Scientific Advisory Board Report

The visit was conducted May 2 and 3, 2006 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

I.1. General Comments

INESC-Porto is a multifaceted Institution organized in 5 Units (Telecommunications and Multimedia (UTM), Manufacturing Systems Engineering (UESP), Information and Communication Systems (USIC), Power Systems (USE), Optoelectronics and Electronic Systems (UOSE) 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 idiosyncrasies of 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 27 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 of US $6,5 million euros and 268 members (~ 30 staff). Looking critically at INESC-Porto, we venture to say that the expertise of its members is world-class, which means that INESC-Porto has the potential to become a player in the international technology market. However to fulfill this role INESC-Porto must define a plan of action and probably a more entrepreneurial structure.

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 loosing 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. This Unit should be reformulated. The activities in USIC are too heterogeneous and there is a solid

scientific foundation in only a subset of the activity. This Unit should also be reformulated.

A very successful effort was undertaken to improve the journal publication of INESC Porto, as the statistics of the last five years clearly show. This is very important because the national and international success of INESC-Porto is predicated in the visibility of its research, for which the publication record is an important indicator. However, the ratio senior researcher/paper 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, but the ratio in UTM is close. It should be mentioned that UTM has brought two projects from a research to a developmental stage, which attests to good focus and continuity of efforts.

The SAB also applauds the effort to attract international post doc students to INESC Porto. In the long run this move will help the internationalization of the visibility of the Institute.

The SAB feels that the scientific atmosphere in INESC-Porto needs reinforcement thru Institute and or Unit 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 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 five heterogeneous areas of activity. 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 with a flagship project 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. Remember 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 emerging examples of exploitation of past R&D efforts, which is a very good sign of maturity and accomplishment. However, the SAB feels that policies should be found to capitalize more efficiently in the R&D effort, and avoid dilapidating the Institute when teams of researchers leave to create start ups. Perhaps this will also imply a reorganization of the INESC Porto to create a more coherent interface mechanism to the outside world. Research tends to narrow the scope of activity, while tech transfer requires system wide expertise, therefore constant cross-fertilization and feedback from products to developers are necessary. Success stories should be analyzed and advertised internal and externally.

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 Laboratory Associado in key technology areas due to its strong research accomplishments, and has already a presence in the Portuguese industrial, service and administration markets. Some projects are maturing and R&D exploitation is taking place.

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 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.

Opportunities

INESC-Porto should strengthen its presence in Portugal by creating highly visible and "use-oriented" flagship projects. INESC-Porto has the potential to become a player in the technology world market.

Threats

The threats come from the excessive dispersion of activity, muddle response and unclear mission goals and implementation plans.

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 for further analysis, internal discussions and possible implementation in the short term.

- Build an institute-wide identity (e.g. thru flagship projects).
- Build a midterm vision for INESC Porto and implement mechanisms to achieve it.
- Have agile (or flexible) group structure
    - Set Research goals
    - Make goals interdisciplinary
    - Adapt the group structure to achieve research goals
    - Funded projects are just means to achieve the research goals.
- Create a term limit mechanism to any management position
- More R&D Exploitation
- Broader search for funding
- Increase number of archival journal publications
- Avoid in-breeding in the recruitment of Faculty.
- Survey and partner with competitors.
- Form an awards committee
    - e.g. promote best (student / senior) papers, seek technical awards etc.
- Members should participate more in top conferences organization, journal editors
- Regular institute (lab)-wide seminars
        - Internal + Distinguished external lecturers
- Prepare better activity reports.
- Update the website with pertinent, up to date information.

III- Individual Units Reports

III.1. Unit: Telecommunications and Multimedia

The Unit is informally organized in 6 groups

- Digital Audio Processing
- Image Analysis and Synthesis
- Communication Networks and Services
- Distributed Multimedia Systems
- Microelectronics
- Optical Communications

In the following the analysis is carried out mostly on the individual groups as they are often not homogeneous in performance

III.1.1. Evaluation of Unit's scientific performance

The scientific record of the unit is adequate overall although not homogeneous for all components.

- Digital Audio Processing: low
- Image Analysis and Synthesis: medium
- Communication Networks and Services: low
- Distributed Multimedia Systems: low
- Microelectronics: medium
- Optical Communications: low (but the group is new)

III.1.2. Balance between depth and breadth

- For Digital Audio Processing the scope of work appears to be too broad exploring too many areas whose connecting thread is just "audio processing"
- Image Analysis and Synthesis
- For the Communication Networks and Service group the breadth is excessive and there is risk that the resources will be spread too thin to achieve results with an impact
- For the Distributed Multimedia Systems group there appears to be a balance between depth and breadth as the group has focused its activity on the "central" part of the value chain concentrating on technologies required for publishing and delivering content.
- For the Microelectronics group the breadth is excessive

- For the Optical Communications it is too early to give a firm assessment. At the moment the areas covered seem too broad, but this may be unavoidable at this early stage of development of the group.

III.1.3. Gaps and required expertise

- Digital Audio Processing: OK
- Image Analysis and Synthesis
- Communication Networks and Service: depends on the actual areas the group will decide to invest in
- Distributed Multimedia Systems: the group misses all the components required to make a complete value chain
- Microelectronics: no gaps, but need to focus
- Optical Communications: OK

III.1.4. R&D and Exploitation

- Digital Audio Processing. The area is mature and the know-how of the group is definitely significant. There is a need to focus on how the know-how acquired can actually be employed in meaningful exploitation efforts. This should not be difficult as the persons involved seem to have good knowledge of what is happening on the web right now.
- Image Analysis and Synthesis
- Communication Networks and Service. The area is rich as a source of investigations. However, it is not clear how the current competitive scenario of the telecommunication business is served by the kind of broad research that is being conducted. There is a beginning of realization of the role that the business component of the problem plays, but this is not sufficient to guide a proper selection of topics for study
- Distributed Multimedia Systems. It is high time for this group to exploit the considerable amount of know-how and developments that has been accumulated. There are indications that the group is aware of the need to package the technologies proper of the group with other technologies in the Unit or available elsewhere to provide appealing solutions. This is a must now.
- Microelectronics. It is necessary to establish links with industry, over and beyond the current contacts within European projects.
- Optical Communications. The group must consolidate the area of endeavor and define precise R&D goals. The need to identify the application domains served by the group’s activity is also a priority.

III.1.5. SWOT Analysis

Strengths

- Digital Audio Processing: good knowledge of the field, good achievements. Probable understanding of the application domains where the know-how can be exploited
- Image Analysis and Synthesis
- Communication Networks and Service: good understanding of the field
- Distributed Multimedia Systems: rich set of developments and practical results
- Microelectronics
- Optical Communications

Weaknesses

- Digital Audio Processing: making practically exploitable systems may require a considerable amount of additional expertise/technology
- Image Analysis and Synthesis
- Communication Networks and Services: the field is too broad for the size of the group and finding the right areas is a challenge
- Distributed Multimedia Systems: in general to make meaningful exploitable systems a very significant amount of effort may be required
- Microelectronics: the group does not appear to have industrial links
- Optical Communications: investments required to achieve meaningful results in interesting areas may be beyond reach

Opportunities

- Digital Audio Processing: there are plenty of exploitation opportunities that can be exploited using the know how of the group
- Image Analysis and Synthesis:
- Communication Networks and Service: this is an area of research and there is indeed the possibility to have an impact if the right choices are made
- Distributed Multimedia Systems: there are plenty of opportunities given the amount of know how and development
- Microelectronics: opportunities can only be found by establishing links with the industry
- Optical Communications: opportunities will depend on the ability to identify the key technologies serving the right application domains

Threats

- Digital Audio Processing: it is hard to sustain continuation of the work if the group does not prove its value by finding meaningful applications

- Image Analysis and Synthesis
- Communication Networks and Service: there is significant risk that work in this area, no matter how scientifically challenging and attractive, does not correspond to the requirements of the current competitive market
- Distributed Multimedia Systems: it is hard to sustain continuation of the work if the group does not prove its value by finding meaningful applications
- Microelectronics: it is hard to sustain this work without significant industry links
- Optical Communications: threats come from the breadth of the area and the investment costs to play a role

III.1.6 Recommendations

- Digital Audio Processing:
    - Target exploitation of the technology
    - R&D should be continued as a consequence of requirements coming from exploitation
- Image Analysis and Synthesis
- Communication Networks and Services:
    - Priority in identifying business requirements (possibly depending on scenarios)
    - Focus on the critical components enabling the scenarios
    - Keep a presence in the overall picture
- Distributed Multimedia Systems:
    - Identify opportunities of exploitation (e.g. like the one shown) and the practical means to implement them
    - Develop solutions
    - Keep presence in R&D with priority to support requirements coming from exploitation (e.g. DRM)
- Microelectronics
    - Establish industry links
    - Focus work depending on industry interest
    - Explore synergies with other Unit groups
- Optical Communications
    - Check selected areas against likely exploitation possibility
    - Confirm business model of valorization of technology
    - Explore synergies with other Unit groups

As a general remark, the Unit contains too many disparate and actually loosely tied components. There may be reasons to keep Distributed Multimedia Systems and Communication Networks and Services together, but the two groups are at different phases and they may share little in spite of significant points of contacts.

III.2. Unit: USIC

III.2.1. Evaluation of Unit's scientific performance

The Unit is under reorganization and has not yet a visible scientific policy. One of the major changes is the arrival as a co-coordinator of J.J. Pinto Ferreira coming from the UESP unit. Currently the unit includes an extremely large number of themes which looks like a heteroclite catalogue. Publication wise the unit benefits from the excellent publication file of the team coming from the UESP unit (2 PhDs) in the field called in the following "enterprise integration". The traditional activity around GIS has a very valuable scientific activity which is more measurable in terms of services including prototypes that have been industrialized and past projects among which MEDSI is the most noteworthy, than in number of publications. The GIS team (2 PhD students under contract) has a nationwide recognition in terms of service and consulting which activity should continue in the future not only because it brings incomes but also for the nice research issues for which the team has an expertise. The GIS publication activity however is far below that could be expected from an INESC Unit. For the time being and as long as the unit has not shown a definite scientific policy, the current number of PhD students (3) is ok. Perhaps because of the on-going reorganization, the presentation (written and oral) of the unit activities and people is not good and did not ease the scientific assessment.

III.2.2. 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: information systems, open source software and e-learning, software engineering, information processing and storage. The coordinators are currently structuring the unit in three areas (GIS, information systems, enterprise integration) and three emerging areas (open source, e-learning, software engineering, and information processing and storage). The challenge of the coordinators with the "emerging areas" is to come up with a more important and less loosely coupled involvement of the faculty members behind these activities. Among those activities the one around data acquisition and e-learning sounds hard to be integrated right now but has the advantage of bringing some expertise around open source software which is of a great value for e-administration clients.

III.2.3. Gaps and required expertise

The gaps come for the too broad scope of fields. As an example it is hard to find bridges between the two main current areas of expertise (GIS and enterprise integration). One potential bridge between the two activities is knowledge management tools (ontology and reasoning are required both for GIS decision support and enterprise integration modeling tools). The expertise around Information processing and storage (emerging area) could also be helpful to bridge the currently large gaps between enterprise integration and GIS.

III.2.4. R&D and Exploitation

The balance between R&D and exploitation is good and the service activity brought a benefit of 200k euros for research. Once the "business model" of the unit has been launched, the unit has the critical mass and expertise in terms of senior programmers to undertake project activities for the short term (i.e. beyond 2006 more changes may be needed).

III.2.5. SWOT Analysis

Strengths

Very strong vertical expertise in Information systems with application to GIS and location based services.
Quality of more academic activity in enterprise integration.
Dynamic, complementary and highly motivated team of two coordinators.

Weaknesses, Opportunities and threats

The ratio between active faculty members and persons under contract is too low.

The academic supervising of the research activities in GIS is not adequate.

There is a too large gap between the two main areas of expertise (GIS and enterprise integration).

The strategy of attempting to involve three or four faculty members in so-called emerging areas is risky because the fields of expertise are not really in the current main stream. However this policy might be successful if they conform and render the activity around GIS and "information systems in the large" more academic.

Recommendations

A strategic plan should be launched within one month with one year horizon to search for a new name for the unit around the two main activities. The integration activity specificity (wrt the UESP unit) should be better stated. The major short term challenge is how to organize, federate and give a single view of activities around GIS, information systems, data bases and knowledge management. If the GIS looks for cooperation with other units, then the research direction around location based mobile services sounds challenging and could be developed in cooperation with UTM (networks and distributed multi-media groups). The presentation of the new structure showing for *each of the areas* (and not globally as it is right now) the names of researchers, the names of PhD and master students, the name of persons under contract, a short description of the scientific goals, the list of publications, the list of on going projects and services should be beneficial for all members of the team and consolidate the current visibility toward the board of directors and the other units. It should be understood that this will not be the definite structure of the team which, with high probability, will need more than one year to have a steady policy. We also recommend to accept and convince everybody that each faculty member should contribute with multiple activities. Although the INESC model is

typically instantiated in this unit (some people activity is oriented toward services, some others toward publication, some have both roles) there is no integrated mental model of this. In particular the significant service and project activity is not defended and emphasized in the written report and its impact on current and future research is not even addressed.

III.3. UNIT: UOSE – OPTOELECTRONICS AND ELECTRONIC SYSTEMS

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

Optical Fiber Sensors
Optical Communications Systems and Networks
Integrated Optics and Micro-fabrication

Although the Optical Communications work has moved to a different unit, but the role of UOSE unit in the continued success of Optical Communications is critical. There has also been a gain in the area of Optical Coherence Tomography (OCT), which will add new dimensions as well as new challenges for the unit to integrate this new found expertise in their existing research activities. It is possible for the unit to apply OCT in characterization of micro and integrated optical devices as well as exploring the application of this imaging technique in the field of medicine.

The quality of research in both areas of fiber optic sensors and integrated optics is very high. The unit has an established track-record and international recognition in the area of fiber optic sensors and I believe it could also be achieved in the area of integrated optics in the future. The main challenge is relative lack of infrastructure necessary to compete with some large research institution around the work in the area of integrated and micro fabrication. This might be circumvented by establishing collaborative research program by other institutions that have such infrastructures.

In the past few years two companies, Multiwave Networks, and Fiber Sensing, have been formed in Porto area based on the expertise gained in this unit.

The unit has the following unique capabilities:

- Fully automated Fiber Bragg gratings fabrication system
- 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

The unit is developing capabilities in:

- Optical Coherence Tomography
- Micro-fabrication
- Integrated modules

The talent level and scientific and technological know-how in this unit is very impressive. In the past four years they have received 9 patents for their innovative work. During 2002-2005 time period the unit members have published 68 journal papers and their total publications during this period is 269. The unit is also very active in its educational activities by providing research opportunities to many M. Sc. and Ph. D. students.

III.3.1. Evaluation of Unit's scientific performance

There is a very good 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 more widely. There is clear evidence of a very high level of innovation in the work of the group. Also, the work of the unit appears to be well informed by and coupled to practical applications needs. The group makes very good use of the fiber grating technology capabilities. 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 group has silicon micro machining capability that is a critical expertise. The thin film research work has resulted to new discoveries in two areas of nano-wires and thin film on fibers. These are not only scientifically very important, but also will enable the unit to apply this new found knowledge in multitude of application areas.

In the areas of micro-fabrication and micro-optics the unit has obtained valuable expertise with their focus on fiber Bragg grating. This unit is planning to apply this expertise in the area of micro-fabrication. The unit can make an important contribution in this particular niche area.

III.3.2. 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. The group has made a strategic decision to expand their activities into the chemical and biological sensors, which is a very positive development. Unit's members possess excellent knowledge of fundamentals in the area of fiber 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. Their activity in these areas is very broad; however, there is a need for a well coordinated effort to fully utilize the potential of this in-house expertise.

III.3.3. 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.3.4. 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. It is expected that the experienced gained will help more technology transfer to occur in the future.

III.3.5. 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.

Weaknesses

The potential technology synergies in the areas of integrated optics, thin film, and micro-fabrication are not fully exploited yet. Fortunately, there is a plan in place to do exactly that.

Opportunities

The experienced gained in transferring technology in the field of fiber sensing will impact this to happen in a timely manner in other areas such as micro-fabrication and integrated modules.

Threats

The new activity in the area of micro-fabrication requires extensive and a very expensive infrastructure, not available to the unit at this time and in the foreseeable future. This requires careful planning and establishment of a few organized collaboration efforts with

other institutions to make sure this in no way hinders their growth in such an important field.

III.4. Unit: Power Systems (USE)

III.4.1. Evaluation of Unit's scientific performance

The overall performance of the Unit in the last four years (2002-05) has been excellent.
The number of publications in international journals has increased reaching an acceptable level (17 in 2005).
The number of PhD students (17 in 2005) and concluded PhD theses (12 in 2002-05) has also increased.
The exploitation of results measured through direct incomes from industry contracts and consultant services has been doubled.
These results are outstanding taking into account that the equivalent number of research scientific staff at this unit was only 5 persons. In this number are not included full time PhD or MSc students.

III.4.2. 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 generation, and electricity markets). International recognition in some of the research areas has been obtained. European projects and specialized publications should be kept as an important target of the unit.

III.4.3. Gaps and required expertise

New research lines can be associated with an international post-doc program that today does not exist. New research inputs can be obtained in a closer collaboration with other INESC units, and with other international research organizations.

III.4.4. R&D and Exploitation

Exploitation of results has been very fruitful in the analyzed period. The high number of funded projects and consultant services has provided important annual operational margins.

III.4.5. SWOT Analysis

Strengths

- Strong and consolidated leadership in the Unit

- High productivity in terms of research publications and incomes from exploitation of results
- International recognition
- Good personal relationships inside the Unit

Weaknesses

- No strategic planning to renew coordinators in the Unit
- No definition of a career for scientific staff researchers

Opportunities

- Define and implement a post-doc program with international flavor
- Find new markets for technology transfer and consultancy related to the new Iberian electricity market

Threats

- The expansion of the Unit is limited due to the lack of new qualified research staff
- The expansion is also limited by the availability of physical space
- The double affiliation, research at INESC and teaching at the University, because of the asymmetry in duties and obligations, can threat the stability in the medium and long term of the research career inside INESC
- The financial model based mainly in partially funded contracts and consultancy services can not be sufficient to stabilize a scientific staff basically dedicated to research. Other more stable funding sources, based on donations or State funds, should be investigated.

III.4.6. Recommendations

- Establish a mechanism to rotate the Unit coordination, creating new expectations and responsibilities for other members of the Unit.
- Define an attractive career for the scientific research staff within INESC that would allow the creation of new positions for brilliant younger researchers.
- Implement a post-doc international program in collaboration with other institutions to promote exchange of scientific research staff and international projects.
- Define a mid-term (5 years) strategic expansion plan for the Unit.
- Look for new more stable funding sources to partially cover fixed costs of new scientific staff positions.

III.5. Unit: UESP: Manufacturing Systems Engineering

III.5.1. Evaluation of Unit's scientific performance

The general presentation of the scientific strategy of the unit shows out very clearly the two main competencies areas as

Operations management
Enterprise information systems

both of them applied to industrial companies and enterprise networks. The unit has a well known and profound expertise especially in the area of Meta heuristic, planning and scheduling and different fields for optimisation and simulation,

That leads to the actual differentiation of the following core activities in two main groups:
Group A, as the more scientific oriented and therefore "Content" driven in the areas of:

Enterprise cooperation networks
Optimisation and scheduling
Cutting and packing

and
Group B, which is due to its close relationship with industrial partners more or less "Activity" driven in the areas of

Systems Integration
Internal Logistics
Consulting services

- The unit now is consisting of in total 41 members in the following distinction

PhDs	11
MSCs	11
Other Researchers	17
Staff	2

The actual addiction to specific core activities show 11 contracted collaborators, that are bound to the Group A activities and 13 persons bound to the Group B activities. Here we see 5 collaborators that are dedicated either to consulting or to Internal logistic activities.

To judge on the actual scientific performance of the group, one may say, that the unit is going to decrease its earlier high performing level:

- Too many papers are published in conference proceedings
- Poor publication number of the PhD/ MSc students results
- Less than 10 % of the turnover is gained through Base research projects, and
- European projects are known to be hard in gaining deep scientific expertise

- **Group A has been known for its deep understanding of meta heuristics since years (i.e. international conference on this topic organized by this unit), but is actually losing on international awareness.**

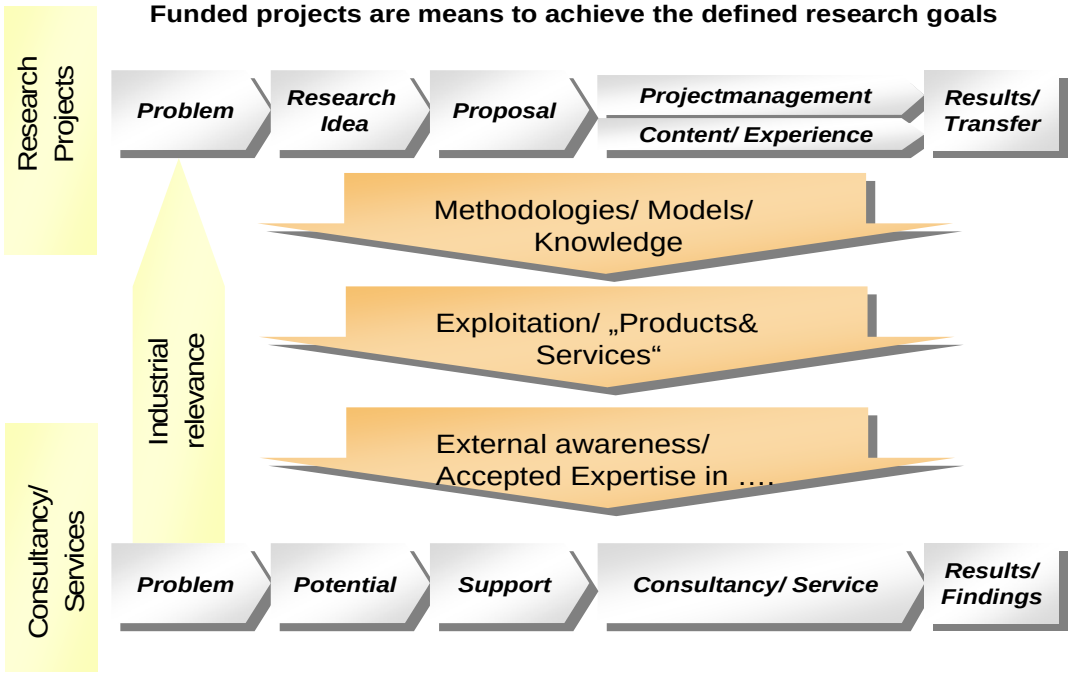
III.5.2. Balance between depth and breath

It could be recognized, that there is a strong depth in a very few fields of activities like optimization and scheduling and a large breath of activities in fields, that obviously could not be covered by the needed critical mass of researchers addicted to specific and well defined topics.
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.
Especially when we are taking into account the planned augmentation of objectives for the next years, the unit must define strategically and mid term oriented its most important future perspectives for further innovative activities.

(Remark: Give the unit a two days external meeting to define its mission and further fields of business in order to derive from here a suitable strategy, on how this mission could be reached in an adequate time).

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.
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.
The required expertise should close the gap between researchers addicted either to the earlier mentioned group A or to Group B activities. A mutual exchange is needed for future seed of innovative new research activities (see Fig 1, that was explained/ discussed with the group coordinators):



(pic 1: glue between research and consultancy services)

- (REMARK in reference to the last report set up in 2001, where it is already stated that:
  „The group has obviously been project driven [= function of money] and not driven by a strategic plan. The actual situation should be used to rethink a long term R&D frame plan, to decide on core competencies to be developed, to have a clear view on market needs and competitors / potential partners, in order to develop the red line for each core competence.“
  This remark is still valid and perhaps has become even more important)

III.5.4. R&D and Exploitation

There is no clear understanding, on how it could be enabled 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”.

- Remark: Unfortunately due to lack of time, it was not possible to explain or to understand, on how the unit works in terms of its efficiency like project management, CRM, financial control e.g, but it is stated, that the unit has the highest turnover in 2005 with a convincing ratio in turnover per Researcher in FTE (Full Time Equivalent).

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

- Shift from the focus on manufacturing systems to enterprise cooperation networks
- 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.5.6. Recommendations

- Activate an “Internal Unit Strategy meeting” of about 2 days, where to define i.e.:
    - Future core competencies to be followed or skipped

    - Continuous SWOT Analysis for the Unit, incorporated with an overview of the “Europe wide state of the art” in specific topics and to identify relevant players in this field for possible, future cooperation
    - Collection and description of existing “Know how” of the group in terms of models or methodologies for…(Avoid poor “marketing activities” of what the unit stands for)
- Rethink the existing form of a two heads coordination of the group, perhaps distinct between a scientific and an industrial responsibility
- Define alternative “internal career-possibilities” to encourage promising younger researchers to stay long term
  Implement a mid-term (5 years) strategic expansion plan for the Unit, that relates, on how the promised 34% expansion up to 2008 could be realized.

Signature Page

The Scientific Board Members

Dr. José Principe

_____ Date _____

Dr. Leonardo Chiariglione

_____ Date _____

Dr. Faramarz Farahi

_____ Date _____

Dr. Tomas Gomez

_____ Date _____

Dr. Volker Stich

_____ Date _____

Dr. Michel Scholl

_____ Date _____