Scientific Advisory Board Report

The visit was conducted October 27 and 28, 2008 at INESC-Porto.

The INESC-Porto Scientific Advisor Board included:

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The meetings were coordinated by Dr. José Principe. This report is an effort of all the above members.

This report is divided into three major parts:

- I- The overall scientific review of INESC-Porto.
- II- Recommendations to the Board of Directors.
- III- Reports for individual Unit activities.

I- Overall Scientific Review of INESC-Porto LA

I.1. General Comments

INESC-Porto Laboratory Associado (LA) is a multifaceted Institution organized in 6 Units (Telecommunications and Multimedia (UTM), Manufacturing Systems Engineering (UESP), Information and Communication Systems (USIC), Power Systems (USE), Optoelectronics and Electronic Systems (UOSE) and Innovation and Technology Transfer (UITT) with a common support services infrastructure. Each Unit was born and grew independent of the others in a bottom up fashion. This evolution created Units with very different profiles, goals and perspectives, which enables each to exploit the local and short-term niches in the Portuguese market, but endangers a coherent, long-term plan for the overall Institution.

INESC-Porto defines itself as an interface Institution, transferring technology from the highly skilled University environment to a mostly traditional and technology "challenged" Industry, to the Service sector and Public Administration. Each Unit has between 3 and 30 Ph.Ds, a varying number of University Professors and graduate students with in most units only one or two full-time staff. A scientific advisory structure was created for each Unit, with a coordinator, and an overall Scientific Advisory Board. Each Unit has a coordinator, who along with the scientific council coordinator reports to a Board of Directors. Across the whole structure we see predominantly academicians.

INESC-Porto was contracted as a Laboratorio Associado in 2002 by the Ministry of Science and Technology, which places it in a very selective group of Portuguese Research Institutions, and demonstrates the caliber of the research and the importance of the current areas of expertise for the technology development of Portugal. INESC-Porto can be considered a medium size research/technology institution with an annual budget approaching $8 million euros and 300 members (~ 70 staff).

The Scientific Advisory Board (SAB) was very impressed with the management of INESC Porto LA because it is effective with a very low overhead. The Laboratorio Associado status brought much needed stability in institutional funding, but we were very impressed with the four fold multiplicative factor achieved from the base funding to the overall budget of the institute. This is rare and attests to the entrepreneurial spirit and effectiveness of INESC researchers and management.

The SAB believes that a major landmark happened in the history of INESC-Porto LA. Looking critically at INESC-Porto LA, we venture to say that the Institute has identified the formula to be visible internationally in academic circles and become a player in the international technology market. Indeed, the expertise of its members is world-class and it is being recognized as such by awards, and is attracting international scholars and students. Moreover, some of its units finally transitioned into a phase of effectively integrating multiple academic disciplines with technological development, which is required to create products that solve real world problems for the Portuguese industry/services and even more importantly for the international technology market.

Finally the Institute has also found a way to transfer this technology effectively to the world market by spawning successful high tech startups. However to fulfill this role in all of its areas of intervention, INESC-Porto must define a global plan of action and probably a more flexible entrepreneurial structure. The Institute is in the process of integrating a large number of academicians from the Science (CRACS) and Economics (LIAAD) areas, which will help create critical mass in intelligent information technologies. This is a great opportunity because it has the potential to jump start growth in vital future directions, but it also brings the "pains" of integrating different cultures and finding the centripetal projects to exploit effectively the new resources.

I.2. Units' Scientific Performance

Across all the Units we observed pockets of research excellence, albeit with different degrees due to the different profiles of each Unit. Research at UOSE is top notch overall and highly visible. Research at USE is world class in a deprived and increasingly vital area worldwide (energy). UESP research is still very good but perhaps losing standing in the international arena. UTM is suffering from a large number of loosely coupled areas of activity, where there are pockets of excellent work and exploitable results. The activities in USIC are too heterogeneous and there is a solid scientific foundation in only a subset of the activity. This Unit should be reformulated. The service activity of UITT is clearly justified by the INESC-Porto mission and it has already justified its creation, but the overall goals are still unclear.

INESC Porto LA made a clear progress in its international visibility. A very successful effort was undertaken to improve the journal publication of INESC Porto LA, as the statistics of the last five years clearly indicate: while the number of researchers doubled the scientific output increased five fold. This is very important because the national and international success of INESC-Porto LA is predicated in the visibility of its research, for which the publication record is an important indicator. However, the ratio paper/senior researcher is still below the international standards and a continuing effort is needed. An honorable exception is UOSE with an excellent publication record, followed at a distance by USE. The largest discrepancy between the quality of research and the publication record is found in USIC.

The SAB also applauds the effort to attract international scholars, post docs and Ph.D. students to INESC Porto. In the long run this move will help recognize the Institute at the world scale.

The SAB feels that the scientific atmosphere in INESC-Porto needs reinforcement thru an Institute-wide regularly scheduled seminar series. This not only invigorates the scientific enterprise but also facilitates inter Unit collaborations.

I.3. Balance Depth / Breadth

Generally speaking the tendency is still to dilute resources. We saw everywhere examples of good depth and experience, but the large breadth of the Units and the limited human resources endanger consolidation of core competencies on a long-term basis. Honorable exceptions are USE and UOSE which have focused activities.

This is not only a problem of the units but also a problem in the composition of INESC Porto with its six heterogeneous areas of activity, which are starting to work as silos that do not promote cross fertilization. Either one finds a way to capitalize on this diversity, or it is necessary to focus efforts around well-established medium to long term goals and synergistically use human resources among the Units to create an identity to the Institute. This could be accomplished thru the identification of institute-wide technical challenges to exploit the full potential of INESC Porto LA that congregates resources and can be understood by the non scientific Portuguese community.

The SAB believes that the Units should improve the way they assess their long term activities. Strategic thinking should be an integral part of the definition of the topics of submitted research proposals and their outcomes, definition of expertise thru Ph.D. topics, and hiring of human resources. It is important to recognize that a grant is just a way to obtain the funds to implement a medium/long term research goal and should not be confused with a goal in itself.

I.4. Gaps in Expertise

We will defer this point to the individual unit evaluations.

I.5. Balance between R&D and Exploitation

There are excellent examples of exploitation of past R&D efforts, which is a very good sign of maturity and accomplishment. The creation of the UITT seems potentially to be a very effective way of transferring R&D to the internal and international markets and the early success stories should be analyzed and advertised internal and externally. It would be interesting to study the feasibility of a similar mechanism for the service sectors.

I.6. SWOT Analysis

Strengths

One of INESC-Porto strengths lies in the young and enthusiastic, highly educated, world-class group of collaborators in key areas and in the low operation costs (when compared with comparable staffed R&D centers). INESC-Porto is a Laboratorio Associado in key technology areas due to its strong research accomplishments, and has already a presence in the Portuguese industrial, service and administration markets. We found clear evidence of the international visibility of the institute, not only in academic circles but also in the international marketing of R&D efforts. This is a turning point for INESC-Porto LA.

Weaknesses

INESC-Porto still lacks an institute wide identity and structured approaches to create and assess mid term R&D plans. Its structure is too rigid and policies do not exist to assess and, if necessary, replace research coordinators are non existent. INESC-Porto needs a better plan for sustainability from R&D exploitation. INESC Porto activities are too dispersed. Perhaps an analysis of best practices in the successful areas should be undertaken, to create guidelines for the other areas.

Opportunities

INESC-Porto should strengthen its presence in Portugal and internationally by creating highly visible and "use-oriented" flagship projects. Now that INESC-Porto is a player in the technology world market, a new phase of strategic alliances should be pursued. The integration of LIAAD and CRACS is a huge opportunity to shore up competencies, and change the perspective and level of intervention in the critical IT area.

Threats

The threats come from the excessive dispersion of activity, muddle response and unclear mission goals and implementation plans. It is necessary to have mechanisms in place to map the organization with the strategic goals of the Institute, e.g. by defining the right level of R&D theme aggregation, with criteria to create, modify and dismantle Units and promote agility.

II- Scientific Advisory Board Recommendations

The SAB presents below a set of recommendations to the Directors. This list addresses in different ways bottlenecks in the present structure and should be interpreted as guidelines/ suggestions for further analysis, internal discussions and possible implementation in the short term.

- Create an identity for the INESC Porto LA addressing the following:
  - Vision (what will INESC PORTO be in the future)
  - Mission (what is the purpose of INESC)
  - Goals (how to accomplish the mission)
  - We believe that "From Knowledge Production to Science Based Innovation" is the right motto…
  - But the story is not told anywhere, it is important to convey it in an exciting message!
- Understand better the relationships among Units to improve effectiveness and emphasize agility.
  - Evaluate and promote cross unit dynamics
  - Develop criteria to create, modify and/or dismantle units
- Identify institute-wide technical challenges to exploit the full potential of INESC (e.g. smart grids).
- Raise the profile of INESC achievements internally and externally
  - Best (student / senior researcher) papers, INESC Porto project award etc.
- Create regular institute (lab)-wide seminars
  - Internal + Distinguished external lecturers
- Demonstrate more clearly how unit goals contribute to INESC strategy
- Create a term limit mechanism to any management position
- Increase further the number of archival journal publications
- Integration of LIAAD and CRACS should be an Institute wide effort.
- INESC Porto should consider how most effectively to engage Industrial /Service/ Community representatives

III- Individual Units Reports

III.1. Unit: Power Systems

III.1.1. Evaluation of Unit's scientific performance

The unit is composed of 13 half time University professors and 17 full time grant holders. The overall performance of the Unit in the last two years (2006-07) since the last SAB evaluation has continued to be excellent.
The number of publications in international journals has reached an acceptable level (16 in average per year).
The number of PhD students and number of concluded PhD theses remains at the same level as in the previous period (17 PhD full-time students and 5 PhD theses in 2006-07).
The exploitation of results measured through direct incomes from industry contracts and consultant services has increased accounting for 75% of the total incomes of the unit.
It is remarkable the strong involvement of the Unit in the two launched PhD programs with MIT and CMU. This will bring new opportunities to have more PhD students and to increase the academic productivity.

III.1.2. Balance between depth and breath

The unit shows a good balance between basic research, in power systems modeling and control and computing algorithms, and well identified application fields (distributed generation, wind power and sustainable generation, microgrids, and electricity markets).
There are new identified areas related to adaptive models using adapted machine learning algorithms, SmartGrids and Electric Vehicles that are very promising. There exists an opportunity for this Unit to contribute to the definition of an INESC cross-unit research area in this field.
International cooperation through European and South American projects and the recent established program of visiting professors would bring benefits for the quality and value of the conducted research.

III.1.3. Gaps and required expertise

The international program in collaboration with MIT and CMU opens new expectations to increase the number of PhD students and scientific production.
New projects in the area of energy can be undertaken as INESC projects in collaboration among several units. The unit should assume a leadership role in this matter.
In the same line the participation in European funded projects is also recommended.

III.1.4. R&D tech/transfer

The incomes from R&D and technology transfer contracts have steadily increased in the last two years, and the Unit contributes with important annual operational margins to the sustainability of INESC. It is recommended to present the research work specially contracts and services as a composite whole, branding the expertise of the unit in specific industrial sectors, mainly in the energy sector. In this aspect, a new view of the web site of the unit can help.

III.1.5. SWOT Analysis

Strengths

- Strong and consolidated leadership in the Unit
- High productivity in terms of incomes from exploitation of results
- International cooperation and recognition
- Good personal relationships inside the Unit

Weaknesses

- No strategic planning to backup and extend Unit leadership
- No research professorships
- Research publications could be increased to three papers per PhD
- Research fellowship is not recognized

Opportunities

- Expand post-doc programs with international cooperation
- Expand markets for a sustainable energy
- Provide leadership to bring INESC skills into energy systems

Threats

- The expansion of the Unit is limited due to the lack of new qualified research staff
- The financial model based mainly in partially funded contracts and consultancy services may not be sufficient to stabilize a scientific staff basically dedicated to research. Long-term contracts for software products can help to look for industrial partnership.

III.1.6 Recommendations

- Identify the key contributions to establish an expertise brand (for presentation of the achievements as a composite whole of the Unit)
- Define a strategic expansion plan for the Unit.
- Establish a mechanism to backup and extend Unit leadership.

- Define an attractive career for the scientific research staff within INESC that allows the creation of new positions for brilliant younger researchers (i.e. research professors).
- Expand post-doc and graduate international programs in collaboration with other institutions to promote exchange of scientific research staff and international projects.
- Good opportunity to contribute to define a flagship INESC research area for instance around SmartGrids concepts
- Look for new more stable funding sources to partially cover fixed costs of new scientific staff positions.
- Create an environment for seeking international recognition (e.g. IEEE Fellows)
- Define a target in the expected number of papers in peer review journals by PhD students

III.2. Unit: Telecommunications and Multimedia

III.2.1. Evaluation of Unit's scientific performance

The unit is organized in four areas

- Multimedia technologies and systems
- Wireless and mobile networks
- Internet architectures and networking
- Optical and electronics technologies

Taken together this reflects, not inappropriately, a layered model view of telecommunications, ranging form physical technologies, though networks to services and applications. However, there appears to be limited interaction between the sub-units so that the potential opportunities for synergy may not be recognized enabling the associated benefits to be realized.

That said, the unit is making valuable contributions in terms of scientific achievements evidenced by PhD theses and research publications produced. In particular, it is good to see that the unit has responded to our earlier comments, placing greater emphasis on publication in leading international journals.

III.2.2. Balance between depth and breath

There is a risk given the relatively disparate nature of some of the activities that depth is sacrificed for breadth of coverage. This is particularly a concern where the number of PhD-qualified staff in a sub-area is small compared with the number/range of topics being addressed and/or the cost barrier to entry and effectiveness is high. The apparently limited linkage between optical and electronics technologies in this sub-area in particular means there is a risk of sub-critical scale which deserves to be addressed.

III.2.3. Gaps and required expertise

There is a good spread of expertise in the unit and it is pleasing to see the very promising start made in the new area of Internet architectures and networking. The gap we note relates less to expertise than to activity. It would be appropriate in our view for consideration to be given to more 'integrative' project activity that could profit from the complementary technical capabilities in the unit.

III.2.4. R&D tech/transfer

The unit has a very wide range of external partners, in Portugal and internationally, providing a strong network for technology transfer. It has also an impressive record in relation to technology exploitation through five successful start-up companies to date.

III.2.5. SWOT Analysis

Strengths

- Technical expertise spans a wide spectrum - ranging across the 7-layers of the ISO protocol stack - from physical layer technologies (electronics, microwaves and optical) through networks (mobile, wireless and internet architecture) to services and applications (multimedia technologies and systems)
- Very able and committed researchers and research students
- Good level of engagement with industry
- Some excellent facilities (with the associated challenge of maintaining these at the state of the art)

Weaknesses

- Technical activities that are relatively disconnected from one another.
- In some areas the activities appear to be sub-critical scale in terms of number of PhD-qualified staff relative to the range of projects and technologies being addressed.

Opportunities

More ‘integrative’ activities could exploit complementary technical strengths within the unit to address projects beyond the confines of the individual ‘layers’.

Threats

Fragmentation amongst the wide spread of activities runs the risk of a lack of critical mass. Vigilance is needed here to ensure the current levels of excellence being achieved are maintained, noting that ‘excellence’ is a central mission commitment of INESC.

III.3. Unit: Innovation and Technology Transfer (UITT)

Establishing a specific focus for technology transfer and a route to innovation and exploitation is an important and appropriate recent development within INESC Porto. The unit is quite small compared with other units but this is not necessarily inappropriate since it is really quite different in character. 'Right-sizing' this activity calls for clarity of the span of activities of the new unit and an assessment of the scale of technology exploitation opportunities within INESC.

III.3.1. Evaluation of Unit's scientific performance

Actions undertaken by UITT include providing service to other units in relation to technology transfer and exploitation possibilities; engagement with companies to raise their appreciation of the business benefit of engaging in R&D and R&D-led innovation. Beyond this the Unit also engages in "academic" scholarship/research on Technology Transfer and Innovation. Despite the relatively limited resources there are indications of significant progress having been made in a short space of time. In particular the growth in spin-out activity associated with INESC Porto is quite marked in the last two years.

III.3.2. Balance between depth and breath

The 'service' and 'scholarship' elements are quite different in character. It would be appropriate for INESC Porto to consider how these different aspects contribute to the overall INESC mission. In our view the principal emphasis should be on building a culture of innovation in INESC and providing support to the 'technical' units to ensure that the opportunities for exploitation are realized, be that through establishing spin-out companies, developing exploitation partnerships/licensing or other forms of mutually beneficial collaboration. This is essentially a 'service' function to be provided by UITT.

It is not immediately apparent that this service provision aspect of UITT sits well along side scholarship/research *per-se* in Technology Transfer. The former is about bringing best practice in Technology Transfer to bear on the INESC portfolio of technology developments to maximize the benefits for INESC and its partners of the investments made in technology R&D. The latter includes identifying new approaches and identifying and highlighting good examples that convey what is best practice. This latter aspect of UITT activity does not appear of itself to contribute directly to what we understand as the mission of INESC.

We were led to contemplate what might be the rational for UITT including both aspects in its activities and concluded that it may be to ensure that high-caliber academically-oriented individuals can be attracted to engage with UITT since they will be able to pursue academic scholarship goals alongside providing the 'service' function. It is telling that we had to conjecture this – the rationale was not stated explicitly.

Since new thinking in Technology Transfer is a worthy endeavor we conclude that it is not necessarily inappropriate for scholarship/research in this area to feature in UITT. However, we suggest there is a risk that will need to be 'managed': the tension, to the point of potential conflict given limited resources, between engaging in academically-rewarding 'TT scholarship' and the academically more mundane 'TT service' function. If the recent successes in TT – notably associated with companies established related to UITM – are to continue and serve to full effect the needs of INESC as a whole then the 'TT service' aspect must be given sufficient prominence. We mention this purely to enable INESC-Porto to recognize and address the potential risk/tension that may be involved here.

Strengths

Caliber and commitment of the staff involved in technology transfer related actions.

Weaknesses

The small size of the specialist TT team may limit the number of actions and possibly also breadth in terms of technology perspective of the unit.

Opportunities

The range of 'frontier' R&D undertaken in INESC-Porto is such that there are many potential 'licensing' and/or 'spin-out' possibilities to be assessed.

Threats

Potential tension (in terms of competition for limited available resources) between 'TT scholarship' activities and 'TT service' functions.

III. 4. UNIT: UOSE – OPTOELECTRONICS AND ELECTRONIC SYSTEMS

The research activities of this unit have been focused on the following areas in recent years:

Optical Fiber Technology and Systems
Micro-fabrication
Integrated Optics
Optoelectronics Integration

The unit is internationally well-recognized in the area of fiber optic sensors and strives to establish itself in Optical Coherence Imaging, integrated optics and thin film devices. The numbers of joint papers and joint projects are clear indications that this unit has been active to developing international collaborations and has succeeded in this regard.

The UOSE unit's expertise and infra-structures are valuable assets to be utilized by the Optical Communications research activities in the UTM unit.

The quality of research in almost all areas of research, fiber optic sensors, integrated optics, etc. is very high. The unit has an established track-record and international recognition in the area of fiber optic sensors. The unit has gained necessary infra-structure and has established international collaboration necessary for a successful program in the area of integrated optics.

In the past few years two companies, Multiwave and Fiber Sensing, have been formed based on the expertise gained in this unit and they both have been successful to creating high-tech jobs in the Porto area.

The unit has the following unique capabilities:

- Fully automated Fiber Bragg gratings fabrication system capable of making costumed grating
- Long period gratings fabrication
- WDM fabrication station
- Thin film fabrication (e-beam, sputtering, laser deposition)
- Optoelectronic device/system characterization
- Optoelectronic/Electronic system Integration
- Sol-gel based integrated optic devices
- Optical Coherence Tomography
- Micro-fabrication
- Integrated modules

The unit continues to improve its micro-fabrication infra-structure.

The unit continues to maintain, and in some areas improve, the talent level which is reflected on the quality of research and development activities. In the past four years they have received 7 patents for their innovative work. During 2003-2007 the unit members have published 109 papers in peer-reviewed journals and 209 papers in conference proceedings. The unit is also very active in its educational activities by providing research opportunities to many M. Sc. and Ph. D. students. Since 2002, 17 former researchers in the unit have found employments in the industry, 6 have obtained positions in academia, 5 are working in R&D institutions and 12 have continued their graduate studies elsewhere.

III.4.1. Evaluation of Unit's scientific performance

There is an excellent research and development activity in the area of fiber optic sensors. The group is well-informed on the state of the art, aware of competitors elsewhere in Europe and in the world. There is clear evidence of a very high level of innovation in the work of the group. The group has expanded the application domain of its sensor expertise into chemical and biological sensors.

The research work in the area of integrated optics has improved significantly in recent years. The thin film research work has resulted to new discoveries which may lead to more efficient solar cells. This is not only scientifically very important, but also will enable the unit to apply this new found knowledge in multitude of application areas beyond solar cell application.

III.4.2. Scientific Breadth versus Depth

The breadth of coverage is very good in the unit's traditional strength of physical sensors, particularly those based on fiber Bragg grating. More than two years ago the unit made a strategic decision to expand its activities into the chemical and biological sensors. The significant progress that the unit has made in this very important area has provided new opportunities for many multi-disciplinary research projects with real-life applications. Unit's members possess excellent knowledge of fundamentals in the area of optical sensors and have very good appreciation of the future direction of this field.

The depth of knowledge in the areas of micro-fabrication, integrated optics and thin film is very impressive. In the past two years the unit has made conscious effort to focus this diverse expertise and capabilities onto two areas of sensors and solar energy.

III.4.3. Gaps in required expertise

There are no obvious concerns relating to gaps in expertise; there is an appropriate emphasis on architectures and applications capabilities rather than simply on scientific

fundamentals, reflecting the industrial/applications focus of the group. Some of the group members have been instrumental in the establishment of two companies, Mutiwave, and Fiber Sensing. This is a good indication of the application values of some of the research work carried out in this group. At the same time these efforts have resulted to very valuable experiences for the unit and INESC Porto.

III.4.4. R&D tech/transfer

As mentioned the technologies developed in the unit have been the foundations of two companies formed in recent years. But the potential is even more than what has been exploited in the past, particularly in the areas of solar energy and chem/bio sensors. It is expected that the experienced gained in the past will help more technology transfer to occur in the future.

III.4.5. SWOT Assessment

Strengths

The unit has some key, world-class technology capabilities (e.g. Automated Fiber Bragg Station, and Long Period Gratings Station, and Micro-Controlled System) and a strong, well-established portfolio of activities in optical fiber sensors. The expertise developed in the areas of optical coherence imaging, thin film, micro-fabrication, integrated optics, and chem./bio sensors in such a short time period is very impressive.

Weaknesses

By any international measure this unit posses invaluable talent level, know-how, experience and the infra-structure to make contribution to the scientific community as well as playing a key role to advance technology in the area of optoelectronics and fiber optics. It is not clear if other units at INESC-Porto or other national research centers are fully aware of this unit's capabilities. There is a risk that this very significant national asset may not be fully utilized; positive external communication to address this is recommended.

Opportunities

New opportunities in the areas of solar energy and life sciences have presented themselves as a consequence of the unit's most recent research successes in thin film technology and chem./bio sensors. The unit may want to explore these opportunities through collaboration with other units at INESC in the area of energy and by establishing organized relations with other research centres in the areas of life sciences and health.

Threats

The infra-structure developed in the area of micro-fabrication has a significant maintenance cost that the unit should bear. However, this infra-structure is very useful for researchers in other disciplines and if it was made available for use to others, the cost would be distributed and could be managed.

III.5. Unit: UESP Manufacturing Systems Engineering

III.5.1. Evaluation of Unit's scientific performance

The Unit presents two main competencies areas in operations management and enterprise information systems both of them applied to industrial companies and enterprise networks. The unit has a track record of expertise especially in the area of Meta heuristic, combinatorics, planning, scheduling, cutting and packing. That leads to the actual differentiation of the following core activities in two main groups:
A more scientific oriented and therefore "Content" driven group in the areas of enterprise cooperation and social networks, optimisation and scheduling, an cutting and packing; and an "Activity" driven group in the areas of systems integration, internal logistics, and consulting services. As already suggested in the previous visit and report, these groups are too small, do not feed on themselves (i.e. there is no cross fertilization of theory and application), and therefore the unit does not have the internal coherence that is expected, which is a missed opportunity.

The unit is stable in its indicators: size is practically constant, scientific production oscillates little, likewise Ph.D. production, and budget (total and itemized). Unfortunately this stability is a "local minima" in performance and something needs to be done to alter the internal dynamics.

From the four activities listed: (1) enterprise cooperation networks; (2) information management and knowledge in collaborative networks; (3) operation management and production planning: (4) optimization of cutting and packing, the unit has international competence only in the latter two. It is unclear how to achieve the same status on the first topic, which requires a larger critical mass of people and diverse expertise in IT technology at two levels: knowledge and performance management and interoperability (integration platforms). It is not clear whether off the shelf tools can be used and this may lead to novel IT tools for which the expertise of the group is insufficient. The expertise of USIC (as well as LIAAD and CRACS) might be useful. It is also not totally clear how (3) and (4) can contribute optimally to the goals of (1). The second activity (collaborative networks) is an important, clearly relevant topic, but there are no clear goals, nor development path. Again, integration of other INESC unit's expertise can help tremendously. This should be discussed expeditiously by INESC and a plan drawn.

III.5.2. Balance between depth and breath

This unit is working in very important and contemporary topics in enterprise cooperation networks (co-operate and the 5 day car), and well establish areas as packing optimization, where they have track record and a clear niche. The recent addition of a line in social networks is a very important future area, but there is no critical mass. There is a strong depth in a very few fields of activities like optimization and scheduling but a too large breath of activities that can not be covered with appropriate depth. The unit has to decide,

whether they want to stay with a few, but clearly defined areas or even if it could be necessary to give up some of the actual wide range of different fields and activities.

III.5.3. Gaps and required expertise

Taking into account the two chains of activities like research projects and industrial applied consultancy and service, one may state, that there is "missing" glue between these two. The addition of cooperative knowledge networks should be better planned, since it does neither have critical mass nor clear direction. Perhaps this expertise can be reinforced within other INESC Units.
Research projects results should aim for a continuous improvement of the Unit-wide shared methodologies, models or knowledge in order to derive from here the needed external awareness of core competencies and furthermore industrial related "products", which are suitable for consultancy and service. Last but not least, this should be the basis to close the loop back to formulate innovative research ideas with high industrial relevance.

III.5.4. R&D tech/transfer

There is no clear understanding, on how to transfer research knowledge into exploitable "products". The consultancy/ service activities seem to be more or less independent from the research activities and do not take into account in a structured way, on how findings and potentials of research results should be turned into new "Services" or "products". Nevertheless the funding is respectable and stable which reflects commitment and entrepreneurship from all the unit members.

The expertise of the unit can be applied in other areas of INESC. Cooperation with the USE was mentioned but seems incipient at the time.

III.5.5. SWOT Analysis

Strengths

- Large expertise in fields like optimisation/ scheduling
- International awareness for the units profound knowledge in meta heuristics
- Highly motivated unit-members
- Large scale of activities in the international context like EU funded projects and international conferences

Weaknesses

- No distinct idea on a comprehensive approach of what industrial partners need to stay competitive

- Poor number of paper publications from purely scientific activities like PhD thesis, books in an international context
- Restrictions through lack of critical mass for clearly defined topics “Who is pushing forward what?”
- Relationship in terms of synergies or overlaps to other units unclear

Opportunities

- Integration of innovative aspects on IT systems integration and homogenisation of the needed IT infrastructure of companies
- Development of new technologies and methodologies on how companies should work together under increasing global pressure (“Performance management”)

Threats

- Unclear distinction, on how to glue between the scientific based and industrial related activities
- Overlap with competencies of other units, i.e. information management
- No clear description of the condensed scientific background and findings in terms of a grown methodology or model, which is clearly developed and promoted by the Units expertise throughout the last years

III.6. Unit: USIC

III.6.1. Evaluation of Unit's scientific performance

In spite of its presentation efforts the unit has not yet a visible scientific policy. One of the major changes since the last visit is the loss of one of the coordinators and another PhD. Currently the unit still includes a too large number of research themes for the number of PhDs. It has very valuable GIS and Software engineering expertise and activity which are more measurable in terms of services including prototypes that have been industrialized and past projects among which MEDSI and CAALYX are the most noteworthy, than in number of publications. These activities have a nationwide recognition and should continue in the future not only because they bring income but also for the potential nice research issues for which the team has an expertise (mobile computing, ambient systems, sensor networks, etc.). The publication activity however is far below what could be expected from an INESC Unit. The oral presentation of the unit activities from which it was hard to figure out who is working on what issue, did not ease the scientific assessment especially w.r.t. future plans. Although ultra large scale systems are a challenge, it was not correlated to the unit expertise. More specifically, the unit should keep focusing on a very small number of research issues having good chances to generate high level publications. Priority should be given to seeking collaborations with other INESC units or with LIAAD or CRAPS. Alternative short term scenarios should be investigated for the future of the unit such as merging with other members of INESC or the Associated Laboratory on new IT challenging issues with the objective of creating a strong unit in computer science inside INESC LA.

III.6.2. Balance between depth and breath

In between the two deep activities around enterprise integration and GIS there are a too large number of potential or existing activities which have not reached any critical mass with people whose involvement is not yet clear. Lately, the coordinator has structured in three activities, one per expertise: advanced information system engineering (location-based information systems engineering, software engineering), communication systems engineering and strategic IT consulting. The lack of well identified research lines with high level publications is compensated by the breadth in national and European collaborations and the importance of societal impact (public administration, healthcare, telecommunications, transport, industry, commerce and services. Internationalization is mainly implemented through European project and consultancy activities.

III.6.3. Gaps and required expertise

The gaps come for the too broad scope of fields. An effort has recently been made to reduce the scope of activities but it still is hard to find bridges between the two main current areas of expertise (location-based systems and software engineering).

III.6.4. R&D tech/transfer

The balance between R&D and exploitation is good. The unit has the critical mass and expertise in terms of senior programmers to undertake project activities for the short term.

III.6.5. SWOT Analysis

Strengths

Very strong vertical expertise in Information systems with application to GIS and location based services and software engineering.
Very strong record and potential for conducting national and European projects with significant societal impact, and IT consulting in their field of expertise

Weaknesses

The level and number of publications should be improved.

The academic supervising of the research activities is not adequate.

In spite of an effort for narrowing down the research scope, there are still too many research issues for the limited number of PhDs in the unit.

With the loss of one co-coordinator and another PhD, the unit has no longer the critical research mass of a desirable INESC unit

III.6.6. Recommendations

Tight collaborations should be urgently searched for, with other units such as Power systems, Manufacturing systems or Telecommunications and multi-media. The integration within INESC of LIAAD and CRACS is probably an opportunity for undertaking new research collaborations. At the same time a short term strategic plan should be launched with one year horizon to search for new scenarios for reaching the critical mass. Such scenarios include but are not limited to (i) creating a new unit out USIC and new members in INESC or LIAAD and CRACS and (2) merging USIC with another unit. The challenge here is to create a strong INESC unit in information systems and computer science around issues for which a strong expertise exists within the associated laboratory such as integration, sensor networks, ambient and mobile based information systems, data mining, web based systems, etc.

III.7. Laboratory of Artificial Intelligence and Decision Support (LIAAD)

III.7.1. Evaluation of Unit's scientific performance

Not being an INESC unit, detailed information on scientific productivity has not been made available to the advisory board. Also, LIAAD was evaluated by FCT in January 2008 and this need not be repeated here. However, from the summary data provided in the presentation on LIAAD the board concluded that the quantity and quality of publications and projects are very good. LIAAD is one of largest European research groups in Machine Learning, covering a wide range of methods, theoretical frameworks and applications.

III.7.2. Balance between depth and breadth

The areas studied by LIAAD members are all related to Machine Learning and Optimization. The presentation lists ten topics for a total of 32 persons in 2008 (including 9 PhD students and 6 "other") but it is not completely clear how many FTE effectively work on a topic. The research is aimed at developing and evaluating new learning methods, preferably in the context of industrial applications. The topics are loosely connected and allow for cross-fertilization both of ideas for methods and of applications. LIAAD is eclectic in theoretical approaches, using a variety of frameworks and the emphasis is on breadth somewhat more than depth. Research is not aimed at fundamental issues in the context of such frameworks.

III.7.3. Gaps and required expertise

Recently, methods that are based on statistical principles (Statistical learning theory/Support Vector Machines, Bayesian networks) are increasingly popular in Machine Learning. They play only a minor role in the LIAAD research. Developing an understanding of an application area and developing a relation with one or more companies in this area is a substantial investment. Here LIAAD could pool forces with others in INESC.

III.7.4. R&D tech/transfer

A number of LIAAD projects involve industrial partners. Probably collaboration with INESC Units could lead to the development of more industrial activities and output.

III.7.5. SWOT Analysis

Strengths

Good Machine Learning research group with enough critical mass.

Weaknesses

The variety of theoretical frameworks is both a source of cross-fertilization and an obstacle to basic research. The physical distance between LIAAD and INESC are an obstacle for individual contacts, seminars and close collaboration.
It would be good to, at some point, invest in statistical approaches to Machine Learning and to consider more focus on smaller range of theoretical frameworks, and possibly also in the context of INESC on certain industries.

Opportunities

INESC offers many opportunities for applying Machine Learning to problems in the context of contacts and areas of INESC units. It is quite likely that Machine Learning can extend the range of tools that are commonly used by engineers. The new situation may make it possible to initiate one or more new units that combine a focused subset of LIAAD with elements of current INESC units into a new unit.

Threats

There is an urgent and strange financial problem caused mostly by the FCT not completing the evaluation and not deciding on funding. The physical distance threatens the integration of LIAAD with INESC and CRACS.

III.8. Center for Research in Advanced Computing Systems (CRACS)

III.8.1. Evaluation of Unit's scientific performance

Not being an INESC unit, detailed information on scientific productivity has not been made available to the advisory board. However, from the summary data provided in the presentation on CRACS the board concluded that the quantity and quality of publications and projects are very good and improving. Particularly impressive are the recently funded and ongoing FCT projects and the persistent visibility and recognition of CRACS work in the top journals and conferences in the area of logic programming. Also encouraging are the emergence of new research efforts that leverage core competencies of the center but extend beyond the mature topics of programming languages and Prolog.

III.8.2. Balance between depth and breadth

The presentation lists four main domains of research – Programming Languages, Parallel/Distributed Computing, Information Mining and Web Systems – with a total of ten subtopics. This breadth is impressive but somewhat of a concern. With ten effective members, on the average there is one subtopic per member and 2.5 members per major topic. There is a definite danger of human resource limitations negatively impacting the depth of work in some of the research areas. To manage this risk CRACS should judiciously choose partnerships with other regional, national and international institutions and researchers. In particular, integration with LIAAD and INESC USIC in the context of the LA should be viewed as unique opportunity to be leveraged to its fullest rather than an administrative convenience without benefits of synergies in research and technical competencies.

III.8.3. Gaps and required expertise

As a systems-oriented center, CRACS has a thin group in the areas of distributed systems, networking, artificial intelligence and operating systems. Some of these gaps can be covered by experts at LIAAD, INESC USIC and INESC UTM.

III.8.4. R&D tech/transfer

This is a weak aspect of CRACS although there is a strong long-lived recognition and deployment of Prolog-related open-source software produced by the center. This reflects a habit and capability of carrying research out into dependable artifacts which is important in the context of the LA culture of "science-based innovation" and transfer of research results to industry. Nevertheless, CRACS could greatly improve in its tech transfer productivity by leveraging the INESC environment and practices.

III.8.5. SWOT Analysis

Strengths

Established research competencies, ongoing projects, cohesive group with critical mass in programming languages and logic programming

Weaknesses

Expanding research portfolio with limited resources, limited connections to IT users and systems in industry and government

Opportunities

Developing partnerships can magnify and leverage CRACS expertise and could bring additional funding and resources.

Threats

Becoming the “last mohican” of Prolog and failing to leverage the unique achievements in logic programming to jump into related new areas of IT; spreading resources too thinly to achieve depth in the new areas of research.

III.9. INESC Porto LA and Integration of INESC Porto, CRACS-LIAAD

III.7.1. Evaluation of Unit's scientific performance

This was done for each organization already. The integration of three organizations has tremendous potential for synergistic reinforcement of their strengths and cooperative elimination of their weaknesses when dealing with real world problems that most often require multiple academic disciplines.

III.7.2. Balance between depth and breadth

The integration of the three organizations should strive to add critical mass and depth where thin efforts currently exist. Where this is not possible, thin efforts should be carefully reassessed for potential, funding availability and realistic likelihood of growth in the near future. Breadth should follow naturally from the large number of research domains in the three organizations.

III.7.3. Gaps and required expertise

It is premature to address this point prior to the integration of the three organizations. However, there seems to be nascent work and interest in networks (in the sense of social networking) in at least four units but there is not an expert in network science.

III.7.4. R&D tech/transfer

It is premature to comment on this matter except for the fact that the cultures of the three organizations are very different in this regard. It will be critical to lead the integration to evolve a new culture that advances the LA's mission in R&D tech transfer.

III.7.5. SWOT Analysis

Strengths

Established research competencies, ongoing projects, critical mass in some areas.

Weaknesses

There is no clearly defined vision, mission and goals for the integration. At the operational level it is unclear whether the integration aims at simply an administrative convenience, how it will reconcile different technical cultures, how it will enable joint work and synergies. For example, how will geographical distances among the organizations be overcome? Will there be incentives for collaborations? How will topical reorganizations of research groups take place?

Opportunities

Developing partnerships can magnify and leverage existing expertise and could bring additional funding and resources.

Threats

Proliferation of thin weak efforts
Incompatible operational models and/or unhealthy competition

Signature Page

The Scientific Board Members

Dr. José Principe

_____ Date _____

Dr. Leonardo Chiariglione

_____ Date _____

Dr. Michel Scholl

_____ Date _____

Dr. Tomas Gomez

_____ Date _____

Dr. Faramarz Farahi

_____ Date _____

Dr. Gerald Bernard Sheblé

_____ Date _____

Dr. John O'Reilly

_____ Date _____

Dr. José A. B. Fortes

_____ Date _____

Dr. Maarten van Someren

_____ Date _____