patient autonomy and range of care network. Three clinical conditions have been selected to run small-scale living labs (5-7 patients each): diabetes, chronic heart failure, youth asthma. Qualitative requirement analysis and an in-between fine tuning of the needs of both patients and care providers will be performed. The project will end with the evaluation of the user experience, organizational consequences and clinical outcomes. Outcomes expected are the improvement of patient-caregivers and patient-doctor communication plus new insights to develop other chronic management tools. The overall objective is to provide the local healthcare authority all the information to move from the living lab to a service.

Fund Raising: LOTO (Ministry of Health), TreC_2 ()

**O2: Medical terminologies creation and integration.** Development of semantic-based resources oriented both to citizens (managing healthcare data, reading clinical documents, editing clinical history) and physicians (communication with patients, encoding Reason For Encounter in records). Providing semantic-oriented resources for physicians and citizens, based on the use of Semantic Web technologies will help bridging the linguistic gap between them and, when integrated into consumer- or clinical-oriented applications, will allow knowledge services, semantic annotations, and automated reasoning. The activities planned to this aim will include: updating of the already developed Italian consumer-oriented medical vocabulary (ICMV) to integrate it with the TreC system; semantic integration of existing standard medical terminologies and classification systems used by physicians and other healthcare providers, both between them to help physicians during the transcodifications process in their clinical records, and with the ICMV. Another activity will be the creation of a Multilingual Reference Terminology, linked to multilingual end-user terminologies, for the general practice and the pharmacological domain

Fund Raising: SafeTherapyMobile: realizzazione di una piattaforma mobile per la gestione del rischio e la somministrazione sicura della terapia in pazienti Oncologici (FESR)

**O3: Clinical care process representation and support (JRP e-Onco).** The aim of the project is to test and validate a mixed qualitative-formal methodology to ana-lyse and represent workflow in complex clinical setting and to design prototypical applications to support it. The method proposed integrates qualitative techniques typical of qualitative social science research (ethnography and semi-structured in-terviews) and formal modeling through the use of collaborative software already validated (Moki). Building on the work done in 2011, in which a living lab approach was adopted in a local oncological department, the objective for 2012 is to enrich the workflow models with semantic annotations, validate them with the healthcare professionals involved and run simulations on them to establish intervention areas through the design of supportive technologies. The outcomes expected are both the validation of the methodology proposed and the prototyping of information management tools for the selected setting.

Fund Raising: Acquisition of grants from EU

## 4.   Funding

| Acronym | Full name | Type | Duration | Total income | Income 2012 |
|---------|-----------|------|----------|--------------|-------------|
| LOTO | Confronti e scenari applicativi di modelli di cura domiciliare, a diversa intensità, rivolti al paziente cronico che si pos-sono avvalere della telemedicina. Loro efficacia, impatto economico e soste-nibilità regionale, con focus sullo scompenso cardia-co cronico e sue comorbidità in LOmbardia e in TO-scana. | Health Ministry | 1/1/2012-31/12/2012 | € 60.000,00 | € 60.000,00 |
| SafeTherap yMobile | Realizzazione di una piattaforma mobile per la ge-stione del rischio e la somministrazione sicura della terapia in pazienti Oncolo-gici | PAT | 1/1/2012-31/06/2013 | € 45.000,00 | € 35.000,00 |

## 5.  Budget

|                                                          | 2011       | 2012      |
|----------------------------------------------------------|------------|-----------|
| Expenses                                                 |            |           |
| Personnel                                                | € 546,43   | € 506,41  |
| Travel                                                   | € 22,00    | € 15,00   |
| Equipment (HW/SW)                                        | € 20,00    | € 15,00   |
| Other (e.g. subcontracting to external contractors)      | € 635,80   | € 55,00   |
| Total Expenditure                                        | € 1.224,23 | € 591,41  |
| Incomes                                                  |            |           |
| EU Projects (total amount financed by EU)                | € 0,00     | € 0,00    |
| Other external incomes (industrial, PAT projects, etc.)  | € 608,73   | € 0,00    |
| Projects to be finalized                                 | € 0,00     | € 215,00  |
| Total Income                                             | € 608,73   | € 215,00  |
| Financial Need (Total Income – Total Expenditure)        | € 615,50   | € 376,41  |
| Self funding                                             | 49,7%      | 36,4%     |

Note: Column 2011 is based on the unit's budget state as estimated at the date of document writing. Column 2012 is the budget planned for 2012.

In the past years (2008-2011), the amount of self-funding has been mainly derived from TreC project. Trec project will end in December 2011 (a second phase of the project will be probably founded in 2012) and this explains the minor percentage of self funding for 2012. In 2012, a greater effort will be devoted to actions for positioning the unit in the international and European context (i.e EU projects)

# ECT* – European Centre for Theoretical Studies in Nuclear Physics and Related Areas

Director: Prof. Achim Richter

## 1.    Summary and vision

The European Centre for Theoretical Studies in Nuclear Physics and Related Areas (ECT*) grew from a concerted action of the European Nuclear Physics community. It started operating in 1993 and has since developed into a very successful research center for nuclear physics in a broad sense, promoting contact between theorists and experimentalists, providing support for ongoing or planned experimental programs, and playing an increasingly important role in the training of young researcher. The objectives of the European Centre for Theoretical Studies in Nuclear Physics and Related Areas (ECT*) concern fundamental research. With hundreds of scientific visitors, growing every year (534 in 2008, 648 in 2009, 782 in 2010 and an estimated number of 872 in 2011), from all over the world, spending from a week to several months at the Centre, ECT* has achieved high visibility and a coordinating function in the European and international scientific community by holding

− Workshops and Collaboration Meetings on topical problems at the forefront of contemporary developments in nuclear physics and related areas like astrophysics, condensed matter physics and quantal physics of small systems,

− Doctoral Training Programs for talented young physicists,

and by fostering

− Research done by an in-house group of Postdoctoral Fellows and Senior Research Associates together with visitors and physicists elsewhere.

Furthermore, since 2009 ECT* administers scientifically a research and development project named

− AURORA, which consists of interdisciplinary proposals that explore the architectural opportunities for high performance computing (HPC) systems optimized for a limited number of highly relevant scientific computing applications in physics, biology, genomics and radiation therapy. It is a joint PAT/INFN project involving several local and national institutions and is furthermore embedded into the European scene of HPC.

ECT* is unique and the only center of its kind in Europe. It is similar in scope and mission to the Institute for Nuclear Theory in Seattle, USA. It is an institutional member of NuPECC, the Associated Nuclear Physics Expert Committee of the European Science Foundation. It also was recognized within the fifth and sixth EU programs as a « Major Research Infrastructure », and since 01/01/09 is recognized and supported as a Transnational Access Activity and from 01/09/10 on also as a member of a Joint Research Activity within the FP7 program of the EC. It has for-

merly been operating as a "Marie Curie Training Site" for several years. For all these reasons ECT* is highly appreciated by the large community of its users and its Scientific Board has recently conducted a reflection on the future of the Centre. This is summarized in a short document ("ECT* in 2020 – A Vision") that was circulated among the ECT* associates for comments and input and is available on the ECT* web site. This document will serve as a guideline for strategic planning over and above the present period of 2009 – 2013.

ECT* has its own Statutes, which have been endorsed by the European Science Foundation and by the FBK. The Scientific Policy of ECT* is decided by an internationally assembled Scientific Board. As stipulated in the Statutes the scientific goals of the ECT* are:

− to arrange in-depth research on topical problems at the forefront of contemporary developments in theoretical nuclear physics

− to foster interdisciplinary contacts between nuclear physics and neighbouring fields such as particle physics, astrophysics, condensed matter physics, statistical physics and the quantal physics of small systems

− to encourage talented young physicists by arranging for them to participate in the activities of the ECT*, by organizing training projects and establishing networks of active young researchers

− to strengthen the interaction between theoretical and experimental physicists .

These benchmarks are reached through the following scientific activities : international workshops and collaboration meetings, advanced doctoral training programs, and research carried out by postdoctoral fellows and research associates as well as long term visitors, interacting closely with the director and the researchers of the centre. Research collaborations exist also with the Physics Department and the Center for Bose-Einstein Condensation (BEC) at the University of Trento. There are further agreements with other scientific institutions worldwide, in particular with the ICTP in Trieste which allows its visitors to spend time at ECT*, and with the Extreme Matter Institute (EMMI) in Darmstadt which provides partial support for two workshops per year.

The gradual emergence of a European Research Area (ERA) and growing international coordination ECT* faces new opportunities and challenges. Significant European and global investments are made presently in accelerator and other experimental facilities. Their efficient utilization requires good coordination and exchanges of ideas – experiments stimulating theory and *vice versa*. Interdisciplinary contacts between the various subfields covered by ECT* and with related areas of physics and science is beneficial to all parties.

The ECT* workshop program has developed very successfully and already serves many of these needs. The unifying Europe and global research scene motivate further strengthening and innovation:

− More proactive measures, whereby ECT* as an ideal meeting ground identifies the need for workshops on specific topics, and makes them happen.

− ECT* as a place of choice for collaboration meetings of experimental and theoretical research groups of various sizes.

−    An active visitor program, including physicists who work in areas related to ongoing training activities at ECT*.

−    Cross-disciplinary activities of nuclear physics with other fields of physics.

The benefits for the ERA are therefore:

−    ECT* furthers the mobility of frontline researchers within and to Europe.

−    ECT* generates future leaders of research. Its fixed-term faculty forms a talent pool for universities and laboratories.

The prerequisite for reaching all these ambitious goals of the research program and for guaranteeing and still improving the present high performance of ECT* requires:

−    Fixed term competitive positions at the Research Associate and Postdoctoral level,

−    An administrative framework and a fully developed infrastructure for an optimal operation of the Centre,

−    A fully developed infrastructure, and

−    A continuing financial support from the FBK, European research councils and EU programs.

Finally it should be stressed that Europe faces a shortage of skilled scientists. To improve the situation in the years to come ECT* will thus increasingly support the training of PhD students and Postdocs through lecture courses and visits.

−    Extended training periods in topical areas. Students attend lectures, are guided by ECT* scientists and participate in workshops during their stay. They are provided with office space and encouraged to pursue also their own research work.

−    Promotion of joint research projects between its researchers and physicists elsewhere. In the context of such projects ECT* senior researchers may serve as co-supervisors of PhD students at European universities.

*Unit composition*

|  | 2011 | 2012 (planned) |
|---|---|---|
| Research director | 1 | 1 |
| Senior researchers | 1 | 2 |
| Researchers (including postdocs, etc.) | 9* | 8* |
| Administrative Staff and Technologists | 7 | 7 |
| PhD students (Fellowship at Unitn) | 0 | 1 |
| Total | 18 | 19 |
| Tenured | 6 | 6 |
| Tenure track | 2** | 2** |

Note: "Research directors" are level 1 researchers; "Senior researchers" are level 2 researchers. Category "Researchers" covers all other cases, including level 3 and 4 researchers, postdocs and other contractual forms used to enroll researchers.

\* Including Dr. Marco Cristoforetti and Dr. Luigi Scorzato who are both supported through the Aurora Project.

\*\* The positions of tenure track are the ones of Gian Maria Ziglio (according to statement "Essenzialità del termine/nullità del contratto" in his contract) and of Senior Research Associate Dr. Dionysis Triantafyllopoulos.

Note that the researchers (Research Director and Researchers) at ECT\* have collaboration contracts (two or three years contracts) and not permanent contracts except for Dr. Daniele Binosi who obtained a permanent contract in January 2011. He is in the category of Senior Researchers.

*Top researchers by citations (max. 5)*

| Researcher | H-index | Citations (total) |
|---|---|---|
| Achim Richter | 51 | 13467 |
| Luigi Scorzato | 20 | 1536 |
| Daniele Binosi | 20 | 1396 |
| Dionysis Triantafyllopoulos | 20 | 1231 |
| Alexis Diaz-Torres | 16 | 640 |

## 2.  Recent publications

| Recent Publications | | | | |
|---|---|---|---|---|
| Year | Jour. Papers | Jour. Papers (IF) | Top Journal | Books Authored |
| In print | 3 | 3 | 1 | 0 |
| 2011 | 23 | 21 | 3 | 0 |
| 2010 | 29 | 27 | 8 | 1 |
| 2009 | 17 | 17 | 0 | 0 |
| 2008 | 12 | 12 | 0 | 0 |

The number of journal papers in 2011 is still expected to increase since several articles are submitted and presently under peer review.

Top 5 publications in the last 3 years (2009-2011):

− D. Binosi, J. Papavassiliou, *Pinch Technique: Theory and Applications,* Phys. Rept. 479, 1 (2009), (92 citations) [UGOV: 38981]

− J. L. Albacete, N. Armesto, J. G. Milhano, C. A. Salgado, *Non-linear QCD meets data: A global analysis of lepton-proton scattering with running coupling BK evolution*, Phys.Rev.D80:034031 (2009), (61 citations) [UGOV: 39193]

− R. Baron, Ph. Boucaud, P. Dimopoulos, F. Farchioni, R. Frezzotti, V. Gimenez, G. Herdoiza, K. Jansen, V. Lubicz, C. Michael, G. Muenster, D. Palao, G.C. Rossi, L. Scorzato, A. Shindler, S. Simula, T. Sudmann, C.

Urbach, U. Wenger, *Light Meson Physics from Maximally Twisted Mass Lattice QCD*, JHEP 1008, 097 (2010), (54 citations) [UGOV: 38582]

- C. Aguilar, D. Binosi, J. Papavassiliou, J. Rodriguez-Quintero, Non-perturbative comparison of QCD effective charges, Phys.Rev.D80:085018 (2009), (53 citations) [UGOV: 38983]

- D. Binosi, J. Collins, C. Kaufhold, L.Theussl, *JaxoDraw: A graphical user interface for drawing Feynman diagrams. Version 2.0 release notes*, Comput.Phys.Commun. 180, 1709-1715 (2009), (42 citations) [UGOV: 39981]

## 3. Objectives for 2012

The scientific activities of ECT* concern fundamental research. As recalled above, these accompany the developments of nuclear physics in a broad sense, and occasionally concern cross-disciplinary topics. The choices of the various workshops and training programs are made by the Scientific Board in accord with the scientific director of the Centre. Both also decide about the main orientations of the research done at ECT* by selecting the research personnel and taking initiative in opening positions in specific areas.

Here the various goals of ECT* for 2012 described in some detail below are again summarized as follows:

- Workshops and collaboration meetings on topics at the forefront of physics

- Doctoral training programs for talented young researchers

- Research at the forefront of theoretical nuclear physics

- Foster interdisciplinary contacts between nuclear physics and neighboring research fields

- Strengthen the interaction between theoretical and experimental physicists

*International Workshops and Collaboration Meetings*

For 2012 the following fifteen projects are already approved:

*Scattering amplitudes: from QCD to maximally supersymmetric Yang-Mills theory and back"* (A. Belitsky, Arizona State University)*; "Drell-Yan scattering and the structure of hadrons"* (P. Reimer, Argonne National Laboratory)*; "Hadrons in the nuclear medium"* (S. Strauch, University of South Carolina); *"Exclusive and diffractive processes at high energy proton-proton and nucleus-nucleus collisions" (*A. Szczurek, Institute of Nuclear Physics PAN, Krakow)*; "Beautiful mesons and baryons on the lattice"* (M. Wingate, University of Cambridge); *"QCD in strong magnetic fields"* (A. Schaefer, University of Regensburg); *"EDM searches at storage rings"* (H. Stroeher, Forschungszentrum Juelich); *"New trends in the low-energy QCD in the strangeness sector: experimental and theoretical aspects"* (C. Curceanu, INFN Frascati)*; "The nuclear dipole polarizability and its impact on nuclear structure and astrophysics"* (P.G. Reinhard, University of Erlangen/Nuernberg); *"Initial state fluctuations and final state correlations in heavy-ion collisions"* (M. Luzum, IPhT,

CEA/Saclay); *"Mathematical aspects of hadron physics"* (C. Roberts, Argonne National Laboratory); *"Many-body open quantum systems: From atomic nuclei to quantum dots"* (M. Ploszajczak, GANIL); *"Towards a resolution of the double beta decay problem"* (S. Stoica, Horia Hulubei National Institute of Physics and Nuclear Engineering, Bucharest); *"Electro-weak probes: from low-energy nuclear physics to astrophysics"* (D. Gazit, Hebrew University of Jerusalem); *"Spectral properties of complex networks"* (D. Shepelyansky, CNRS, Toulouse).

Furthermore proposals for two more workshops, one by R. Roth (TU Darmstadt), on the topic "*From few-nucleon forces to many-nucleon structure*", are expected for 2012.

Because of the cut of the budget of the Fondazione Bruno Kessler we had to reduce the number of workshops in 2012 with respect to 2011.

*Advanced Doctoral Training Programme*

The advanced training of young researchers represents an important part of ECT*'s activities. The by now traditional spring doctoral training program (DTP) has developed into a very successful format, with each year a group of about 20 full time students and about 5 part time students spending two/three months at ECT*. In 2011 (April 11 – June 17), the doctoral training program was focused on «Neutrinos in Nuclear-, Particle- and Astrophysics». In 2012, because of the decrease of the budget for 2012, the programme will last one week less than the previous DTP. Furthermore, both the number of students and lecturers will be lower for the same reason. The lecturers of the DTP 2012 will be: A. Bacchetta (Università di Pavia and INFN), A. Deshpande (Stony Brook and RIKEN BNL), M. Diehl (Deutsches Elektronen Synchroton DESY), D. Hasch (INFN, Laboratori Nazionali di Frascati), B. Pasquini (Università di Pavia and INFN), M. Stratmann (Brookhaven National Laboratory).

The DTP will be organized by Professor Mauro Anselmino (Universita' di Torino and INFN). The program will be centered about "The 3-dimensional nucleon structure". The program will cover a new phase of the theoretical studies and the experimental exploration of the internal structure of protons and neutrons (nucleons). Over the past 40 years an understanding of nucleons in terms of elementary constituents (partons, i.e. quarks and gluons) has gradually and successfully emerged. Much information has been obtained about the nucleon in terms of its "one-dimensional" parton structure, relevant when partons are assumed to move colinearly with their parent nucleon, and encoded in the so-called parton distribution functions (PDFs). In the last years theoretical breakthroughs have extended this simple picture, leading to new concepts, like the "Generalized Parton Distributions" (GPDs) and the "Transverse Momentum Dependent parton distributions" (TMDs). These concepts help to address long-standing questions concerning the motion of quarks and gluons inside the nucleon, their orbital motion, their spin and their spatial distribution. Dedicated experiments, either running or proposed, and a related intense theoretical activity have made, and keep making, enormous progress towards a true 3-dimensional unraveling of the nucleon structure.

As in previous years George Ripka (Saclay) will act in an important function as student coordinator and advisor within the **2012** DTP from April 30 to June 15.

*Visiting Scientists, Research Personnel and Collaborations*

The presence of visiting scientists (over and above the workshop participants) is extremely important for the research carried out at the Centre. Usually typical times visitors spend ant interact with the research personnel range from a week to a few months. In 2011, 46 scientists visited the ECT*: Brazil (1), China (1), Cyprus (1), France (4), Germany (19), Italy (7), Russia (1), Spain (6), Switzerland (1), USA (5).

For the year 2012 (and each year to come afterwards) the number of visiting scientists is expected to be about the same as in 2011 and the years before.

The research personnel at ECT* in 2011 consisted of the following members:

–   Massimiliano Alvioli (Junior Postdoc for HP2/WP3)

–   Daniele Binosi (Senior Postdoc)

–   Alexis Diaz-Torres(Senior Research Associate)

–   Marco Cristoforetti (Junior Postdoc for Aurora)

–   Cesar Fernandez Ramirez (Junior Postdoc)

–   Lorenzo Fortunato (Junior Postdoc)

–   Vincent Mathieu (Junior Postdoc as successor of C. F. Ramirez)

–   Stefano Melis (Junior Postdoc for HP2/WP3)

–   Laura Munoz (Junior Postdoc)

–   Luigi Scorzato (Senior Postdoc for Aurora)

–   Pavel Stransky (Junior Postdoc as successor of L. Fortunato)

–   Dionysis Triantafyllopoulos (Senior Research Associate)

Scientific collaborations between the in-house researchers will continue and start new, respectively, with each new researcher joining ECT*. Furthermore, strong collaborations with physicists outside the Centre are particularly important for its scientific standing, and for these the last ECT* Annual Report from 2010 (www.ectstar.eu), Chapter 4, p. 110-143, provides several recent examples.

## 4.   Front Edge & New Initiatives

In 2012 for the first time an advanced course of three weeks duration on "High-Performance Computing (HPC) and computational tools for nuclear physics" focused on lectures and exercise sessions will be held at ECT*. With this course (and many more to follow) proposed by a large, new Trans-Atlantic initiative called TALENT (Training in Advanced Low Energy Nuclear Theory) it is planned "to create a graduate-level curriculum for new generations of nuclear scientists worldwide that would be impossible to develop and offer at individual institutions". The organizers are: Jacek Dobaczewski (University of Warsaw, Poland, and University of Jyväskylä, Finland), Morten Hjorth-Jensen (University of Oslo, Norway, and Michigan State University, USA), Marek Ploszajczak (GANIL, Caen, France),

Giuseppina Orlandini (University of Trento) and Achim Schwenk (TU Darmstadt, Germany).

Sighing out a course on numerical methods of great importance for nuclear few- and many- body problems on running it in Trento will yield a maximal overlap between the competences within ECT*, the Physics Department of the University of Trento and the newly developed HPC facility Aurora. Due to the restricted budget of ECT* this first TALENT initiative needs partial support from outside and so far the UNITN has agreed to provide some.

Another front edge research and development project scientifically administrated by ECT* is the above mentioned HPC facility Aurora. The project started about two years ago and the first phase of it has been successfully completed on July 31, 2011. A computing power of 15 Teraflops has been installed, i.e. 50% more than the original milestone set for 2011. The AuroraScience collaboration submitted a report on the scientific and technical results and a proposal for the second phase on April 28, 2011 to the respective funding institutions, PAT and INFN. The two documents were subsequently evaluated favorably by two independent committees from the PAT and the INFN/FBK who both recommended the continuation of the project in a second phase with the goal to increase the computing power considerably. Before entering phase 2 fully it has, however, been requested to test in a five month long phase 2a some scaling properties of networks and algorithms with the small number of nodes presently available from phase 1 of the Aurora project. The results of the tests are very positive and the AuroraScience collaboration is thus confident to enter phase 2 finally with the beginning of fiscal year 2012. The computer time at the present Aurora prototype of the machine is already oversubscribed with several users from outside the PAT, and it can clearly be started that on top of its technical and scientific results, this research and development project is having a significant impact on the local scientific community by training also junior researchers at the forefront of scientific and technological problems and to provide the basis to create and exploit a leading High Performance Computer infrastructure. This will eventually put the Autonomous Province of Trento on the map of HPC centers in Europe.


## 5.  Funding

Since the ECT* was founded 18 years ago as the first truly international institution in Trentino it has grown scientifically year after year to a very high level of recognition. Despite the cut of the PAT/FBK budget for 2012, it wants and has to carry out the foreseen ambitious scientific program for 2012 outlined in Sect. 3 above. In this way ECT* has decided to have one workshop less in 2012, to reduce the period, the number of lecturers and of fully supported students of the annual DTP.

During the last years, the funds provided by the PAT/FBK have decreased from 736 k€ in 2008, 534 k€ in 2009 to 498 k€ in 2010 and 2011, respectively. In a prebudgetary meeting ECT* has been informed that it can expect 492 k€ in 2012. During these years third party funds collected from the outside (17 European funding agencies and institutions, FP7 projects HP2, ENSAR and Quantum Information

Processing, EMMI and other extra sources of income from workshops) have increased from 539 k€ in 2008 to 590 k€ in 2011. In other words: while in 2008 institutional funds from the PAT/FBK amounted to 58% vs. 42% of funds from outside of the total budget, are the respective numbers 45% and 55% in 2011. While this co-funding system between the PAT/FBK and ECT*'s supporters from an international network of institutions is and might be a model for other institutions/research units within the FBK, great care has to be taken that the FBK/PAT contribution is not decreasing further since it would become likely that the third party funding institutions from outside would cut their contributions also.

Funds from the EU FP7 project HadronPhysics2 will cease at the end of 2011 since the project ends then. However, ECT* will receive sizable funds from 2012 on for three years from the follow-up project HadronPhysics3, and it is expected that also the other third party funds from outside will stay in 2012 at about the level of 2011.

Since the decision on the continuation of the Aurora project, which is overlooked by the ECT*, is presently still pending (see Sect. 4 above) no statement can be made yet concerning its funding in 2012.

## 6.   Budget

|  | 2011 | 2012 |
|---|---|---|
| Expenses |  |  |
| Personnel | € 1.030,21 | € 733,14 |
| Travel | € 54,00 | € 30,00 |
| Equipment (HW/SW) | € 474,00 | € 12,00 |
| Other (e.g. subcontracting to external contractors) | € 965,82 | € 374,73 |
| Total Expenditure | € 2.524,03 | € 1.149,87 |
| Incomes |  |  |
| EU Projects (total amount financed by EU) | € 151,06 | € 46,62 |
| Other external incomes (industrial, PAT projects, etc.) | € 1.129,55 | € 455,00 |
| Projects to be finalized | € 731,23 | € 155,61 |
| Total Income | € 2.011,85 | € 657,23 |
| Financial Need (Total Income – Total Expenditure) | € 512,18 | € 492,64 |
| Self funding | 79,7% | 57,2% |

## 7. Remarks

After the number of researchers at the ECT* has decreased continuously from 14 in 2006 to 6 in the first part of 2009, it has fortunately started to increase to 9 researchers in 2010 and it has also grown again to 10 in 2011. This is totally in line with an increase in the number of projects and the size of the scientific activities of the Centre. In order to execute the ambitious research program in 2012 and the years thereafter the three Junior Postdoc positions (presently held by Massimiliano Alvioli, Stefano Melis and Laura Munoz, respectively, who will leave ECT* in 2012) must be filled again with three new Junior Postdocs. The calls for applications will have to be opened soon in order to compete with other European institutions

Although it is understandable that the research personnel at ECT* in 2012 shall remain unchanged because of the decrease of the budget, every possible effort should be made to increase the number of researchers in the coming years.

Special attention should be paid to the fact that the funding of two researchers within the AURORA project (Junior Postdoc Marco Cristoforetti and Senior Postdoc Luigi Scorzato) runs out at the end of the first part of the second phase of the project, i.e. on December 31, 2011. Therefore every effort should and is being made to continue AURORA into its foreseen second part of the second phase and secure the funding of these positions.

We expect also that the period of tenure track for Senior Research Associate, Dionysis Triantafyllopoulos, can be initiated still in 2011 such that he might receive "stabilizzazione" when his present co.co.pro contract ends in October 2012.

Finally in order to operate the ECT* with its large and ambitious scientific program described in Sect. 3 above a dedicated and efficient administrative and technical staff is necessary. Despite the increasing scientific activity of ECT* the administrative staff has been reduced continuously since 2008. It is presently composed of only of 6 people. Given the fact, that out of the 6 positions 4 (Ines Campo, Susan Driessen, Tiziana Ingrassia, Gian Maria Ziglio) are filled by persons with part-time contracts, the present administrative personnel of ECT* is working at its limits and can not be reduced anymore in the future.

# Cirm – Centro Internazionale per la ricerca matematica

Director: Prof. Fabrizio Catanese

## 1. Summary and vision

In 1978 the CIRM was founded by ITC in partnership with the Italian National Council for Research (C.N.R.), with the primary purpose of organizing seminar and meeting weeks on mathematics research.

The CIRM has continued its activities without interruption ever since and, at the moment of the transition from ITC/irst to Bruno Kessler Foundation, the Centre has enlarged its spectrum of activities. The Statutary norms which rule the CIRM were formally re-established by the Board of Directors on May 2.nd, 2011. These foresee the combination of the original purposes together with the additional aim of supporting mathematical disciplines in the perspective of an integration with scientific domains of interest of other FBK Research Centres.

Next to the traditional activity, which has seen the CIRM organize 247 international mathematical Meetings and Conferences, and next to the related editorial activity, which has seen the publication of 59 research books and journal volumes, present in the libraries of most Universities in the world, in 2008 the Comitato Direttivo set up a new range of activities, focused on the aim to have research done at the CIRM, along with scientific training.

Especially a new program was set up, encompassing four types of visiting positions, with the intention of stimulating the interaction between the mathematical research community of the Trento area and the European and international mathematical community.

The new range of activities includes:

- 2 Post Doc positions per year;
- Visiting Professor and Visiting Scholar positions;
- Research in Pairs.

For the year 2012, after an agreement with the President and the Secretary of FBK and due to an extra income of the Mathematical Department of the University of Trento, the Advisory Board (AB, formerly Comitato Direttivo) decided to open the application for three Post Doc positions, a triennial one and two annual ones.

The CIRM's Advisory Board met at the beginning of October 2011 to prepare the scientific plan for the year 2012 and to examine the applications for post doc positions and the proposals for conferences.

Most of the applications for Post Docs were of very high level, and the AB agreed to appoint for the 3-year position PhD Alessandro Ottazzi and for the two 1-year positions (ex aequo) PhD Paolo Antonini and PhD Sonia Mazzucchi.

As for the conferences the AB decided that CIRM will support the organization of nine scientific events in the fields of: Calculus of Variations, Sub-Riemannian Geometry, Mathematical Fluid Dynamics, Methods for Evolution, Invariant Theory and Projective Geometry, Holomorphic Dynamics, Real and Complex Geometry, Birational and Affine Geometry. For the detailed program please see sections 3 and 4. Let us recall that in the last two years (2010-2011) the conferences organized by Cirm, in Trento and Levico, see the partecipation of more than 1.200 researchers from all over the world.

The AB will consider proposals for Visiting Professors and Research in Pairs in the course of the year, as soon as they will be submitted (according to the rules set, applications can be submitted at any time and are evaluated by the Advisory Board and by the referees within a short time, always less than three months). According to the excellent programs we have had in the last two years (see the following list) high quality applications are again expected.

*Visiting Professors 2010-2011*

Jaroslaw WISNIEWSKI (reference in Trento: Marco Andreatta), 24/01-14/02/2010 and 19/09-26/09/2010 *"Symplectic (or hyperkaehler) manifolds and geometry of Mori dream spaces"*.

Jorge NEVES (reference in Trento: Roberto Pignatelli): 12-26/04/2010: *"Surfaces with* $p\_g=0$ *and* $K^2=3$*"*.

Fausto GOZZI (reference in Trento: Luciano Tubaro): 3 weeks in May 2010: *"Controllo di equazioni integro-differenziali per modelli stocastici applicati alla finanza"*.

Joseph FU (reference in Trento: Silvano Delladio): 4-23/10/2010: *"Certain analytic questions connected with integral geometry"*

Dariush EHSANI (reference in Trento: Alessandro Perotti): 1/11/2010-30/01/2011 and 16/05-8/06/2011: *"The \partial-Neumann problem on singular complex spaces"*

Michael VAUGHAN-LEE (reference in Trento: Andrea Caranti – Willem De Graaf): 24/01-22/02/2011: *"Development of a corresponding set of algorithms and programs for finite nilpotent rings"*.

Michele ELIA (reference in Trento: Massimiliano Sala): 29/05-11/06/2011: *"Applicazioni della teoria delle curve ai codici e alla crittografia"* .

Viorel BARBU (reference in Trento: Luciano Tubaro): 1-30/11/2011: *"On a variational approach to nonlinear stochastic equations"*.

*Research In Pairs 2010-2011*

1)   Jean-Francois COULOMBEL, Alessandro MORANDO, Paolo SECCHI: April 6-16 2010: *"Free boundary problem for compressible Euler equations with self-gravitation in physical vacuum"*.

2)   Elizabeth GASPARIM (Edinburgh) (1-31/07/2010), Christophe EYRAL (Aarhus) (1-23/07/2010), Oren BEN BASSAT (Haifa) (25-31/07/2010), Carlos CASORRAN AMILBURN (12-21/07/2010): *"Moduli of bundles over products of curves"*.

3) Ivan CHELTSOV (Edinburgh) 6/6-5/7/11, Constantin SHRAMOV (Steklov Moscow) 2/6-6/7/11, Jihun PARK (Pohang Institute of Science and Techn.) 3/6-6/7/11, Timothy LOGVINENKO (Warwick) 25/5-15/06/11: *"Exceptional singularities and Fano varieties"*.

4) Nero BUDUR (Notre Dame), Mathias SCHULZE (Oklahoma State Uni), Wim VEYS (K.U. Leuven), Hans Ulrich WALTHER (Purdue): 15/06-26/06/2011: *"Questions around the monodromy conjecture"*.

5) Sergio ALBEVERIO (Bonn) 16-24/6/11, Mauro SPREAFICO (S. Paulo) 13-18/6/11 and 11-21/12/11: *"Investigation of certain singular operators appearing in models of mathematical and quantum physics"*.

6) Richard HIND (Notre Dame), Costantino MEDORI (Parma), Adriano TOMASSINI (Parma): 25/7-03/08/2011: *"Cohomological properties of almost-complex manifolds"* and *"Tangent bundles of Hermitian spaces"*.

*Unit composition*

|  | 2011 (as of Jan 1st) | 2012 (planned) |
|---|---|---|
| Research directors |  |  |
| Senior researchers |  |  |
| Researchers (including postdocs, etc.) | 2 | 3 |
| Technologists |  |  |
| Administrative Assistant | 1 | 1 |
| Total | 3 | 4 |
| Tenured |  |  |
| Tenure track |  |  |

Note: "Research directors" are level 1 researchers; "Senior researchers" are level 2 researchers. Category "Researchers" covers all other cases, including level 3 and 4 researchers, postdocs and other contractual forms used to enroll researchers.

## 2. Recent publications

The first two cited publications are proceedings' volumes of two conferences held at CIRM, containing both surveys and original papers.

From number 3 until number 25 are original research papers written by our CIRM post-doc. The last eight in the list are original papers written by Visiting Professors at CIRM in collaboration with researchers of Trento area or written by members of a Research in Pairs. This is only a part of the publications rising from Cirm activities: it is not easy to keep track of the publications of visitors, who finished the paper in a different place, we started to do it only recently.

– G. Casnati, A. Di Scala and R. Notari eds., Workshop on Hodge Theory and Algebraic Geometry, Rendiconti del Seminario Matematico Università e Politecnico di Torino, vol. 68, n. 3, 2010.

- G. Da Prato and L. Tubaro, Stochastic Partial Differential Equations and Applications, Quaderni di Matematica, Dipartimento di Matematica Seconda Università di Napoli, 2011.
- M. Correggi, *A two-particle quantum system with zero-range interaction,* Séminaire X-EDP 18, 2009, 1-17.
- M. Correggi, G. Dell'Antonio, D. Finco, A. Michelangeli, A. Teta, in preparation.
- M. Correggi, G. Dell'Antonio, A. Michelangeli, in preparation.
- M. Correggi, F. Pinsker, N. Rougerie, J. Yngvason, *Critical speeds in the Gross-Pitaevskii theory on a disc with Dirichlet boundary conditions,* J. Stat. Phys. 143, 2011, 261-305.
- M. Correggi, F. Pinsker, N. Rougerie, J. Yngvason, *Rotating superfluids in anharmonic traps: from vortex lattices to a giant vortex state,* in preparation.
- M. Correggi, F. Pinsker, N. Rougerie, J. Yngvason, *Critical rotational speeds for a Bose-Einstein condensate in a homogeneous trap,* in preparation.
- M. Correggi, N. Rougerie, J. Yngvason, *The transition to a giant vortex phase in a fast rotating Bose-Einstein condensate,* Commun. Math. Phys. 303, 2011, 451-508.
- Bernardi, A. Gimigliano, M. Idà, *Computing symmetric rank for symmetric tensors, Journal of Symbolic Computation,* 2010, in press.
- E. Ballico, A. Bernardi, *On the X-rank with respect to linear projections of projective varieties,* Mathematische Nachrichten 284, n. 17-18, 2011, 2133-2140.
- E. Ballico, A. Bernardi, *Stratification of the fourth secant variety of Veronese variety via the symmetric rank,* preprint.
- E. Ballico, A. Bernardi, *On the X-rank with respect to linearly normal curves,* preprint.
- E. Ballico, A. Bernardi, *Decomposition of homogeneous polynomials with low rank,* preprint.
- E. Arrondo, A. Bernardi, *On the variety parametrizing completely decomposable polynomials,* Journal of Pure and Applied Algebra, in press.
- Bernardi, E. Carlini, M.V. Catalisano, *Higher secant varieties of* Pn Pm *embedded in bi-degree* (1,d), preprint.
- S. Barbina, D. Zambella, *Generic expansions of countable models,* Notre Dame Journal of Formal Logic, in press.
- S. Barbina, K.M. Chicot, B.S. Webb, *Affine, projective and other -categorical Steiner triple systems,* preprint, 2011.
- S. Dinew, P. Hoang Hiep, *Convergence in capacity on compact Kähler manifold,* preprint.
- V. Guedj, P. Hoang Hiep, A. Zeriahi, *Monge-Ampère measures with Hölder potentials,* preprint.
- F. Montefalcone, *Isoperimetric and Sobolev inequalities on hypersurfaces in sub-Riemannian Carnot groups,* preprint.
- F. Montefalcone, F. Serra Cassano, *Intrinsic variational formulae for sets of finite H-perimeter in 2-step Carnot Groups,* preprint.
- M. Eleuteri, J. Habermann, *A Hoelder continuity result for a class of obstacle for permanent inelastic effects in shape memory materials,* Netw. Heter. Media 6, 1, 2011, 145-165.

- S. Mazzucchi, *Functional-integral solution for the Schrödinger equation with polynomial potential: a white noise approach,* to appear in Infin. Dimens. Anal. Quantum Probab. Relat. Top., 2011.
- D.M. Evans, E. Pastori, *Amalgamation properties in stable theories and co-homology groups,* to appear in Journal of Logic and Applications.
- W. de Graaf, A. Elashvili, *Induced nilpotent orbits of the simple Lie algebras of exceptional type,* Georgian Mathematical Journal 16, 2009, 257-278.
- S. Cicalò, W. de Graaf, M. Vaughan-Lee, *An effective version of the Lazard correspondence,* Journal of Algebra, submitted, 2011.
- E. Ballico, M. Elia, M. Sala, *On the evaluation of multivariate polynomials over finite fields,* submitted, 2011.
- M. Elia, M. Piva, D. Schipani, *The Rabin cryptosystem revisited,* submitted, 2011.
- M. Andreatta, J. Wisniewski, *4-dimensional symplectic contractions,* submitted, 2011.
- E. Ballico, C. Eyral, E. Gasparim, *On the geometry of moduli spaces of anti-self-dual connections,* submitted, 2011.
- Fino, A. Tomassini, *On astheno-Kaehler metrics,* submitted.
- J. Neves, R. Pignatelli, *Unprojection and deformations of tertiary Burniat surfaces,* submitted, 2011.


Top 5 publications in the last 3 years (2009-2011):

- G. Casnati, A. Di Scala and R. Notari eds., Workshop on Hodge Theory and Algebraic Geometry, Rendiconti del Seminario Matematico Università e Politecnico di Torino, vol. 68, n. 3, 2010.
- G. Da Prato and L. Tubaro, Stochastic Partial Differential Equations and Applications, Quaderni di Matematica, Dipartimento di Matematica Seconda Università di Napoli, 2011.
- S. Barbina, D. Zambella, *Generic expansions of countable models,* Notre Dame Journal of Formal Logic, in press.
- F. Montefalcone, F. Serra Cassano, *Intrinsic variational formulae for sets of finite H-perimeter in 2-step Carnot Groups,* preprint.
- S. Cicalò, W. de Graaf, M. Vaughan-Lee, *An effective version of the Lazard correspondence,* Journal of Algebra, submitted, 2011.


## 3. Objectives for 2012

The Scientific Program of CIRM for the year 2012 includes the organization of the following conferences and schools:

1) "XXII Convegno Nazionale di Calcolo delle Variazioni"
   Scientific Organizers: Luigi Ambrosio (SNS Pisa), Gianni Dal Maso (SISSA Trieste), Paolo Marcellini (Firenze), Raul Serapioni (Trento), Francesco Serra Cassano (Trento)
   Period: February 5-10, 2012

2) "Symmetric Spaces and their Generalisations II"
Scientific Organizers: Willem de Graaf (Trento), Oksana Yakimova (Erlangen)
Period: June 25-29, 2012

3) "Sub-Riemannian Geometry and PDEs"
Scientific Organizers: Raul Serapioni (Trento), Francesco Serra Cassano (Trento), Andrea Malchiodi (SISSA Trieste)
Period: July 1-5, 2012

4) "International Summer School on Mathematical Fluid Dynamics"
Scientific Organizers: Hugo Beirao da Veiga (Pisa), Paolo Secchi (Brescia)
Period: July 2012

5) "Variational Models and Methods for Evolution"
Scientific Organizers: Augusto Visintin (Trento), Ulisse Stefanelli (Pavia)
Period: September 9-12, 2012

6) "School (and Workshop) on Invariant Theory and Projective Geometry"
Scientific Organizers: Giancarlo Casnati (Pol. Torino), Federica Galluzzi (Torino) Roberto Notari (Pol. Milano), Francesco Vaccarino (Pol. Torino)
Period: September 17-22, 2012

7) "New Trends in Holomorphic Dynamics"
Scientific Organizers: Marco Abate (Pisa), Arnaud Chéritat (Toulouse), Jasmin Raissy (Milano Bicocca)
Period: one week in September 2012

8) "Progressi Recenti in Geometria Reale e Complessa"
Scientific Organizers: Vincenzo Ancona (Firenze), Paolo de Bartolomeis (Firenze), Alessandro Silva (Roma I)
Period: October 14-19, 2012

9) "Groups of Automorphisms in Birational and Affine Geometry"
Scientific Organizers: Ciro Ciliberto (Roma II), Ivan Cheltsov (Edinburgh), Hubert Flenner (Bochum), James Mc Kernan (MIT, Boston), Yuri Prokhorov (Moscow), Mikhail Zaidenberg (Grenoble I)
Period: October 28-November 3, 2012

Short description of the expected scientific activity of the Post Docs

Alessandro Ottazzi will start his research at CIRM at the beginning of January 2012; he will work on the theme of *"Quasiconformal maps on subriemannian manifolds"*, in collaboration with Francesco Serra Cassano and Raul Serapioni of the University of Trento.

Paolo Antonini has already begun his research at CIRM on November 1, 2011. He is working under the scientific supervision of Boris Dubrovin (SISSA Trieste) about the research project *"Equivariant Novikov conjecture and index theory"*.

Sonia Mazzucchi will continue her research at CIRM on the theme of *"Functional integration of oscillatory type: theory and applications"*, in collaboration with Luciano Tubaro, Sergio Albeverio (Bonn) and the group of stochastic processes in the Department of Mathematics of the University of Trento.

### 4.  Front Edge & New Initiatives

1)  "XXII Convegno Nazionale di Calcolo delle Variazioni"

This is the twenty-second edition of a series of meetings starter in 1990 focused on the scientific personalità of Ennio De Giorgi, one of the most famous Italian mathematicians, dead on October 25th, 1996. The purpose of this conference is to give an overview of the current researches and to define a few open problems in the field. The Organizing Committee has been composed by the national responsibles of three National Projects of research. More than 100 participants attended the last editions of this conference and the exchanges of ideas and the fruitful interactions have produced a lot of scientific collaborations and papers. We expect the same number of participants in the next edition.

2)  "Symmetric Spaces and their Generalisations II"

This conference is a sequel to the conference of the same title, which was held in Levico Terme in June 2010. The aim of this second conference, similar to the first one, is to bring together researchers with diverse backgrounds, such as Representation Theory, Algebra, and Lie Theory.

Symmetric spaces are particularly nice examples of homogeneous spaces and are studied from different points of view in algebraic and symplectic geometries, harmonic analysis, and invariant theory. The last year has seen a lot of progress in the area. The scientific organizers of this event feel that there is a need for further exchange of views and ideas on the subject and therefore intend to organise a sequel to the first conference. The tentative list of speakers includes: Giovanna Carnovale (Padova), Corrado De Concini (Roma), Michel Duflo (Paris), Evgeny Feigin (Moscow), Benedict Gross (Harvard), Viktor Kac (MIT), Wilberd van der Kallen (Utrecht), Ross Lawther (Cambridge), Peter Littelmann (Koeln) Dmitri Panyushev (Moscow), Paolo Papi (Roma), Donna Testerman (Lausanne), Michele Vergne (Paris).

3)  "Sub-Riemannian Geometry and PDEs"

The aim of the workshop is to offer a glimpse on selected research topics in Sub-Riemannian Geometry and PDEs and to focus on their applications. Analysis and Geometry on these structures has been the object of extensive research in the last few years, with applications ranging from the classic ones – degenerate elliptic equations, optimal control theory, differential geometry, harmonic analysis – to a very new ones as the functional structure of the visual cortex. It is intention of the organizers to put together young researchers and well-known researchers active in the field and to encourage informal discussion on current research trends and developments in the area. The tentative list of speakers include: A. Agrachev (SISSA Trieste), L. Ambrosio (SNS Pisa), Zoltan Balogh (Bern), Ugo Boscain (Palaiseau), Luca Capogna (Arkansas), Sagun Chanillo (Rutgers), Giovanna Citti (Bologna), Nicola Garofalo (Purdue), Bruce Kleiner (Courant, New York), Bruno Franchi (Bologna), Enrico Le Donne (Berkeley), Gianpaolo Leonardi (Modena), Valentino Magnani (Pisa), Pertti Mattila (Helsinki), Manuel Ritore' (Granada), Roberto Monti (Padova), Davide Vittone (Padova).

4) "International Summer School on Mathematical Fluid Dynamics"

The school is directed to post-doc students and researchers who wish to become acquainted with recent developments and promising methods in the mathematical theory of fluid dynamics. Four courses will be delivered by leading experts in the field. The courses will be organized in such a way that not experts in the field will be able to understand the directions of the actual research. The lecturers will be chosen inside this list: Claude Bardos (Paris VII), Peter Constantin (Chicago), Josef Malek (Prague), Nader Masmoudi (New York), Joachim Naumann (Berlin), Michael Ruzicka (Freiburg), Steve Shkoller (California at Davis), Vladimir Sverak (Minneapolis), Roger Temam (Bloomington).

5) "Variational Models and Methods for Evolution"

The following list of researchers accepted to give a talk: G. Allaire (Palaiseau), S. Bartels (Bonn), A. Braides (Roma II), M. Briane (Rennes), G. Bouchitte' (Toulon), G. Buttazzo (Pisa), J. Casado-Diaz (Sevilla), N. Dirr (Cardiff), E. Feireisl (Praha), A. Fiaschi (Pavia), I. Fonseca (Minneapolis), A. Mielke (Berlin), S. Neukamm (Leipzig), G. Savare' (Pavia), F. Serra Cassano (Trento), E. Spadaro (Bonn), P. Stelzig (Siemens), B. Svaiter (Rio de Janeiro).

6) "School (and Workshop) on Invariant Theory and Projective Geometry"

The main speakers for this school are L. Manivel (Grenoble I) and G. Ottaviani (Firenze). D. Faenzi (Pau) will serve as common assistant for the main speakers. As for the previous schools of this type the 2012 event is primarily aimed to graduate students, postdoc and researchers. The meeting is articulated in a school and in a workshop. The school will give the students and young researchers the opportunity of learning the subject from experts in the area. Provisional programs are the following:

L. Manivel: Actions of algebraic groups on algebraic varieties. Prehomogeneous spaces, relations with gradings of Lie algebras, elements of classification. Applications to birational geometry. Relations with homogeneous spaces and their isotropy representations. The Tits-Freudenthal magic square.

G. Ottaviani: Invariants of forms. Classical examples. The two fundamental theorems. Connections with Young tableaux. Computational tricks. Invariants of ordered points on the line as a graphical algebra. Connections with quivers and their invariants.

The Workshop on the state of the art will give the opportunity to senior researchers to address common problems. Most of the conferences will be delivered by invited speakers, some others by participants in the school. The invited speakers will be: V. Baldoni, Ch. Boening, M. Bolognesi, P.E. Chaput, Ch. Ranestad, N. Ressayre, F. Russo.

7) "New Trends in Holomorphic Dynamics"

Dynamical systems are one of the most important objects of study in contemporary mathematics, with numberless applications outside mathematics too. Among them, holomorphic dynamical systems occupy a notable position, as shown for instance by the fact that in the last few years three Fields medals

(J.-C. Yoccoz, C. McMullen, S. Smirnov, the latter in 2010) and two Abel prizes (L. Carleson, J. Milnor, the latter in 2011) have been awarded to mathematicians who worked in this area.

The field of holomorphic dynamical systems can be, roughly speaking, divided in two subfields, one devoted to one-dimensional systems, and the other devoted to several-dimensional systems, somewhat reflecting the division of complex analysis in one complex variable and several complex variables. The two subfields rarely interact, even though there are several analogies between the problems studied. One of the main goals of this Conference is to bring together specialists of one-dimensional and higher dimensional holomorphic dynamical systems to present the most relevant recent results, with the aim of favoring interactions and strengthen links between the two communities. We also propose to explore analogies and affinities among problems relevant to both schools, and to implement a transfer of ideas and techniques between the two communities. Experts in both subfields will interact with young researchers, fostering their mathematical growth. In particular, about one-third of the speakers will be chosen among the most brilliant young researchers working in this field.

The theory of holomorphic dynamical systems was born in Europe at the beginning of the twentieth century; and today still a large number of main experts in this field is in Europe. So, the scientific organizers would like to give an European connotation to this event, with the possible aim of linking it to future European projects in this area. The tentative list of speakers includes: A.M. Benini (Pisa), F. Berteloot (Toulouse), F. Bracci (Roma Tor Vergata), X. Buff (Toulouse), S. Cantat (Rennes), N. Fagella (Barcelona), C. Favre (Paris), E. Fornaess-Wold (Oslo), J.H. Hubbard (Marseille), D. Marìn (Barcelona), L. Rempe (Liverpool), J. Rueckert (Liverpool), M. Ruggiero (Paris), N. Sibony (Paris), S. Smirnov (Geneve), V. Timorin (Moscow), A. Zdunik (Warsaw). This event will be organized in collaboration with INdAM.

8) "Progressi Recenti in Geometria Reale e Complessa"

This conference is the eighth of a series, which started in Bari 1997 and followed then in Palermo 1999 and 2002, Levico Terme 2004, 2006, 2008, 2010). This conference is directed to young mathematicians (post-doc students, researchers) actively involved in researches of Complex and Real Geometry.

The advances of the current Geometry propose a costant and deep interaction between methods and techniques of different kinds (algebraic, differential-geometric, homological, etc.): the exploitation of this mixture is one of the most qualifying aspects of this event, in the perspective to build a solid community of young mathematicians becoming acquainted with researchers working in different fields and places (in Italy and abroad).

We foresee the participation of 40-50 young researchers plus 20-25 senior researchers.

9) "Groups of Automorphisms in Birational and Affine Geometry"

Among the eventual participants of the conference there are specialists in

a. affine and complex geometry,

b. projective geometry (including Mori Theory),

c. algebraic group actions (including related rational dynamics).

This meeting should allow them to join their efforts and to learn methods from adjacent fields in order to reach a new understanding and to obtain new results of common interest.

More concretely, the scientific organizers are planning:

− To present surveys on the effective Mori program in dimension three, on classification of singularities and elementary links needed in order to realize the Sarkisov Program in dimension three, as well as its logarithmic version or other versions better adapted to the needs of affine geometry. Conic bundles and Del Pezzo fibrations are of particular interest here. Classification of singularities of affine varieties in presence of a group action (e.g., a torus action), or under certain topological restrictions. Deformation and moduli theory of these objects.

− To survey on recent studies of affine varieties and complex Stein varieties with a controllable automorphism group. For instance, studies on the authomorphism groups of flexible affine varieties, of certain affine cones or similar conic constructions over projective varieties.

− To highlight recent results on the automorphism groups of affine varieties based on the Cox ring construction, and on wild and tame automorphisms of the affine space.

− To review studies of the Cremona group and its subgroups, in particular, of finite subgroups in the Cremona group of rank two or three, and related studies on finite automorphism groups of affine varieties, including applications to the essential dimension. To present the recent solution by Cantat and Lamy of the classical Enriques Problem (the non-simplicity of the Cremona group of rank two).

− To present studies on locally transitive unipotent group actions and on equivariant completions of affine varieties.

− To survey on the global log canonical threshold of toric and closely related Fano varieties, and their impact on the automorphism group. To survey on the birational rigidity.

− To survey on the dynamics of automorphisms and its applications in the combinatorial group theory.

## 5.    Funding

| Acronym | Full name | Type | Duration | Total income | Income 2012 |
|---------|-----------|------|----------|--------------|-------------|
| Dipmat | Dipartimento di Matematica, UNITN | opa | 2010-2012 | € 45000.00 | € 15000.00 |
| Dipmat | Dipartimento di matematica, Unitn | opa | 2012 | € 24000.00 | € 24000.00 |
| INdAM | Istituto Nazionale di Alta Matematica | opa | 2012 | € 34800.00 | € 34800.00 |
| ComLev | Comune di Levico Terme | opa | 2012 | € 500.00 | € 500.00 |
| APTVAL | Azienda per il turismo Valsugana | opa | 2012 | € 500.00 | € 500.00 |

Type: EU, PAT, Other public agency, Industrial.

The first fund coming from the Dipartimento di Matematica di Trento is regulated by a three years agreement; the second fund is outside this agreement and it is ''una tantum'' for the present year.

## 6.    Budget

|  | 2011 | 2012 |
|---|------|------|
| Expenses |  |  |
| Personnel | € 114,54 | € 138,46 |
| Travel | € 7,00 | € 4,00 |
| Equipment (HW/SW) | € 1,00 | € 0,60 |
| Other (e.g. subcontracting to external contractors) | € 114,46 | € 119,60 |
| Total Expenditure | € 237,00 | € 262,66 |
| Incomes |  |  |
| EU Projects (total amount financed by EU) | € 0,00 | € 0,00 |
| Other external incomes (industrial, PAT projects, etc.) | € 40,00 | € 74,80 |
| Projects to be finalized | € 0,00 | € 0,00 |
| Total Income | € 40,00 | € 74,80 |
| Financial Need (Total Income – Total Expenditure) | € 197,00 | € 187,86 |
| Self funding | 16,9% | 28,5% |

Note: Column 2011 is based on the unit's budget state as estimated at the date of document writing.
Column 2012 is the budget planned for 2012

Other Research Areas

# CNR-FBK. BIOMOLECULES AND BIOLOGICAL MEMBRANES (IBF-CMM)

Head of Unit: Mauro Dalla Serra

## 1.    Summary and vision

The main activities of the Unit are focused on the understanding the mechanism of action of macro biomolecules with high relevance for human health and environmental impact. The activities (iii) and (iv) belong to researchers who have recently joined the Unit and will start their activity here in 2012.

### (i) Pore-Forming Toxins and AntiMicrobial Peptides (Mauro Dalla Serra)

Pore-Forming Toxins (PFTs) and AntiMicrobial Peptides (AMPs), are mainly bacterial toxins relevant for human health, and constitute their arsenal weapons for attack or defence. Their characterization is important since they are excellent archetypal model systems for understanding key aspects of protein-protein and protein-lipid interactions. Particular attention will be focused towards the understanding of the secondary cellular effects induced by sublitic amounts of PFTs; furthermore some PFT behaviour are also adopted by perforin, a key player in immune response. In addition, PFTs offer a number of biotechnological applications as component of antitumoral and antifungal drugs, as element of biosensors and as component in drug delivery systems.

### (ii) Molecular Imaging (Daniele Arosio)

Molecular imaging is a new integrative discipline that enables non invasive investigation of cellular functions and molecular processes in vivo under physiological or pathological conditions. Within this new stream of research, our current activities focus on the development of new biosensor for monitoring specific cellular functions and pathways. Thanks to a strong collaboration between physicists and biologists, we also developed a system to efficiently visualize HIV dynamics in the nucleus; currently, we plan to extend its use to study the interaction of HIV with cellular factors and nuclear membrane complexes involved in nuclear import. Complementing biochemical and molecular biology approaches, our intranuclear tracking technology is a key asset in the emerging pharmacological research of therapies against cellular cofactors, which are needed for viral replication.

### (iii) Sensory photobiophysics (Carlo Musio)

Channelrhodopsins (ChRs) is a new family of photoreceptors sharing functions of both photoreceptors and ion channels. The new establishing lab is aimed to face 1) the mutagenesis of ChRs, their heterologous expression and electrophysiological characterization 2) the use of ChRs for optogenetic applications *in vivo*.

*(iv) Superstructural organization of polyribosomes (Gabriella Viero)*

Very recently, an unpredicted paramount role of translational control in outlining gene expression at the genome-wide level has been recognized. Our aim is to address the superstructural organization of polysomes, the most common and complex cytoplasmic machinery of eukaryotic cells related to the translational control con gene-expression. By using different nanoresolution imaging approaches we aim to reveal the structural and functional details of translation.

*Unit composition*

|  | *2011 (as of Jan 1st)* | *2012 (planned)* |
|---|---|---|
| Research directors |  |  |
| Senior researchers | 2 | 2 |
| Researchers (including postdocs, etc.) | 4 | 8 |
| Technologists | 1 | 2 |
| PhD students | 2 | 3 |
| Total | 9 | 15 |
| Tenured |  |  |
| Tenure track |  |  |

Note: "Research directors" are level 1 researchers; "Senior researchers" are level 2 researchers. Category "Researchers" covers all other cases, including level 3 and 4 researchers, postdocs and other contractual forms used to enroll researchers.

*Top researchers by citations (max. 5)*

| *Researcher* | *H-index* | *Citations (total)* |
|---|---|---|
| Mauro Dalla Serra | 22 | 1311 |
| Daniele Arosio | 15 | 340 |
| Lavinia Liguori | 8 | 132 |
| Valeria Antonini | 3 | 38 |
| Laura Tosatto | 2 | 43 |

## 2. Recent publications

Top 5 publications in the last 3 years (2009-2011):

− Arosio D., F. Ricci, L. Marchetti, R. Gualdani, L. Albertazzi, and F. Beltram. 2010. Simultaneous intracellular chloride and pH measurements using a GFP-based sensor. *Nat Methods* 7:516-518. (IF 20.720)

− Rebolj,K., B. Bakrac, M. Garvas, K. Ota, M.Sentjurc, C. Potrich, M. Coraiola, R.Tomazzolli, M.Dalla Serra, P.Macek, and K.Sepcic. 2010. EPR and FTIR studies reveal the importance of highly ordered sterol-enriched membrane domains for ostreolysin activity. *BBA - Biomembranes* 1798:891-902 (IF 4.647)

− Marchetti, L., L. Comelli, B. D'Innocenzo, L. Puzzi, S. Luin, D. Arosio, M. Calvello, R. Mendoza-Maldonado, F. Peverali, F. Trovato, S. Riva, G. Biamonti, G. Abdurashidova, F. Beltram, and A.Falaschi. 2010. Homeotic proteins participate in the function of human-DNA replication origins. *Nucleic Acids Res.* 38:8105–8119. (IF 7.836)

− Allouch, A., C. Di Primio, E. Alpi, M. Lusic, D. Arosio, M. Giacca, and A. Cerese-to. 2011. The TRIM Family Protein KAP1 Inhibits HIV-1 Integration. *Cell Host and Microbe* 9:484-495. (IF 13.730)

− Praper, T., A.F.P. Sonnen, G. Viero, A. Kladnik, C.J. Froelich, G. Anderluh, M. Dalla Serra, and R.J. Gilbert. 2011. Human perforin employs different avenues to damage membranes. *J Biol Chem* 286:2946-2955. (IF 5.328)

## 3. Objectives for 2012

Many of the running activities will continue in 2012. In particular we intend to:

− continue studying the membrane interaction of PFN and CDC with electrophysiology on PLM, spectroscopy on GUV and AFM for discovering the pore architecture;

− study the cell effects induced by the internalization of functionalized nanoparticles;

− study the post translational cell effects induced by sublitic doses of *S. aureus* aHL;

− characterize at the single molecule level the aggregation processes of a-syn in solution and in membranes;

− continue the characterization of actinoporins form sea anemonae;

− construct a biosensor in acqueous solution based on proteic nanopores;

− optimize ClopHensor sensor for its use in non linear microscopy in vivo and highthroughput screening;

− continue the study of HIV dynamics in the nucleus with microscopy;

− start studying the ChRs biophysical properties to investigate possible optogenetic applications;

− define role and organization of human RNA-protein macrocomplesses into translational control with nanoresolution imaging techniques;

Fund Raising

The support for the research will be obtained through submitting proposals to local, national and international agencies. Proposal are recently or are going to be presented to the following agencies:

− Project PAT "team incoming" (submitted)

− Project post-doc caritro (submitted)

− Bilateral Project Trentino-Uni. Maryland (submitted)

− Projects EU, ICT call 8 2011 under submission

− Projects PRIN e FIRB

- Projects PAT
- Projects Caritro Foundation
- Projects NIH, SNSF
- Call and fellowships Human Frontier Science Program (HFSP) Organization
- Call and fellowships European Science Foundation (ESF)
- Villum Foundation (DK)
- International Exchange Scheme Royal Society (UK)

## 4. Funding

| Acronym | Full name | Type | Duration | Total income | INCOME 2012 |
|---|---|---|---|---|---|
| FBK – IBF | | | | | |
| NanoArtPore | Construction and characterisation of a proteic transport machine that mimics nuclear pore complex | PAT, post doc outgoing 2010 | 1/7/2011-30/6/2014 | 180,000 | 60,000 |
| CNR – IBF | | | | | |
| SingleSyn | Single molecule fluorescence approach to study protein oligomer formation | PAT, post doc outgoing | 16/9/2010-15/9/2013 | 180,000 | 60,000 |
| | Progettazione razionale di Nano-Biosensori per misure intracellulari di Cl- e pH per microscopia in-vivo | PRIN 2009 | 1/12/2011-30/11/2013 | 90,000 | 45,000 |
| | Structural and dynamical aspects of the pheromone-receptor interaction in the "model" ciliate Euplotes | PRIN 2009 | 1/11/2010-30/10/2012 | 10,000 | 10,000 |
| | Epilepsy: mechanisms of circuit hyper-excitability and novel therapeutic strategies. | Salute 2009 | 1/12/2010-30/11/2012 | 100,000 | 50,000 |
| THINC | Targeting HIV integration Co-factors, targeting cellular proteins during nuclear import or integration of HIV | FP 7 Health 2007 | 1/4/2007/31/3/2012 | 40,000 | 20,000 |
| | Biosensor-based assay for high-throughput quantitative screening of chloride transport | Salute 2009 | 1/10/2010-30/9/2013 | 180,000 | 45,000 |
| SMEI | Inter-neuronal dysfunction in genetic epilepsies: insights | Telethon | 1/1/2011-31/12/2013 | 110,000 | 30,000 |

| | | | | |
|---|---|---|---|---|
| | from a mouse model of severe myoclonic epilepsy of infancy | | | |
| | Alterazione strutturale del controllo traduzionale in risposta ad uno stimolo ambiental | Caritro post-doc 2011 | 2 years, if approved | |
| | Development, characterization and use of a plasma membrane optical voltage-dependent sensor | PAT team 2011 | 3 years, if approved | |
| | Microchip-based solid-phase extraction of polysomal mRNA for translatome analysis | Caritro | 2 years, if approved | |
| | A fully integrated lab-on-chip for oncological analyses based on polysomal mRNA | FP 7 ICT | 3 years, if approved | |
| | Making Clinical "Omics" possible: polysome separation by electrophoresis | (PAT/UMD) | 3 years, if approved | |
| | Micro/Nano Systems for Biofilm Research towards Implantable Devices | (PAT/UMD) | 3 years, if approved | |

Type: EU, PAT, Other public agency, Industrial.


## 5.    Budget CNR_IBF – U.O.S. Trento

| | 2011 | 2012 |
|---|---|---|
| Expenses | | |
| Personnel | 387.763,37 | 458.722,22 |
| Travel | 10.671,72 | 28.566,50 |
| Equipment (HW/SW) | 0 | 30.000,00 |
| Other (e.g. subcontracting to external contractors) | 32.000,00 | 185.000,00 |
| Total Expenditure | € 413.350,05 | € 702.289,22 |
| Incomes | | |
| EU Projects (total amount financed by EU) | | 20.000,00 |
| Other external incomes (PAT projects, etc.) | 113.328,28 | 60.000,00 |
| Other external incomes (industrial, prin,telethon etc.) | | 180.000,00 |

| Total Income | € 113.328,28 | € 260.000 |
| Financial Need (Total Income – Total Expenditure) | € 300.021,27 | € 442.289,22 |
| Self funding | 27,42% | 32,02% |

Note: Column 2011 is based on the unit's budget state as estimated at the date of document writing. Column 2012 is the budget planned for 2012

## 6.    Budget FBK_IBF

|  | 2011 | 2012 |
|---|---|---|
| Expenses |  |  |
| Personnel | € 30,00 | € 71,71 |
| Travel | € 1,50 | € 4,52 |
| Equipment (HW/SW) | € 0,00 | € 0,00 |
| Other (e.g. subcontracting to external contractors) | € 4,92 | € 25,00 |
| Total Expenditure | € 36,42 | € 101,24 |
| Incomes |  |  |
| EU Projects (total amount financed by EU) | € 0,00 | € 0,00 |
| Other external incomes (industrial, PAT projects, etc.) | € 0,00 | € 60,00 |
| Projects to be finalized | € 0,00 | € 0,00 |
| Total Income | € 0,00 | € 60,00 |
| Financial Need (Total Income – Total Expenditure) | € 36,42 | € 41,24 |
| Self funding | 0,0% | 59,3% |

Note: Column 2011 is based on the unit's budget state as estimated at the date of document writing. Column 2012 is the budget planned for 2012

# CNR-FBK. PHOTONICS: MATERIALS, STRUCTURES AND DIAGNOSTIC (IFN-CMM)

Head of Unit: Maurizio Ferrari

## 1.   Summary and vision

Three significant activities, i-e. *Glass photonics, X-ray photonics, Quantum mechatronics,* characterized by a common scientific background that, thanks synergistic exploitation of the different competences and transversal technological and scientific interests, contribute to the strategic motivations of the unit "Photonics: Materials, Structures and Diagnostic". The main activities concern research, innovation, as well as education through the study of advanced devices, systems and structures for photonics and nanotechnology. The research unit promotes the development and the application, both from the scientific and technological point of view, in several fields such as Photonics, Nanotechnologies and Microfabrication, Microelectronic, Lasers and Incoherent Sources, Synchrotron light and X rays, Quantum mechatronics.

*Glass photonics* activity, responsible M. Ferrari, refers to the strategic areas identified by European Union in the Photonics21 technological platform and the corresponding Technological Italian Platforms devoted to Sources and Photonic Sensors, Nanotechnologies, and Concentrated Solar Energy. Motivation of glass photonics research is related to the historical fact that breakthroughs in technology – and hence new applications that create wealth and improve the quality of life and of the environment – come from blue sky frontier research, and in photonics several examples demonstrate that the time lag from research to the market is relatively small. Research addressing this challenge develops emerging materials such as metamaterials, nanostructured and nanocomposites systems, plasmonic based structures, as well as confined geometries. The issues are connected to optics and physics of the materials joint to the accompanying technological development. Examples are photonic crystals, quantum dots of different complexities, such as composite colloidal quantum dots, and different kind of waveguides, integrated optics systems, solar energy conversion photonic structures, microresonators and micro-nano cavities.

*X-ray photonics* activity, responsible F. Rocca, mainly refers to the development and application of instrumentation and methodologies for X-Ray investigations in Material Physics. The Activities of the Group are centered on the study of structural and dynamical properties from a local point of view on systems having different degree of disorder (glasses, amorphous systems, gels, crystals, dopants, films,…). We develop techniques and methodologies to investigate, at the local level, the origin of applicative properties. The current state of researches at Synchrotron Radiation Facilities promises for the next years the possibility of new structural investigations and spectroscopies with coherent beams having nano dimensions and peculiar temporal structure. These aspects, together with the possibility to have dif-

ferent complementary information on different scales (from interatomic distances, to short and medium range ordering, to large scale aggregations of matter) justify the choice to be present in the field with sufficient critical mass in frontier experiments. The project "STRUMEX" is active since many years within these perspectives. The main aim is to gain an ab initio interpretation of physical and physico-chemical phenomena that determine the useful properties, through an integration of experimental techniques.

*Quantum mechatronics* activity, responsible P. Falferi, is mostly dedicated to the development of ultra-low noise sensors applied to detectors of gravitational waves. The scope of the activity is the direct detection of gravitational waves, one of the great challenges of contemporary experimental physics, to open up a new window on the Universe, in astrophysics as well as in cosmology and in fundamental physics. The group is involved in a good fraction of the worldwide activities in the field of gravitational waves, being an active partner in AURIGA (INFN resonant detector), LISA (ESA/NASA space interferometer) VIRGO (ground based interferometer) and ET (Einstein Telescope, a third generation cryogenic interferometer) projects. The group has developed a variety of original experimental techniques. These include for instance high sensitivity, almost quantum limited, SQUID amplifiers, to be used as the final stage of ultra sensitive motion detectors in gravitational wave antennas and similar systems. They also include femto-Newton sensitivity torsion-pendulums to test parasitic forces on test-masses to be used as geodetic tracers in space-borne gravitational experiment. These technologies are and will be employed for the development of the mirror control system of ET, the feedback cooling of ultracryogenic mechanical resonators and for testing on ground of LISA sensor performances.

*Unit composition*

|                                         | 2011 (as of Jan 1st) | 2012 (planned) |
|-----------------------------------------|----------------------|----------------|
| Research directors                      |                      |                |
| Senior researchers                      | 3                    | 3              |
| Researchers (including postdocs, etc.)  | 4                    | 5              |
| Technologists                           | 4                    | 4              |
| PhD students                            | 2                    | 4              |
| Total                                   | 13                   | 16             |
| Tenured                                 |                      |                |
| Tenure track                            |                      |                |

Note: "Research directors" are level 1 researchers; "Senior researchers" are level 2 researchers. Category "Researchers" covers all other cases, including level 3 and 4 researchers, postdocs and other contractual forms used to enroll researchers.

*Top researchers by citations (max. 5)*

| Researcher | H-index | Citations (total) |
|---|---|---|
| Maurizio Ferrari | 24 | 2901 |
| Francesco Rocca | 21 | 1847 |
| Alessandro Chiasera | 16 | 792 |
| Paolo Falferi | 15 | 689 |
| Antonella Cavalleri | 10 | 288 |

## 2. Recent publications

− G. Speranza, S. Torrengo, A. Miotello, L. Minati, I. Bernagozzi, M. Ferrari, M. Dipalo, E. Kohn, "*XPS and UPS in situ study of oxygen thermal desorption from nanocrystalline diamond surface oxidized by different process*", Diamond and Related Materials 20 (2011) pp. 560-563, doi:10.1016/j.diamond.2011.03.001

− Alessandro Chiasera, Guillaume Alombert-Goget, Maurizio Ferrari, Simone Berneschi, Stefano Pelli, Brigitte Boulard, and Claire Duverger Arfuso, "*Rare earth activated glass-ceramic in planar format*", Optical Engineering 50 (2011) pp. 071105-1/10, doi: 10.1117/1.3559211

− D. Ristić, V. Holý, M. Ivanda, M. Marciuš, M. Buljan, O. Gamulin, K. Furić, M. Ristić, S. Musić, M. Mazzola, A. Chiasera, M. Ferrari, G.C. Righini, "*Surface characterization of thin silicon rich oxide films*", Journal of Molecular Structure 993 (2011) pp. 214-218, doi:10.1016/j.molstruc.2010.11.066

− G.C. Righini, Y. Dumeige, P. Féron, M. Ferrari, G. Nunzi Conti, D. Ristic, S. Soria, "*Whispering gallery mode microresonators: fundamentals and applications*", Rivista del Nuovo Cimento 34 (2011) pp. 435-488, doi 10.1393/ncr/i2011-10067-2

− L. Minati, G. Speranza, I. Bernagozzi, S. Torrengo, A. Chiasera, M. Ferrari, "*Luminescent short thiol-functionalized multi-wall carbon nanotubes*", Diamond and Related Materials 20 (2011) pp 1046-1049, doi:10.1016/j.diamond.2011.06.013

− S. Torrengo, A. Miotello, L. Minati, I. Bernagozzi, M. Ferrari, M. Dipalo, E. Kohn, G. Speranza, "*The role of oxygen in the one-step amination process of nanocrystalline diamond surface*", Diamond and Related Materials 20 (2011) pp 990-994, doi:10.1016/j.diamond.2011.05.014

− Antonello, G. Brusatin, M. Guglielmi, V. Bello, G. Perotto, G. Mattei, M. Maiwald, V. Zöllmer, A. Chiasera, M. Ferrari, A. Martucci, "*Novel multifunctional nanocomposites from titanate nanosheets and semiconductor quantum dots*", Optical Materials 33 (2011) pp. 1839-1846, doi:10.1016/j.optmat.2011.02.027

− S. Berneschi, A. Chiappini, M. Ferrari, S. Pelli, and G.C. Righini, "*Erbium doped silica-hafnia glass ceramic waveguides*", Phys. Status Solidi C 8 (2011) pp. 2875–2879, doi10.1002/pssc.201084101

–   Guillaume Alombert-Goget, Davor Ristic, Alessandro Chiasera, Stefano Va-
    ras, Maurizio Ferrari, Giancarlo C. Righini, Belto Dieudonne, and Brigitte Bou-
    lard, "*Rare-earth doped materials enhance silicon solar cell efficiency*", SPIE
    Newsroom 2011 doi10.1117/2.1201105.003701

–   Andrea Chiappini, Cristina Armellini, Alessandro Carpentiero, Nicola Bazza-
    nella, Giancarlo C. Righini Maurizio Ferrari, "*Hybrid colloidal crystals for pho-
    tonic application*", Invited paper Proc. of SPIE Vol. 8069 80690I-1/7 doi:
    10.1117/12.886825

–   Guillaume Alombert-Goget, Davor Ristic, Alessandro Chiasera, Stefano Va-
    ras, Maurizio Ferrari, Giancarlo C. Righini, Belto Dieudonné, Brigitte Boulard,
    "*Down-converter layers based on rare earth doped fluoride glass to improve
    Si-based solar cell efficiency*", Proc. of SPIE Vol. 8069 80690N-1/7 doi:
    10.1117/12.886789

–   Davor Ristic, Mile Ivanda, Marijan Marciuš, Vaclav Holý, Zdravko Siketic, I-
    vancica Bogdanovic-Rakovic, Milko Jaksic, Ozren Gamulin, Kresimir Furic, Mi-
    ra Ristic, Svetozar Music, Maja Buljan, Alessandro Chiasera, Maurizio Mazzo-
    la, Giancarlo C. Righini, Maurizio Ferrari, "*Characterisation of thin LPCVD sili-
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    10.1117/12.886783

–   Bing Han, Romain Guider, Eveline Rigo, Silvia Larcheri, Gualtiero Nunzi Con-
    ti, Manga Rao Vanacharla, Alessandro Chiasera, Maurizio Ferrari, Lorenzo
    Pavesi, Georg Pucker, Giancarlo C. Righini, Mher Ghulinyan, "*Development
    and optical characterization of vertical tapers in SION waveguides using gray-
    scale lithography*", Proc. of SPIE Vol. 8069 80690K-1/9 doi:
    10.1117/12.886820

–   Guillaume Alombert Goget, Davor Ristic, Belto Dieudonné, Enrico Moser, Ste-
    fano Varas, Simone Berneschi, Mile Ivanda, Andre Monteil, Claire Arfuso Du-
    verger, Giancarlo C. Righini, Brigitte Boulard, Maurizio Ferrari, "*Rare-earth-
    activated glasses for solar energy conversion*", Transparent Optical Networks
    (ICTON), 2011 pp 1-4, doi 10.1109/ICTON.2011.5971092

–   Radosław Belka, Małgorzata Suchańska, Elżbieta Czerwosz, Alessandro
    Chiasera, Maurizio Ferrari, "*Optical study of nanoporous C-Pd thin films*", Pro-
    ceedinds of SPIE Vol. 8070 (2011) pp. 807019-1/8., doi: 10.1117/12.891944

–   Simone Berneschi, Massimo Brenci, Giancarlo C. Righini, Marco Bettinelli,
    Adolfo Speghini, Ulises Caldiño, Enrique Álvare5, Alessandro Chiasera, Sree-
    ramulu Valligatla, and Maurizio Ferrari, "*Soda-zinc-aluminosilicate glasses
    doped with $Tb^{3+}$, $Ce^{3+}$ and $Sm^{3+}$ for frequency conversion and white light
    generation*", Proc. of SPIE Vol. 8011 801159-1/10, doi: 10.1117/12.903223

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    ZnO surfaces: implications for nanorods.*", J. Phys.: Condens. Matter 23
    (2011) 315501 (6pp), doi:10.1088/0953-8984/23/31/315501

–   M. A. Mohiddon, K. Lakshun Naidu, M. Ghanashyam Krishna, G. Dalba and F.
    Rocca, "*Growth, optical, and electrical properties of silicon films produced by
    the metal-induced crystallization process.*", J. Nanoparticle Research (2011)
    online first, 6 pp, doi: 10.1007/s11051-011-0444-6

– Dolesi R.; Hueller M.; Nicolodi D.; et al, *Brownian force noise from molecular collisions and the sensitivity of advanced gravitational wave observatories*, PHYSICAL REVIEW D Volume: 84 Issue: 6 Article Number: 063007 DOI: 10.1103/PhysRevD.84.063007 Published: SEP 8 2011

– Antonucci F.; Armano M.; Audley H.; et al., *From laboratory experiments to LISA Pathfinder: achieving LISA geodesic motion*, classical and quantum gravity volume: 28 issue: 9 article number: 094002 doi: 10.1088/0264-9381/28/9/094002 Published: MAY 7 2011

– Antonucci F.; Armano M.; Audley H.; et al., *LISA Pathfinder: mission and status,* classical and quantum gravity volume: 28 issue: 9 article number: 094001 doi: 10.1088/0264-9381/28/9/094001 published: may 7 2011

– Antonucci F.; Armano M.; Audley H.; et al. *LISA Pathfinder data analysis* CLASSICAL AND QUANTUM GRAVITY Volume: 28 Issue: 9 Article Number: 094006 DOI: 10.1088/0264-9381/28/9/094006 Published: MAY 7 2011

– Audley H.; Danzmann K.; Marin A. Garcia; et al , *The LISA Pathfinder interferometry-hardware and system testing*, CLASSICAL AND QUANTUM GRAVITY Volume: 28 Issue: 9 Article Number: 094003 DOI: 10.1088/0264-9381/28/9/094003 Published: MAY 7 2011

– Falferi Paolo, *Testing the intrinsic noise of a coil-magnet actuator for cryogenic gravitational wave interferometers*, CLASSICAL AND QUANTUM GRAVITY Volume: 28 Issue: 14 Article Number: 145005 DOI: 10.1088/0264-9381/28/14/145005 Published: JUL 21 2011

– Hild S.; Abernathy M.; Acernese F.; et al., *Sensitivity studies for third-generation gravitational wave observatories*, CLASSICAL AND QUANTUM GRAVITY Volume: 28 Issue: 9 Article Number: 094013 DOI: 10.1088/0264-9381/28/9/094013 Published: MAY 7 2011

– Falferi Paolo; Mezzena Renato, *Simple Wide-Range Noise Thermometer With DC SQUID Readout for Operation Down to 10 mK*, IEEE TRANSACTIONS ON APPLIED SUPERCONDUCTIVITY Volume: 21 Issue: 2 Pages: 48-51 DOI: 10.1109/TASC.2010.2100391 Published: APR 2011

Top 5 publications in the last 3 years (2009-2011):

– Paolo Falferi, Testing the intrinsic noise of a coil-magnet actuator for cryogenic gravitational wave interferometers, Classical and Quantum Gravity 28 (2011) pp 145005-1/8, doi: 10.1088/0264-9381/28/14/145005

– Alessandro Chiasera, Yannik Dumeige, Patrice Féron, Maurizio Ferrari, Yoann Jestin, Gualtiero Nunzi Conti, Stefano Pelli, Silvia Soria, and Giancarlo C. Righini, "Spherical whispering-gallery-mode microresonators", Laser & Photonics Reviews 4 (2010) pp. 457-482, doi: 10.1002/lpor.200910016

– Alessandro Antonello, Massimo Guglielmi, Valentina Bello, Giovanni Mattei, Alessandro Chiasera, Maurizio Ferrari, Alessandro Martucci, "Titanate Nanosheets as High Refractive Layer in Vertical Microcavity Incorporating Semiconductor QDs", The Journal of Physical Chemistry C 114 (2010) pp. 18423-18428, doi: 10.1021/jp106951y

–   S. I. Ahmed, G. Dalba, P. Fornasini, M. Vaccari, F. Rocca, A. Sanson, J. Li
    and A. W. Sleight, Negative thermal expansion in crystals with the delafossite
    structure: An extended x-ray absorption fine structure study of CuScO2 and
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    10430210.1103/PhysRevB.79.104302

–   A.Cavalleri, G. Ciani, R. Dolesi, A. Heptonstall, M. Hueller, D. Nicolodi, S. Ro-
    wan, D. Tombolato, S. Vitale, P. J. Wass, and W. J. Weber, Increased Brown-
    ian Force Noise from Molecular Impacts in a Constrained Volume, Physical
    Review     Letters     103     (2009)     pp     140601-1/4,      doi:
    10.1103/PhysRevLett.103.140601

## 3.   Objectives for 2012

*Glass photonics* activity will exploit its competences to succeed in the achievement
of the scheduled deliverables related to several specific projects already funded or
still in evaluation. Fabrication of photonic crystals based structures for the devel-
opment of photonic devices is a project allowing to exploit the competence of the
unit in sol-gel photonics, plasmonic structures, and sensing. The main goal is the
realization and the characterization of new class of nano-microstructured systems,
for the development of specific different functionalities involving a large area of
photonic technologies and application-specific photonic components and subsys-
tems. Moreover, the research unit is focused on the development of techniques
that enable in-situ controlling properties of the designed metamaterials and
demonstrate their applications in novel devices to light control. Fabrication of ox-
ide-based structures for downconverter application is a project where the compe-
tences of the unit in the fabrication of active waveguides, also by rf sputtering tech-
nique, will be exploited with the aim to increase the efficiency of the silicon-based
solar cells. Advanced materials for coherent emission at new wavelengths activity
aims at establishing a forefront of research in the field of novel optical coherent
sources working at new wavelengths, i.e. in the visible and in the mid-IR, at wave-
lengths higher than 2 micron and up to 10 micron. The advanced materials investi-
gated will then be processed into different configurations including optical fibres
and planar waveguides. Micro-nano structures exploit the competences in 1D
microcavities, spherical microresonators to develop a new generation of micro-
laser, hyperfrequency systems, and optical sensors.

*X-ray photonics* activities will be continued in the next year, as expected, within the
possibilities of the available man power and ordinary grants. The main goal is to
maintain the level of research at the state of art, with new experiments at Synchro-
tron Radiation Facilities in Italy and Europe and with the publication of results on
previous studies. We are currently investigating on the negative thermal expansion
in crystals, on the role of Cr and Ni in a-Si for metal-induced crystallization; on the
influence of Cu on the ferromagnetism in Cu-doped ZnO films (and in general di-
luted magnetic semiconductors (DMS)); on the micro-structural modifications in-
duced by Laser annealing in Lead-Vanadate Glasses; on the local structure of mo-
bile cations in fast-ion conducting systems. The latest very appealing Synchrotron
Radiation Proposal we have already submitted is titled: "Negative thermal expan-

sion of $ScF_3$: an EXAFS study at the Scandium K-edge". Aim of the project is to measure by EXAFS the dependence on temperature of the local atomic structure and lattice dynamics around Scandium in $ScF_3$, a crystalline compound having much stronger negative expansion than the isostructural $ReO_3$, recently investigated by diffraction studies. This study is part of our effort to better

understand the origin of negative thermal expansion in solids where rigid ion motions (RUM) can be identified.

*Quantum mechatronics.* The launch of the ESA LISA Pathfinder mission is foreseen for the beginning of 2014. This mission aims to demonstrate the near-perfect free-fall of geodesic reference test masses inside a satellite, to within 3 fm/s2/Hz1/2. In addition to demonstrating the key technology for the LISA gravitational wave observatory - which aims at a launch in roughly 10 years - LISA Pathfinder represents the test-bench for all future missions requiring high precision free-fall. Third generation cryogenic GW detectors, like the proposed underground ET, aim at a sensitivity curve 100 times better than that of current LIGO and Virgo detectors; to this end the development of new techniques for the control system used to keep the interferometer on resonance is required and the noise introduced by the actuators on the mirrors must be kept below their mechanical thermal noise at 4.2K In the field of the experimental tests on quantum effects in macroscopic objects the remarkable result obtained in 2010 (A. Vinante, M. Bonaldi, R. Mezzena and P. Falferi, EPL, 92 (2010) 34005) on an electrical resonator should be replicated on a macroscopic mechanical resonator.

## 4. Front Edge & New Initiatives

Glass photonics will be active in developing local and national platforms based on common and complementary skills and facilities in the field of photonics and matter. The research group is organizing a COST conference that will be held in Trento on January 2012 involving people coming from several counties. International project application is scheduled.

The activity of STRUMEX is based on a strong strategic cooperation with the local Department of Physics and on many international relationships, but on very limited external financing. The experimental activity is performed totally on Large Scale International Facilities, where Beam time and partial economic support is assigned only on competitive basis. We are continuously submitting Research Proposals, with good rate of approval. Of course, any effort will be done to reinforce our network of cooperation starting from the local level, in order to have access to EU or International Grants. Possible further fields for future projects will be: glasses for photonics, Nano-scale chemical mapping, X-ray Spectroscopies and Applications, Large Scale Facilities.

Preparation of the launch of the ESA LISA Pathfinder mission foreseen for the beginning of 2014. Development of new techniques for the control system used to keep the third generation cryogenic GW interferometer ET on resonance. Quantum effects in macroscopic objects: tests on a macroscopic mechanical resonator Tests at ultracryogenic temperatures of the MKIDs produced in FBK.

## 5.   Funding

| Acronym | Full name | Type | Duration | Total income | Income 2012 |
|---------|-----------|------|----------|--------------|-------------|
| CNR - IFN | | | | | |
| nsbmo | "Novel Silicon Based Materials for Optoe-lectronics" | POST DOC PAT | 01/06/2010 31/05/2013 | 149.000 | 49.000 |
| shyro | "Sources hyperfréquences à très haute pureté spectrale à base de mini-résonateurs optiques : Phase de démonstration de la performance" | RE-SEARCH AND TECHNO-LOGY PROJECT | 01/04/2011 31/03/2015 | 75.960 | 31.400 |

Type: EU, PAT, Other public agency, Industrial.

## 6.   Budget CNR-IFN – U.O.S. DI Trento

|  | 2011 | 2012 |
|--|------|------|
| Expenses | | |
| Personnel | 478.988,13 | 417.446,68 |
| Travel | 10.000,00 | 25.000,00 |
| Equipment (HW/SW) | | 10.000,00 |
| Other (e.g. subcontracting to external contractors) | 13.000,00 | 82.700,00 |
| Total Expenditure | 501.988,13 | 535.146,68 |
| Incomes | | |
| EU Projects (total amount financed by EU) | | |
| Other external incomes (industrial, PAT projects, etc.) | 121.328,00 | 90.400,00 |
| Total Income | 121.328,00 | 90.400,00 |
| FINANCIAL NEED (TOTAL INCOME – TOTAL EXPENDITURE) | 357.660,13 | 393.946,68 |
| SELF FUNDING | 33,92% | 22,95% |

Note: Column 2011 is based on the unit's budget state as estimated at the date of document writing. Column 2012 is the budget planned for 2012

**Budget FBK-IFN**

|  | 2011 | 2012 |
|---|---|---|
| Expenses |  |  |
| Personnel | € 266,87 | € 258,50 |
| Travel | € 11,00 | € 9,00 |
| Equipment (HW/SW) | € 0,00 | € 0,00 |
| Other (e.g. subcontracting to external contractors) | € 24,28 | € 18,92 |
| Total Expenditure | € 302,15 | € 286,42 |
| Incomes |  |  |
| EU Projects (total amount financed by EU) | € 0,00 | € 0,00 |
| Other external incomes (industrial, PAT projects, etc.) | € 0,00 | € 0,00 |
| Projects to be finalized | € 0,00 | € 0,00 |
| Total Income | € 0,00 | € 0,00 |
| Financial Need (Total Income – Total Expenditure) | € 302,15 | € 286,42 |
| Self funding | 0,0% | 0,0% |

## 7. Remarks

The main difficulty of the unit is related to human resources. The researchers have excellent skills and competences in the specific topics and the human resources are based on motivated Post-Doc, PhD and graduate students However, the research unit is clearly understaffed in respect to the scheduled activities. Moreover there are some young and active researchers, which have the competences and the scientific skill to be the perfect candidates for a permanent position as researcher in the unit Photonics: Materials, Structures and Diagnostic. A tenure track position is strongly requested.

The quantum mechatronics group, with two FBK researchers with permanent position, needs permanent staff growth. In particular, Andrea Vinante, for a long time co-worker of the unit and key person for the project on the quantum ef-fects in macroscopic objects and for the characterization of the Kinetic Inductance Detectors at ultracryogenic temperatures, works now in a competing lab in Leiden (the Netherlands).

The Glass Photonics group considers as priority a research position requiring specific competences in the field of fabrication by sol-gel route of photonic crystals, planar waveguides, microresonators and microcavities and in the structural and spectroscopic diagnostic techniques. Actually, this activity is performed by dr. Andrea Chiappini with a time contract CNR research grant until February 2012.

## CNR-FBK. NANOSCIENCE: MATERIALS, FUNCTIONALIZATION AND PROTOTYPE DEVICES (IFN-IMEM-CMM)

Head of Unit: Verucchi Roberto

### 1.    Summary and vision

The approach and horizon of the activities developed by the research group "Nanoscience: materials, functionalization and prototype devices" span from basic studies and methods up to prototype development to validate and enable potential applications and technology developments. Our interdisciplinary vision and research practice complements refined growth synthesis and characterization methods with device prototyping aiming at exploring and demonstrating functional properties, applications and technological perspectives. This is carried out via the fruitful interchange among the very active principal investigators of the team and the strong interactions at the international and national levels as well as within the provincial research network, FBK to start with.

The team has as CNR referring institute IMEM, Institute of Materials for Magnetism and Electronics, having its main location in Parma. The team includes researchers of FBK and CNR-IMEM, working on projects focused on state of the art themes that well fit the CNR-FBK general agreement signed on 8th June 2009 and at the core of the major trends defined by the strategic plans of the Materials and Devices CNR Department. The group is also involved in major research projects involving the Department System of Production dealing with industrial research.Three main activities are developed within the Nanoscience unit, here described.

*Functional/multifunctional inorganic, organic and hybrid materials*

The nanoscience paradigm is more anad more showing a great potential to achieve materials with tailored final properties. In this framework, our group has developed an original approach to both the synthesis of materials based on growth of thin films in vacuum by means of supersonic seeded beams (SuMBD), and to functionalization by direct co-deposition of inorganic materials by organic molecules. These processes pave the way to the realization of devices engineered at the nanoscale and based on novel hybrid materials, particularly well suited for application to health care, energetic, electronics.

The chemical, physical and structural properties of the synthesized materials are studied  first of all in UHV in the same system devoted to the growth of thin films in a co-deposition approach, by means of in-situ surface electron spectroscopies and ellipsometry. Ex-situ SEM/EDX analysis, sensing and electronics device characterization can then performed as well.

The group is involved in several medium term projects (1-2 years), having as main goals the synthesis of thin film organic/inorganic hybrid materials, to be used as active elements in sensing (gas, electrochemical), energetic, organic based electron-

ics and optoelectronics. We plan to explore the use of multifunctional materials as SiC and graphene and their functionalization while a particular attention will be devoted to the interaction of molecules with nanoscale structured inorganic material such as quantum dots, nanowires, nano-aggregates.

### Spontaneous fluctuations and dissipation

The study of the spontaneous fluctuations (thermal noise) and dissipation in mechanical systems probes fundamental aspects of statistical mechanics. In fact fluctuations and dissipation originate by the same physical phenomenon, namely the interaction with the thermal bath, which is also responsible for the irreversible entropy production. For this reason fluctuations give an insight into the behavior of systems kept out of equilibrium, where standard thermodynamics it is no applicable anymore.

We produce silicon oscillators properly designed to allow the application of a thermal gradient and the detection of the thermal noise with a sensitivity better than 10-13 m/√Hz. The choice of silicon make our results readily applicable to other fields of research, as it is the elective material for most MEMS and high-precision devices.

### Laser Spectroscopy and Mass Spectrometry Methods for Sensing and Monitoring

At present many chemical/physics processes, produced by human activities, are the subject of more and more accurate and sensitive controls for achieving environmental quality, improved process quality or safety reason. Detailed understanding of such processes is hence more and more demanding with the need of real time and high sensitivity detection of many molecular systems at the same time. Real time multicomponent trace gas detection is quickly growing in interest: monitoring and diagnosis of complex processes need the knowledge, possibly in a non destructive way, of the largest number possible of molecular species emitted. Several studies have been already developed in collaboration with relevant partner in the Trento area, exploring the relationship between VOC (Volatile Organic Compounds) emissions and physiological aspects in plants, quality air control, combustion processes, modified atmospheres in food preservation and products of interest for the local territory. High sensitivity trace gas detection of interest for biological, agro-industrial processes, energetics and environmental quality control by means of $CO_2$ and/or diode lasers based resonant photoacoustic spectroscopy and proton transfer reaction mass spectrometry techniques are currently performed and will further be developed to extend selectivity and sensitivity.

### Unit composition

|  | 2011 (as of Jan 1st) | 2012 (planned) |
|---|---|---|
| Research directors | 1 | 1 |
| Senior researchers | 2 | 2 |
| Researchers (including postdocs, etc.) | 8 | 5 |

| Technologists | 4 | 3 |
|---|---|---|
| PhD students | 2 | 2 |
| Total | 17 | 13 |
| Tenured | | |
| Tenure track | | |

Note: "Research directors" are level 1 researchers; "Senior researchers" are level 2 researchers. Category "Researchers" covers all other cases, including level 3 and 4 researchers, postdocs and other contractual forms used to enroll researchers.

*Top researchers by citations (max. 5)*

| Researcher | H-index | Citations (total) |
|---|---|---|
| Roberto Verucchi | 9 | 233 |
| Tullio Toccoli | 12 | 626 |
| Andrea Boschetti | 13 | 521 |
| Michele Bonaldi | 15 | 711 |
| Salvatore Iannotta | 17 | 1092 |

## 2.    Recent publications

| year | Conference | ERA A | Journal | IF Journal | IF cumulative |
|---|---|---|---|---|---|
| 2011 | 0 | 0 | 8 | 8 | 53.240 |
| 2010 | 8 | 0 | 21 | 20 | 77.509 |
| 2009 | 0 | 0 | 7 | 7 | 21.553 |
| 2008 | 0 | 0 | 12 | 12 | 37.064 |

In the last Table are shown the main numbers regarding the scientific production of the IMEM-CNR Unit, in terms of published papers, in the last four years. The impact factor (IF) is calculated on the basis of its value in the referring year, while for 2011 the 2010 values have been used.

Top 5 publications in the last 3 years (2009-2011):

−   "Nonequilibrium Steady-State Fluctuations in Actively Cooled Resonators", Bonaldi, M, Conti, L, De Gregorio, P, Rondoni, L, Vedovato, G, Vinante, A, Bignotto, M, Cerdonio, M, Falferi, P, Liguori, N, Longo, S, Mezzena, R, Ortolan, A, Prodi, GA, Salemi, F, Taffarello, L, Vitale, S, Zendri, JP, PHYSICAL REVIEW LETTERS , Vol. 103, n.1, pp. 010601 (2009)

−   "Influence of olive (cv Grignano) fruit ripening and oil extraction under different nitrogen regimes on volatile organic compound emissions studied by PTR-MS technique", Vezzaro, A,  Boschetti, A,  Dell'Anna, R,  Canteri, R,

Dimauro, M, Ramina, A, Ferasin, M, Giulivo, C, Ruperti, B, ANALYTICAL AND BIOANALYTICAL CHEMISTRY Vol. 399, n.7, pp. 2571-2582 (2011)

- "Tetraphenylporphyrin electronic properties: a combined theoretical and experimental study of thin films deposited by SuMBD", Nardi, M, Verucchi, R, Corradi, C, Pola, M, Casarin, M, Vittadini, A, Iannotta, S, PHYSICAL CHEMISTRY CHEMICAL PHYSICS Vol.12, n.4, pp.871-880 (2010)

- "Ambipolar organic thin film transistors based on a soluble pentacene derivative", Isik, D, Shu, Y, Tarabella, G, Coppede, N, Iannotta, S, Lutterotti, L, Cicoira, F, Anthony, JE, Santato, C APPLIED PHYSICS LETTERS Vol.99, n.2, pp. 023304 (2011)

- "Supersonic molecular beams deposition of alpha-quaterthiophene: Enhanced growth control and devices performances", Toccoli, T, Tonezzer, M, Bettotti, P, Coppede, N, Larcheri, S, Pallaoro, A, Pavesi, L, Iannotta, S, ORGANIC ELECTRONICS Vol.10, n.3, pp.521-526 (2009)

- The above list has the aim to represent the most significant results in the several research fields explored by the three groups of the IMEM-CNR Unit. More in details, the field concerns Spontaneous fluctuations and dissipation (1), Laser Spectroscopy and Mass Spectrometry Methods for Sensing and Monitoring (2) and Functional/multifunctional inorganic, organic and hybrid materials (3-5).

## 3. Objectives for 2012

**O1: Functionalization of inorganic nanostructures by SuMBD**. This will be mainly developed by means of supersonic beams seeded by organic molecules and will be finalized to the following specific aims. Realization of hybrid nanostructures based on SiC 1D nanowires functionalized by porphyrins to be used as photosensitizers in a PhotoDynamic Therapy based on X ray irradiation for cancer healing. It is expected to properly define the processes leading to the formation of the stable hybrid nanostructure. A project has been proposed (NHyNa, PAT) to this end, involving also the LISC-FBK group for the theoretical modeling of the processing, as well as groups in Parma from IMEM and University. The functionalization of graphene 2D layers by macrocycles and metallic atoms/clusters will be explored, for application in OECT showing FET architecture, for biosensing applications. The formation of chemical bonds at the interface will be initially studied. This research is connected to the approval of a PostDoc project (GraFun, CARITRO). Study of functionalization of silicon based nano-micro structures for light harvesting, energy generation and catalysis with cubene-like molecules, in the mainframe of an international collaboration between the PAT and the University of Maryland, USA. This is a project (under reviewing) involving several FBK and UniTn groups.

**O2: Thin film growth of pi-conjugated molecules and organic electronics**. We have demonstrated by our deposition techniques based on supersonic molecular beams of lighter gases seeded by the organic semiconductors the key role played by the kinetic energy of the impinging molecules in the molecular asssemblying at surfaces and the further growth processes. Our research work will be further de-

veloped and devoted: - to understand in detail how the molecules assemble on the surface and the role played by the molecules-molecules and molecules-surface interactions in these processes. - the realization of devices with improved characteristics for sensing, lighting and photovoltaics.

**O3: Organic Electrochemical sensors OECT for biosensing**. We have recently developed electrochemical transistor based on organic polymeric semiconductors (PEDO T:PSS). The idea is to develop new classes of sensors operating in solution and in biological environment. We are now solving approaching the questions of developing better performing devices with higher specificity and seleectivity. Our approach is based on functionalizing the polymer so that only specific molecules of interest will bee detected. The goals of the research are related to: - realize sensors detecting the different shells (coatings) used to stabilize the NPs and the processes of their degradation. – sensors able to detect specific molecules (i.e. sarcosine) that should be used as markers of the early stages of diseases or that may considered responsible of health problems.

**O4: Trace gas detection by PTR mass spectrometry and photoacustic laser spectroscopy**. The application of PTR-MS for analysis in biomedicine will be pursued by means of a multidisciplinary approach where several local and national groups are involved. In the mainframe of a project presented at the National Institute of Tumors, aiming at monitoring and preventing the formation of prostate cancer, the PTR-MS technique will be used to characterize the urine VOC emissions. The analysis of industrial processes leading to energy production by pyrolisis/gasification or combustion of materials with of materials will be performed in the mainframe for the GALEF project (PAT; REET-FBK, IVALSA-CNR)), in order to evaluate the impact from the point of view of pollution and efficiency control of the overall.

**O5: Measurements of mechanical dissipation in low loss silicon resonator with an applied temperature gradient**. The activity will show if nonequilibrium steady states can spoil off the performances of precision instruments. This issue is important in Gravitational Wave detectors and MEMS devices, where a heat flow is often applied by the readout system or by the system under measurements. The results will be also useful to reveal the extent to which theese systems departs from equilibrium in a statistical mechanics perspective. The experiment will make use of the MEMS devices developed during 2011, that will be characterized at cryogenic temperatures with different temperature gradients. The results will be useful as design guide for the future generation of gravitational wave detectors.

## 4.   Front Edge & New Initiatives

Most of the proposed researches, in the scheduled objectives represent not only the continuation of past studies but the application of well established skills and experiences for new and challenging fields. Most of the efforts will be devoted towards the realization of materials and devices for applications in biosensing and biomedicals, with the aim to explore potentialities of our original approach to surface functionalization based on the use of supersonic molecular beams seeded by

organic molecules or inorganic aggregates. Our role in two projects, NAOMI and NANOSMART, involving several FBK groups, aimed at understanding and developing important topics in protein sensing and drug delivery, has paved the way for the participation of the IMEM unit in a network of research groups active in biomedicals, arousing interest and desire to pursue other research in several local and national partners. This will is further assessed by the proposed projects where analysis by mass spectrometry/laser spectroscopies are applied to medicals and health care.

There is a firm will to develop studies on key materials, aiming at defining a multifunctionality that could make them suitable for application in sensing, energetics, electronics and biomedicals. To this end, several efforts are devoted to the creation also of european networks, that could improve the possibility to exploit EU funding. The strong connection with research groups in FBK will be further developed, from the point of view of the well established collaborations in biosensing but also from challenging and new fields, namely graphene.

## 5.   Funding

| Acronym | Full name | Type | Duration | Total income | Income 2012 |
|---------|-----------|------|----------|--------------|-------------|
|         |           |      |          |              |             |
|         |           |      |          |              |             |

Type: EU, PAT, Other public agency, Industrial.

As stated, in the previous text, several projects have been proposed to local funding agencies (PAT, CARITRO) and are currently under evaluation. Most projects came to the end during 2011, also if some activities will be performed in the next year, no incomes are foreseen.

## 6.   BUDGET CNR_IMEM – sede di Trento

| Expenses (EUROS) | 2011 | 2012 |
|------------------|------|------|
| Travel | 10.000,00 | 15.000,00 |
| Equipment (HW/SW) | | |
| Other (e.g. subcontracting to external contractors) | 12.000,00 | 15.000,00 |
| Internal collaborations: "subcontracting" to other unit | | |
| Total Expenditure | €482.574,50 | €361.504,21 |
| Incomes (EUROS) | | |
| EU Projects (total amount financed by EU) | 23.500,00 | 0 |

| Other external incomes (projects, grants, etc.) | 175.193,80 | 0 |
| Internal incomes ("subcontracted" by other units) | 0 | 0 |
| Total Income | 199.193,80 | 361.504,21 |
| Financial Need (Incomes – Expenditure) | €283.380,70 | €361.504,21 |
| SELF FUNDING | 41% | 0% |

Note: Column 2011 is based on the unit's budget state as estimated at the date of document writing. Column 2012 is the budget planned for 2012

**Budget FBK_IMEM**

|  | 2011 | 2012 |
|---|---|---|
| Expenses |  |  |
| Personnel | € 238,39 | € 208,80 |
| Travel | € 3,00 | € 1,51 |
| Equipment (HW/SW) | € 1,99 | € 2,00 |
| Other (e.g. subcontracting to external contractors) | € 16,29 | € 19,06 |
| Total Expenditure | € 259,67 | € 231,37 |
| Incomes |  |  |
| EU Projects (total amount financed by EU) | € 0,00 | € 0,00 |
| Other external incomes (industrial, PAT projects, etc.) | € 22,83 | € 7,00 |
| Projects to be finalized | € 0,00 | € 0,00 |
| Total Income | € 22,83 | € 7,00 |
| Financial Need (Total Income – Total Expenditure) | € 236,84 | € 224,37 |
| Self funding | 8,8% | 3,0% |

## 7.  Remarks

Next year will be characterized by the ending of major projects (such as NAOMI aand NANOSMART) that have been a very good playground to develop and test strategies toward bio-medical applications as well as novel hybrid materials for energy harvesting and photovoltaics (DAFNE). The successful completion of such projects paves the way to novel initiatives and perspectives that need to be fueled by the financial support of new projects. From this point of view a series of proposal have been submitted, most of which represent a collaborative effort of several of the research institutions operating inf Trentino together with international collaborations. The perspective of bioelectronics is becoming of growing interest for our approaches. It will be even more explored on the basis of the materials and

functionalization processes already developed, of the studies that are being envisaged and of prototype devices based on organic and polymeric materials as well as SiC and Graphene. Novel, specifically tailored devices such as OFET, OECFET and Memristors will be developed  Our approach to these questions is very promising at the international state of the art while it is complementary and synergic to the know-how and perspectives developed in FBK and other research institutions in Trento.

## SPIN-OFFS

In 2011, only a single spin-off has been created, also because of the relevant number of partecipated companies that had been created in previous years. This new company creation has taken the total number of FBK spin-off (in which FBK has a share) to the number of 11 companies. During 2012, it is not foreseen that this number can significantly grow. Meanwhile, for some of these companies (for others this is already happened during 2011) the deadline stated by the policy for the way out of FBK is approximating (following the policy the deadline is 3 years, extensible to 5). Given these facts, during 2012, in the framework of "Comitato di Valutazione Imprenditoriale", a potential way out of the Foundation from some of the spin-offs will be evaluated.

From a more strategic point of view, also because of the discussions developed in the framework agreement with Mach Foundation and Trentino Sviluppo, during 2012 an evaluation will be done regarding the overall FBK strategy about enterprise creation. The point is if some relevant change must be introduced in the policy for enterprise creation. The main issues concern the participation of FBK in the spin-off, the possibility of launching bigger initiatives (possibly with the help of venture capitalists) and how to manage the subject of enterprise creation in the context of Trento Rise.

HUMAN AND SOCIAL SCIENCES

# Presentation

During 2012 FBK will be engaged in laying the foundations for letting the Human and Social Sciences Site become an internationally recognized beacon on a number of topical issues of significance for the contemporary society from an ethical, political and economic standpoint and due to the effects they will have on the local community. These can be briefly grouped into two macro-areas:

– Improvement of the wellbeing of citizens in a context of greater efficiency and responsibility of the public system

– Economic and social dynamics between cooperation and conflict.

**Improvement of the wellbeing of citizens in a context of greater efficiency and responsibility of the public system**

- *Public policies effects*: The systematic analysis of the possible practical effects of public policies implemented at local, national and international levels have on their target populations, allow research to provide political and administrative environments with useful indications on the results of (a part) of their decisions and the ways in which they are - and should be - translated into practice by the appropriate agencies. The methodological paradigm underlying these empirical evaluation type of investigations is the so-called "counterfactual model of causality." This means that the effect of public policy is measured as the difference between what is seen in its presence and what would have been observed in its absence.

  Through this type of assessment, not used much in Italy yet, FBK aspires to become an important interlocutor of those people that, for reasons of study or institutional responsibility, deal with public policies, particularly as regards the following areas: actions for education and professional training; actions for labor and welfare issues, in general (including the pension system) and specifically to support families on one hand and against poverty and social exclusion on the other, and actions for the regulation of migration processes and the integration of immigrants, political support to enterprises, particularly to promote R & D and innovation.

- *The Behavioural Economics as a tool to improve people's welbeing*: citizens do not always have the opportunity to fully evaluate the services offered by the Public Administration. It is not only a matter of information but about the ways in which information is conveyed and perceived by citizens. The same applies to the problems caused by "traps" into which citizens often fall when consuming and purchasing goods due to information and cognitive distortions. A typical example is the growing debt rates of Italian families that in many cases is the side effect of choices encouraged by the promotion of consumer credit designed to "reduce" from one side of the awareness of the negative long term

consequences and to amplify on the other hand, the immediate benefits obtained from the loan. The design of public rules that will improve citizensì decision-making is one of the other issues related to behavioral economics. From a regulatory standpoint, the results of behavioral economics can therefore be used to design better policy actions to direct people towards better choices: without imposing decisions from above. Institutions, then, become architects of the decision-making by structuring the environment so that people are guided, not forced, to make better informed choices.

- *European Economics Governance and business networks.* The process of European integration has completely changed the nature of domestic economic issues for member countries of the European Union and, especially, of the internal problems of the Eurozone countries. While until the late 60s of the last century you could still rely on a vision of a nearly closed economy and think in Italian, French, etc. macroeconomics terms, the growth of European integration - together with the evolution of globalization - forces us today to a transnational take which imposes a radical review, both theoretical and empirical. In fact, we are faced with a complex evolution, a structural change that involves the adaptation of old analytical tools and even the creation of new ones. The main geographical reference is now Europe. Speaking of French, Italian or German macroeconomics is like talking about California or Texas or Illinois macroeconomics. A qualified study of scenario predictions in this regard will enable us to support both local and Italian political and economic choices, trying to deal with the possibility of creating business networks fit for future challenges.

## Economic and social dynamics between cooperation and conflict

- *Interreligious dialogue*: In the face  of the international debate on the "clash of civilizations" and the ever more apparent urgency in Italian society and in the Trentino region community itself, to develop a deeper awareness of their multicultural and multi-religious dimensions, the ISR Center is called to set as high priority all research activities involving this new frontier of theological and religious-historical studies. The traditional emphasis on sacred texts, especially biblical ones, must be expanded in the key of "dialogue among religious traditions", opening up spaces for scientific collaboration in the field of ethics and social studies. The theme of the conflict between religions and modernity needs to be expanded in the direction of the increasing impact of different religious traditions on social and political behavior, both within the Western democracies and in developing countries. On these assumptions, in addition to its historical and philological research, we intend to enhance the most recent history of relations between the Jewish world, Christian denominations and Muslim currents so that the still generic current concept of "tolerance" will translate into a real sharing of knowledge and values intrinsic to each denomination, and a new sense of responsibility of believers of different religions toward the environment, the assistance to the underprivileged, the reconciliation in conflict areas.

-   *Applied ethics*: In a social local and national context increasingly characterized by a strong plurality of values, the traditional presence of shared values has failed because of the weakening grip of religion, the migration process and the accentuation of individualism. This pluralism is even more apparent in the international arena, where cultural differences are structural. In this social context, applied ethics, developed since the seventies of last century, has tried to provide legitimate and shared answers to problems that divide public opinion in contemporary society. Among the various research areas in which applied ethics has specialized, we identified as particularly significant for FBK's scientific context of the humanities and social sciences site the field of business ethics, international ethics, environmental ethics, organizational ethics and communication and media ethics.

    Research in this field should aim at formulating interdisciplinary analyses that combine the skills of the operators of the various sectors of investigation with those of academics primarily in the areas of ethics and moral philosophy. Business ethics will focus on the objectives of responsible management issues towards employees, shareholders and the society as a whole. As far as international ethics is concerned, it will be important to address the issues that divide public opinion on the challenges of global society, from poverty to war. Regarding environmental ethics, it will be crucial to address the dilemmas posed by development and sustainability for present and future generations. The ethics of the organization's objectives will involve the reconciliation of efficiency and legitimacy within both public and private organizational models. Finally, the ethics of communication and media issues relevant targets will be those that create tension between the freedom of the press and the confidentiality of information.

-   *Peace and War*: The period following the end of the Cold War, instead of leading to the conclusion of the rivalry between states and the end of the use of force - as many had expected and everybody had desired - has seen numerous military conflicts both between States and  and within States, which reaffirm the importance of measures of power and violence control at an international level. FBK intends to become, through the setting up of the Institute on peace and war studies (Ispeg), a leading research center on conflicts, promoting the study of the causes of war and the conditions for peace, and the evolution of military strategy and its effects on international politics.

-   *"Transition" as a historiographical problem*: One of the most disturbing issues in today's society, in the Trentino region and at a national and European level as well, is the sense that can be given to a "transition period" as the one in which we live. The current one is not an "unique" experience at all as  other times the history of humanity, as well as the history of the Trentino region itself, have gone through this kind of "crisis". The reconstruction of these events both in the various singularities and in the diachronic dimension, is a useful tool for "knowledge" to understand and interpret events that modify the parameters of our lives.

It is not only a major theme of historical research, but a key concept for the contributions that human sciences can give in this delicate moment in history. There is broad consensus on the fact that our time has been shaping itself as a "transition time" but it is not clear where the world is actually headed and, above all, what "new cultural paradigms" it is developing to address this delicate transition.

**Structure**

FBK's Human and Social Sciences Site is being structured according to a new model with respect to the past, looking at a better cohesion and interaction among the different themes dealt with, both in the case of existing Centers  and Centers to be built, or among specific projects and activities. In adherence to this, next to the existing centers, new centers or projects will be created aiming at the in-depth study of the topics cited above.

The activities of the Human and Social Sciences Site will start meetings dedicated to the coordintion called "Coordination Table", directed by FBK's Chairman and composed of all Directors/coordinators of Centers/projects/activities. The Table will meet every four months. Among its top duties are the definition of the layout of relatioships among the key areas of the Site, the definition of a shared pathway for the strengthening of  the scientific credibility of the Site on an international scale, keeping suggestions coming from local Trentino agencies in mind. The pathway should run along the lines of the contents of the Research Multiyear Program, to which the detailed scientific programs refer to as well.

We will establish an open and dynamic organism, a true Think tank at the Site level, involving prominent figures called ad hoc to bring an international insight into the discussion. The Think Tank meets regularly in Trento to focus attention on highly topical international issues, and on issues affecting our local society and its future. The Think Tank will periodically involve  the local public through forums, workshops and conferences, inviting international scientists, politicians and civil society personalities, to expand the basis for discussion of the issues mentioned above.

This way, FBK's humanities and social sciences site will become a reference point for some of the scientific and cultural themes studied; a scientific point of reference on an international scale through research excellence and contribution to the Think Tank, as well as cultural reference for the local communiry which, when properly engaged, will have a useful tool to determine strategies and trajectories to address "hot" problems for the future.

The Coordination Table and the Think Tank will also promote initiatives of multidisciplinary research revolving around two or more activities of the Site. Some examples of potential tracks are as follows:

Isig, Irvapp and the newly formed Ispeg could usefully cooperate in the study of economic and social effects of long-term war. We could, for example, start a project that examines the consequences of the Second World War - by reducing the number of men of marriageable age - on the marriage market and on the function-

ing of the reproductive behavior. On the other hand, or alternatively, we could study the effects of war or social unrest in Africa, the Near and Middle East, the migration processes and career mobility of migrants in developed countries.

Isig and Ispeg could promote research on the autonomy of the Trentino-Alto Adige Region as a model of identity conflict resolution by comparing the Italian experience with other situations of ethnic tension in different historical and geographical contexts. The results could be presented at a conference to be organized in conjunction with the 40th anniversary of the reform of the second Statute of autonomy in 2012.

Isr and Irvapp could cooperate in the study of the effects of religious norms and values existing in different countries on the configuration of their welfare systems and, viceversa, the study of the impact of specific public policies on the regulatory guidance of individuals and groups.

Isr and Ispeg could cooperate in the study on the ethics and legitimacy of the use of force in Western and non-Western thought.

Ispeg and Irvapp could instead make a joint research on the assessment of foreign policy and defense in Italy.

Regarding the future Institute for Behavioral Economics (IBE), we might think of its collaboration with IRVAPP and CIMEC (Mind and Brain Center) in the development of structural models able to account for the mechanisms underlying the ways in which recipients of a policy respond to it; in this area, an involvement of Isr would also be desirable in order to thoroughly explore the ethical aspects of libertarian paternalism in the field of public policies.

The multidisciplinary research efforts thus far mentioned are of course just a few examples, without any pretense of completeness; however, they are intended to identify the potential grounds of scientific interaction between the various centers of the Site on innovative research topics.

Among internal collaborations within FBK, we will then have to include those involving both the science and technology Site and the humanities and social sciences Site. A significant example in the area could be represented by the participation of FBK in the constitution of the Italian Data Archive and, therefore, the collaboration between FBK's IT research compartment and Irvapp.

The *Human and Social Sciences Site Support Services* will be in charge of the Site's organizational, managerial and instrumental functions and will be composed of: a) staff with organizational and secretarial functions to assist the directors and research groups in their interactions with other administrative offices and research support services at FBK b) a library that provides specialized tools and bibliographic resources (traditional and digital) to internal and external scholars and researchers c) a publishing structure that enhances FBK's research results by publishing paper and digital editorial products. The Service Head Officer will act as coordinator of the various support activities, as well as liaison with research areas, especially in view of the commuting of Directors, who are also engaged in their respective academic institutions.

# ISIG – Istituto storico italo-germanico

Director: Prof. Paolo Pombeni

## 1. Summary and vision

The Italian- German Historical Institute (ISIG) is a research centre devoted to the study of history from $15^{th}$ to $20^{th}$ Century. Originally planned to deal especially with the problem of relationship between the Italian and the German areas, ISIG is now turned to a more wide approach to European History, even if a special attention is still payed to the panorama of Italian-German relations and to their development during the centuries.

After a long story of different types of research (very important that on "disciplining society" in Modern Age when Paolo Prodi was in charge as Director), now Institute's mainly research object is the historiographical problem of what could be meant by "transition". A team of 13 researchers plus the director and the vice-director are inquiring the ideal type of transition in 3 different contexts – the age of Reform and Counter Reform; the "Sattelzeit" between the end of $18^{th}$ and the beginnings of $19^{th}$ centuries; the years between 1945 and 1973 as a "fading stabilization".

The result expected in 3 years time is the production of a large collective book on the ideal type of "transition", a theme now at the centre of the fore considering the today situation. In addition each researcher will produce a monograph on a special issue concerning a peculiar approach to the general theme.

A big international conference is scheduled for September 2012 to give a first check of the state of the art.

In addition to this main research duty the ISIG promotes regularly seminars and conferences on major topics under discussion in European historiography in order to create the largest possible network of historical intelligence and to gain a relevant position in the international market of historical research.

ISIG is at the same time always ready to assist and to serve the needs of learning arousing from the local context , be the University of Trento or other intellectual institutions active in the city and in the region.

ISIG also produces a book collection by Il Mulino and by Duncker und Humbolt and a learned journal, "Annali", from 2011 produced yearly in two issues, the first written in Italian to translate significant German authors made accessible to Italian readers, and the second written in German to translate Italian authors made accessible to a German readerships.

*Unit composition*

|  | *2011 (as of Jan 1st)* | *2012 (planned)* |
|---|---|---|
| Research director | Paolo Pombeni | Paolo Pombeni |
| Senior researchers | Bellabarba Marco | Bellabarba Marco |
| Researchers (including postdocs, etc.) | Alfieri Fernanda<br>Balestracci Fiammetta<br>Bauer Stefan<br>Bernardini Giovanni<br>Cau Maurizio<br>D'Ottavio Gabriele<br>Delivré Emilie Marie<br>Ferlan Claudio<br>Mondini Marco<br>Nubola Cecilia<br>Occhi Katia<br>Rospocher Massimo<br>Taviani Carlo | Alfieri Fernanda<br>Balestracci Fiammetta<br>Bauer Stefan<br>Bernardini Giovanni<br>Cau Maurizio<br>Cont Alessandro<br>D'Ottavio Gabriele<br>Delivré Emilie Marie<br>Ferlan Claudio<br>Mondini Marco<br>Nubola Cecilia<br>Occhi Katia<br>Taviani Carlo |
| Technologists | - | - |
| PhD students | - | - |
| Total | - | - |
| Tenured | 6 | 5 |
| Tenure track | 0 | 0 |

## 2. Recent publications

| *year* | *Jour.- Article (IF)* | *Books (authored)* | *Books (edited)* | *Chapters in Book* |
|---|---|---|---|---|
| In print | 0 | 0 | 0 | 0 |
| 2011 | 0 | 0 | 0 | 1 |
| 2010 | 4 | 2 | 1 | 13 |
| 2009 | 0 | 0 | 0 | 0 |
| 2008 | 0 | 0 | 0 | 0 |
| 2007 | 0 | 0 | 0 | 0 |
| 2006 | 0 | 0 | 0 | 0 |

This is only a selection of recent publications, limited to most significant contributions. Of course our researchers regularly review books in learned journals and take part as invited speakers in local, national and sometime international conferences. There is a wide range of subjects in the selected publications- what is due

for the moment to the absence until 2011of a common focus on the research activities of the Institute.


Top 5 publications in the last 3 years (2009-2011):

−   P. POMBENI, *La ragione e la passione. Le forme della politica nell'Europa contemporanea*, Bologna, Il Mulino, 2010

−   F. ALFIERI, *Nella Camera degli sposi*, Bologna, Il Mulino 2010

−   K. HÄRTER – C. NUBOLA (eds), *Grazia e giustizia. Figure della clemenza fra tardo medioevo ed età contemporanea*, Bologna, Il Mulino 2011

−   F. TROCINI, *L'invenzione della Realpolitik*, Bologna, Il Mulino, 2009

−   G.E. RUSCONI, Th. SCHLEMMER, H. WOLLER, (eds.), *Berlusoni an der Macht*, München, Oldenbourg, 2010


## 3.   Objectives for 2012

The main objective for 2012 is the second step in our research on "Transition as an historiographical problem". Next September is scheduled an international conference to confront the results of our research with a panel of prominent European historians.

We will also conclude a research financed by the "Fondazione Caritro" on the problem of how it was treated the memory of the recent past in the rebuilding of democracy after 1945 in Italy, Austria, Germany and France.

For the late autumn is expected a book, produced with the support of a private sponsor, on Enrico Conci at the Vienna Parliament in the first decade of 20$^{th}$ century. The book will publish his speeches at Parliament, an unpublished diary he kept in the first years of his experience at the Habsburgian Parliament and a selection of the letters he sent to his wife from Vienna

The routine activity of organizing seminars and learned conferences will see as one of the main event the international conference on " Narrating the wars" (May 2012) .

Of course all the members of our research team continue to be invited at speaker at various national and international conferences


## 4.   Front Edge & New Initiatives

The key novelty in our research is to be seen in the methodology of work. Usually in history as in many fields of humanities the research is conducted individually, or in very small groups. In our case a large group of researchers is working together on the same topic. If we will be successful we think to be able to show that also in the field of humanities a real research team, linked by the sharing of the same "laboratory" and not simply of the same topic or of the same literary references, can

gain results of significance for the intellectual community beyond the strict academic and specialized borders.

## 5.   Funding

| Acronym | Full name | Type | Duration | Total income | Income 2012 |
|---|---|---|---|---|---|
| PESTO | Il peso della storia nella rifondazione dei sistemi politici post 1945 | Industrial | 31/1/2011-30/01/2013 | € 17.000,00 | € 5.000,00 |
| ATRE | Riordino e valorizzazione degli Atti Trentini: Secc. XII-XIX | Industrial | 15/11/2011 14/11/2013 | € 20.000,00 | € 12.7375,00 |
| CONCI | Un Politico Trentino al Parlamento di Vienna nel tramonto dell'Impero: E. Conci | Industrial | 1/12/2011-31/9/2012 | € 8.000 | € 8.000 |

Type: EU, PAT, Other public agency, Industrial.

Funding is far from easy in humanities. We try to encourage local sponsors to invest in historical research and at the same time we support young researcher who apply for fellowships sponsored by local, national and international institutions to spend their opportunity at our Institute.

## 6.   Budget

|  | 2011 | 2012 |
|---|---|---|
| Expenses |  |  |
| Personnel | € 881,47 | € 663,87 |
| Travel | € 28,00 | € 29,00 |
| Equipment (HW/SW) | € 116,00 | € 110,50 |
| Other (e.g. subcontracting to external contractors) | € 133,40 | € 105,48 |
| Total Expenditure | € 1.158,87 | € 908,85 |
| Incomes |  |  |
| EU Projects (total amount financed by EU) | € 0,00 | € 0,00 |
| Other external incomes (industrial, PAT projects, etc.) | € 34,61 | € 5,00 |
| Projects to be finalized | € 0,00 | € 12,38 |

| Total Income | € 34,61 | € 17,38 |
|---|---|---|
| Financial Need (Total Income – Total Expenditure) | € 1.124,26 | € 891,48 |
| Self funding | 3,0% | 1,9% |

Note: Column 2011 is based on the unit's budget state as estimated at the date of document writing. Column 2012 is the budget planned for 2012

## 7. Remarks

The Director is in charge from September 2010, after he served as a consultant in the period March-July 2010 in order to elaborate a project of reorganization of the Institute. This makes difficult to speak properly of what happened before he was on duty, especially taken into account that the way to organize the research is largely changed in the last year.

# ISR – Centro per le scienze religiose

## Summary of 2011 activities

2011 has been a year of transition for the CRS, marked by a further reduction of research positions and by the end of Antonio Autiero's term, which left the Center without a Director for the last six months of the year. Thus, a projectual phase that was intended to start a new comprehensive research project was interrupted and no new project has replaced the former one.

Under these completely anomalous circumstances, the research work, once a number of projects that had been activated during the previous years (the "Future of Human Nature" project, that ended last Spring with the end of Jonathan Davies's contract and with the workshop on *Varieties of Determinism: Science and Free Will* that was held on February 24-25, and the project focusing on "Gender and corporeality", that closed with the seminar *The social body: Negotiations of religion and gender in the public realm* on December 1-2), we were compelled to focus on the individual activities of the 5 researchers (Valentina Chizzola, Paolo Costa, Stefanie Knauss, Debora Tonelli and Davide Zordan). Such activities produced the following works, published during these past months: 1 monograph, 1 curatorship and 31 essays for journals or collective volumes (6 of them in English or other language). Two other monographs, 4 curatorships (1 of them in English) and 6 essays on journals or collective volumes (4 of them in English or other language), containing the results of work conducted during 2011, will see the light in early 2012.

Additionally, all Center researchers have been permanently involved in teaching activities for the Advanced Course in Religious Sciences (Academic year 2011-2011 and Academic year 2011-2012), for which Paolo Costa, in his capacity of Head Officer, has dealt specifically with organization and management matters.

# RESEARCH SUPPORT, ADMINISTRATION, AND FUNCTIONING

# In support of research, administration, and functioning

The Bruno Kessler Foundation arose from a major transformation that involved various aspects essential to a research institution, from its scientific strategy to its internal organization. The transformation has had as its pervasive factor the transition from a bureaucratic public institution (former-ITC) to one that is quasi-private and based on results.

Over the past 4 years FBK has obtained unexpected results in terms of growth from a scientific excellence, self-financing and support to the Trentino region standpoint, and these results were achieved mainly thanks to the strong motivation of the staff who faced the challenge.

One of the key aspects in this framework is the identification of an organizational structure - including its powers and responsibilities – for the Administration and Research Support Services Division (CASSR) at FBK able to meet the challenges of the next 4 years by means of the creation or refinement of specific tools to support research activities, the bodies of the Foundation and the various parties involved in the life of the Foundation. This in light of the fact that the activities conducted by the "non-research component" of FBK have been gradually enriched in recent years by other functions such as those relating to the definition and extraction of parameters and metrics of research results, and those aimed at achieving a structured relationship with local businesses (Innovation and Local Relations Area).

A shared way of working for all activities supporting research is an increasingly apparent dimension at FBK, a dimension that will allow sighting ever new organizational improvement goals; what we are seeing today means already a substantial increase in contracts and external contacts to be managed involving internal and outgoing data flows that require the introduction of new information and management systems. After the transition period that allowed the passage from ITC to FBK between 2007 and 2011, we are now working on a change of perspective to manage the new four-year period 2012-2014, in which the role of CASSR is increasingly seen as a Partner and Service Provider for the research centers and institutional bodies that are the heart of FBK. This role, given the changed geo-economic world scenario and its challenges at a global scale, will confirm the organizational logic recently adopted which aims at "doing more and better with less"; in this perspective we are managing the relationship between the halt in staffing for the Division and the strong growth in the research and innovation compartment as well as, more generally, we are managing the whole process of reclassification of expenditure and organizational rationalization.

Nine are the key points that innervate the components of the new structure of the CASSR and that will act as a basis for the definition of the strategic actions to be carried out: simplification and integration.

- Simplifying the organizational structure in order to achieve greater integration, efficiency and economy. Obtaining a homogeneity and cohesion of the different services.
- Shared objectives between CASSR and research. The point is, both for the strategic objectives linked to the program agreement and for operational ones more related to technical and administrative improvement projects, shared procedures with research that will ensure the greatest possible alignment with the purposes of FBK and with the operational trajectories that they require.
- Definition of models for service charters (and their SLAs) for each service. This is basically to get to produce a "dynamic"Service Charter, which will catalog and define services available, not with a static view of FBK, but with a vision of continuous transformation of services that may be refined and renovated, as the research scenario constantly redefines and changes internationally and locally.
- Setting of regulations, procedures and processes in line with the basic principles listed above.
- Redefinition of the 'system of powers of attorney, starting from the central role of the Unit Managers, and involving Directors and Executives.
- Creation of an international benchmark of organizations that are comparable to ours.
- Introduction of new models of internal communication to increase transparency within the organization.
- Introduction of the instrument of customer satisfaction.
- Services to partners under the program agreement.

Inside this new organizational structure, we will initially focus on the implementation of some main guidelines that will be the foundation for the novel elements mentioned above. The most important initiatives on which to focus our effort will be: organizational simplification: the introduction and development, in stages, of an adjustment of the current organization aiming at a simplification of current operations and functional relationships. Organizational integration: a new organizational structure that will consider a single support to global research, characterized by greater cohesion and integration of strategic components of the Research Evaluation and Innovation and Local Relations Areas. Personnel management: development of a new model of personnel management and introduction of a solution composed of a registry based on systems and processes (personnel database solution and Human Resource ERP) aimed at the management and enhancement of the human capital of the Foundation, deemed as the main capital which supports the achievement of strategic objectives. Decision-making flows: study, experimentation and introduction of a model of decision-making flows in order to introduce both a higher and more uniform governance and activity planning at the Foundation, to direct investments towards both the short and long term strategic objectives of the Foundation . Integration within the Program Agreement: integration of support services provided by FBK to related entities in the context of the Program Agreement, offering more value to the system connected to the Foundation. Affirmation of the role of Research Evaluation: finalize some important ongoing evalua-

tion activities (such as peer reviews and involvement in evaluation programs) and affirm the involvement of Research Evaluation in decision-making flows. Relations with the foundation's partners: to consolidate and implement system profitable relationships and collaborations with some partners such as, for example, the Trento Chamber of Commerce and the Association of Artisans of Trento.

For a detailed view of the program framework briefly described above, please refer to the document "Organizational Logics of the Administration and Research Support Division for the period 2011-2014".

# STRATEGIC INVESTMENTS

## LABORATORIES AND EQUIPMENT

In 2012, some specific actions will have to be implemented in order to support the technological capabilities of the CMM laboratories. This will primarily entail specific investments on the MTlab and the MiNAlab to update existing equipment and recruit personnel to fill vacancies.

Regarding the MTlab, several actions that have been discussed for some time and whose implementation was approved during 2011, have been planned for 2012. Such actions involve the implementation of the upgrading of the microfabrication line to make it suitable for 6" wafers as opposed to the current 4" ones.

In particular, planned actions include: the installation of the furnace system, whose call for tenders is underway; a call for tenders for the purchase and installation of two chemical fume hoods; the upgrading of three existing chemical fume hoods and finally the initiation of orders for the upgrading of all remaining equipment for the new 6" line which will start operating during 2013.

## ORDINARY INVESTMENTS ON BUILDING PLAN

*Access control to the via alla Cascata site.* The buildings located on via alla Cascata do not have enough parking spaces compared to the number of workers identified. To solve this situation, we decided to formally prohibit the use of parking spaces whenever signing a rental contract on areas decicated to companies/administrative offices.

The porter's service often reports cars parked outside the marked spaces and the presence of non authorized cars. To ensure that parking is used by authorized people only, an access control system like the one already in place at the FBK-Povo site needs to be activated.

*Internal space requalification.* As per the requalification program, included in the 2009-2013 FBK Building Plan, spaces located on the first floor of the North building, currently used as classrooms, will have to be gradually transformed into offices. For this purpose, the entire electrical wiring and data transmission will need to be reconstructed and the air conditioning system will need to be nenovated.

A large number of new movable walls will also be needed due to the new floor plan of such areas.

Based on data obtained upon completion of the similar works, estimated costs are as follows:

*Analysis and planning.* LEED certification completion with the support of Consorzio Habitech.

*East Building energy efficiency improvement.* The mechanical/electrical systems of the East building at the Povo site, built in the early eighties, do not provide cost-efficient air-conditioning. Additionally, this building hosts the two clean rooms of the Foundation which use up 39% of its electricity demand (FBK Povo complex) and 27% of its fuel gas demand adding up to 35% of the entire Povo site consumption.

*Internal space requalification of TN RISE 2013.* The space requalification program, as per FBK's 2009-2013 Building Plan, has laid down the gradual transformation of the first floor spaces of the North Building currently used as classrooms into office space. This entails the total rebuilding of the electrical and data transmission systems and the renovation of the air-conditioning system.

A large number of new movable walls will also be needed due to the new floor plan of such areas.

*Internal safety.* There are basically three areas that have needed repair works for some years now, as far as internal safety issues are concerned:

- The first one involves the need of further work on the water infiltration in the basement of the North Building, in partcular the waterproofing of the basement wall facing south and waterproofing of the central basement window.
- The second one involves the removal of the debris coming off the rocky wall behind the building located in via alla Cascata. This is necessary because the attempts made so far to assign responsibilities and burdens of the removal of such construction defect to the construction company have been unsuccessful.
- The third one involves the entire reconstruction of the ventilation system in the east Building due to the presence of deteriorated insulation material inside the distribution ducts.

*Energy efficiency improvement.* Given the large energy expenditure at FBK (€ 844,967 electricity, € 431,000 natural gas) and the ambitious policy of sustainability recently promoted (-15% emissions by 2012), further action needs to be planned on the heating and air conditioning systems, starting from the most obsolete and energy-consuming ones.

*West Building heating system*

The current consumption of natural gas for the West Building is 75.000mc of methane gas for an amount of € 55,000. The current forced-air technology heat generators, installed in 1993, are out-of-date. The heat transfer fluid distribution system uses end elements such as fan coils and radiators. The former can be fed for most of the season with water at a temperature close to 55 ° C, with incoming temperatures of 45 ° C.

In this situation, the mere replacement of the current generator with condensing boilers would allow a conservatively estimated 15% consumption reduction, about € 8,250 per year, with an approximately 5-year investment pay back.

*West Building Cooling system*

The current cooling system in the West Building is composed of 3 chillers (4 piston compressors each) with about 1,2 MW total cooling capacity.

Two out of the three chillers have a total of four faulty compressors that need regeneration. Given the obsolescence of the equipment and the availability on the market of much higher performance refrigeration technologies, we deem it appropriate to consider the purchase of a new "magnetic levitation" chiller. A lower power unit will suffice as the CR-D and the server room are equipped with their own cooling systems. This would also free up the "chillers" room (about 72.5 square meters) and eliminate some of the condensing units installed over the "south" technical areas of the West building.

*Replacement of clean room furnaces.* The installation of new furnaces for the manufacture of environment sensor semiconductors and LPCVD for semiconductors, planned for the summer of 2012 will require renovation works of walls and electrical and air treatment system.

## INFORMATION SYSTEMS

The Bruno Kessler Foundation, following the redefinition of its organizational and operational model, has initiated a project to replace the current information system with the aim of achieving greater efficiency, effectiveness and timeliness in the execution of the various processes, in a manner consistent with its strategic goals, organizational structure, information flows and business processes. Currently, FBK has multiple information systems that result in a dispersion of data and a significant time investment in terms of manual and operational activities.

To allow the evaluation and introduction of the new system, the revision and redefinition of key business processes in an improvement perspective through the practical implementation of short term, quick wins, and medium to long term solutions was required.Thus, we decided to replace the information system considering it as a structural investment.

The project will have a minimum duration of three years. It will be focused on Human Resources first and will then involve administration and accounting activities and project management.

It will include the following activities:

–   selection of the ERP software, providers and project partners;

–   detailed project definition and selection of the project manager;

–   search of Human Resources and Administration key users who will interface with the analysts;

–   search of project dedicated operators (functional analysts, programmers, trainers);

–   user training.

SUBSIDIARIES UNDER PROGRAM AGREEMENT

# Ahref Foundation

Director: Michele Kettmaier

## 1.    Executive Summary

The mission of <ahref Foundation is to study the quality of information emerging from today's social networks and digital media. Its research activities aim at innovation geared toward designing, implementing, testing and establishing tools and practices for good journalism and citizen participation. <ahref is also committed to develop open platforms & projects to increase the quality of information produced by online collaboration.

This process covers a series of research topics and fields: the definition of "quality of information" and "information"; a knowledge of social and technology dynamics of people sharing stories on the Internet; the relationship between digital networks and the broader social fabric being developed locally; an understanding of the non-linear pattern underlying the complex ecosystem of information; the definition of opportunities and incentive mechanisms in this landscape, including people's roles and skills.

Established in 2010, the <ahref Foundation started its operation only in autumn 2010. Its initial activities focused on the necessary bureaucratic structure, defining an appropriate work plan, hiring full-time and part-time contributors until April 2011. In its first six months of activities (April-October2011), the <ahref Foundation has produced various initiatives both locally (with a specific attention to the Trento area) and at the International level -- thus putting the Trentino region at the centre of the social innovation process triggered by a broader Internet penetration in Italy.

## 2.    Vision and Scientific Program

*Context and State of the Art*

Ever since the advent of the Internet and social media, the pace of innovation in the information ecosystem has accelerated in all respects. In particular, the collapse of technological and economic barriers relating to the publication of information has led to the exponential growth of active participants in the production of publicly available knowledge. In turn, this led to a shifting in the information filtering system and to the emergence of a new paradigm for the information ecosystem.

In this context, the concept of "quality of information" is most affected by this transformation. In the previous paradigm, that quality was the implicit result of a traditional editorial filtering. However, today anybody can essentially publish anything online, thus giving way to engaging technologies and shared practices that bring up a new breed of quality information.

The standards defining the quality of information, previously outlined by those 'gatekeepers', must now be evaluated in reverse and is defined by strategies and mechanisms constantly under development. The fundamental dynamic now concerns the activation of social filters, based on the action of people who express themselves, connect together, and recognise one another online. Perhaps this process could even help the reconstruction of the social capital that had been partially lost, due to the old filtering system (or at least, it can create the conditions for this to happen in the near future).

Therefore, the quality of information in the era of social media becomes a primary research topic: it enables the construction of a shared agenda and broader coordination among individuals. Addressing the quality of information emerging from today's social networks leads to study the feasibility of building appropriate platforms and incentives. Given the Net dynamics, embracing any proposed "top down" definition of the "quality of information" would not only be a losing proposition, but would also betray its historic role in balancing the social capital lost by the media power in the previous paradigm. In order to renew the very concept of quality of information and to enhance the definition of a shared agenda, it is then enough to enable a set of practices to emerge, to foster a "bottom up" approach.

Of course these assumptions require research activities, and can only be tested on the field by specific pilot projects. Design and development based on this research outcome will then be implemented outside the <ahref structures and/or in cooperation with other existing bodies.

The context of this research is structurally multidisciplinary. The key points of reference are found in media literacy studies, along with the theoretical knowledge acquired during this digital evolution, or produced by scholars of social capital, human-computer interface designers, critics of new forms of narrative, analysts of the media economy.

This research studies must also cover the activities performed by users, citizens and entrepreneurs who are actually changing today's ecosystem of information.

The end result of this research activity is the promotion of specific projects, services and surveys related to five main (but not exclusive) strands:

−   Analysis of the quality of information. The evolution of the standards pertaining the research on information and the evolution of platforms upon which this information develops within the social networks, in terms of design, narration and technological efficiency.

−   Analysis of the notions of credibility, reputation and attention on the web, in regards to emerging relationships in the social networks and to their interrelation within the information practices for facts filtering on social platforms.

−   Analysis of the quality of the platforms used to tell people's daily life and of the social functions of the information that is being exchanged. Storytelling is a crucial dimension for the construction of social networks and for enabling the "word of mouth" process. Actually, this dimension becomes a medium in its own right, made up of people linked together online. In turn, this helps the emergence of hyper-local information, now considered one of the most promising features for tomorrow's media system.

- The implementation of social networks to increase specific knowledge in science and technology, seen also as a fundamental part of a regional development. This sector is particularly relevant in regards to quality and verification of information -- thus holding important consequences for other scientific fields concerned the issue of quality.
- Training and education about narrative techniques used or suitable for social media, with particular attention to open data and other practices fostering broader transparency of public institutions, media literacy, citizens' rights and responsibilities.

Each research project takes shape through a dedicated working group, several workshops and other practices to produce verifiable working hypothesis. The appropriate technical solutions are eventually drafted and tested on the field.

The research projects carried at the <ahref Foundation will result in top-level scientific output on the international scene (see below for a list of publications produced during the first year of operation) while also having a key impact on the overall activities of the Foundation itself.

During 2011, the Foundation attended several specialized events throughout Italy, starting with the International Journalism Festival in Perugia (13-17 April 2011): the unveiling of its activities, particularly the launch its first collaborative inquiry on school drop-out rates in Southern Italy, aroused considerable interest both in the media sector and the public at large. In May, <ahref and Fondazione con il Sud co-hosted a series of discussion panels on the issue of submerged economy in Naples, as an introduction to the Festival of Economics in Trento. More recently, <ahref assumed a central role in Italy's Internet governance process by hosting the 2011 Internet Governance Forum Italy in Trento (10-12 November). For that event, the Foundation set up an articulated topic agenda, while also involving prominent Italian and international speakers.

Besides direct participation and organization in events with National relevance, <ahref adhered to its mission by carrying out an intense dissemination of activities on the field. This activity targeted schools, institutions and associations, while at the same time promoting peoples' participation, to help using the Net as a shared environment to learn, develop engaged citizenship and to create new, direct relationships between citizens and public bodies.

In this regard, the timu platform was instrumental for the success of specific events, such as the 9th Edition of the "Workshop on social entrepreneurship" (Riva del Garda, 15-16 September), co-hosted by The Hub Rovereto and the Journalism Master at Milan's IULM University, and for several events held in various schools in the Trento province.

Designed and developed to encourage the production of quality information, timu is indeed the pulsating engine working to achieve the Foundation's goals. Given the overall mission of <ahref (increasing the quality of information independently produced by netizens) and its research activities (concerning Media Literacy, Internet Studies, convergence of Science, Technology and Society, social media dynamics and on-line reputation), timu is an ideal tool to engage the Foundation's main

stakeholders -- citizens willing to collaborate in producing original content on the Net.

Released in beta on 1st September 2011, timu is being constantly improved and expanded, as shown by the recent release of its English version. This implementation stage is expected to continue throughout 2012.

*Vision and Goals*

The mission of <ahref Foundation is to study the quality of information emerging from today's social networks and digital media. Its research activities aim at innovation geared toward designing, implementing, testing and establishing tools and practices for good journalism and citizen participation. <ahref is also committed to develop open platforms & projects to increase the quality of information produced by online collaboration.

This process covers a series of research topics and fields: the definition of "quality of information" and "information"; a knowledge of social and technology dynamics of people sharing stories on the Internet; the relationship between digital networks and the broader social fabric being developed locally; an understanding of the non-linear pattern underlying the complex ecosystem of information; the definition of opportunities and incentive mechanisms in this landscape, including people's roles and skills.

<ahref is the first Italian Foundation that explicitly includes in its charter the study of the overall Internet audience and its relationship to information and institutions. Article 2 of the Foundation Statute defines its purpose as follows:

– To study, research and analyse the Internet and the media, in particular their economic, political, social and cultural effects on society; to study social media, the role of the individual, of institutions and enterprises in the generation of information;

– To share tools and information services and knowledge for the ordinary citizen in dealing with institutions, business, government and all social participants; to assess and enhance the quality of information, study and promote innovative forms of financing information and those people generating the information;

– To study the possible future scenarios and innovative interactions between the Internet, the media system, society, the economy and technology, innovation in language, design and information storage technology;

– To teach people to produce information, to decode messages offered by the media, to study and appreciate the social dynamics linked to the media, that favour the development of civil co-existence and of the cultural quality of information;

– To contribute to the creation of relational goods, the human capital that becomes social capital, to the content of the *horizontal* conversations between people, with government bodies and business;

– To promote awareness of such issues in society and particularly in schools.

– To transfer knowledge and research results to individuals, institutions, businesses and the workplace;

–    To promote and develop projects that will also include pilot projects designed to test, verify and disseminate ideas that emerged in the research, consistent with its aims and objectives at local, national and even international attention with particular attention paid to the countries of the southern hemisphere;

–    To promote events, exhibitions, conferences, and to design and implement multimedia projects consistent with its goal.

The Foundation activities for year 2012 will be designed and carried out according to the above nine provisions.


*Activities and Work Plan*

For the year 2012, <ahref has already planned several specific activities in order to better fulfill its mission.

The **timu** platform will be constantly improved and updated, including the implementation of such features as:

–    A reputation system easy to access and use for all users;

–    A rewarding system, based on the above reputation structure, to increase the quality of information produced by all users;

–    A mechanism helping or enabling funding opportunities for individuals interested in pursuing inquiries in the public interest;

–    Agreements with major National media to further disseminate the best content produced by the timu community;

–    Opportunities for promoting (particularly in school and local bodies) the platform potentialities to activate broader citizen involvement in the Trentino region and beyond.

These options address explicitly, but not exclusively, provisions 2, 3, 4, 5, 6 of Article 2 of the Foundation Statute.

**Fact Checking.** This is the second major service that <ahref will make available to all netizens. While timu is a content production platform, according to a shared method based on the standards of accuracy, impartiality, independence and legality, Fact Checking is intended as a mechanism to verify the reliability and relevance of information distributed through the media ecosystem.

Fact Checking is a tool provided by <ahref to people sharing a specific interest and characteristics to check the reliability level of an information product or event – such as a TV show, a magazine or newspaper article, an online story, etc.

**Wavu**: Designed as a collaborative tool for "public social discovery" of quality information on the Net, especially focused on the evolution of social media evolution, Wavu will improve its functions for synthesis and selection of in-depth online content. The new release (forseen in 2012) will also be experimenting with innovative options pertaining to the semantic web.

**iData Project.** As a research project to improve data journalism practices with open source tools, iData plans to develop and implement the first Italian platform of this kind. Entirely released under a Creative Commons license, this platform will be linked to those online communities interested in collaborating to gather, produce

and process a variety of data. The original sources will include public databases, public domain resources or ad hoc data produced by the same communities. During 2012, iData will specifically develop four databases to gather and process certain data sets publicly available in Italy.

The iData project addresses explicitly provisions 2, 4, 5 of Article 2 of the Foundation Statute.

**"Tell your Trentino" project**. This initiative is specifically aimed at residents of the Trentino region interested in sharing stories related to their own community and personal experiences. The timu platform will be used to collect different kinds of content related to local people, under the premise that our future depends on what we are building today. There will be interviews with important figures of the economic, social and cultural life in Trentino, but every citizen will be encouraged to share his/her own personal story on timu.

The main goal of this project is to gather a vast array of stories (relevant for both their quality and quantity) and try to extract a narrative model defining a shared perspective and (possibly) identifying a cultural identity belonging to the entire Trentino community. Researchers of the **Italian-German Historical Institute** will also provide their expertise in interpretative tools and processing.

The "Tell your Trentino" project addresses explicitly provisions 1, 4, 5 of Article 2 of the Foundation Statute.

**Attendance at important National events.** At the time of this writing (late November 2011), <ahref will participate with specific panels or ad hoc projects in some public events scheduled for 2012 in Italy, such as:

–    Festival of Economics in Trento;

–    International Journalism Festival in Perugia;

–    Festival of "Internazionale" magazine in Ferrara;

–    Festival of Literacy in Mantova.

The Foundation also plans to organize other events throughout the year, with a special emphasis on the Florence's Storytelling Festival in the fall of 2012.

During the year, <ahref will also design and carry out several workshops and seminars in accordance with its mission to promote the public debate on the development of Civic Media in Italy.

This direct involvement in important National events and in fostering the public debate address provisions 6, 7, 8, 9 of Article 2 of the Foundation Statute explicitly.

**Presence on the National and International scene.** <ahref plans to gain strong reliability and trustworthiness in the scientific/research community. To this end, <ahref researchers will do whatever is necessary to ensure the inclusion of the Foundation's research outcomes in relevant National and International conferences and journals. Along with a presence in various publications and events, the Foundation's material will be included in a special issue of the Critical Studies of Peer Production journal.

**IGF 2012.** <ahref will be an active member in the organization of the 2012 Internet Governance Forum Italy that will take place in Torino. This involvement will confirm

its key role in promoting broader understanding and the spreading of the Internet in Italy.

**Education.** One of the priorities defined in the establishment of the Foundation itself is its commitment to provide training opportunities and knowledge-sharing to young people. The standard method defined for the timu platform is already an educational pattern aimed at personal accountability on the Net. But young people, whose daily life is strictly intertwined with the online environment, should be aware of appropriate behaviors and norms used on the Internet. In this regard, the "Privacy Traders" is a learning experiment embedded in an innovative role-playing game, where teenagers learn how to produce quality content while at the same protecting their own online privacy. This project, recently carried out for the first time in a senior class in Trento's Leonardo Da Vinci high school, will soon be replicated in other schools in Trentino and other Italian regions (in accordance with provision 6 of Article 2 of the Foundation Statute).

**Journalism Training**. Among other initiatives in this sector, <ahref plans to organize high quality courses and training, particularly in the area of "Data Journalism" in collaboration with International partners.

In particular the Foundation is organizing an international school of journalism during the Journalism Festival in Perugia.

The course attendance will be open not only to students and professional journalists but also to all the citizens interested in the subject. This event will have an high teaching level for the presence of important speakers hosted at the Festival in Perugia. One partner for the organization will be The Eruopean Journalism Centre.

The second training project will be held in Rome with the aim to train the Istat (Istituto Italiano di Statistica) employees in the use of data for civic media activities.

**Higher Education Teaching**. Several <ahref researchers are actively teaching at the University of Trento (both in short courses and as teaching assistants). This ongoing linkage with University students is important for a research centre like <ahref, which can enlist people doing their dissertations on subjects close the Foundation's goals. Not to mention that fact that students are always able to come up with fresh and innovative ideas.

*Collaborations and Partnerships*

<ahref Foundation collaborates with a variety of Italian and International bodies, operating in both research/higher education and the civil society (e.g. associations, companies, etc.).

Research and Higher Education Partners:

–   MetaLab: MetaLab (at) Harvard is a research unit dedicated to innovation and experimentation in the arts, media and humanities hosted at the Berkman Center for Internet and Society.

–   MIT Center For Civic Media: The Center creates and deploys technical and social tools that fill the information needs of communities and is a joint effort between the MIT Media Lab and the MIT Comparative Media Studies Program.

- Nexa, Torino: An independent research center, focusing on quantitative and interdisciplinary analysis of the Internet and of its impact on society.
- School of Informatics and Computing: A leading project in education, research, and outreach that integrates the full breadth of computing and information technology, including the scientific and technical core, a broad range of applications, human and societal issues.
- Sissa (Scuola Internazionale Superiore di Studi Avanzati, Trieste): A leading scientific institution, provides advanced research and post-graduate training in physics, mathematics, and neuroscience for worldwide students.
- Centro Studi di etnognafia digitale: A research center covering the emerging forms of cultural life on the Net and in the society at large.
- ProPublica: An independent, nonprofit newsroom that produces high-level investigative journalism in the public interest.
- Trento Attiva: As association focused on environmental and legal issues, while supporting the affirmation of people's rights.

Civil Society Partners:

- AltraTv: An Italian observatory monitoring and promoting micro web TVs and hyper-local media created by citizens.
- FilmWork: An independent movie production company founded in 1988 in Trento and whose projects are hosted in prestigious museums across the world.
- Fondazione Con il Sud: An organization supporting the development of projects aimed at strengthening local communities and collaborative ventures in the civil society.
- Fondazione Giuseppe di Vittorio: An organization aimed at studying and disseminating information about the history of the Italian and European workers' movement.
- Fondazione Sistema Toscana: A non-profit, collaborative organization founded by Regione Toscana and Monte dei Paschi to promote Tuscany's territorial system.
- Futur3: A company involved in the wireless telecommunication sector and developer of a major EU wireless network, Mesh FREE LUNA.
- Ninja Marketing: An innovative company focused on communication, marketing, social and technology innovation.
- Trento Media Player: A cultural centre hosting events and training related to film-making, photography, Web radio and TV, visual arts.

### 3.    Budget

|  | 2012 |
|---|---|
| Expenses |  |
| Personnel | € 991.929 |
| Travel | € 40.000 |
| Equipment (HW/SW) | € 34.125 |
| Other (e.g. subcontracting to external contractors) | € 775.951 |
| Total Expenditure | € 1.842.005 |
| Incomes |  |
| EU Projects (total amount financed by EU) | € 0.00 |
| Other external incomes (industrial, PAT projects, etc.) | € 300.000 |
| Total Income | € 300.000 |
| Financial Need (Total Income – Total Expenditure) | € 1.542.005 |
| Self funding | 16,29% |

### 4. Human Resources

The <ahref Foundation currently has 18 employees and 5 external contractors.

- 1    president
- 1    general director
- 1    secretary
- 1    team & project manager
- 1    research content manager
- 1    systems administrator
- 1    event coordinator
- 11    researchers
- 3    junior technologists
- 1    PhD Student

With its staff structure still in progress, in 2012 <ahref plans to activate new col-laborations in specific sectors, in accordance with projects still being finalized.

### 5.    Publications

- De Paoli S. & Teli M. (2011). Editors of a Special Issue of "Etnografia e Ricerca Qualitativa" (*Ethnography and Qualitative Research*), Entitled "*New groups and new methods? The ethnography and qualitative research of online groups*":
  URL:http://www.mulino.it/edizioni/riviste/scheda_fascicolo.php?isbn=14856&il mulino.

−   De Paoli S. (2011). *An STS Approach to the Design of Online Reputation.*In Proceedings of the 10th IAS-STS Conference, Graz 2-3 May 2011.

−   Kerr. A., De Paoli S. & Keatinge M. (2011). *Human and Non-Human Aspects of Governance and Regulation of MMOGs* (September 12, 2011). Presented at the " A Decade of Internet Time" Symposium, Oxford 22-24 Settembre 2011.URL http://ssrn.com/abstract=1926196

−   De Paoli S. & Kerr A. (2011). *On Crimes and Punishments in Virtual Worlds.* Published Online in Ethics & Information Technology, DOI: 10.1007/s10676-011-9281-7 .

−   Kerr, A., De Paoli S. & Keatinge M. (2011) *Governance and Participation in Massively Multiplayer Online Games'.* Invited paper at the 'Social Participation and Digital Communities' track at the Intel European Research and Innovation Conference, Leixlip, Ireland, 12th Oct., 2011.

# Celct – Center for the Evaluation of Language and Communication Technologies

Head: Emanuele Pianta

## 1. Executive Summary

Celct is an independent center founded in 2003 under the initiative of ITC-irst (now FBK) and DFKI (Deutches Forschungszentrum für Künstliche Intelligenz), with the mission of becoming a competence unit for the evaluation of multimodal language and communication technologies. Evaluation activities in this area were already performed within the two institutions that are the charter members of the center. However FBK and DFKI thought that it was convenient for them to move those activities to an independent specialized organization, which could offer its services to a larger research and industry community, and could also guarantee the high level of competence and independence which is expected from an international evaluation center. In the last seven years the center has interpreted its mission by promoting and participating in a number of evaluation-related activities. The activity of Celct should be put in a international context where evaluation activities for language and communication technologies are becoming more and more widespread especially in the research community.

Evaluation activities imply at least four aspects: definition of a task to evaluate, production of reference datasets (benchmarks); development of evaluation paradigms and methodologies; organization of evaluation campaigns. Celct can play an important role in this international context. The main rationale for Celct activity is the need to concentrate and factorize competences which are now scattered in different organizations and that suffer a lack of coordination and long term view, as well as shortage of funding. The role of a small center as Celct cannot be that of substituting those activities, but should be facilitating and promoting them, acting as reference point and multiplier. In the first phase of its activities Celct has mainly struggled to gather competences and to gain visibility and credibility in the evaluation community. It is now in the process of increasing the level of linking and interaction with all the important players in the arena. We have contacted a number of international institutions sharing common strategic views about the relevance of evaluation activities for research and industry, about the role of Celct to foster such activities, and about the best ways of promoting and sustaining them in a European context. In the long run the goal of this networking activity is involving those institution at various level (from the Advisory Board to the Members Assembly), and starting new projects that will improve the level of self-financing of the center.

## 2. Vision and Scientific Program

*Context and State of the Art*

Celct is an independent center founded in 2003 under the initiative of ITC-irst (now FBK) and DFKI (Deutches Forschungszentrum für Künstliche Intelligenz). The activities of the center actually began at the end of 2004 and have been funded up to 2008 by a grant of the Province of Trento (PAT). The grant has been extended for one year in 2009. Since 2010 Celct has been included in the FBK Accordo di programma.

The center was funded with the mission of becoming a competence unit for the evaluation of multimodal language and communication technologies. Evaluation activities in this area were already performed within the two institutions that are the charter members of the center. However FBK and DFKI thought that it was convenient for them to move those activities to an independent specialized organization, which could offer its services to a larger research and industry community, and could also guarantee the high level of competence and independence which is expected from an international evaluation center.

In the last seven years the center has interpreted its mission by promoting and participating in a number of evaluation-related activities. More specifically Celct has contributed to the organization of national and international evaluation campaigns, such as CLEF (Cross Language Information Access - with specific focus on Cross Language Question Answering, and, more recently, Question Answering for Machine Reading), DUC (Document Understanding Conference, automatic summarization), IWSLT (International Workshop on Spoken Language Translation, speech-to-speech automatic translation), Evalita (Evaluation of tools for Italian language processing), RTE-PASCAL (Recognizing Textual Entailment). The center contributed to the evaluation activities of three European Projects (EuroMatrix, PatExpert, Cosyne, Treble-Clerf) and to a number of national research projects such as ontoPrivacy (creation of domain ontology from the Italian Data Protection Code) and LiveMemories (annotation of a corpus of Italian news according to the TimeMl standard). Celct has also been involved the SmsCollector industry project (collection and annotation of a corpus of 2 million words of Sms messages), and participates currently in the PROMISE European project (evaluation of cross-language and multi-modal information access).

The activity of Celct should be put in a international context where evaluation activities for language and communication technologies are becoming more and more widespread especially in the research community. Evaluation activities imply at least four aspects: definition of a task to evaluate; production of reference datasets (benchmarks); development of evaluation paradigms and methodologies; organization of evaluation campaigns.

The *selection of a target task* to evaluate is a crucial aspect of any evaluation activity. The choice can be done on the basis of theoretical motivations or as an answer to the (real or supposed) needs of technology users; it can follow research community interests and practices, or can be urged by funding agencies (possibly inspired to political motivations). For instance, evaluation activities on information extraction and machine translation have been promoted in the United States by pub-

lic government agencies, in specific domains such as terrorist attacks, and for specific languages such as Arabic or Farsi, which show a clear connection with the priorities of the foreign policy of the United States government. On the other side, evaluation activities on the task of word sense disambiguation have been promoted by researchers groups in Europe mostly in accordance with the theoretical interests of the research community. Finally, evaluation in the area of information retrieval may constitute an example of technology-driven evaluation activities, given the high impact of search engine development for the Internet industry. It should be noted that whereas in the United States the institutions responsible for research funding have since long time understood that evaluation can be used as a means to orient and foster research according to specific strategic directions, in Europe evaluation activities have been basically left to the research community, with little or no public support. This has both advantages and disadvantages, as we will see below.

Once a task has been chosen, it is very important that it is clearly defined in a way that allows for actually measuring and comparing the performance of concrete systems. For instance, whereas the natural language processing research community has since longtime recognized the importance of inference for text understanding, only with the definition of the task of textual entailment it has become possible to evaluate the ability of systems to deal with inference on a shared and measurable ground.

The second activity crucial to evaluation is producing *reference benchmarks*. This requires first of all a *selection* of relevant data (e.g. text documents, user clicks, video-recordings, etc.), so that they constitute a significant sampling of the data on which systems are expected to operate in a real life situation; for instance, if the task consists in extracting relevant texts from HTML pages (by skipping menus, advertisement, copyright warnings, etc.), then we need to collect a set of HTML pages which reflects the variability of structures and layouts that can be found in current websites. Reference datasets are usually split in two parts, the *development* and the *test dataset*. The development dataset can be inspected by system developers and used to train or tune their systems, whereas the test dataset should be used blindly to evaluate the final performance of a system. The splitting between development and test dataset should be performed so that they are reasonably homogeneous in terms of sampling of significant phenomena. In most, but not all, cases a manual annotation of the selected dataset is performed, which is then used as gold standard (or ground truth) for measuring the performance of automatic systems, that is as the optimal output that systems should try to obtain. Note that if the manual effort to annotate data is too intensive, the benchmark may be produced only for test purposes (no development set is made available). *Manual annotation* of data requires very specialized skills: design of the annotation scheme; production of clear annotation guidelines; development or adaptation of specific graphical user interfaces for annotation; selection, instruction, training and coordination of annotators; assessment of the agreement between them; release of the annotations in standard-compliant exchange formats.

In the area of manual annotation, two innovative approaches have been recently introduced with the aim of getting more annotated data at lower costs. They are

both based on Internet and on-line communities. The first approach exploits on-line games. The idea here is set up on-line games that are entertaining for internet users, and allow, as a side effect, for the collection of data which can be used in the same way as manual annotations (see the ESP game, which allows for collecting word-annotated images). Another innovation in this area comes from the recent introduction of the so called Mechanical Turk, which is a web-based service made available by Amazon America. The service can be seen as a sort of on-line work market, where people can propose simple tasks to be executed through an on-line interface, and other people from all over the world accept to execute the task. The proposed tasks must be very simple and their cost are usually relatively low. A number of people have proposed the following strategy to exploit the Mechanical Turk for data annotation: take a possibly complex annotation task and try to decompose it in a number of elementary steps; propose each of them as an elementary task through the Mechanical Turk; propose each elementary task to at least 5 or more annotators, and keep only those annotations which show a good level of agreement between annotators. The total number of annotators required by this strategy is much higher than in the traditional approach, but, given their lower cost, the total cost of the annotation may be consistently lower as well.

It should also be noted that not all tasks allow for adopting the gold standard approach to evaluation, that is deciding in advance what is the optimal output of a system. In some cases, as for instance in information retrieval, where systems are expected to select a ranked list of documents relevant for a topic, the nature of the task makes the gold standard approach unfeasible. For this tasks it is necessary to use post-hoc evaluation, that is we first take the output of the system and then assess its goodness.

Whether the evaluation is based on a priori gold standard, or post-hoc evaluation, a crucial issue is what *metrics* can be used to measure the performance of a system in comparison with other systems. A good metrics should be clearly defined; it should be meaningful, that is it should be easy for humans to understand what aspect of the task it measures; ideally it should also be possible to calculate the metrics in a automatic way, without the need of human judgment/intervention, but maintaining a good correlation with human judgments. The field of information retrieval has produced some of the most widely used metrics that are *precision*, *recall*, and a combination of them called *F-measure*. The rationale behind these metrics is measuring on one side how accurate the output of the system is (precision) and on the other side how much of the expected output is actually produced (recall). Other metrics have been proposed for different tasks. For instance the so called Bleu Score proposed for the evaluation of machine translation, turned out to be crucial for a substantial advancement of the field. Note that the machine translation task can exploit the gold standard approach, as human-made translations can be used to this purpose. However the research in this field did not develop all its potentialities until a metrics was developed which could be calculated automatically by comparing the output of the machine translation systems with a pool of reference human translations, and which proved to correlate in a significant way with human judgment about the quality of a translation. Generally speaking the availability of a gold standard combined with a metrics which can be calculated inde-

pendently of human intervention is crucial for the development of any task, as it allows system developers to tune and measure in any moment the performance of their systems.

The so called *evaluation campaigns* are the most successful modality for promoting the assessment of the state of the art of a field on a specific task, although they are and should not be considered as the only option (see below). A typical evaluation campaign is based on the following steps: definition of the task which is object of the campaign; publication of a call for participation; preparation of a possibly annotated dataset to be distributed to participants; distribution of the training data to be used by participants to train or tune their systems; distribution of the test set to the participants, who in a limited time slot (e.g. one or two weeks) are expected to run their systems on the test data and to send the results to the organizers; evaluation of the results of the systems on the basis of well established and shared evaluation metrics; analysis of the results of the campaign; organization of a workshop or conference, where the results of the campaign are made public and are analyzed by all participants in order to assess the degree of advancement of the field on the specific task and the perspectives for further developments; publication of the papers presented at the workshop/conference. The datasets used for the campaign use usually made available through a portal and can be used by other system developers to compare the performance of their systems against the results of state of the art systems.

This approach to evaluation can be labeled as *in-vitro*. As all in-vitro research, it has a huge number of advantages, but also some shortcomings. The main problem with the in-vitro evaluation of technology is that it does not take into account the role of the user of the technology. This may explain perhaps why the research on language and communication technologies has had so far relatively little impact on the industry. To obviate to this lack of impact, evaluation of language and communication technologies should be more and more concerned with the role, the needs, and the reaction of users of such technologies. This is not an easy task, however. Involving the user can be highly challenging from an organization and methodology point of view, and will require much higher investments than in-vitro evaluation.

### *Vision and Goals non andare a pag. nuova*

Celct can play an important role in the international context sketched in the previous section. The main rationale for Celct activity is the need to concentrate and factorize competences which are now scattered in different organizations and that suffer a lack of coordination and long term view, as well as shortage of funding. The role of a small center as Celct cannot be that of substituting those activities, but should consist in facilitating and promoting them, acting as reference point and multiplier. In the first phase of its activities Celct has mainly struggled to gather competences and to gain visibility and credibility in the evaluation community. It is now in the process of increasing the level of linking and interaction with all the important players in the arena. The search for interactions and collaborations is based on the sharing of the following strategic views:

–   *Evaluation* is crucial to the development of HL-MCT research; this is clearly shown by the growing number and relevance of evaluation campaigns in the research practice of the field; evaluation campaigns provide the ground for a fair and methodologically sound comparison of results obtained by competing scientific approaches; they also provide benchmarks and annotated data that foster research beyond the campaign itself.

–   Organizing an *evaluation campaign* is a complex, specialized and costly task, which requires scientific strategic vision, managing skills, specialized method-ological competence, computational infrastructures, trained human resources to annotate data and/or evaluate them.

–   Although the HL-MCT community already deems evaluation-related issues as fundamental, there is much space for improvement. For instance, it still hap-pens too often that the results described in a published paper can hardly be reproduced by other researchers. What we would like to see is something like the following: if a researcher runs an experiment and publishes its results, then the set up, the data sets, even the software used for the run, are made available from a stable and public repository so that other researchers can re-produce the same results, understand how they where obtained, test the same software on a different dataset. At least, it should be possible to make a difference between researcher that follow this practice and those who do not.

–   Whereas in the United States, there exist an *official institution* (National Insti-tute of Standards and Technology - NIST), funded by the central government, which promotes and co-ordinates evaluation activities, in Europe evaluation activities are self-organized and promoted by individual researchers on a vol-untary basis. A few exceptions to this trend are the two European projects Treble-CLEF (closed), and PROMISE, on-going (Celct has been involved in both). This bottom-up approach to evaluation has in immense value and should not be neglected. However it also has its weaknesses, such as the lack of coordination and long-term view, the potential lack of continuity due to its volunteering basis, the difficulty in finding synergies and exploit scale factors; the inability to trigger fund raising.

–   Another crucial aspect sets Europe apart from the Unites States, as far as the evaluation of language related research is concerned. Europe is strongly *mul-tilingual*. The evaluation effort must be multiplied by the number of languages that are spoken in the European Union. The lack of evaluation benchmarks and organized evaluation activities can seriously hinder the development of HLT research on minority languages. A super-national institution or coordina-tion-board could take the role of facilitating the development of language-specific evaluation activities by factorizing effort and porting methodological and managing expertise from resource-rich to resource-poor languages.

–   It is time for the European research community to support institutions that promote and coordinate evaluation activities in a *stable* and *organized* way, complementing and integrating the bottom-up, volunteering approach.

–  Although the European Commission seems not to be ready at the moment to directly create/fund a European evaluation body, *European research institutions* can promote and support the development of such a body, with the final aim of getting recognized (and partly funded) by the EU. The supporting research institutions share the view that the evaluation body should be distinct from each of the supporting institutions, but also recognize their interest in influencing and promoting its evaluation policy.

A number of accompanying conditions make Celct a good candidate to become a European reference point for the evaluation of HL-MCT research and development. Based in Trento, near the cross-point of the boarder between South and Nord Europe, and the border between West and East Europe, Celct takes advantage of the financial and strategic support of a local government that strongly believes on the necessity to foster research and innovation, as a means to win the challenges of economical and social development. Also, Celct is based in a geographical area hosting a pool of research institutions and companies which form a sort of education, research, and development district focused on HL-MCT topics: FBK, University of Trento (DISI, CIMEC, HLTI Master), University of Bolzano (European Master in Language and Communication Technologies), Expert System spa, PerVoice spa. Some of the research institutions in this group contributed, along with Celct, to the creation of TrentoRise, an association that with a big number of other research institutions in Europe participates to the ICT Labs Knowledge and Innovation Community (KIC) funded by the European Institute of Innovation and Technology (EIT). We expect that thanks to all the relationships that Celct has created, it will possible to start new projects which will improve the level of external funding of the center.

Although the European research community is the first addressee of the Celct activity, we think that the interaction with the industry world and with the local organizations working on language technologies is also an essential part of our mission. To improve on these aspects, on one side we contacted a number of local, national and international industry players in the HL-MCT field and asked them to participate in the Advisory Board of the Center. This organism gives Celct advice about the needs and the perspectives of the HL-MCT industry with a focus on evaluation-related activities. On the other side we contributed to the creation of two new local organizations: the LinMiTech Association, that gathers the local institutions dealing with minority languages, and the SemanticValley consortium, which has the aim of promoting the creation of a district in Trentino for all activities related to knowledge and language technologies. We are now actively participating to the initiatives of the Semantic Valley consortium, trying to explore possible collaborations with other consortium members.

*Activities and Work Plan*

Here follows a list of activities that Celct can carry out to realize its mission:

–  Define, organize and run *evaluation campaigns*.

–  Provide *managing support* to research individual/groups willing to organize an evaluation campaign.

- Develop evaluation-oriented *benchmarks*.

- Promote the evaluation/comparison of specific *HL-MCT engines* distributed for research purposes and or under open/free software license.

- Promote the development of a *Web Service infrastructure* facilitating the comparison of HL-MCT software installed in different places but accessible trough the Internet.

- Support *companies* developing HL-MCT applications in the (public or private) assessment of the software they produce.

- Design and support a rich and *interactive portal*, collecting all information about evaluation related issues.

- Certify that a commercial HL-MCT application is compliant with a recognized *standard* (should such a standard be defined).

- Certify that a publicly funded research project has followed *safe evaluation methodologies*.

- Provide consultancy on the usage of *crowd-sourcing* techniques to collect reference data.

The evaluation related activities of Celct span on a broad range of HL-MCT tasks. For some of them Celct has already internal scientific competences:

morphological analysis, PoS tagging, chunking, sentence splitting, word and sentence alignment, multi-word extraction, key-phrase extraction, entity recognition, relation extraction, event recognition, local and cross-document co-reference, shallow and deep parsing, question answering, lexical acquisition, wordnet and framenet development, cross-language semantic projection, ontology learning, corpora annotation, textual entailment.

For other tasks the center can rely on the scientific co-operation with its two supporters, FBK and DFKI, and the increasing integration between FBK, Celct and University of Trento, in the HL-MCT area:

anaphora resolution, semantic role labelling, opinion mining, dialogue processing, word sense disambiguation, text classification, information extraction, machine translation, speech recognition, human computer interaction, computational humour, assisted cognition.

We expect that the broadening of the pool of research institution that cooperate with Celct can widen also the range of scientific topics for which Celct has the expertise or scientific consultancy to carry out evaluation activities: see for instance automatic generation, summarization, ontology development.

As for the coming year (2012) Celct has already planned a number of specific activities which are described in the following list:

- *CLEF2012*: Celct will be the organizer of *CLEF2012* (Conference on Multilingual and Multimodal Information Access Evaluation), to be hold in Rome, September 2012. More specifically it will be responsible for maintaining the site of the conference and the related evaluation campaign, and will also be responsible for the publications. This activity is part of the PROMISE European Project.

– *TOSCA*-MP: Celct will participate as FBK's linked partner to the *TOSCA-MP* European research project, which addresses professional audiovisual media production and archiving workflow.

– *Excitement*: Celct will participate as FBK's linked partner to the *Excitement* European project, which addresses research in the textual entailment field.

– *EAMT*: Celct will collaborate with the European Association for Machine Translation, participating to the organization of an evaluation campaign for Machine Translation that exploits human adequacy judgments collected through crowdsourcing techniques.

– *RTE*: Celct will collaborate with the University of Utrecht to jointly develop a reference dataset handling specific linguistic phenomena related to textual entailment.

– *Italian TimeBank*: Celct will continue an activity started in 2009 aiming at the annotation of a corpus of local newspaper documents according to the TimeML standard. TimeML allows for annotating information about temporal expressions, events, and temporal relations between events. Temporal processing is becoming a very important task for language processing, and Celct aims at becoming a reference point at international level for the evaluation of this task.

– CAT: Celct will continue the development and distribution of the Celct Annotation Tool (CAT).

– *Evaluation Portal*: Celct will continue an activity aiming at building a portal where evaluation related information and resources will be collected and made available to the public. In building this infrastructure we will experiment with innovative ways of offering evaluation services through the Web.

– *Publications*: acquiring credibility in the scientific community is crucial for a center which aims at being considered a reference point for evaluation activities. For this reason it is important that Celct gets published the results of its work in relevant scientific conferences and journals.


*Collaborations*

Celct collaborates with Italian and international institutions.

– FBK is the main partner of Celct; in 2012 we will collaborate in two European Projects: TOSCA-MP and Excitement. Also DFKI is among the Excitement partner

– Celct cooperates with the University of Padova in the framework of the PROMISE Network of Excellence.

– Celct cooperates with the National Institute of Standards and Technology (NIST, USA), and with the Bar Ilan University (Tel Aviv, Israel) in the framework of the RTE (Textual Entailment) initiative.

– Semantic Valley Consortium: We are members of the Consortium. We cooperate with other partners to the promotion of the pool of companies composing the consortium, and we look for synergies and complementarities with other consortium partners.

−   LimniTech Association: We are founding members of the Association. We provide consultancy on the usage of language technologies for supporting minority languages.

## 3.   Budget

|  | 2012 |
|---|---|
| Expenses |  |
| Personnel | €250,000 |
| Travel | €13,000 |
| Equipment (HW/SW) | €5,000 |
| Other (e.g. subcontracting to external contractors) | €50,000 |
| Total Expenditure | €318,000 |
| *Accantonamento* | *€83,670* |
| Total Outcome | €401,670 |
| Incomes |  |
| EU Projects (total amount financed by EU) | €68,400 |
| Other external incomes (industrial, PAT projects, etc.) | €18,000 |
| External Income | €86,400 |
| *Recupero Accantonamento 2011* | *€105,270* |
| Total Income | €191,670 |
| Financial Need (Total Income – Total Expenditure) | €210,000 |
| Self funding (External Income/Total Expenditure) | 27.2% |

Comments on the budget. Expenses are slightly higher than those foreseen for the final balance of 2011. More specifically we foresee an increase of 10.000 Euros in personnel expenses, justified by the start of two new EU projects. We also preview a 10.000 Euros increase in the travel expenses, due to the fact that FBK will not pay anymore for the travel expenses of E. Pianta and L. Bentivogli (as it did in 2011). External income will almost double with reference to 2011. The self funding rate will clearly improve going from around 16% to 27.2%. In spite of this improvement, we still need to work on this parameter to get to the 50% of self-funding which we consider as optimal.

## 4. Human Resources

The Celct staff is currently composed of 11 people; 2 of them are FBK employees. Distribution of works is as follow:

1 director (part-time)

1 secretary (full-time)

2 senior researchers (one part-time and one full-time)

3 researchers (full time)

2 junior researcher (full and part-time)

2 computer technicians (part-time)

Given the high complexity of the skills required by the work, permanent education will be pursued mainly thanks to the cooperation with FBK, DFKI and the University of Trento. Salary levels are relatively low. Although the financial situation for 2012 does not allow for much improvement on this area, it should be kept as important action for the following years.

## 5.    Publications

2011

−   Forner, P, Gonzalo, J, Kekäläinen, J, Lalmas, M, and de Rijke, M, (Eds.) 2011 "Multilingual and Multimodal Information Access Evaluation". Proceedings of the Second International Conference of the Cross-Language Evaluation Forum (CLEF 2011), Springer Lecture Notes in Computer Science (LNCS) 6941, Amsterdam, The Netherlands, 19-22 September, 2011.

−   Petras, V, Forner, P, and Clough, P, (Eds.) 2011 "CLEF 2011 Labs and Workshop" Abstracts of the Notebook Papers, Amsterdam, 19-22 September, 2011. ISBN 978-88-904810-4-8, ISSN 2038-4726.

−   Clough, P, Ferro, N, Forner, P, Gonzalo, J, Huurnink, B, Kekäläinen, J, Lalmas, M, Petras, V, and de Rijke, M, 2011 "CLEF 2011 Conference on Multilingual and Multimodal Information Access Evaluation". SIGIR Forum, 45(2).

−   Peñas, A, Hovy, E, Forner, P, Rodrigo, À, Sutcliffe, R, Forascu, C, and Sporleder, C, 2011 "Overview of QA4MRE at CLEF 2011: Question Answering for Machine Reading Evaluation". In CLEF 2011 Labs and Workshop Notebook Papers, Amsterdam, 19-22 September, 2011. Online Proceedings. ISBN 978-88-904810-1-7, ISSN 2038-4726.

−   Bentivogli, L, Clark, P, Dagan, I, Dang, H, Giampiccolo, D, 2011 "The Seventh PASCAL Recognizing Textual Entailment Challenge". In TAC 2011 Workshop Noobook Papers and Results, NIST, Gaithersburg, MD, USA.

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2010

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- Peñas, A, Forner, P, Sutcliffe, R, Rodrigo, A, Forascu, C, Alegria, I, Giampiccolo, D, Moreau, N, and Osenova, P. 2010 "Overview of ResPubliQA 2009: Question Answering Evaluation over European Legislation". In Peters C et al, editors Multilingual Information Access Evaluation I. Text Retrieval Experiments, 10th Workshop of the Cross-Language Evaluation Forum, CLEF 2009, Corfu, Greece, LNCS 6241, Springer-Verlag, September 2010.

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# Irvapp – Istituto per la ricerca valutativa sulle politiche pubbliche

Director: Prof. Antonio Schizzerotto

## 1. EXECUTIVE SUMMARY

In 2012 Irvapp will conclude the two and three year research programmes started in 2010 and 2009. Specifically, it will conclude the impact evaluations of policies implemented by the Autonomous Province of Trento (Minimum Income Programme, Merit-based aid to students from low-income families, Role of 'service vouchers', Effects of vocational training courses), of a national measure regarding lower secondary school (Classi 2.0), and of the commercial agricultural development project of the World Bank in Nigeria.

In 2012, Irvapp will undertake also new important research projects described in the next section. Among those projects it is worthwhile mentioning the project regarding the development of a model for the evaluation of the Italian policies for the integration of migrant people recently commissioned to Irvapp by the Italian Ministry of Interior as a result of the commitment of Irvapp in diversifying its research funding and to widen the focus of its research activity.

Turning to external training activities, the fourth edition of the WINTER SCHOOL on "Fundamentals and Methods for Impact Evaluation of Public Policies" will take place in February 2012. The School is organised by Irvapp in cooperation with the Istituto Veneto di Scienze, Lettere ed Arti (IVSLA) and the Trentino School of Management (TSM) and is intended primarily for PhD students and researchers in the Social Sciences. The course will present the fundamental principles of impact evaluation analysis with a specific focus on the counterfactual theory of causal inference as well as on the statistical methods and techniques for counterfactual analysis.

In terms of external collaboration, Irvapp is now entering a second phase of its internationalisation strategy. Expressively, in 2012, it intends to: (i) consolidate its relationships with current partners (e.g.: World Bank); (ii) develop stronger relationship with similar Institutions in Europe and USA (such as IZA, CREST, MIT); and (iii) diversify the funding composition mainly by applying for EU research grants.

Moreover, Irvapp intends to develop research projects together with ISIG, ISR and with the two new Institutes which are being established by the Fondazione Bruno Kessler (FBK) (i.e.: "Istituto di Studi Economici" and "Istituto di Studi sulla Pace e sulla Guerra") on themes of common interest in order to contribute to the development of a multidisciplinary centre for social sciences and humanities within FBK.

As part of its Institutional activities Irvapp will also capitalise on the lasting datasets created as part of many of its research projects. In order to make these data available to the research community, Irvapp will devote a section of its website to con-

sultation and downloading of these datasets. This dissemination activity can also be conceived as a first step towards the establishment of an Italian Data Archive for social sciences.

By the end of 2012 the Irvapp research staff will be composed of a multidisciplinary team of 15 researchers in Economics, Sociology and Statistics, a Deputy Director, carrying out managerial and communication tasks, and an employee with administrative and secretarial duties (see Section 5). A few researchers and consultants in the fields of educational, welfare and immigration policies evaluations are likely to be hired on short term contracts for carrying out specific research tasks.

In the year to come, Irvapp's Institutional network (composed of Istituto Regionale di Studi e Ricerca, Consiglio per le Scienze Sociali, Fondazione Istituto Carlo Cattaneo, Dipartimento di Economia dell'Università di Torino) will not widen, as the transformation of Irvapp in a center of FBK is under consideration.

## 2. VISION AND SCIENTIFIC PROGRAM

### Context and State of the Art

Irvapp was established in March 2008 by FBK and started its activity on April 1st, 2008. Irvapp aims at carrying out evaluation studies of the impact of public policies at international, national and local level in order to contribute to the establishment of an informed and evidence-based policy making, among scholars, national and local governments, and relevant agencies. The methodological paradigm underlying Irvapp's empirical work is the counterfactual model of causality. That is, the effects of public policies are measured as a difference between the observed/measured outcomes after the intervention and what would have occurred in the absence of the intervention.

In 2011 Irvapp has completed four research projects and accomplished some important steps in other long-term research programmes. Specifically, the following projects have been completed:

- The Italian programme 'Liste di Mobilità': An analysis of the impact of its 'passive' component

- Changes in the Italian unemployment insurance scheme and estimation of their effects on unemployment duration and transition to a new job.

- Evaluation of the 2001 reform of higher education in Italy.

- Whip4Policies.

The results of the scientific activities carried out by Irvapp's researchers up to October 2011 are well documented in several articles or book chapters and in the working papers series of Irvapp. Both are listed in the appendix to this document and the latter can be downloaded from Irvapp's website: http://Irvapp.fbk.eu/it/pubblicazioni.

**Vision and Goals**

Irvapp is a policy-relevant research organisation. It aims at carrying out policy evaluation research to quantify the effects of policy interventions. Its mission includes the evaluation of social policies, the dissemination of findings from this research, the promotion of a culture of impact evaluation in Italy, the training of policy evaluators, and the setting-up of a policy-relevant data archive.

Although some progress has been made in recent years, in Italy the lack of a culture of impact evaluation and the difficulty in accessing both administrative and survey data remain major problems in policy evaluation. Therefore, promoting a culture of impact evaluation through training activities, research dissemination, and the establishment of a policy-relevant data archive will be key activities for the Institute.

As already mentioned, Irvapp intends to fulfil its mission also through the implementation of a service platform designed to archive data relevant to the evaluation of public policies. More precisely, Irvapp is considering the opportunity, in collaboration with FBK, to contribute to the setting up of an Italian data archive for the social sciences internationally recognized and integrated with the existing European network of data-archives.

**Activities and Work Plan**

*Research projects for the year 2012*

In this section the research projects for year 2012 are listed moving from those regarding local policies, through those regarding national policies, to those concerning policies designed or funded by international organisations.

*Evaluation of local public policies*

–   *Evaluating the impact of a Minimum Income Guarantee programme in the Province of Trento*

    The project is aimed at evaluating the impact of 'Reddito di Garanzia', a minimum income scheme introduced in the Province of Trento in October 2009. This programme is means-tested and aims at lifting out of poverty families living below the ICEF poverty line of € 6,500 of equivalent disposable income per year, by topping their income up to the above mentioned level. The effects of this programme are measured on a timely ex-post evaluation with regard to several outcomes: risk of poverty, labour market participation and consumption behaviour.

    In 2011 a short questionnaire was administered to the universe of the programme beneficiaries to monitor their perception of the programme and gather information on their material wellbeing, and in the first months of 2012 a report summarising preliminary results will be available.

    Most important, in order to carry out a rigorous evaluation of the effects of the Minimum Income Guarantee programme, Irvapp has collected data through a panel survey of participants and observationally equivalent non participants.

So far, the first wave of data collection was completed, and the linkage with administrative data made available by the agency in charge of the management of the programme was carried out, so that preliminary descriptive evidence was produced. During 2012 Irvapp's effort will be devoted to perform the impact evaluation of 'Reddito di Garanzia' exploiting the data gathered, and both reports for local policy makers and papers for dissemination at international academic conferences will be produced to contribute to the debate on the design and implementation of anti-poverty measures.

– *Reconciling paid work and family responsibilities: The role of 'service vouchers' in the Province of Trento*

The project aims at evaluating the impact of a programme recently introduced by the Province of Trento and designed to help women or single fathers to reconcile work and family responsibilities. This was done by alleviating the cost of childcare through a voucher scheme that subsidises relevant services. Over the last year Irvapp has produced two reports using administrative data of recipients of the vouchers, and has made some important policy recommendations that have been accepted and implemented by the policy makers in the Province of Trento. The follow up for the year 2012 seeks to integrate and enrich the available administrative data with the data from other sources, in order to allow for the impact evaluation of the voucher scheme on women and their employment perspectives and its reconciliation with family responsibilities. Moreover, since there was an important change in the modality of policy implementation, during the next year Irvapp will monitor the beneficiaries and produce a monitoring report for the local policy makers in order to inform them about any revealed dynamics among the beneficiaries of the programme.

– *Merit-based financial aid to students from low-income families and its effects on university enrolment*

The project is aimed at measuring the effectiveness of a means-tested intervention of the Province of Trento designed to reduce education inequality by increasing the transition rates from higher secondary school to university through financial aid. The policy, introduced in 2009, aimed at compensating indirect costs of university enrolment of good students from lower class families.

In the last two years data on transitions from higher secondary school to university and on the performances of university students were collected, exploiting CATI and CAWI procedures. Both a working paper reporting the main results of the survey, and an executive summary containing some practical suggestions in order to adjust and make more effective the intervention were produced. In 2011 a further working paper with various outcomes (enrolment, university location and prestige) was produced and presented in several international conferences. The resulting paper will be submitted to the Journal of Labor Economics by the end of 2011.

2012 will be devoted to the dissemination of the results, as well as the prosecution of data collection. Indeed, an article will be published in Polis and the data collection on university enrolment for the academic year 2011/2012 and on performances of university students will continue. More precisely, Irvapp intends to collect data on performance for students enrolled in 2009 and 2010, in order to produce a longitudinal dataset which will allow Irvapp to enhance the evaluation of the programme with respect to the transition rate to university, as well as its impact on drop-out rates and academic achievements of students from lower class families who benefit from it.

– *Evaluation of the impact on learning achievements of economic incentives to teachers*

Irvapp has been contacted by the PaT administration in order to evaluate the possible introduction of incentive schemes for primary and secondary school teachers. Irvapp will cooperate with other research groups already involved on the issue (Commissione Provinciale di Valutazione del Sistema Scolastico Trentino, Istituto Provinciale per la Ricerca e la Sperimentazione Educativa, Centro Formazione Scuola Trentina).

Irvapp will design a preliminary experimental phase of this possible programme aimed at modifying either the pay scales or the promotion rules (or both) for teachers working in the province of Trento. Subsequently, Irvapp should be involved in the implementation of the programme in order to evaluate the potential impact of its possible components. More precisely, by means of gradual implementation at territorial level and/or by varying the intensity of the monetary incentives (for example by using identical incentives to the group of teachers or varying it within the group), Irvapp expects to be able to identify which are the most effective means to elicit greater effort from the teaching body.

Irvapp is currently waiting for updates about timing and financial resources connected to the project, which is conditional on the approval of an European Social Fund project.

– *Impact evaluation of some active and passive labour policies in the Province of Trento*

Impact evaluation of labour market policies has been an important strand of activity of Irvapp, and will remain one of its significant research areas. Recently the Agenzia del Lavoro of the Province of Trento has approached Irvapp, in order to get scientific cooperation for assessing the effectiveness of existing labour market policies, as well as of some innovations to be introduced for strengthening their "active" component. Irvapp has been invited to evaluate the effects of some of these policies on crucial outcomes such as: (i) level of living of persons receiving either unemployment benefits or a wage supplementation fund (CIG); (ii) duration of the unemployment spells of workers benefitting from passive labour policies, especially Unemployment insurance and "Mobility" income support (indennità di mobilità); (iii) employment chances for workers receiving active labour policy measures. Reasonably,

these activities will entail an investment on an intensive, systematic utilisation of administrative data sources, particularly of the "Compulsory communications" (Comunicazioni obbligatorie), that is the communications on associations/ extensions/transformation/separations provided by any employer jointly to the Labour Exchange Offices (then to the Agenzia del Lavoro), the Ministry of Labour and the Social Security Agency.

*Evaluation of national public policies*

–   *Development of a model to evaluate migrants integration policies*

Irvapp, in partnership with Vision and Values S.r.l., has been commissioned by the Italian Ministry of Interior the task of defining a model for evaluating the policies for the integration of migrant people implemented at the local level by Italian regions, provinces and municipalities. The project, which will start at the end of 2011, aims to develop a consistent system of indicators to monitor the social integration of immigrants in Italy. 'Integration' is conceived as a term indicating the processes of socio-structural assimilation, inclusion in the system of social citizenship rights and participation in community life. The project is based on the secondary analysis of available data sets (ISTAT labour force survey and EU-SILC), to identify and measure: (i) the disparities between immigrants and natives in the labour market participation and in the level of well-being; and (ii) possible differences occurring in the above dimensions between immigrant groups. Moreover a survey intended to measure the degree of integration of migrants belonging to three different nationalities (Rumanian, Moroccan and Ukrainian) will be carry out in four Italian regions. The survey will be based on a questionnaire administrated to 1800 interviewees selected according to a factorial design that will takes into account national origin, gender, generation and migration seniority. Finally, the project will compile information on public policies specifically designed to foster immigrants integration. On the basis of the results of the above analyses, a model for the implementation and subsequent evaluation of integration policies will be supplied to the Ministry.

–   *The project Cl@ssi 2.0.*

The project is developed in cooperation with the Italian Ministry of Education, the Fondazione "Giovanni Agnelli" (Turin) and the "Fondazione per la Scuola" (Turin). It seeks to evaluate the impact of ICT enhanced teaching on students achievement through the systematic comparison of a paired treatment-control classrooms across a sample of Italian Junior High schools. In the year 2010 a benchmark survey has been run on newly recruited students in the sample schools to measure their initial educational achievements before the treatment group started the program. Irvapp has produced the first report based on this data showing that the treatment and control groups within each school have indeed a very similar level of educational achievement once some relevant individual and family characteristics of the students are controlled for. During 2011 the monitoring of the program has developed according to the established protocol. The final collection of data will take place by June 2012 when students will take part in the final exam of their three-year Junior High school

program. Based on that data Irvapp will measure the impact of the ICT technologies on the educational achievement of the students.

– *Evaluation of the "Maestro Unico" reform.*

The project aims at providing new insights on the relationship between students' cognitive achievements, labour supply of mothers and school inputs in the form of length of the school day and the pupil to teacher ratio. To this end, we would exploit the exogenous change in school inputs introduced through the "Maestro Unico" reform in Italy. The proposed research would offer new contributions of considerable policy and practical relevance, as well as of methodological interest. The contents of the project will be organised into three main themes, aimed at distinguishing a dimension in which economic research can inform policy analysis at the national and international level. These are: (1) the effects of the length of the school day on cognitive abilities of children enrolled at the primary school; (2) the effects of changes in the supply of primary schools offering full day attendance on the supply of work of the mothers; (3) the interplay between family inputs and school inputs, the latter being measured by different hourly profiles and by the pupil to teacher ratio, on the development of cognitive abilities in key dimensions of child learning.

In each of these domains, the proposed research would contribute to the existing international literature by providing: (a) robust evidence on school-level and household-level responses to policy interventions aimed at lowering financial resources made available to schools; (b) insights on the estimation of structural models for the education production function, using frontier methods suited to the ex-ante analysis of future policy reforms; (c) linkages to other studies considering the same issues in other countries of the EU, to draw from such research wherever possible. This project will be submitted for funding to ERC by Erich Battistin under the starting grant scheme.

– *Does randomly drawing the selection committee improve the quality of academic recruitment?*

Over the last twenty years the Italian universities experimented several different ways to select the committees in charge of recruiting the academic staff. A new modality has been introduced in 2009 as part of a more general reform of the governance of the state universities. All these recruitment systems share the common feature of operating in the absence of a clear incentive scheme to reward those universities able to recruit good researchers. In fact, the last reform passed by the Italian parliament in December 2010 seems to recognize the need to introduce such incentive scheme even if postponing its actual design to time to come.

This project focuses on the effect of the last change in the rules of the game according to which the members of the recruitment committees are randomly selected among the professors belonging to the same Settore Scientifico Disciplinare (SSD, i.e. the scientific field) of the academic position to be appointed. According to the rules in operation before this reform, the members of

the recruitment committees were elected by the professors belonging to the same SSD. The rationale for the reform seems to rest on two premises: 1) the academic institution appointing the position might not be willing to select a 'good' candidate, hence there is the need to put the recruitment under the control of an independent board and 2) electing the committee members does not guarantee a panel of referees sufficiently independent in their judgment. A randomly drawn recruitment committee – the argument goes on - should instead guarantee their independence of judgment and by this way a better outcome of the selection process.

To check whether randomly selecting instead of electing the committee makes the difference we compare the final outcomes of the academic competitions run after the reform to a comparable pool of competitions run just before the reform. The comparison is established with respect to the quality of the winners as measured by their bibliometric indicator scores. We also plan to analyse the correlation between the score of the winners and the average score of the institution appointing the position. If randomising the composition of the recruitment committee were truly making the difference we should find a weaker correlation after the reform.

The data needed are 1) a detailed list of the competitions to be included in the analysis available on the MIUR (the Italian Ministry for Education, University and Research) website, 2) the bibliometric indicator scores of the candidates taking part in the competitions available using 'Publish or Perish' and 3) the bibliometric indicators scores for the faculty members of the institutions appointing the position available as in 2).

– *Effects of changes in the Italian unemployment insurance scheme on transition to employment and unemployment*

This project builds on a previous project, which in principle had a similar focus, but in fact took a different route. Indeed, that project had to face the bizarre (mal-)functioning of the Italian Unemployment insurance (UI) scheme – an interesting example of divergence between the "law on the books" and "the law in action" –. Thus, it was mainly devoted to an in-depth analysis of the actual ways of operating of UI (role of the eligibility conditions; diverse, sometimes opportunistic, use of the UI by different typologies of workers; etc.). This project will address issues about the effects of changes in the UI scheme introduced by the January 2001 reform, that raised (i) the replacement rate from 30 to 40%, and (ii) the maximum duration from 6 to 9 months for workers aged 50 years or more at the time of dismissal. It will exploit these discontinuities, over time and across age groups, in order to estimate their impact on the length of unemployment spells and on the probabilities of re-employment and wages (conditional on re-employment). Administrative data from two sources, the UI archive and a new, enlarged version of WHIP (the Work Histories Italian Panel, updated to 2005, made available by a research agreement with the Department of Economics, University of Turin) will be used. They refer to 1/15th sample (24 dates of birth, two per month) from the population of UI beneficiaries, 1999-2003.

*Evaluation of policies designed by international organisations*

– *Impact evaluation of the Nigeria Commercial Agriculture Development Project*

  The Commercial Agriculture Development Project (CADP) aims at strengthening agricultural production systems and supporting the dissemination and adoption of new technologies, for targeted value chains among small and medium scale commercial farmers in five participating states in the country. The impact evaluation will quantify the effects of the roll out of various project components in five pilot states of the country. During the last year a sampling scheme was developed across pilot areas, after which the baseline survey (i.e. before the programme roll out) was conducted. The information derived was coded and cleaned and a preliminary baseline report with the analysis of key economic and demographic indicators at baseline has been developed. During 2012 Irvapp will be involved in the development of the follow up survey which will allow the research team to draw causal inference on the effects of the CADP.

– *FESTA- Female Empowerment in Science and Technology Academia*

  Irvapp has been requested to cooperate with FBK in a EU-financed research project studying gender roles in academic and research institutions. Irvapp will contribute to the analysis of the effects on gender disparities, in the process of research production, after the implementation of gender sensitive organisational arrangements in a set of different EU Universities and Scientific Foundations.

– *Social innovation against inequalities in the European Union*

  Taking advantage of a previous successful participation of one Irvapp senior fellow to a previous call on similar theme (http://www.gini-research.org/articles/home), Irvapp is exploring the possibility to present a new application on the EC 7th Framework Program - work programme 2012 – cooperation - theme 8: Socio-economic Sciences and Humanities - topic SSH.2012.2.1-1. It will be framed as a follow up of the previous project and therefore should involve some of the previous units (like Dublin, Amsterdam and Antwerp). But given the requirement of the call it will also necessitate the involvement of additional foreign units. Irvapp will take advantage of the expertise existing in the universities of Milano, Padova and Trento, but will act as the coordinating unit. This requires an intensive activity of contacts and project writing in the next months. If the project gets approval, then in the following three years (starting on January 2013) Irvapp will be involved in leading the research activity of the network, as well as in conducting researches on its own.

  With respect to the contents of the intended project, there are three specific requests in the call:

  – Are European policy makers concerned with inequality?
  – Social innovations in the third sector – communities creating meaning – post crises policies – anti-poverty measures count against inequality?

– Encouraging social innovations in post crisis - initiatives that will be promoted under the European Platform against Poverty and Social Exclusion

Irvapp's intention is to go for a project containing a macro, a meso and a micro perspective. The macro perspective may develop the idea of different policy making before and after the financial crisis. The meso perspective can follow the same strategy of pre/post analysis, looking at inequality and poverty at the regional level (EU-SILC has sufficient disaggregation at regional level) to be matched to the analysis of local policies against inequality/poverty, in order to provide a general classification of policies. With respect to the micro perspective, the proposed project will focus on social innovations, reviewing existing evidence and collecting new ideas about policy making.

– *Power calculations for the Minimum Detectable Effect*

The aim of the project is to review the existing literature on the optimal design of social experiments considering statistical problems of longstanding concern in agricultural, biological, educational and social policy research, and to look into the possibility of addressing the same problem for non-experimental designs, providing new results of practical relevance for the design of evaluations.

So far Irvapp has reviewed the existing literature about the case of randomised experiments and we have extended it to the case of clustered-random trials. As for the case of non-experimental methods, in the 2011 Irvapp found that this issue has been recently discussed in the applied statistical literature and that interesting results about regression discontinuity designs have been found (Schochet 2009). In the following months we aim to continue this methodological research, in order to provide practical guidelines to be used in propensity-score matching estimators.

*Training activities for the year 2012*

– *Fourth edition of Irvapp School.* In February 2012 Irvapp, in cooperation with IVSLA (Istituto Veneto di Scienze, Lettere ed Arti) and TSM (Trentino School of Management), the fourth edition of the school on "Fundamentals and Methods for the Evaluation of Public Policies" will take place. The course, which is intended primarily for PhD students and researchers in the Social Sciences, will present the fundamental principles of impact evaluation analysis with a specific focus on the counterfactual theory of causal inference as well as on the statistical methods and techniques for counterfactual analysis.

– *Introductory training course for managers of the public sector.* Irvapp, in cooperation with TSM (Trento School of Management), will organise an introductory course on Counterfactual Impact Evaluation of public policies intended for high and middle grade PaT officers. The course is designed to describe the basic features of the counterfactual approach in tackling the evaluation of policy interventions.

– *Seminars.* In 2012 Irvapp will organise a series seminars held by internationally outstanding scholars (among whom Erich Marlier - CEPS, Joshua Angrist

– MIT, Andrea Ichino - Università degli Studi di Bologna, Thomas Lemieux - University of British Columbia) and regarding substantive and methodological topics related to impact evaluation of public policies. The seminars are addressed to Italian researchers in the field of public policies evaluation.

*Collaborations*

– *Institution: THE WORLD BANK*

Irvapp reference persons: Antonio Schizzerotto and Erich Battistin.

Word Bank's reference person: Arianna Legovini, Head, Development Impact Evaluation Initiative.

The aim of this partnership is to collaborate on the impact evaluation of an important Development Project in Nigeria. The Commercial Agriculture Development Project (CADP) aims at strengthening agricultural production systems and supporting the dissemination and adoption of new technologies, for targeted value chains among small and medium scale commercial farmers in five participating states in the country.

– *Institution: DEPARTMENT OF ECONOMICS OF THE UNIVERSITY OF TURIN*

Irvapp reference persons: Antonio Schizzerotto and Ugo Trivellato.

University of Turin's reference person: Roberto Leombruni, researcher at the Dpt. of Economics.Irvapp, jointly with Department of Economics of the University of Turin is going to develop a new database - Whip4Policies – derived from administrative information by the National Social Security Institute (INPS) suitable for the evaluation of policies regarding public pensions and unemployment benefits.

– *Institution: MIUR/FONDAZIONE GIOVANNI AGNELLI*

Irvapp reference persons: Antonio Schizzerotto and Enrico Rettore.

Fondazione Giovanni Agnelli's reference person: Andrea Gavosto, President of Fondazione.

The aim of such collaboration is to assess the impact of the introduction of new learning technologies in the Italian lower secondary school system.

**Goals**

| Description | Type | Scope | Time frame | Measurement mean | Pre-conditions |
|---|---|---|---|---|---|
| Research activity | R | E | Dec. | 14 research projects | |
| Research dissemination | R | E | Dec. | 1 conferences, 6 seminars, 8 publications | |
| Promoting culture of impact evaluation | O | E | June | 2 training courses | |

*Type*: I = Innovation; R = Research, A = related to improve financing; F = related to achieving internal goals; O = Other
*Scope: I = Internal; E = External*

### 3.  BUDGET

The budget of Irvapp's activities for year 2012 has been defined following FBK's indications and, specifically, travel and equipments costs have been reduced by 10% and subcontracting by 12%. In comparison with the budget for year 2011, personnel costs have increased by 53% as a consequence of the transformation of the employment contracts of resident researchers in fixed term contracts and of the appointment of four additional researchers as planned in 2010. Finally, it is worthwhile highlighting that the amount of external incomes (i.e.: net of funding from the province of Trento) have more than doubled (from about €100.000 to €250.000) as a result of the commitment of IRVPP to diversify the composition of its sources of funding.

| Expenses (EUROS) | |
|---|---|
| Personnel | 795.000 |
| Travel | 18.000 |
| Equipment (HW/SW) | 9.000 |
| Other (e.g. subcontracting to external contractors) | 560.000 |
| Internal collaborations: "subcontracting" to other unit | 0 |
| Total Expenditure | 1.382.000 |
| Incomes (EUROS) | |
| EU Projects (total amount financed by EU) | 0 |
| Other external incomes (projects, grants, etc.) | 250.000 |
| Internal incomes ("subcontracted" by other units) | 0 |
| Total Income | 250.000 |
| Financial Need (Incomes – Expenditure) | 1.132.000 |
| Required Structural funding from PAT (it should be equal to the previous item) | |

### 4.  HUMAN RESOURCES

At the end of November 2011, Irvapp's research staff is composed of an interdisciplinary team of 11 researchers in Economics, Sociology and Statistics, a Deputy Director and an administrative secretary.

*Antonio Schizzerotto* (professor of Sociology at the University of Trento) is Director of Irvapp and together with *Ugo Trivellato* (professor Emeritus at the University of Padova), *Enrico Rettore* (professor of Economic Statistics at the University of Padova), *Daniele Checchi* (professor of Economics at the University of Milano) and *Erich Battistin* (Research Director of Irvapp and associate professor of Economic Statistics at the University of Padova) is part of Irvapp's team of senior researchers.

Silvia Girardi, Nevena Kulic, Gianluca Mazzarella, Loris Vergolini, Nadir Zanini and Slavica Zec are resident researchers of Irvapp. Other fourth researchers will join the group of the resident between December 2011 and May 2012.

Paola Antonicelli (former personnel manager of the University of Trento and consultant of the Ministry of Education, Universities and Research) is the deputy Director of Irvapp and Anna Stenghel is the administrative secretary.

## 5. PUBLICATIONS IRVAPP AND OF ITS RESEARCHERS (FROM 2009 TO OCTOBER 2011)

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−   Martínez Pérez A., (2009), An Analysis of the Implementation of the Programme "Buoni Di Servizio" in the Trento Province, Irvapp Internal Notes No. 2009-01.

−   Martini A., Rettore E., Trivellato U., (2009), Valutare gli effetti delle politiche attive del lavoro: la logica controfattuale, Irvapp Reprint Series No. 2009-02.

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−   Paggiaro A., Rettore E., Trivellato U., (2009), Il programma Liste di mobilità: il mix di componenti attive e passive e gli effetti della diversa durata di ammissibilità nelle liste, Irvapp Reprint Series No. 2009-03.

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# Create-Net – Center for REsearch And Telecommunication Experimentation for NETworked communities

Director: Prof. Imrich Chlamtac

## 1. Executive Summary

Create-Net was founded by some of the most prestigious universities and research centers in Europe in April 2003. We have now established a network of over 300 research partners throughout Europe, including top research institutions and companies. We also have funded collaborations with leading institutions in the US (MIT and Georgia Tech), China (Tsinghua and BUPT), South Africa (SAP) and Israel (Technion).

Create-Net has been very successful in attracting EU, commercial and local funding. In the last three calls of Europe's FP6 programme, the first four calls of FP7 and the recent FI-PPP (Future Internet-Public Private Partnership) calls, we were awarded a total of 26 projects, out of which 5 as Coordinator and 2 as Technical coordinator. In particular, during 2011, Create-Net has won the iCore Integrated Project (total cost 13.4 Ml Euro) as Coordinator, which is introducing an innovative cognitive framework for the Internet of Things (IoT). Create-Net is establishing strategic partnership with local companies, such as Trentino Network, playing also an advisory role with respect to the Public Administration regarding the development and deployment of NGN (next-generation network) solutions. Create-Net is constantly collaborating with a wide network of academic and industrial players, in the ICT sector, at a national level. In particular, example as the Politecnico di Milano, University Politecnica di Madrid, INRIA, ACREO, EICT GmbH, CNR, the Fondazione ISI (Torino), Technion, Budapest University of Technology and Economics, and so on. Likewise, collaborations are in place with a number of industries, present on the Italian territory, including Telecom Italia, Engineering, Ericsson HP and CISCO Photonics, ATM Milano, Autoguidovie, Vodafone, and outside Italy as GFI International, Alcatel Lucent/BellLabs, SAP, Telefonica, and many others.

Create-Net established a state-of-the-art Testbed for the testing and experimentation of new technologies. The Testbed includes an optical and wireless network, plus the Living Space home-of-the-future, Ambient Intelligence Lab. The Testbed concept recently been extended to the overall Trentino research system in ICT and Create-Net is now strongly involved in implementing a Province-wide experimental infrastructure which supports applied research of all the local institutions, together with the public administration and the SMEs (Small-Medium Enterprises).

By creating synergies between leading academic institutions, companies and research centers in Europe and around the world, Create-Net's objective is to sponsor the highest quality research and innovation, and help convert talent and human capital into Intellectual Property and start-ups for promoting European high-tech competitiveness, with the aim of building a global platform of scientific collaboration and experimentation in communications-driven technologies and applications.

Through research and development of these technologies Create-Net seeks to positively impact the local and global society, by contributing to improving the quality of life of its citizens, while ensuring a sustainable future.

In fact, being an international association, with technology trasnfer and innovation as part of its original mission, Create-Net acts as a promoter of "globalization of knowledge and research" facilitating the cooperation and interaction of researchers from around the world to became the focal point in Europe for "engineering of research and innovation" in ICT (Information & Communication Technologies).

Create-Net's objective is to provide significant benefits to the Autonomous Province of Trento by not only creating opportunities for research, research exploitation and growth but also to act as a conduit for attracting research and innovation talent to the territory, enhancing the prestige of the Province internationally and thus making an important contribution to the local economy.

Over the coming years, the research endeavours in Create-Net will contribute to the realization of the Future Internet, with focus on the Internet of Things, and on being a catalyst for the Trentino research, industry and technology eco-systems both in terms of enabling technologies and the corresponding applications and services that will be disseminated, capitalised and exploited trough our Innovation and Technology Transfer Initiatives.


## 2.   Vision and Scientific Program

### Context and State of the Art

During the course of 2011 Create-Net has reviewed internally its research activities and organization with the objective of identifying its strenghts and weaknesses, in order to define a strategy also in view of the changing market trends and opportunities.

As a result, Create-Net has positioned itself as one of the leading research players in the Future Internet arena, at a European level and a European leader in the Innovation drive on the continent. In terms of technology research, the center is focussing on the following key areas:

–   Future Network Infrastructure
–   Internet of Things
–   Internet of Contents and Knowledge (especially interactive multimedia)
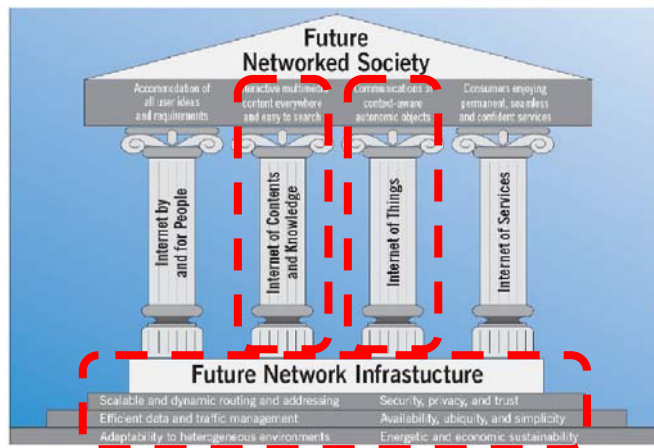
as depicted schematically in Figure 1:

Figure 1. Create-Net's positioning in the Future Internet arena.

In particular, Create-Net is contributing to develop a number of Future Internet enabling technologies, including:

−   Reconfigurable optical networks

−   Software-defined networks (Virtualised Networks Infrastructures)

−   Generic Service Delivery Platforms (SDPs)

−   Dynamic resource management

−   Cognitive Technologies applied to Networks and IoT

−   Data management in the context of IoT

−   Models/algorithm for large scale networks

−   Autonomic bio-inspired systems

−   Trusted systems

−   Identity & access management

−   Long-term security

−   Context intelligence and adaptation

−   HCI (human-computer interaction)

By the nature of its research and through the support of its Innovation Project in particular, Create-Net is investing in the application of ICT to other sectors, addressing the need to make public service infrastructures and business processes significantly "smarter" (i.e. more intelligent, more efficient and more sustainable), through tighter integration with the Future Internet networking and computing capabilities. In particular, Create-Net is focussing on the following application domains:

−   Intelligent transportation and sustainable mobility

−   Interactive and mobile social media

−   Smart Energy Systems

−   Well being and e-health

## Organizational Structure

The current organisational structure of Create-Net includes Business and Administration Department, Human Resource and Logistic Department, Marketing and Communication Department, Research and Engineering Department (comprising the Application Areas) and the Innovation Project.
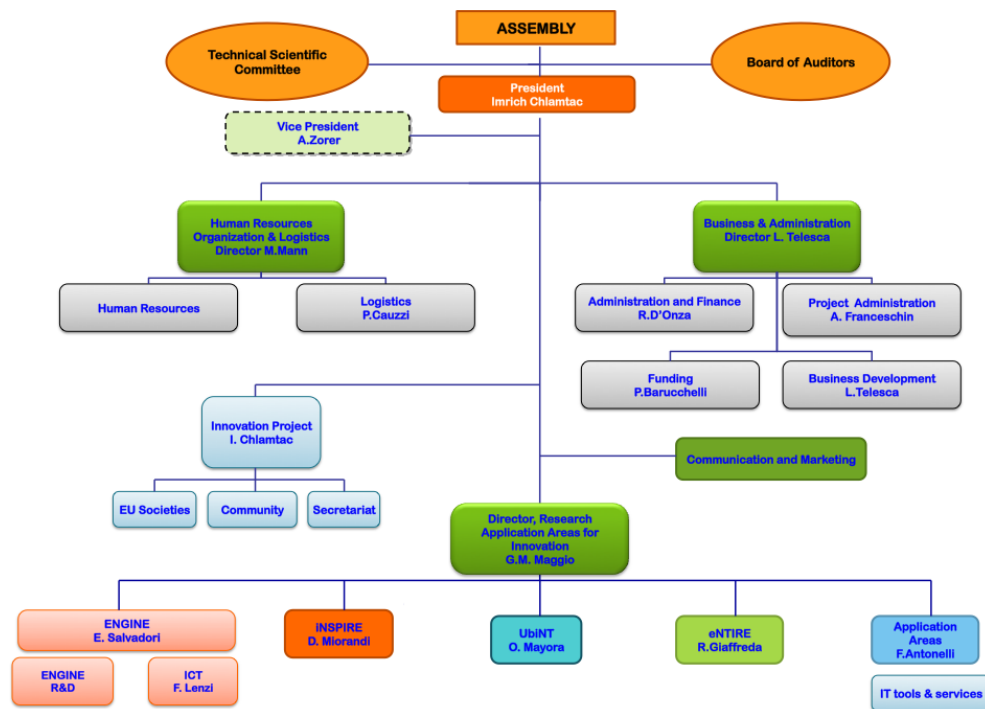


The *Research and Engineering Department* is structured according to three Research areas that with a synergic approach cover different scientific and technological fields in the ICT sector, plus an Engineering area dedicated to technology transfer and innovation projects.

The Research and Engineering Department is coordinated by the Research Director who is in charge, among the other tasks, of monitoring the research developments at European and global level as well as the ICT market evolution, in order to define the strategic research directions of the centre.

The *Application Areas* are transversal with respect to the Research/Engineering areas, focussing on specific application domains and leveraging on the expertise of the research areas themselves, and are under the scientific supervision of the Research Director and the responsibility of the Business and Cooperation Director.

The *Innovation Department* is supporting the establishment and growth of the European Alliance for Innovation (EAI), and is coordinated by the EAI Director of Operations. Through the EAI, Create-Net and the other local institutions leverage on a large pan-European organization where the local stakeholder have a strong opportunity for connecting with the major players and for marketing and promoting the results of the research activities.

A detail of Create-Net's Research / Engeneering / innovation organizational structure is illustrated in Figure 2:
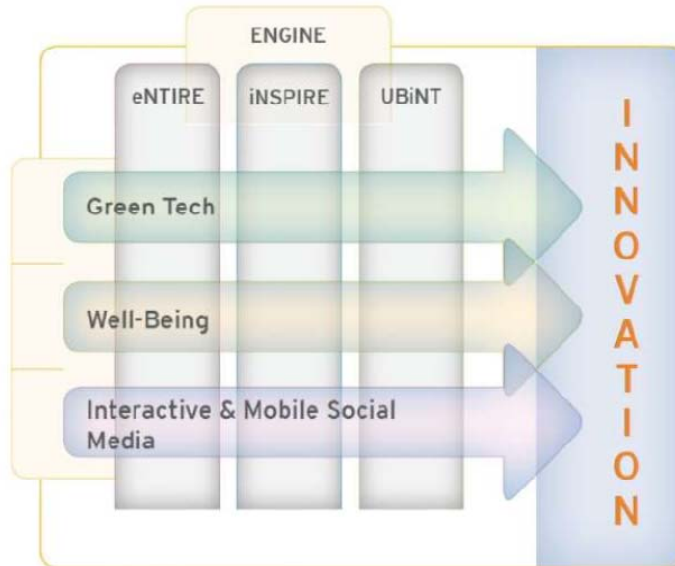


*Figure 2. Create-Net's organizational structure.*

## Vision and Goals

Create-Net's vision is to build an internationally recognized center for research and innovation centered around the Future Internet theme, focussing on research excellence in telecommunications and ICT-driven innovation.

Drawing on a multidisciplinary approach, Create-Net builds a bridge between researchers, users' communities and industry with the overall aim of identifying and proposing solutions in order to respond effectively to the new technological and societal challenges. Correspondingly, Create-Net envisions a future scenario involving a co-evolution of technology and society, whereby the network, according to the Internet of Things paradigm, becomes pervasive, delivering and processing user-centered information in a distributed and secure manner.

Create-Net's overal mission may be summarized as: '*ICT innovation for quality of life and a sustainable future*'. Correspondingly, Create-Net's mission statement consists of four main pillars:

− Research excellence in ICT (Information & Communication Technologies) with focus on telecommunications
− Promote technology transfer through engineering of technologies and experimentation of solutions on the territory
− Foster ICT-driven innovation in 'vertical' market sectors with demonstrated societal impact
− Promote innovation at a European level, in order to contribute to Europe's competitivness in the high-tech sector

The development of Create-Net mission statement provides a clear path of the lifecycle the centre develops for its activities, that starting from research ideas follow a path through engineering of technologies and solutions to innovation, with the objective of achieving economic and societal impact.

*Organizational Goals*

Goals in Create-Net identified for the different areas according to the following four categories:

- Funding,
- Research Excellence,
- Business Development, Industry and IPR,
- Dissemination and Outreach,
- People Development.

These general goal categories are mapped and scoped to the different areas, according to their role and activity plan.

| *Description* | *Type* | *Scope* | *Time frame* | *Measurement mean* |
|---|---|---|---|---|
| Funding | A | E | Dec. | Number of successful projects and funding level |
| Research Excellence | R | E | Dec. | Number and type of publications |
| Business Development, Industry and IPR | I | E | Dec. | Number of processed industry contacts, industry funding, number of invention reports, number of National and EU Advisory Boards participation, number of high level meeting with key decision makers attended. |
| People Development | CN | I | Dec. | Performance Evaluation |
| Dissemination & Outreach | I | E | Dec | Number of professional panels, conferences, summits, consultations invited / chaired / organized, number of strategic and community members involved in operations, number of National and EU Advisory Boards participation, number of high level meeting with key decision makers attended. |

*Type.* I = Innovation; R = Research, A = related to improve financing; F = related to achieving internal goals; O = Other

*Scope.* I = Internal, E = External

**Activities and Work Plan**

An overview of Create-Net's activities and the 2012 Work Plan is provided for each of the areas within Research and Engineering, for the Application Areas and for Innovation/EAI.

***eNTIRE - Network and service Technologies and InfrastructuREs.*** The research scope of the eNTIRE area covers, broadly speaking, networking resource and service provisioning supported by cognitive technologies and energy efficiency. The applications domains span from control and management of connected objects in the Internet of Things to energy efficient management of access and backhaul networks and datacentres in the traditional Internet. For this we leverage on extensive knowledge in the fields of cognitive radio, access networks coexistence and interoperability, cooperative networking, broadband wireless, constraints programming and energy-aware use of computing resources.

*Workplan for 2012*

The workplan for 2012 will see the eNTIRE area involved in a number of different collaborative projects listed hereafter in summary. eNTIRE researchers will contribute mainly to 3 EU FP7 existing collaborative projects. These consist of the recently acquired Integrated Project iCore where we are the prime contractors looking after the whole project coordination activities and of the STREPs C2POWER and FIT4GREEN. More in detail, beyond the coordination activities, in iCore eNTIRE team will contribute to the conceptual activities dedicated to the virtual representation and exploitation of objects in IoT applications as well as to the implementation of some of the envisaged use cases (location-based and transport related ones).

In C2POWER we contribute to the work on cooperative short range communications for power saving as well as to the main dissemination activities of the project (standardisation as well as workshop organisation). Finally in FIT4GREEN our involvement is in the domain of optimization algorithms aimed at minimizing the power consumption of datacentres and in the implementation of the related plug-ins.

Apart from project related tasks, some of the 2012 activities will seek further funding opportunities to strengthen focus and achieve further momentum necessary to sustain a common future vision for the above mentioned project activities. A clear area of further investment will be the Internet of Things, supported by the substantial funding secured with iCore project; leveraging on the expertise developed we plan to seek further funding in the area of IoT supported location-based and transport-related services. For the network and communication domains where the group has a substantial expertise, we will further explore the enablers for modularisation of such resources fostering more dynamic and flexible control, management and integration of communication resources. Envisaged applications will be the deployment of networking resources in rural areas or in emergency scenarios or of solutions for the end-to-end cost optimisation of communication services.

To sustain such a vision eNTIRE people will be involved in the preparation of at least 3 proposals for FP7 Call 8. Conferences like CrownCom for radio spectrum, C2POWER workshop and IERC Cluster events, where eNTIRE people are directly involved, will also provide good opportunities for dissemination in these directions.

***iNSPIRE - Networking and Security Solutions for Pervasive Computing Systems.*** The iNSPIRE research team pursues a multidisciplinary approach to devise innovative networking and security solutions for pervasive computing systems. The group activities are inspired by a hybrid approach, whereby research is deeply intertwined with experimentation, leading to solutions able to turn novel scientific paradigms into working prototypes leading to innovative start-ups.

*Workplan for 2012*

The workplan for 2012 for the iNSPIRE area includes a number of different cooperative projects. The iNSPIRE team will contribute to 6 EU collaborative projects FP7 SUPERHUB (IP, Create-Net acting as Technical/Scientific Coordinator), FP7 OUTSMART (IP, FI-PPP), FP7 ENDORSE (STREP), FP7 SMART-Net (STREP) and FP7 EPIWORK (IP), two industrial projects with local company (TI-SENTO and LOCOS) and an industrial project with a major French industry (DOGMATIX).

Apart from project-related tasks, iNSPIRE will seek further funding opportunities to increase the critical mass of the group and achieve further momentum: such fund raising activity will be approached accounting for the common future vision for the area and for Create-Net as a whole as well.

In this respect, the iNSPIRE group will explore (i) opportunities arising from the widespread diffusion of smart-phone devices carrying on-board a number of sensors (GPS, audio, video, accelerometers), which represent an ideal enabler for 'crowdsensing' applications (ii) solutions for enabling 'green' management of light infrastructure networks (WMNs, LTE, HAPs) (iii) research avenues related to the design and development of novel security solutions data governance in pervasive computing environments. To this aim, one important objective is the strengthening of existing links with major players in the ICT arena, as well as the establishment of new strategic partnerships with key stakeholders in the field.

***UBiNT- Ubiquitous Interaction Group.*** The UBiNT's research activity focuses on design, development, evaluation and understanding of user-centered, ubiquitous computing environments. The nature of technologies investigated in UBiNT is such that through the core research activity, these technologies are utilized in three main phases: acquisition of users' context information; analysis of this information to understand users' mobility and behavior; and, development of novel interfaces and interaction modalities in response to the acquired understanding. State of the art methodologies in design and evaluation of interactive ubiquitous environments are used throughout realization of each phase.

*Workplan for 2012*

In 2012 UBiNT Group will be involved in 6 projects. Among these projects, 3 of them are EU projects: MONARCA and INTERSTRESS funded in FP7 - Call 4 on Personal Health Systems; SUPERHUB funded in Call 7 on Low Carbon & Trans-

port on the topic of Intelligent Transportation Systems. At the Local and National level, UBiNT will be involved in 3 projects including GEOMEDIA (PAT-FESR), ACube (PAT-"Grandi Progetti"), DesigNet (funded under the National framework "Made in Italy"). UBiNT will also be active in activities related to the EIT ICT Labs.

In addition, UBiNT will participate in open calls in 2012 including FP7 - Call 8, Legge 6, EU-Japan Call and other potentially open calls at EU, National and Local levels in collaboration with other Create-Net areas.

UBiNT will pursue new funding opportunities in 2011 in the framework of FP7 - Call 8 and other National and Local instruments. Particular efforts will be dedicated towards implementing collaborations with other Create-Net areas in both, funded projects and exploration activities.

The focus of UBiNT research activities in 2012 will include the following aspects:

−   Investigation of innovative aspects of Interaction including captology, behaviour change and persuasion.
−   Research on mobile computing with focus on context aware systems, participatory sensing, mobile user interfaces and human activity recognition.
−   Research on design and evaluation of interactive ubiquitous environments in fields such as healthcare and education.


***ENGINE - Engineering and Fast Prototyping.*** ENGINE contributes to the realization of the global Create-Net vision by engineering novel technologies to translate research results into solutions for real-life applications for users and communities. This mission is implemented through a tight collaboration with the research areas in the development of proofs of concepts and prototypes for possible long-term commercial exploitation. Turning research ideas into experimental pilots whose objective is to prove the feasibility and potential impact of innovative concepts is of tremendous importance while performing applied research today. Nevertheless, this "hands-on" approach provides real-world feedback to researchers, helping them to refine their ideas and to identify new challenges, ultimately triggering new research directions.

*Workplan for 2012*

During 2012 Engineering will be involved in several projects, 9 in total, most under ENGINE direct coordination. Indeed, being strongly focused on experimental research activity, ENGINE is strongly tied with research performed by all Research Areas in Create-Net, and contributes to many of the projects they are involved with.

The ENGINE group is involved in three European projects: INFINITY, an FI-PPP project funded in FP7 - Call 1 (and where Create-Net is holding a technical coordination role); OFELIA, a FIRE project running an OpenFlow-enabled experimental infrastructure; and CHRON, an FP7 project funded in Call 5. ENGINE is furthermore involved in cooperation activities with several industrial partners such as one of the leading networking equipment manufacturer (DAIGO-3 project), Win.net Srl (SEROFON project), Far System R&D (TERACOM project). In term of collaboration with other areas, ENGINE people are going to be involved in two European FP7 project: SUPERHUB (led by iNSPIRE group) and OUTSMART, another FI-PPP Use cases project (led by iNSPIRE group), as well as in a local project

(CRISALIDE II) funded through ERDF funds and led by the Energy Application Domain group. Another key activity in 2012 will be the set up of several experimentation scenarios within the new Trentino Testbed, in collaboration with University of Trento and Trentino Network.

ENGINE will pursue new funding opportunities in 2011 in the framework of FP7 Call 8, EU-Japan Call, and other National and Local instruments (e.g. FESR). Particular efforts will be dedicated towards implementing collaboration with other Create-Net areas in both, funded projects and exploration activities.

During 2012, more efforts will be devoted to consolidating relationships with industry and building new collaborations, including local SMEs in the Trento province. Few funding opportunities at EU level will also be pursued in collaboration with all Create-Net Research Areas with the purpose of bringing research results toward prototypical outcomes, by possibly testing them on top of Trentino Testbed experimental facility.

***Application Areas.*** Create-Net focuses its Research2Market and Business Development approach on three Application Areas that are representative of key sectors of the market itself, with strong impacts on the local setting, and linking to the Innovation/EAI activities. 2012 will be an important year for the development of the application areas by increasing the number researchers, the number of funded activities contributing to important direct/indirect results in the identified fields of action. The application areas will develop a series of piloting projects and initiatives that will leverage on the R&D areas and the Innovation Department with the objective to close commercial agreements with important companies and SME working in the identified sectors. Thanks to the leading business development activity of the application areas Create-Net will be able to further expand its commercial relations and contracts expanding to new services and consultancy services. Objectives to be defined in terms of pilot projects, demos, Business Development and commercial projects funded by companies and public administrations.

**Green Tech.** This Application Area relates to the confirmed international trends linking climate change to green-house gas (GHG) emissions and a more efficient energy resources usage. In this context, Create-Net plans to leverage on the points of strength of the research groups to promote the use of ICT technologies for reducing the environmental impact associated with people's behaviour in daily activities, including the usage of ICT technologies themselves. The relevance of this Application Area within Create-Net's strategy is supported by the involvement in projects focused on the delivery of concrete results in the area of 'green' technologies.

*Workplan for 2012*

In 2012 this application area will be leading the technical coordination of one EU Project (SUPERHUB) and will be involved in a number of different cooperative projects. The team will contribute to 4 EU collaborative projects FP7 SUPERHUB focussing on smart multi-modal urban mobility (IP, Create-Net acting as Technical/Scientific Coordinator), FP7 OUTSMART in collaboration with BIM Adige and

Dolomiti Energia trying to develop a use case in the field of water management (IP, FI-PPP), AUTOCLUSTER (South East Europe) and one industrial project with a two local companies in the field of Smart Grid (CRISALIDE II).

In 2012, the key applications related to the Green Tech Area will include:

− Green ICT (e.g. energy-efficient data centers)
− Green wireless network protocols
− Smart Grids
− Water Management
− ICT for Energy Efficiency
− Sustainable and multi-modal mobility

**Well Being.** The rapid evolution of ICTs during the recent year translates into a huge opportunity to apply such technologies to achieve a positive impact on people's well being across the different dimensions of their everyday life. In Create-Net such opportunity is being exploited to apply the various ICT competences of the Research Areas to the development of services and solutions able to improve quality of life and people's well being through ICT. The focus of this Application Area is on the development and application of ubiquitous computing technologies for managing and monitoring personal health, providing assistance in daily activities and, more in general, supporting through continuous monitoring and care the personal wellness of people.

*Workplan for 2012*

In 2012 this group will be involved in 3 projects. Among these projects, 2 of them are EU projects: MONARCA and INTERSTRESS funded in FP7 - Call 4 on Personal Health Systems; one local: ACube (PAT-"Grandi Progetti").

In 2012, the key applications related to the Well Being Area will include:

− Personal Health Systems for remote management of diseases
− Non-invasive monitoring of Alzheimer patients in day-care centers
− Multi-parametric monitoring of patients affected by bipolar disorders
− Use of virtual reality techniques for developing appropriate therapies for people affected by stress disorders
− ICT for smart and personalized inclusion
− Intelligent and social computing for social interaction (e.g. social networks)
− Persuasive interfaces for virtuous behavior change

*Interactive and Mobile Social Media.* Social Media is emerging as the new medium of mass communication. Today Web 2.0 technologies allow users to communicate and share experiences in an interactive, participatory fashion. A set of factors are currently concurring to widen social interaction to new multimedia channels and patterns: the digital TV transition and the convergence of broadcast and broadband channels offer the opportunity to transform the TV as a new media of interaction, allowing to access content and services in a more flexible and personalized way, directly from our living rooms. The extensive spread of mobile phones, the immediacy and instinctive nature of interactions they offer, allows entirely new applicative scenarios to be developed, where individuals can capture specific mo-

ments of their life and share them instantly with others, and make their content available to the other members of the community.

*Workplan for 2012*

In 2012 this group will be involved in the definition of the local multimedia testbed for Trentino, on WOTBL infrastructure, in collaboration with Trentino Networks (media platform, IPTV), 1 international cooperation project called Zooranet developing a multimedia platform for collaborative video editing for Palestinian and Israeli media professionals in collaboration with the Innovation department and EAI, 2 local projects including GEOMEDIA with Interplay and PUBLICAMENTE with Cogito and Ymir (PAT-FESR).

This Application Area has been established with the intent to foster the development of innovative solutions in this domain and in 2012 will focus on the following key applications:

– Digital Terrestrial Television
– IPTV (Internet Protocol Television)
– Web 2.0 technologies and services (e.g. social networking)
– E-Learning
– Web Platforms & Events Management Systems
– Mobile advertising

### Innovation/EAI - European Alliance for Innovation.

*"There is no future without challenges, but every challenge aiming at the future requires a shared commitment in the present."* (Lorenzo Dellai, President of the Autonomous Province of Trento)

*"The EIT has been created in order to face the problem of improving the relationship between knowledge, business and education. The EAI of course can help to spread the new culture that the EIT is trying to implement…the alliance can of course work as a spreading tool."* (Giovanni Colombo, EIT Executive Committee)

*"As a global company we look for talents around the world. As we come to Europe we realize the diversity and fragmentation that exists in this Market. The EAI offers us a portal to interact not just with universities but also with companies and various public agencies that control technology that lead innovation in this continent."* (Gabriel Silberman, Senior Vice President and Director, CA Labs -CA Technologies)

The European Alliance for Innovation (EAI) is a membership-driven, grassroots ecosystem for fostering ICT enabled innovation to improve European competitiveness and to benefit society. EAI is unique in its use of open e-platforms to inspire matchmaking, collaboration and to reduce fragmentation among all relevant actors, from organisations to individuals. Through active participation, organisations find ideas and talent, and individuals find organisations for their ingenuity and craft.

EAI's activities are centred on the Innovation Cycle, a framework for classifying the different stages and stakeholders related to the development of innovation. Supported by EAI's platform of online tools, innovation-centred events, and online portals, EAI allows participants to leverage the power of crowd-sourced innovation and engage where and how it is most relevant to them.

From education to business to government institutions, EAI provides a bottom-up, grassroots forum for participants to contribute knowledge, communicate views, and collaborate together to advance their respective as well as Europe's broader innovation initiatives.

European Alliance works in close relations with other Pan European organizations as European Institute of Technology, NEM European Technology Platform and global knowledge platforms like UNECE, OECD and many others.

**Assembling a collective voice for European Innovation.** In its advocacy role EAI aims to bring together key European organisations involved in different steps of innovation, including education, research, industry, business, investors, and governmental and regulatory bodies. This group of important innovators engages through EAI's activities and organisational bodies and provides a critical collective voice to improve innovation at a European Level.

Each member organisation is essential to EAI, as it provides top expertise and a significant contribution in one or more stages of the innovation cycle. By sharing their assets and communities, every member organisation contributes in leveraging the added value of the wider spectrum of competencies and people in the enlarged EAI Community.

**Bringing Trentino's success stories to a larger audience.** In its role of promoting Trentino's as an established and fully functioning ecosystem in which "innovation" leads strategic and political decision and is considered as an asset of Trentino region, EAI brings to the attention of mayor European stakeholders and to the European Commission experiences, policies and concrete achievements related to innovation driven development of the area.

With its worldwide outreach near to 4 million persons, EAI is presenting Trentino as a place where "Innovation happens".

*Workplan for 2012*

Create-Net plan for supporting the EAI growth, particularly in terms of the local impact, is put Trentino economic and research ecosystem in the center of this European innovation network and provide the following benefits locally:

- Following the indication given by DGInfso, EAI is trying to overcome the fragmentation among the European Professional Societies by action as an umbrella organization for all those professional societies that understand that innovation can be facilitated by creating a collective voice;

- By promoting defragmentation of European Research, EAI also acts as Umbrella Organisation for professional societies. In this particular effort, EAI is following Commission's guidelines supported by DGInfso. Bringing Societies under EAI umbrella, will allow EAI itself to ensure a large audience to summits and conferences that are planned to be held in Trentino, using all Trentino facilities and accommodations;

- In its role of matchmaking ecosystem, EAI is planning to act as a catalyst for corporates that are planning to invest in Trentino;

- In its role of innovation related advocacy EAI is planning to work together with EU Commission in order to ensure Trentino the role of key player on innovation in Europe;

In order to achieve these objectives in 2011 Create-Net is establishing a coordinating and operational entity that serve as a coordination point for the European Innovation Alliance. In particular, it develops and manages a series of portals, which serves as the online meeting place of what is today a collection of uncoordinated, fragmented organizations in the scientific community in Europe, and it supports the dissemination and marketing activities of the Alliance both in terms of magazines and journals and of event organizations.

## Collaborations

Local-Level Collaborations

*Local Partners*

Create-Net is well integrated in the local research ecosystem within the Autonomous Province of Trento, in the ICT sector.

The strategic collaborations with the *FBK (Fondazione Bruno Kessler)* Centers, namely Information Technology (IT) and Materials and Microsystems (M&M), with the *DISI (Department of Information Engineering and Computer Sciences) at the University of Trento*, Trentino Network, Informatica Trentina, *Centro Ricerche Fiat, GraphiTech Foundation* and to a lesser degree with other connected centers, are based on three main aspects:

• A common vision of the Future Internet and embedded intelligence & systems programs, where, as mentioned above, Create-Net's specific vision and strategy, which move from a telecommunications standpoint, fit into the same context and into a clear system of relationships between the closest research areas. In particular, strong points of contact can be found with the FBK-IT Center, on topics connected with NGN (next-generation networks) infrastructures and SDPs (service delivery platforms) with architectures and methodologies for future Internet service delivery and user interactions. The same goes for the link between the Internet of Things and WSNs (wireless sensor networks) topics developed in Create-Net, and the GeoVisualization and 3D content issues researched by GraphiTech, as well as the advanced and low-consumption sensors developed by the FBK-M&M Center.

• Being focused and aligned on application domains of mutual interest, such as: i) Green Tech, ii) ICT for e-Health and Ambient Assisted Living services (Well Being), and iii) Interactive & Mobile Social Media. All three of the above domains are deemed to be strategic both in terms of global trends and for their impact on the Province of Trento's cultural and socio-economic development. In particular, on Green Technologies – as far as energy savings and monitoring, as well as sustainable mobility are concerned (thanks also to the Habitech District) – and on Ambient Assisted Living, given the considerable skills and a high number of projects where local research institutions and companies are involved, the Province of Trento is showing a highly specialized production chain. On Interactive & Mobile Social Media, as a result of the ever-increasing availability of an extensive optical broadband

network on the territory, the issue of delivering value added services and multimedia content is becoming more and more strategic for local development, for citizens and businesses alike, thanks also to the boost and awareness that early migration to DTV is bringing about.

• Integrating and making the most out of the existing laboratories leveraging on the Trentino Testbed as a concrete collaboration tool on the application domains, in order to implement the concept of a distributed laboratory on the territory, in which the research centers, their private partners, and the public administration test trial services based on advanced ICT infrastructures, following the Living Labs model. Through this initiative several small innovation projects and one international cooperation project have been recently activated in collaboration with Trentino Network and local companies (e.g. TCA, Future3, Ymir, Wasabi), specifically in the field of IPTV and Social Media.

Likewise, Create-Net is establishing strategic partnership with local companies on the telecommunication sector together with Trentino Network, playing also an advisory role with respect to the Public Administration regarding the development and deployment of the new NGN (next-generation network) initiative, which aims at providing Fiber to the Home (FTTH) to 100% of the Province of Trento population by 2018. .

*Create-Net is collaborating with a number of local companies, in the context of several R&D projects funded through ERDF funds. These includes Cogito, regarding human activity sensing in urban environments (TiSento project), Interplay, for the realization of geo-located video content (GeoMedia project), Win.net, concerning network virtualization (SEROFON project), Futur3, focusing on wireless mesh networks (ACKA project) and indoor localization (LOCOS project), and Algorab, regarding Smart Grids applications of ICT (CRISALIDE II project).*

*Furthermore, Create-Net is linked and collaborates with local supported start-ups, namely: i) U-hopper, operating in the field of mobile advertising, ii) Exrade, active in the field of electronic negotiation, and iii) Intelincs, that is developing advanced IT tools for the management of events and fairs.*

*Trento RISE (Research, Innovation & Education System)*

Trento RISE, that is representing the Trentino system of research, innovation and high educational system, especially after the promotion to Co-Location Centre of the EIT ICT Labs can provide a renewed momentum at a local level in terms of integration of the various local research institutions focusing on ICT and its applications.

In this context, Create-Net is playing a key role and in the future is expected to reinforce existing synergies and complementarities in terms of research scope, in particular with the University of Trento and FBK centers - Materials and Microsystems Center and Center for Information Technology.

Currently, Create-Net is leading one of the inter-institutional Trento RISE research areas (i.e. i-Networks) and coordinating the local activities in the domain of Smart Energy Systems.

National-Level Collaborations

Create-Net is very well connected with both academic and industrial players, in the ICT sector, at a national level. In particular, well-established collaborations exist with leading Universities and research centres, like for example the Politecnico di Milano, CNR, Fondazione Don Gnocchi, Istituto Auxologico, Fondazione ISI (Torino), Fondazione Legambiente, and so on. Likewise, collaborations are in place with a number of industries, present on the Italian territory, including Trentino Networks, Dolomiti Energia, Informatica Trentina, Deda Group, Telecom Italia, Engineering, HP and CISCO Photonics, Vodafone, Ericsson, ATM Milano.

*EIT ICT Labs – Italy*

In the context of the EIT ICT Labs initiative, EIT ICT Labs – Italy is a nation-wide network of outstanding research, education and business players, strong local governments that represent some of the most dynamic Italian regions support partners of Italian network. This framework is expected to boost collaborations with a number of Italian organisations, namely:

- Politecnico di Torino
- Politecnico di Milano
- Università di Bologna
- Scuola Superiore S.Anna
- CNR

as well as leading industries such as Telecom Italia, Engineering, STMicroelectronics and CRF (Centro Ricerche FIAT).

International Collaborations

The international dimension is the key element that made it possible for Create-Net to obtain international visibility in such a short time - and which has immediately been seen as fundamental - was our vision open to international collaboration and the creation of a global network of scientific collaboration projects. In particular, Create-Net's strategy was to set up an extensive network of collaboration projects with leading public and private research institutions worldwide in the areas of competence, but also to strengthen its privileged relations and structured cooperation with the Scientific Members and a few selected centers (e.g., Georgia Tech and Tsinghua University). Create-Net is also becoming a key player in the field of Future internet and in particular on Internet of Things and is becoming a catalyser of important interests in the field of e-Infrastructures and Future Internet experimental facilities collaborating with players such as ACREO ERIS@, UPM, DANTE, GEANT, GFI and many others. Create-Net is also expanding its network thanks to the role played by EAI that is becoming a key player in the EU arena.

*European Alliance for Innovation*

Accomplishing one of Create-Net' statutory objectives, the Innovation project department, in collaboration with the Research and Application Department and the Business Development, trough the European Alliance for Innovation, has a synergistic strategy and is functional to Create-Net both for internationalization, technology transfer and innovation promotion of Trentino research, industry and technology transfer activities.

In particular, past and current EAI activities connected Trentino ecosystem to worldwide key players in policy, funding, industry and research in two main areas:

*Innovation driven development*

Thanks to EAI, President Dellai met Simon Peres, Prersident Of Israel starting a fruitful collaboration.

Nowadays this collaboration brought a concrete project, "Zooranet", in support of the peace process in Middle East. Thanks to this project and its teaser on Facebook (the YaLa group), Trentino and EAI was exposed worldwide on the front page of New York Times and received letters of endorsement by Bill Clinton, Tony Blair, Abu Mazen and the Pope.

*Innovation & Business*

EAI, as a catalyst for innovation in Trentino, is connecting the Province with major corporates in ICT.

IBM, Computer Associated, Cisco Systems are some of the companies that are currently evaluating the option to collaborate with Trento.

EAI is accomplishing its role with two core groups: the Strategic Forum and the Community.

The Strategic Forum is the strategy and advocacy body of EAI, where leading minds with insight and influence in industry, society, and government come together to engage in the mission of advancing innovation in Europe through EAI and its many facets. There are currently 125 members which include key players in ICT innovation such as IBM, Microsoft Research Center, Huawei, Computer Associated, CEIT Austria, CNRS, ENEA, several European professional societies such as COST, ESEI, ACEEE, AICA universities such as Techninon, Universidad Politécnica de Madrid and umbrella associations like ERISA, EUREC and EPE. One of the role of SF is to internationalize EAI activities, this is done by a specific committee which contains representatives from both European Institutions and Foreign Institutions.

The role of the Forum is to examine inputs from the community, policy makers, experts and other interested parties to facilitate a connection and exchange of ideas, positions and requirements between institutional members and the community and act as a grassroots advocacy body for European ICT and its explittion in potential growth domains on the continent. The Strategic Forum targets the enablement of an outreach of European capabilities, such as in research, to be exported to the world. Likewise these activities enable the import to Europe, from the rest of the world, of best practice and potentially technology, which synergistically with European technology can leverage new innovation opportunities.

In its role for EAI's advocacy activity, SF members propose Position Papers that are implemented and promoted by the community and presented to Europe's policy makers and stakeholders. Presenting these grassroots positioning papers EAI is not promoting any specific interest but amplifying the "innovation community" collective voice.

Here are some highlights so far:

"Following the EU's expression of the need for an 'umbrella' structure for professional societies, the goal should be to start a discussion on key coordination topics, potentially resulting in some first kernel group of societies agreeing about common strategies. As EAI is a grassroots-based movement, this 'bottom-up' approach would be in good compliance with the nature of our initiative." Karl Erwin Grosspietsch - Chairman, Euromicro

"Innovation policy with its practical application in the business world and wider society, and creating a defensible competitive advantage in Europe. The term defensible competitive advantage can be specifically defined as a capability in priority markets that competitors cannot easily replicate... EAI's role in this should be to address the barriers to success in accelerating innovation on behalf of citizens, businesses and government." Charles Watt - CEO, ERISA (European Regional Information Society Association)

"Public initiatives, such as the European Commission's ICT Framework Programmes, should continue to be part of the EU's Common Strategic Framework Horizon 2020, as they form a powerful and effective instrument to profoundly foster European research, development, and innovation activities to address sustainable growth and respond to societal challenges." Pierre Yves-Danet, NEM (Networked and Electronic Media)

Earlier this year, the Strategic forum also made a joint contribution to the Green Paper on a Common Strategic Framework for future EU Research and Innovation Funding. This response was recently quoted in the Final Report of the Horizon 2020 Workshop on Future and Emerging Technologies.

Once a year EAI organizes a 3 days event, the European Forum for Inovation, EFI, for gathering the community providing a face to face opportunity for interaction and policy making complementing the virtualon-line community work. At EFI, members of the Strategic Forum engage in a joint policy initiative which will culminate in a high profile discussion panel and presentation before the media. This policy effort is driven by the contributions of Strategic Forum members including IBM, IBBT, ERISA, NEM and CEIT, forming a holistic overview of current priorities in the area of ICT innovation. Last EFI 2011 has been held in Rome in partnership with Telecom Italia and APRE and the support of EU Commissioner N.Kroes who opened the forum with a video message; EFI 2011 counted more than 60 speakers (Prof. M.Hack, Prof. W.Hanson, Dr. ML Ghisi, Amb U. Savir, Amb M. Levi, etc), 12 panel more than 800 "live" attendees and more than 25.000 persons who interacted with the panelist using live streaming and web 2.0 tools dedicated to EFI.

To promote defragmentation of European Research EAI also acts as Umbrella Organisationfor professional societies.In this particular effort, EAI is following Commission's guidelines supported by DGInfso. EAI endorses and provides technical sponsorship to more than 100 professional conferences per year from its members network attended by tens of thousands of professionals, for this reason EAI is currently signing agreement with Riva del Garda Fiere and is running to be the management team of the new Centro Congressi Polo Sud.

EAI is promoting Open Innovation: EAI's Open Innovation brings the principles of Open Access to publications. The European Union Digital Library (EUDL) is the

open access central repository for all content published by the different branches of the European Alliance for Innovation. EUDL also hosts and indexes content from selected partner and member organizations and affiliates.

Thanks to the Funding and Business development working group EAI is also trying to collect dispersed capacities and financial resources from all over Europe to develop an integrated, simplified idea evaluation method and coaching methodology that will increase the European capacity of transferring technologies and creating new successful companies in Europe.

The EAI Community at Work: the EAI Community professionals are coming from all the Innovation Value Chain sectors and engaged in several EAI activities, ranging from Publications, Science for Innovation and Business Councils to Events. In the 2011 EFI alone over eight thousand professionals participated in the various sessions. The activities of EAI Community evolve around the EAI Website and Community Portal www.eai.eu that is based on the revolutionary "Innovation Matchmaking" concept. In the spirit of Open Innovation, the EAI Portal has been built using exclusively open source technologies and in a collaborative effort with the Community. The EAI website counts more than 5000 hits per day, counting visitors from all over the world.

EAI Communications (Newsletters, Conferences Updates, Call for Papers distributions, Publications Opportunities, Members Network News) reach out to over 4 millions people.

EAI is a fully functioning organisation, currently supported by a team of Create-Net professionals as part of the Innovation project, dedicated to supporting grassroots driven activities, reaching out to a worldwide community of individuals and organisations at all levels, who participate to improve innovation policy, process and outcome for Europe. By playing a key role in EAI activites the Create-Net team is able to pay special attention to promoting the benefits, meeting the needs and opening opportunities for Trentino from research to industry.

*EIT ICT Labs*

An important opportunity for the development of new strategic partnerships across Europe is represented by the EIT ICT Labs KIC (Knowledge and Innovation Community), in the context of the recently established EIT (European Institute of Innovation and Technology). In fact, the EIT ICT Labs consortium includes world-leading companies (such as Alcatel-Lucent, BT, Deutsche Telecom, Ericsson, Telecom, Nokia, Philips and SAP), globally-renowned research institutes and top-ranked universities (e.g. DFKI, INRIA, KTH, Max-Plank, TKK, TU Berlin and VTT).

During 2011 Create-Net became an official partner of EIT ICT Labs. Create-Net is playing and will be playing a key role, in terms of collaborations with EIT ICT Labs partners, in a number of Action Lines and the corresponding "catalyst" activities, such as:

−   Smart Energy Systems
−   Intelligent Mobility and Transportation Systems
−   Business - Innovation Radar

### 3.   Financial Needs

In 2012 the financial needs to cover the core functioning of the center will be provided by the current AdP and by other financial sources, which could consider even a further increase of the AdP in order to cover the needs of the Innovation Project. Current discussions with the Province of Trento, FBK management and all the other relevant stakeholders are in place to finalise before the discussion. The basic financial needs for the year 2012 are foreseen for a total amount € 3.822.500 divided in the following way:

- € 2.422.500 from current AdP, corresponding to € 2.550.000 with a deduction of 5% as agreed with FBK and in line with the request of the P.A.T. in relation to Legge di Stabilità. This budget cut will be applied to specific elements of the budget like consultancies services (Consulenze, Prestazioni di Servizio) and institutional travels.

- € 400.000 from current AdP, devoted to Innovation and already part of the AdP as agreed and specified from P.A.T. (addendum to AdP 2010-2013) during September 2009.

- € 1.000.000, additional to the current budget, discussed in several occasions with the top management of P.A.T and related to the Innovation Project. This increase of the budget is directly linked with the further development of EAI (European Alliance for Innovation) activities in Trentino and the growth of Create-Net's secretariat role in Trento. The discussion has to be finalised with the P.A.T. in the next few months.

Additional financial resources (revenues) to support the growth of the Innovation project will come from funded projects from the European Commission, the National Government, from local funds, from commercial projects and from EAI related activities.

### 4.   Human Resources

To manage the increased number of activities in the research projects Create-Net is involved, we need to hire selected resources in certain areas. The overall hiring plan is as follows:

| Research and Engineering HR plan | 2011 | 2012 |
|---|---|---|
| Research and Engineering | 52 | 56 |
| Management and Support personnel | 24 | 25 |
| Total | 76 | 80 |

For the Innovation group working on EAI (European Alliance for Innovation) related activities we plan the following Human Resources plan:

| Alliance for Innovation HR Plan | 2011 | 2012 |
|---|---|---|
| Total | 22 | 28 |

## 5.    Publications (2011)

Journals

| Author(s) | Title | Journal |
|---|---|---|
| Bert Arnrich, Venet Osmani, Jakob Bardram | Mental health and the impact of ubiquitous technologies | Personal and Ubiquitous Computing Journal, doi: 10.1007/s00779-011-0464-3, |
| Aleksandar Matic, Priyal Mehta, James M. Rehg, Venet Osmani, Oscar Mayora | Monitoring Dressing Activity Failures through RFID and Video | Journal of Methods of Information in Medicine, Apr 29;50(4), 2011 |
| Oscar Mayora | The MONARCA Project for Bipolar Disorder Treatment | Journal of Cybertherapy & Rehabilitation. Vol. 1, 2011. |
| Maristella Agosti, Franco Crivellari, Giorgio Maria Di Nunzio, Silvia Gabrielli | Understanding user requirements and preferences for a digital library Web portal | Springer International Journal on Digital Libraries, 2011 |
| I. Carreras, A. Zanardi, E. Salvadori and D. Miorandi | A Distributed Monitoring Framework for Opportunistic Communication Systems: an Experimental Approach | IJARAS, vol. 2, n. 3, p. 45-62, Jul-Sep 2011 |
| D. Tacconi, D. Miorandi, I. Carreras and F. De Pellegrini | Cooperative Evolution of Services in Ubiquitous Computing Environments | ACM Trans. Aut. Adapt. Systems., vol. 6, n. 3, p. 20:1-20:24, Sep. 2011 |
| D. Miorandi | A Stochastic Model for Molecular Communications | Elsevier Nano Communication Networks, vol. 2, n. 3, p. 205-212, Dec. 2011. |
| R. Doriguzzi, R. Riggio, D. Miorandi, E. Salvadori | AiroLAB: A Framework Toward Effective Virtualization of Multi-hop Wireless Networks | International Journal of Communication Networks and Distributed Systems 2011 - Vol. 6, No.3 pp. 302 – 321 |
| E. Altman, T. Basar and F. De Pellegrini. | Optimal Control in Two-Hop Relay Routing | IEEE Transactions on Automatic Control, Vol. 56 No 3, pp. 670-675, March 2011. |
| E. Altman and F. De Pellegrini. | Forward correction and fountain codes in delay-tolerant networks | IEEE/ACM Transactions on Networking 19(1): 1-13 (2011) |

| Dang Minh Quan, Federico Mezza, Domenico Sannelli, Raffaele Giaffreda | T-Alloc: A practical energy efficient resource allocation algorithm for traditional data centers | Future Generation Computer Systems – Elsevier Journal, Article in Press, Accepted for Publication 28 April 2011 doi:10.1016/j.future.2011.04.020 |
|---|---|---|
| A. Somov, A. Baranov, A. Savkin, D. Spirjakin, A. Spirjakin, and R. Passerone | Development of wireless sensor network for combustible gas monitoring | Sensors and Actuators, A: Physical – Elsevier Journal Vol. 171 (Issue 2): 398-405, 2011. (doi:10.1016/j.sna.2011.07.016) |
| G. Baldini, T. Sturman, A. Rahim, et. al. | Security Aspects in Software Define Radio and Cognitive Radio Networks: A Survey and A Way Ahead | To appear in IEEE Communications Survey and Tutorials, Accepted for Publication in 2011 http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=05742780 |

## Conferences

| Author(s) | Title | Conference |
|---|---|---|
| Gabriela Marcu, Jakob Bardram and Silvia Gabrielli | A Framework for Overcoming Challenges in Designing Persuasive Monitoring Systems for Mental Illness | Pervasive Health Conference, May 2011, Ireland |
| Silvia Gabrielli, Oscar Mayora, Alessandra Sabatino | BeeParking: Feedback Interfaces for Collective Behavior Change | Proceedings of CHI 2011. Vancouver, Canada, May 2011 |
| Anthony Jameson, Silvia Gabrielli, Per Ola Kristensson, Katharina Reinecke, Federica Cena, Cristina Gena, Fabiana Vernero | How Can We Support Users' Preferential Choice? | Proceedings of CHI 2011, Vancouver, Canada, May 2011 |
| Aleksandar Matic, Venet Osmani, Oscar Mayora | RFID-based System for Tracking People: Approaches to Tagging Demented Patients | Proceedings of Ambi-Sys 2011. Portugal, Lisbon, March 2011 |
| Aleksandar Matic, Venet Osmani, Andrei Popleteev, Oscar Mayora | Smart Phone Sensing to Examine Effects of Social Interactions and Sedentary Work Style on Mood Changes | Proceedings of the 7th International and Interdisciplinary Conference on Modelling and Using Context (CONTEXT '11), Karlsruhe, Germany 2011 |
| Piret Saar, Aleksan- | Comm2Sense: proximity detection | eHealth conference, 21- |

| dar Matic, Iacopo Carreras, Venet Osmani | via smart-phones | 23 November 2011, Málaga, Spain. |
| Alessandro Puiatti, Steven Mudda, Silvia Giordano, Oscar Mayora | Smartphone-Centred Wearable Sensors Network for Monitoring Patients with Bipolar Disorder | 33rd Annual International IEEE EMBS Conference. Boston, MA. 201 |
| Jesús Muñoz, Michele Marchesoni, Cristina Costa | i-Theatre: Tangible Interactive Storytelling | Intetain 2011, Genova Italy. |
| Silvia Gabrielli, Rosa Maimone, Michele Marchesoni, Jesus Munoz | BeeParking: An Ambient Display to Induce Cooperative Parking Behavior | Proc. of ACM-ICMI 2011, November 2011, Alicante, Spain |
| K. Gomez, R. Riggio, T. Rasheed, D. Miorandi, I. Chlamtac and F. Granelli | Analysing the Energy Consumption Behaviour of WiFi Networks | Proc. of IEEE GreeCom 2011. |
| K. Gomez, R. Riggio, D. Miorandi, I. Chlamtac and F. Granelli | TUNEGreen: A Distributed Energy Consumption Monitor for Wireless Networks | Proc. of IEEE WoWMoM 2011. |
| G. Casagrande, D. Miorandi and F. Granelli, | TCPMoon: Monitoring the Diffusion of TCP Congestion Control Variants in the Internet | Proc. of IEEE ICC 2011. |
| D. Paolotti, I. Carreras, C. Gioannini, P. Saar, D. Miorandi, V. Colizza and A. Vespignani | Influweb: an internet-based and mobile platform for influenza surveillance | Proc. of eHealth 2011. |
| E. Salvadori, R. Doriguzzi Corin, M. Gerola, A.o Broglio, and F. De Pellegrini, | Demonstrating Generalized Virtual Topologies in an Opendflow Network | Demo paper, in Proc. of SIGCOMM 2011, 16-18 August 2011, Toronto, Canada. |
| K. Gomez, R. Riggio and T. Rasheed. | On Efficient Airtime-based Fair Link Scheduling in IEEE 802.11-based Wireless Networks | Proc. of the 22nd IEEE Symposium on Personal, Indoor, Mobile and Radio |

| | | Communications (IEEE PIMRC 2011), Toronto, Canada, 11-14 September, 2011. |
|---|---|---|
| S. Kandeepan, K. Gomez, L.Reynaud and T. Rasheed. | Energy Efficient Cooperative Strategies in Hybrid Aerial-Terrestrial Networks for Emergencies | Proc. of the *22nd IEEE Symposium on Personal, Indoor, Mobile and Radio Communications (IEEE PIMRC 2011)*, Toronto, Canada, 11-14 September, 2011. |
| R. Riggio, M. Gerola, A. Zanardi, F. Jan and T. Rasheed. | Network Topology Visualization and Monitoring for Multi–Hop Wireless Networks | Proc. (Applications Session) of IEEE International Symposium on Integrated Network Management (IM 2011), Dublin, May 2011 |
| M. Ion, G. Russello and B. Crispo | Enforcing Multi-user Access Policies to Encrypted Cloud Databases | IEEE International Symposium on Policies for Distributed Systems and Networks (POLICY), 6-8 June 2011 |
| M. R. Asghar, M. Ion, Giovanni Russello and B. Crispo. | ESPOON: Enforcing Encrypted Security Policies in Outsourced Environments | Proc. of the Sixth International Conference on Availability, Reliability and Security (ARES), 22-26 August 2011, p. 99-108. IEEE, 2011. |
| M. R. Asghar, G. Russello and B. Crispo | POSTER:ESPOONERBAC: Enforcing Security Policies in Outsourced Environments with Encrypted RBAC | Proc. of the 18th ACM conference on Computer and communications security, CCS '11, p. 841-843, New York, NY, USA, 2011. ACM |
| P. Saar, A. Matic, I. Carreras and V. Osmani. | Comm2Sense: inferring social interactions via smartphones | Proc. of Demo Session - eHealth 2011. |
| D. M. Quan, R. Basmadjian, H. De Meer, R. Lent, T. Mahmoodi, D. Sannelli, F. Mezza, L. Telesca, C. Dupont | Energy efficient resource allocation strategy for cloud data centres | 26th International Symposium on Computer and Information Sciences, 2011 |
| A. Somov, S. Kandeepan, A. R. | Detect and avoid mechanism for ultra wide-band WiMedia: experimen- | IEEE International Conference on Ultra Wide- |

| Biswas, A. Krause | tal evaluation of detection capabilities | band (ICUWB'11), pp. 307-311, Bologna, Italy, September 14-16, 2011 |
| M. Mueck, A. Rahim, et. al. | Cognitive Control Channels: From Myth to Reality - Implementation Options | IEEE Symposium on New Frontiers in Dynamic Spectrum Access Networks (DySpan) May 2011, Aachen, Germany |
| S. Kandeepan, A. Giorgetti, M. Chiani | Distributed ring-around Spectrum Sensing for Cognitive Radio Networks | IEEE ICC 2011, June 2011, Kyoto |
| Y.V. Kiran and R. Giaffreda | A Dynamic Pricing Method for Efficient Radio Resource Management in Wireless Access Networks | IEEE ICC 2011, June 2011, Kyoto |
| S. Kandeepan, C. V. Saradhi, M. Filo, R. Piesiewicz | End-to-End Delay Analysis with Delay Constraints in Cognitive Radio Networks | IEEE VTC, 15-18 May 2011, Budapest |
| S. Kandeepan et al. | Energy Efficient Cooperative HAP-Terrestrial Communication Systems | ICST Personal Satellite Service (PSATS) conference 2011, Malaga |

## Workshops

| Author(s) | Title | Workshop |
|---|---|---|
| Michele Marchesoni and Cristina Costa | Augmenting natural interaction in projective capacitive displays with tangible interfaces | Engineering Patterns for Multi-Touch Interfaces 2011 ACM Workshop, Pisa Italy. |
| Alban Maxhuni, Aleksandar Matic, Venet Osmani, Oscar Mayora | Correlation between self-reported mood states and objectively measured social interactions at work: A Pilot Study | Pervasive Health MindCare Workshop. May 2011 Ireland |
| Cristina Costa, Oscar Mayora, Silvia Gabrielli | i-Theatre: developing narratives skills in kindergarten children | 2nd CHI workshop on UI technologies and their impact on educational pedagogy, Vancouver, Canada, May 2011 |
| Silvia Gabrielli, Rosa Maimone and Oscar Mayora | Mobile Relaxation Technology: Looking into User Preferential Choices | Proc. of Interact 2011 Workshop on Promoting and Supporting Healthy Living By De- |

| | | sign, Lisbon, Portugal, September 6th, 2011, pag. 27-30. |
|---|---|---|
| R. Riggio, M. Gerola, D. Miorandi, A. Zanardi and F. Jan | A Distributed Network Monitoring Framework for Wireless Networks | Proc. of IEEE IM/ManFI 2011. |
| M. Constantinescu, E. Borcoci, T. Rasheed and D. Hayes. | An analysis of smart antenna use for WiMAX vehicular communications | Proc. of LNICST Springer Mobilight Conference (MOWAN workshop), Bilbao, May 2011. |
| M. R. Asghar, M. Ion, G. Russello, and B. Crispo. | Securing Data Provenance in the Cloud. | Open Research Problems in Network Security - IFIP WG 11.4, iNetSec 2011, Luzern, Switzerland, June 9, 2011, vol. 7039 of Lecture Notes in Computer Science, p. 145–160. Springer, 2011. |
| M. R. Asghar, M. Ion, G. Russello, and B. Crispo. | Securing Data Provenance in the Cloud. | Open Research Problems in Network Security - IFIP WG 11.4, iNetSec 2011, Luzern, Switzerland, June 9, 2011, vol. 7039 of Lecture Notes in Computer Science, p. 145–160. Springer, 2011. |
| M. R. Asghar, G. Russello | Flexible and Dynamic Consent-Capturing | Open Research Problems in Network Security - IFIP WG 11.4, iNetSec 2011, Luzern, Switzerland, June 9, 2011, vol. 7039 of Lecture Notes in Computer Science, p. 119–131. Springer, 2011. |
| G. Baldini, A. Rahim, et. al. | COGMAN: A cognitive management framework to support exploitation of the Future Internet | 2nd Workshop on Software Services: Cloud Computing and Applications based on Software Services 2011, Romania |
| G. Baldini, R. V. Prasad, A. Rahim Biswas, Klaus Moessner, et. al. | A cognitive framework for realizing and exploiting the Internet of Things concept | WWRF27, 18-20 October 2011, Düsseldorf, Germany |
| R.V. Prasad, E. Onur, A. | Approximate Service pro- | WWRF27, 18-20 October 2011, |

| Rahim Biswas, et. al. | visioning in an Invisible Network of the Future | Düsseldorf, Germany |
|---|---|---|
| Q. Thai, S. Kandeepan, S. Reisenfeld, G. M. Maggio | Energy Efficient Spectrum Sensing with Cyclostationarity | IEEE VTC (C2POWER WS), 13-15 May 2011. Budapest |
| K. Jacek, S. Kandeepan, R. Piesiewicz | New Cluster Formation Framework for Energy Efficient Short Range Cooperative Strategies | IEEE VTC (C2POWER WS), 13-15 May 2011. Budapest |

# GraphiTech – Center for Advanced Computer Graphics Technologies

# Financial planning 2012

| | 2012 | | |
|---|---|---|---|
| Polo scientifico e tecnologico | **Costi** | **Ricavi** | **AdP** |
| CMM | 9.534.429 | 4.770.407 | 4.764.022 |
| CIT | 11.151.117 | 5.520.095 | 5.631.021 |
| ECT | 1.149.866 | 657.228 | 492.638 |
| Cirm | 262.656 | 74.800 | 187.856 |
| CNR-FBK | 670.242 | 67.000 | 603.242 |
| Polo umanistico | | | |
| Nuovo Polo SUS | 1.500.000 | 0 | 1.500.000 |
| ISIG | 908.854 | 17.375 | 891.479 |
| ISR | 350.614 | 44.060 | 306.554 |
| Progetti speciali | 1.741.236 | 0 | 1.741.236 |
| Valutazione | 231.452 | 0 | 231.452 |
| AIRT | 892.601 | 0 | 892.601 |
| Supporto al polo umanistico | 881.593 | 17.000 | 864.593 |
| Comunicazione | 553.518 | 0 | 553.518 |
| Technology Innovation | 686.732 | 0 | 686.732 |
| Legale | 292.481 | 0 | 292.481 |
| Sicurezza | 395.632 | 0 | 395.632 |
| Organi Istituzionali | 861.901 | 0 | 861.901 |
| Amministrazione contabile | 1.769.436 | 0 | 1.769.436 |
| Amministrazione del personale | 1.221.580 | 8.000 | 1.213.580 |
| Patrimonio | 865.408 | 0 | 865.408 |
| Plessi | 2.407.390 | 0 | 2.407.390 |
| Costi comuni | 3.305.873 | 762.000 | 2.543.873 |
| Investimenti strategici | 1.880.000 | 0 | 1.880.000 |
| Piano edilizio | 1.467.900 | 669.545 | 798.355 |
| Sistema Informativo | 350.000 | 0 | 350.000 |
| Partecipate - spin-offs | 363.000 | 0 | 363.000 |
| Partecipate in Accordo di Programma | | | |
| Ahref | 1.000.000 | 0 | 1.000.000 |
| Celct | 210.000 | 0 | 210.000 |
| Irvapp | 854.000 | 0 | 854.000 |
| Create-Net | 2.950.000 | 0 | 2.950.000 |
| Graphitech | 400.000 | 0 | 400.000 |
| RICERCA CORE | 27.269.013 | 11.150.965 | 16.118.048 |
| SUPPORTO ALLA RICERCA | 3.934.010 | 17.000 | 3.917.010 |
| AMMINISTRAZIONE | 4.718.325 | 8.000 | 4.710.325 |
| FUNZIONAMENTO | 5.713.263 | 762.000 | 4.951.263 |
| INVESTIMENTI STRATEGICI | 3.697.900 | 669.545 | 3.028.355 |
| PARTECIPATE - SPIN-OFFS | 363.000 | 0 | 363.000 |
| PARTECIPATE IN ACCORDO DI PROGRAMMA | 5.414.000 | 0 | 5.414.000 |
| **TOTALI** | **51.109.510** | **12.607.510** | **38.502.000** |

| Copertura dei costi a carico ADP | 2012 |
|---|---|
| Fondi ordinari AdP | 34.650.000 |
| Fondi SIEP | 1.000.000 |
| Utilizzo crediti ex ITC | 2.800.000 |
| Economie | 52.000 |
| **TOTALE** | **38.502.000** |