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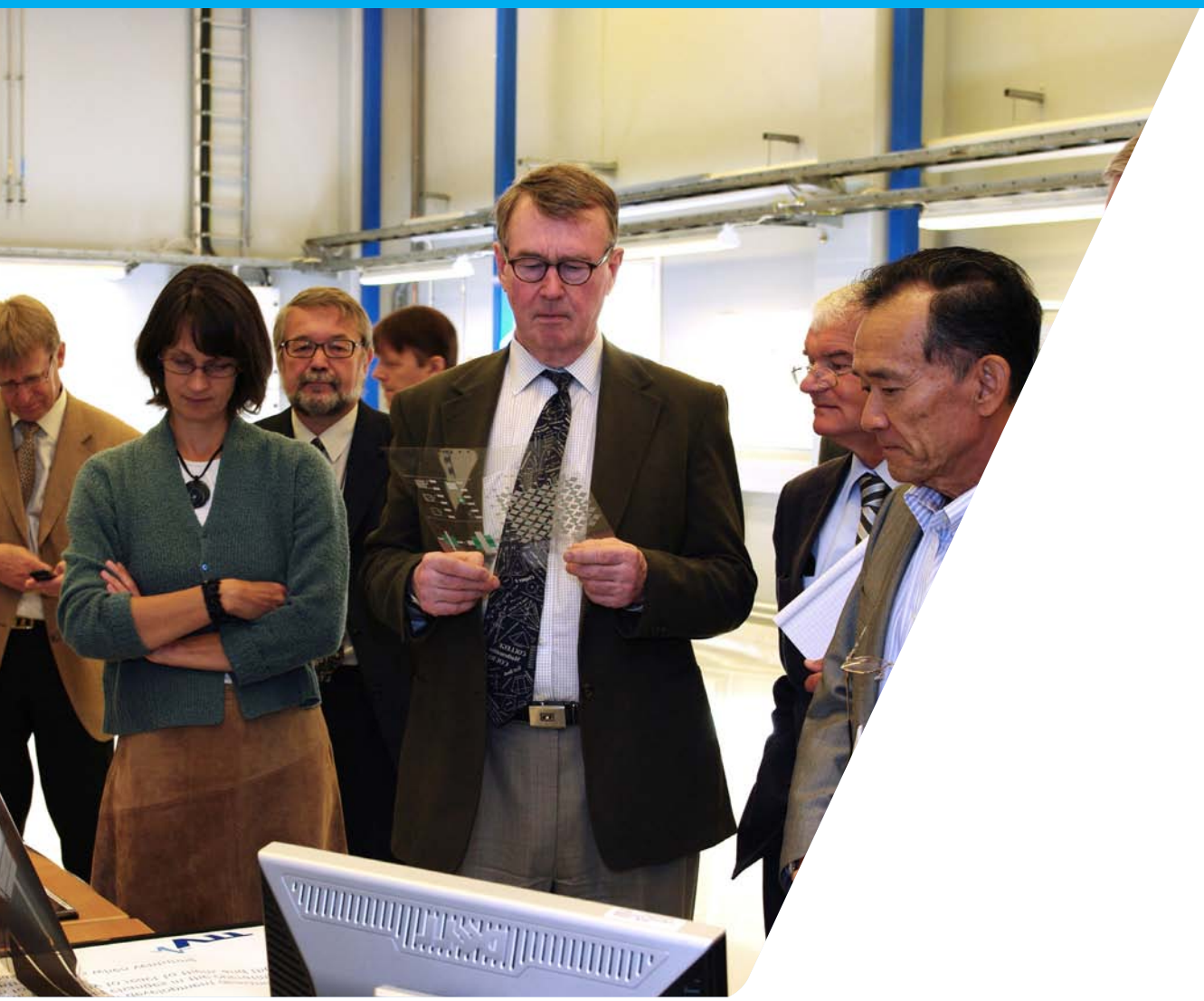

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VTT Scientific Advisory Board Final Report 2009–2010

VTT TIEDOTTEITA – RESEARCH NOTES 2549

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Abstract

VTT Technical Research Centre of Finland appointed its second Scientific Advisory Board for the period 2009–2010 to continue the work started in 2006. The new Board had four meetings between January 2009 and August 2010, during which the Members become acquainted with a number of VTT's operations. This Final Report describes the key findings and recommendations to VTT from that time period. Due to the broad extent of VTT’s activities this view is naturally somewhat limited. In spite of this the Board believes that the report contains valuable general guidance on how VTT can even better nurture its long term knowledge and competence bases.

Preface

I would like to express my sincere thanks to the Members of the Scientific Board for their active participation in the meetings and the great enthusiasm to dive into the diverse issues that came up during the meetings and through their individual direct contacts with VTT.

The scientific contents of the visits as well as the practical arrangements were planned and implemented in a highly professional manner by VTT staff. On behalf of the whole Board I want to extend our warmest thanks especially to Ms Leena Tuiro, Dr Markku Sipilä and Dr Jorma Lammasniemi for their excitement and devotion to support the Board over the whole two year period.

Yrjö Neuvo
Chairman of VTT Scientific Advisory Board

Participants of the VTT Scientific Advisory Board meeting in Oulu, August 19, 2010. From the left: Jorma Lammasniemi (VTT), Duc-Truong Pham, Yrjö Neuvo, Richard Mathies, Masaki Kitagawa, Aija Leiponen, Josef Spitzer and Markku Sipilä (VTT).

Contents

1. Introduction

VTT Board has established the Scientific Advisory Board (SAB) to be a forum with broad views on global trends in research and technology. The SAB is invited to suggest ideas and initiatives for the development of VTT and for the direction of its research activities. The mandate also invites the SAB to give feedback on the scientific competence of VTT. In addition to the regular SAB meetings, the individual SAB members can have topical meetings with smaller groups of the scientific staff of VTT.

Now as the term of the second SAB has come to the end it is proper to look at the development over the four years time frame that the two SABs cover. Naturally this is a relatively short time to get measurable results in many areas but still long enough to notice a change in direction. It is a pleasure to note that VTT has made excellent progress towards internationalization of its activities. This report gives a number of further recommendations in this direction. Excellence is a core issues for an expert organization like VTT and was covered extensively by both SABs. This board makes a number of concrete recommendations on what actions in the continuous strive for excellence could be initiated. The importance of business understanding and commercialization of research results emerged already during the first SAB. This Board wants to further strengthen the good start VTT has already taken in this direction.

Naturally it is impossible for the Board to have a comprehensive view of VTT's activities in any specific research area. Thus the more detailed substance comments presented in Chapter 3 of this report are to be seen to reflect the SAB's views on the presentations and material given to the SAB. On the other hand, the views presented in Chapter 2 are of general nature and apply to the VTT organization as a whole.

In addition to the regular meetings the SAB members have had individual topical meetings and other activities with VTT staff. Discussions with young

VTT researchers around their poster presentations were particularly rewarding. The presentations were of high quality and researchers radiated a lot of positive energy and pride of their work.

The SAB members feel honored to have been invited to serve this term. This has been a highly rewarding experience to all of us. Guiding a scientific organization requires a long-term engagement and perspective. The SAB feels that the experiences gathered over the four years are quite encouraging. The Board strongly recommends continuing to engage external scientific experts in a scientific advisory board also in the future.

2. General observations and recommendations

2.1 Excellence

A fundamental strategic question is, does VTT want to be a local or a global player in the highly competitive field of research and technological services? A global player should probably be more internationally connected than VTT presently is. A local player also needs an understanding of international developments in the technological fields of activity. Internationally recognized excellence in the majority of the fields of activity is a necessary condition for the success of a research institute such as VTT.

Scientific publications continue to be strong indicators of the quality of research and act as entry tickets to many forms of international cooperation. VTT should recognise and reward this properly. The Board recommends putting special emphasis on high impact joint publications with international partners. To generate realistic and helpful targets for publication rates, other institutes should be looked at. AIST and NIMS in Japan would provide useful benchmarks. The Board recommends that VTT quantify goals and develop measures to track them over time.

VTT needs to carefully analyse its positioning with respect to universities. VTT cannot be a basic research institute, because its paying customers typically want (leading edge) engineering solutions rather than fundamental scientific discoveries. Hence, VTT needs to define the meaning of excellence for its own purposes. Instead of basic discoveries, VTT can develop excellence e.g. in the speed, quality, and effectiveness of its service solutions. The Board is very supportive of VTT strengthening its capabilities to commercialize its innovations. VTT already has a broad experience base to develop new technologies to the point of industrial adoption. This expertise, which includes complex project

management skills, is of significant value and a strong differentiator against most university research activities. Overall, the Board feels that the complementary nature of VTT's and universities' areas of expertise should support strong cooperation ties with a selected set of universities. A good measure of success to track over time in this regard would be the number of joint projects with leading (international) universities.

The awareness and motivation of scientists to develop research and commercialization excellence should be supported by VTT's incentive schemes. Successful discoveries or commercialization should be rewarded and recognized, and each group should set ambitious medium- and long-term targets and follow up if they are being reached. Globally leading technology development can be evaluated through the number of research papers, citations, awards, and patents. Measurement of service provision for the Finnish industry can consist of market studies, patents or contracts. The development of future technological areas could be assessed with market trend studies and technology strategy proposals.

Based on the projects and demonstrations presented, the Board was happy to observe areas of global excellence. In general, however, although there are many highly skilled research scientists, they did not always demonstrate awareness of the best practices, the latest scientific or technological breakthroughs, or even direct competitors' offerings in the rest of the world. Many of the projects presented to the Board did not discuss any comparison with international state-of-the-art. Awareness of global state-of-the-art and a mindset aspiring toward international excellence should be promoted more explicitly.

2.2 Internationalization of VTT

The Board strongly supports VTT's ongoing efforts on internationalization. Extensive international exchange between VTT researchers and experts in other organizations is critical for future success. Finding solutions to complex problems requires diverse competencies that cannot easily and efficiently be assembled in one institute. Moreover, VTT scientists must stay abreast with myriad rapidly advancing technologies. International conferences and publications, extensive scientific visits to foreign institutions, and long-term customer relationships with global leaders will be essential for continued success in the globalizing world.

The previous SAB recommended VTT to strengthen its international activities in a strategically coordinated manner and made a number of still relevant rec-

ommendations on the steps to be taken. It is a pleasure for this SAB to note that VTT has developed an explicit internationalization strategy that involves specific targets for foreign offices and contract research. Sales and marketing offices have been set up in the US, Russia, South Korea, Japan, China, and Belgium. South Korea is the first office that is a legal entity. In addition a VTT-Kemira joint water research project/partnership will be located in Brazil. VTT target is to have five research teams of 10–20 people outside of Finland (in Europe and elsewhere) within five years (by 2015). This would imply that around three percent of the research workforce would reside abroad.

VTT's 2020 vision expects that competition in the contract research market is fully global. In each technology area there will be two to five global research organizations. New models for research-industry collaboration to speed up commercialization will be applied. An important change is that competition for public R&D funding also takes place on a global basis. In 2020 VTT expects to employ 3300 researchers globally with 700 being non-Finnish. In the Board's view, this vision is both appropriate and important, but more needs to be done to operationalize the goals.

VTT is trying to attract international customers. In some fields, for example, in industrial biotechnology, there have been some promising progress recently. Moreover, international marketing of VTT's services has improved. The Board recommends that VTT's international activities be increasingly shifted toward direct contract research, joint ventures, and collaborative projects. Indeed, VTT's goal is to double the number of international contracts. Currently about 15% of contract research revenue is from foreign clients, varying between 6% (ICT) to 28% (biotechnology).

VTT has a successful track record of participation in international research co-operation, especially in EU projects (presently in the 7th Framework Programme). EU programmes are the most important element in VTT's portfolio of international co-operation, and VTT is acknowledged to be an excellent and reliable partner in them. The current volume of EU project participation appears to have reached a level where further expansion is limited by human resources. The Board feels that VTT has the expertise and recognition that allow it to be more involved in setting the EU research agenda, e.g., by engaging more in the early planning phases of new EU programmes and project development. This would help VTT's research strategy renewal, improve international networking, and help in participating in the most impactful projects.

VTT's Graduate School shall play a key role in reaching the internationalization targets. VTT should actively encourage graduate students as well as young PhDs to get meaningful, preferably one year, working experience abroad. International experience has to be an important qualification in filling permanent positions at VTT. International experiences of middle-management should also be expanded but these activities should be well connected with VTT's strategic research goals and new business development.

VTT's engagement in EIT KIC (European Institute of Innovation & Technology, Knowledge and Innovation Communities) will be another important vehicle for internationalization. In particular, this will provide new opportunities for young scholars in certain fields to visit foreign research institutions. The strong role of VTT in the ICT KIC is an excellent start. The Board recommends that KIC activities at VTT receive significant investment of human resources and long-term commitment.

The Board's recommendation is to double both the number of long term scientific visits to foreign institutions in five years and to double the number of foreign scientists in the staff also in five years (from about 5 percent to 10).

To achieve the above targets, there need to be explicit mechanisms including both financial and career-progress incentives for sending people abroad and attracting them into VTT. Job rating, salary raise, and promotion should depend upon international exposure. Currently, 60–70 people annually change their research fields as part of the competence renewal process. These employees could visit a foreign center of excellence and learn a new strategically chosen field. For more senior people, there needs to be a connection with the strategic goals of VTT, in order for the individual's motives and interests to closely align with those of VTT itself.

In terms of international scientific exchange of VTT researchers, the Board recommends providing incentives for visits of longer duration than the current practice. Many of the scientists seeking international exposure visit foreign institutions for a period of one month. Whereas this is helpful for learning about the overall research activities in the host institution, these visits are generally too short to generate lasting research relationships. In the Board's view, one semester (about three months) would be a more desirable length for international visits, but they should preferably last for one year or even longer. The Board also recommends tapping opportunities for exchange of researchers with the institutions represented by the Board members.

International exchange of materials and components constitute reaching ambitious leading edge goals and is also part of internationalization. In this area, the Board noted with pleasure the international activities of the terahertz imaging project.

2.3 Competence management and career path development

Organizational excellence is based on highly competent individuals. As for any research institution, the investment associated with the development of new competences is substantial. Therefore, the decisions to renew competencies are highly strategic: they should be based on careful analyses of the long-term evolution of the market and existing strengths.

Competence renewal plans should be based on an analysis of the future needs of each strategic research area taking into account the limited number of resources available. In most cases, new recruitment is necessary to start new strategic research areas. This requires a long-term strategy and a plan on how to manage these resources.

The Board recommends VTT to continue to periodically review the competence areas with respect to their (continuing) relevance, the need for new competence development and special competencies required for business solution development. Each of these issues is important separately, and they also interact with one another.

Ideally, each competence area should provide at least one of the following capabilities:

1) Research expertise to compete in world class
2) Expertise to support the global competitiveness of client industries
3) Expertise to develop emerging spearhead technologies for future VTT business with a clear target level and target date (e.g. fusion reactor robotics and printed intelligence).

Leaders of each competence area should decide how they target the above classes.

Whereas individual competencies can provide isolated areas of excellence, for enhanced competitive advantage of the whole VTT, synergy and collaboration are essential. The Board noted that there are important and growing areas of

cross-cutting core competencies and multidisciplinary endeavours. To support the development of these areas, special emphasis should be placed on designing career paths which enable the staff to actively engage in competence development.

One specific area of competence development and management that the Board views as critically important for VTT's success is competence for business solution development. Business solution careers at VTT currently appear to take place after an employee in the scientists' career track crosses over to the business solution career path. The Board feels that business solution development is an after-thought rather than a strategically planned activity. The Board recommends that VTT analyze, clarify and properly recognize the business career track.

Ideally, VTT should develop multiple, equally prestigious, career tracks for junior employees. First, allowing the scientists to cross over from pure research to business focus should be possible and rewarded appropriately. This would allow scientists and technical developers at multiple levels to take ownership of a project and to passionately follow it through the pipeline from invention, to technical feasibility, to product development.

Second, there should also be opportunities for junior level people to enter the career paths from the business development side. This would enable recruitment of people who are driven and motivated to develop business opportunities.

Although scientists should be encouraged to take ownership of their projects and to lead them through to product or service development, it is important to make sure that there are enough business management capabilities available at the later stages of commercialization. This could create career opportunities for certain individuals having specialized skills and expertise in the commercialization process itself. This is analogous to start-up companies where the original innovators are often supplemented by an experienced CEO who can better manage the commercialization process. VTT could build careers to match capabilities needed for managing the process of commercialization of new products or services.

VTT has three sources of research funding: VTT itself, contract customers in public research programmes, and industrial customers. In order to serve industrial customers, VTT needs to be "smarter" than the customer, and this is often a tall order. To be successful in this type of business development, social science and business competencies are needed, too. This should be recognized as a key recruiting challenge.

2.4 VTT's mode of operation

VTT operates as a network or matrix organisation. The Board had at times difficulties to understand how the organisation operated, which may reflect the diversity of understandings of the organization within VTT itself. The Board recommends that VTT crystallizes its mode of operation and improves the way it is communicated internally and externally.

Even though VTT states that entrepreneurship is one of its key processes, the Board feels that there is a need to strengthen the orientation toward commercialization right from the start of new research projects, for example through a business plan for new projects showing the initial expectation regarding the commercialization. The linear sequence of research should be transformed into a concurrent engineering process. This change in the organization of innovation would not just compress time-to-market, but also enable incorporating the market perspective from the beginning in strategic decision-making. In printed intelligence, a step in this direction has been taken and seems to have led to quite a different outcome than traditional projects. The Board strongly supports this new approach, where business development is incorporated as a key element right from the start. Annual reviews of projects should include evaluation of scientific and technological progress and potential, and the validity of the business plan, and these assessments should determine further support for the project.

To get technologies out into markets, VTT may need to be flexible and more liberal in terms of IP. IP-based strategy is difficult for an organization like VTT to profit from. IP can reinforce the commercialization strategy but it is unlikely to be a rich source of profits. Practical exit strategies for VTT are likely to include joint ventures, licensing, startups, and contract research. All of these options should be thoroughly evaluated in each case.

3. Technological topics, key observations and recommendations

3.1 Energy and environment

The Board was impressed by the supercapacitor bus (hybrid bus) implementation that demonstrated good engineering skills, but there was no intellectual property at VTT associated with this activity. The system concept associated with the bus makes sense, but the commercial viability also has to be investigated. This requires a thoughtful business plan.

In the case of fuel cells for Wärtsilä, the business case has already been confirmed, and the technology development is based on good engineering. Wärtsilä's major business is in large diesel engines, whereas a more efficient technology alternative is needed in the low power range. Fuel cells may provide this alternative in the future.

The Board emphasises the need to understand international competitors in the area of battery research. For example, the Japanese car industry spends a large amount of money on battery research. Therefore, VTT's most promising opportunity in this technology area is likely to be in the development of materials and engineering solutions rather than basic battery research.

Gasification research including the development of gas utilization options for liquid and gaseous biofuels appears to be one of international excellence at VTT. There are not many other groups as advanced as VTT, their expertise and leadership in this are internationally recognized.

The development of biofuels technology and its use for fuel production is also important in the VTT energy portfolio. While bio-ethanol production from grains is of questionable long-term value, the development of practical demonstrations of cellulosic ethanol and cellulosic bio-diesel fuels is to be encouraged.

These efforts will integrate with the longer term synthetic biology efforts discussed below.

Recently VTT's energy research has been evaluated by an international panel. The Board appreciated the report and gives its support to the recommendations.

3.2 Boron neutron capture therapy

The boron neutron capture therapy, provided by using VTT's nuclear reactor, is an interesting and valuable societal asset, and the Board was very impressed by the medical promise this technology offers. The Board suggested that VTT investigate if this could be made into a successful, internationally operating business. This would include selecting a managing director with considerable business experience and developing a business plan and a well-functioning organization structure. In order to keep the reactor going, a sizeable investment is needed in the next few years to internationally commercialize the treatment.

As a useful benchmark, Dr Kitagawa provided the following information on the international activity in this field:

Country	**Running reactor(s)**	**Patients (Total including stopped reactors)**
USA	MITR	141
Holland	HFR Pettern	22
Finland	FiR-1	150
Czech	LVR-15	2
Sweden	None (R2-0 stopped)	52
Italy	Experimental R	2
Argentina	Experimental R	7
Japan	KUR-R, JRR-4	525

Experts on the Board assess that the demand in this area will increase in the future. Whereas Finland has a good track record of operating the reactor and provide treatments, it may be a good idea to collaborate with Japanese JAEA or Kyoto University on further development of the service. Technological innovation opportunities include the development of a compact neutron generator which can be operated in the hospital, instead of a nuclear reactor.

The Board recommends VTT make a thorough effort and evaluation of the business opportunity for the boron neutron capture therapy. The technological

opportunity is extremely promising but the current organizational arrangement does not seem appropriate to achieve international success. VTT will probably need to reconsider the commercialization strategy.

3.3 Synthetic biology

Synthetic biology and later generation biofuels are likely to become globally highly relevant technologies for producing fixed carbon feedstocks. VTT and Finland as a country have a great strategic interest in this area. Synthetic biology has the potential to fundamentally change the forest product industry. However, VTT's investments in this area are dwarfed by those recently committed, for example, by University of California Berkeley and by the United States Department of Energy. This is a classic example of an emerging scientific area where international exchange and collaboration would strongly support and accelerate VTT's and Finland's activities with a high benefit-to-cost ratio. If VTT wants to be a leading institute in synthetic biology and in cellulosic biofuels, biomaterials and chemical feedstock production, it should urgently develop a portfolio of strategic international collaborations, especially in the US in order to avoid being left behind. The Board recommends intensifying the collaboration with universities and research institutes internationally through exchange of scientists and joint work. To achieve this, a formal institutional framework may need to be set up, rather than relying on individual scientists' exchange activities. A significantly enhanced or spearhead program in this area would be useful to focus research activities, infrastructure development and business solutions development in synthetic biology.

3.4 Smart microsystems

The Board's impression is that the sensor and connectivity research at VTT is strong and the results can be applied in several different areas. However, the Board felt that the connection between research and applications in different areas was not very well organized. There were also concerns about the management of the sensor portfolio. An analysis of VTT's true core competencies in this area appears to be lacking. Based on information obtained from a number of presentations and concrete demonstrations, the Board stated:

- The general impression of the work was good. At least some of the projects seemed to be in the leading edge or world class. That is difficult to achieve on a broad spectrum.
- Most of the demonstrated things at Micronova seemed to be state-of-the-art. VTT compares favorably for example with IBM and CSIRO, which also have a broad spectrum of research in the area.
- Long term prototyping is not well suited to universities, but it is suited to VTT.
- Again, the presentations did not state VTT's position with respect to competitors, universities and companies.

3.5 Eco-efficient environments

The work presented to the Board on this area concentrated on three topics: Ubiquitous computing and smart spaces, eco-efficient intelligent built environment and intelligent transport systems.

In the area of ubiquitous computing and smart spaces, the Board suggested focusing the work on human interaction and business driven aspects. To be successful, VTT has to know the needs of the customer's customers.

Commenting on VTT's IBEN (Eco-efficient intelligent built environment) programme, the Board was interested in VTT's relative position in building information modelling research. Finland is at state-of-the-art in this area, and VTT's tools are used in Finland. International tools are also used here, and Finnish technology development projects are linked to those, but few Finnish tools are used abroad. The relative importance of materials in a building's carbon budget is increasing.

The customers of VTT in this are construction companies, area developers, service companies, cities and municipalities. The amount of intellectual property of VTT in this area is currently small. The overall goal is to have 40 percent of industrial funding in the future of the total annual budget of 2.5 million euros.

VTT is engaged in developing intelligent transport systems making use of advanced sensor and positioning technologies. Finnish expertise in the intelligent transport sector is focused on sensor technology, wireless communication and services based on them. Furthermore, VTT's activities focus on human-machine interaction, understanding user needs and behaviour, requirements and impacts

of safety systems and technologies. VTT is developing sub-systems enabling autonomous travel and use of moving work machines. Many tools exist at VTT to approach these problems, but in order to make business out of this, system approach is required.

Commercial applications for acceleration sensors already exist. Other sensors and service applications could be developed. Considering the vast investments by other global players in this area, VTT needs to find a niche to excel on a global scale.

3.6 Materials

In terms of the Materials research, the Board recommends focusing on areas of fundamental chemistry that promise relevant applications to the Finnish industry. Industry involvement would enhance the likelihood that highly uncertain science-based projects lead to practically relevant results. For example, the goal and application prospects for nanocellulose development were clearly identified and based on clear industrial needs. The Board felt this could be a long-term spearhead area for VTT. In contrast, the painted sensor development project appears to need goal clarification and market analysis. Similarly, it remained unclear to the Board what is the research goal for moving materials.

Overall, the Board noted that it is useful for VTT to have a variety of materials research projects. In other words, these technologies are still in the exploration phase, and “science push” to market can follow if the approach turns out to be successful. An industrially oriented institute, VTT is relying on universities in basic research, but some freedom should remain within VTT to conduct some basic research also.

3.7 Printed intelligence

The Printed Intelligence program is a good example of what can be done to advance a technological area of long-term strategic importance to VTT with a well-chosen spearhead effort. Key aspects of this effort include (1) the development of a break-through technology that will enable the printing of basic electronic and microfluidic integrated systems in a very inexpensive high-throughput way; (2) the integration of technology development and business development personnel to drive the evolution of the project; (3) The clear progress that has been made in a very wide variety of application areas of this technology as re-

ported to the Board in their visit and elaborated on in much more detail in the annual report. This is early stage state-of-the-art technology and a significant investment has been made in key infrastructure that is necessary for this development. Integration of core and basic technologies with business applications is properly done. It is excellent to have business development experts included in the project right from the beginning. The breadth of interesting work presented in the Annual Report was very impressive.

The also Board identified some issues that should be addressed to improve the likelihood of a successful outcome of this spearhead project for VTT. The Board felt that business application development is still problematic: This project is engaged in too many and too vaguely developed applications and target audiences. For 50 million euros of investments, it appears that more than just the one rudimentary product should be finished by now. Moreover, besides the Clean Card, many of the other technologies seemed more like demonstration projects of technical capabilities than the development of prototype products. The Annual report presents 29 relatively distinct projects each appearing to be driven by a single individual. The root cause seems to be that capabilities are spread too thin across different areas. Initially, diversity of experimentation is necessary, but perhaps it is time to substantially focus the work. The Board would welcome a critical presentation of which projects were being halted so that those with the best technical and business opportunities would be accelerated. Projects should be driven by the needs of industrial partners, not by VTT trying to develop the applications/products in isolation.

Overall Printed Intelligence is a program with outstanding technical possibilities that has build up impressive and necessary infrastructure. The opportunities to make a major impact in low cost diagnostic, medical, consumer and environmental sensor applications are excellent. These wide opportunities have led to the examination of a very wide range of applications over the past two years. It is now time to make critical business and technical decisions that lead to a sharper focus of the effort and place stronger bets on the best technical and business opportunities.

3.8 Information and communication technologies

The ICT group at VTT is a good, active, and enthusiastic group. However – as was the case in other areas – this Board received a limited presentation of this technology area, because of the time constraints. Therefore, these comments

focus on the limited number of applications that were discussed more extensively.

NFC (Near-Field Communication) is an emerging global communication standard, and it is a good time to develop new applications for the emerging market opportunity. However, the applications demonstrated to the Board seem to be largely technology driven, not needs-driven. Technology itself is interesting, but the application examples (e.g. Hot in the City) are not responding to clear commercial user needs. In ICT innovation there is a need for market experimentation, as it is impossible to know what is accepted by users. Nevertheless, more explicit attention to business model development would be necessary from the beginning of new application development. A free application is not a business. By now there should be more industrial interest in the work that was demonstrated, before there is more investment in market development.

M3 is a large European program attempting to develop interoperability technologies for a broad set of appliances and devices, and it is important to develop this initiative in the open-source environment. The challenge is to achieve a global standard with major consumer electronics and communication technology manufacturers. There are competing commercial projects. It will be crucial to get major players on board from outside of Europe.

3.9 Fusion reactor robotics

The fusion reactor robotics is a very interesting example of VTT participating in an international scientific network. The project presents a good set of competencies, facilities, opportunities for commercialization in other applications. In general, the program appears to be impeccably organized, and nice progress has been made in the past two years. The project strengthens VTT's scientific excellence and international reputation, which probably more than compensate for the lesser direct short term industrial benefits. The robotics technologies developed may have other applications in other areas. The 9-degrees of freedom robot poses many new challenges for control that will be interesting to solve and will be of value for other areas of industrial robotics, particularly maintenance, and potentially also mining equipment. Indeed, VTT should have more long-term projects like this.

The project is likely to generate great benefits for VTT in terms of international reputation and branding, and lead to future international collaboration and contract research. The close cooperation with Tampere University of Technol-

ogy through the shared professorship and students also seems very productive. A grand challenge such as this project tends to attract very bright students, who will later engage in innovative activities elsewhere. Hence the competencies developed in the project will benefit the Finnish economy, both in terms of VTT projects and commercial industries. The Board recommends engaging in such grand challenge projects where high-level scientific work is combined with identified commercial opportunities. However, it is important to seek to develop commercial activities based on the scientific and technological work.

4. Meeting arrangements

In the SAB meetings, much time was usually spent listening to presentations. The Board also valued the opportunities to walk around and meet researchers at their work. The Board would like to give some suggestions on how to arrange the meetings in the future and on how the presentations given by VTT staff can be improved.

There could be a standard presentation format as follows:

- If one hour is reserved for the topic, the talk should last a maximum of 40 minutes, the rest of the time should be for discussions
- General problem description and introduction should take no more than 15 minutes
- A (measurable) Grand Challenge should be given
- VTT's mission on the topic should be clearly stated
- Finance and budget figures should also be shown
- The capabilities, challenges in future, competitors, networking etc. should be described
- What is VTT doing and how should be shown and the deliverables from that
- The originality of VTT's contribution (in world, Europe, Finland) should be shown
- VTT's future plans should be shown for e.g. the next three years
- The number of presentation slides should be limited (50 to 100 is clearly too much)

- One way for the Board to operate is to go deeply into subjects with individual members, then looking at the whole picture as a team.
- Posters presentations of young researchers have been rewarding and interesting. They may be repeated in future meetings with a limited group of presenters, perhaps six or seven.

If possible, the Board would appreciate receiving copies of the presentations ahead of the meetings.

5. Ideas for future

VTT will decide on the continuation and memberships of the Scientific Advisory Board. This Board feels that the SAB is an important guiding instrument for VTT and recommends that a new SAB be established. A Board of this size cannot possibly cover all areas of VTT's expertise. As many of the Board's recommendations are of rather fundamental and general nature this is not seen as a problem. By properly rotating the expertise areas from Board to Board, quite a reasonable coverage can be achieved.

The visits and presentations gave only a limited view of VTT's activities in a specific technology area. In the future it might be worth inviting the Board members individually to spend time with VTT staff to discuss future trends, VTT's target setting and activities in the Board member's area of expertise and take the findings and recommendations to the Board for consolidating discussions and recommendations. This idea would further strengthen the already significant and mutually fruitful activity that the Board members have had with VTT outside the Board meetings.

The Board members have come up with a good number of topics that a future SAB can address in future meetings. These have been communicated to VTT staff.

6. Executive summary

Internationally recognized excellence in the majority of the fields of activity is a necessary condition for the long-term success of a research institute such as VTT.

Scientific publications continue to be strong indicators of the quality of research and act as entry tickets to many forms of international cooperation. VTT should recognise and reward this properly. The Board recommends that VTT quantify goals and develop measures to track them over time.

VTT can develop excellence e.g. in the speed, quality, and effectiveness of its service solutions. The Board is very supportive of VTT strengthening its capabilities to commercialize its innovations. VTT already has a broad experience base to develop new technologies to the point of industrial adoption. This expertise, which includes complex project management skills, is of significant value and a strong differentiator against most university research activities.

The awareness and motivation of scientists to develop research and commercialization excellence should be supported by VTT's incentive schemes. The Board strongly supports VTT's ongoing efforts on internationalization. Extensive international exchange between VTT researchers and experts in other organizations is critical for future success. Finding solutions to complex problems requires diverse competencies that cannot easily and efficiently be assembled in one institute. It is a pleasure to note that VTT has developed an explicit internationalization strategy. The Board recommends that VTT's international activities be increasingly shifted toward direct contract research, joint ventures, and collaborative projects.

The Board feels that VTT has the expertise and recognition that allow it to be more involved in setting the EU research agenda, e.g., by engaging more in the early planning phases of new EU programs and project development. VTT's engagement in EIT KIC (European Institute of Innovation & Technology, Knowledge and Innovation Communities) will be another important vehicle for

internationalization. The Board recommends that KIC activities at VTT receive significant investment of human resources and long-term commitment.

VTT's Graduate School shall play a key role in reaching the internationalization targets. International experience should become an important qualification in filling permanent positions at VTT.

The Board's recommendation is to double both the number of long term scientific visits to foreign institutions in five years and to double the number of foreign scientists in the staff also in five years (from about 5 percent to 10).

The Board feels that there is a need to strengthen the orientation toward commercialization right from the start of new research projects, for example through a business plan for new projects showing the initial expectation regarding commercialization. The Board feels that, currently, business solution development is an after-thought rather than a strategically planned activity. The Board recommends that VTT analyze, clarify and properly recognize the business career track and involve business development experts in every major project.

VTT operates as a network organisation. The Board had at times difficulties to understand how the organisation operated, which may reflect the diversity of understandings of the organization within VTT itself. The Board recommends that VTT crystallize and articulate its mode of operation and improve the way it is communicated internally and externally.

To get technologies out into markets, VTT may need to be flexible and more liberal in terms of IP. IP-based strategy is difficult for an organization like VTT to profit from.

Appendix A: Scientific Advisory Board Members 2009–2010

- Prof. Yrjö Neuvo, Chairman
- Dr Masaki Kitagawa
- Prof. Aija Leiponen
- Prof. Richard Mathies
- Prof. Duc-Truong Pham
- Prof. Josef Spitzer
- Dr James Spohrer

Meetings and topics

January 28–30, 2009, Espoo

- Materials
- Energy

October 12–14, 2009, Espoo

- Smart microsystems
- Eco-efficient environments

February 23–25, 2010, Espoo

- Energy
- Boron neutron capture therapy
- Competence management
- Synthetic biology
- European Institute of Innovation and Technology (EIT)

August 18–20, 2010, Oulu and Tampere

- Printed intelligence
- Information and communication technologies
- Fusion reactor robotics
- Internationalization
- Preparing the Final Report

Members of the Board

The members of the Scientific Advisory Board are scientists of a high international standard. They are nominated by the VTT Board for a period of two years. The list and short curricula vitae of the members in 2009–2010 are given in the following.

Chairman of the Board:

Yrjö Neuvo

Professor, Research Director, Helsinki University of Technology (HUT), Finland

Expertise: ICT, telecommunications, technology policy

PhD, Cornell University, 1974

1981–1982	Visiting professor, University of California Santa Barbara
1976–1992	Professor (signal processing), Tampere University of Technology
1993–2005	Member of Nokia group executive board, CTO, Nokia
1994–	Vice Chairman, Board of Directors of Vaisala
2004–2008	Chairman of ARTEMIS Technology Platform and President of ARTEMIS Joint Undertaking
2006–	Member, Board of Directors of Metso
2006–2007	Technology Advisor, Nokia
2007–	Research Director, professor, HUT
2008–	European Institute on Innovation and Technology, Member of the Governing Board
2006–	Chairman of the VTT Scientific Advisory Board

In addition he is acting as a member of board or has a position of trust in numerous other organisations.

Other Members (in alphabetical order):

Masaki Kitagawa

Special Senior Advisor, NIMS (National Institute for Materials Science), Japan

Expertise: Materials

PhD, University of Illinois, Champaign-Urbana, USA, 1972

1967–1972	Fulbright Travel Grantee, research assistant and research associate, University of Illinois, USA
1970	Research engineer, Ford Motor Company, USA
1972–1973	Post-doc researcher, Argonne National Laboratory, USA
1973–1990	Researcher in high temperature materials, Ishikawajima-Harima Heavy Industries Co. (IHI), Japan
1990–1994	Head of Structural Materials Research Department, IHI
1994–1998	General Manager of the Research Promotion Department, IHI
1998–2005	Director-General (Technology) and Executive Chief Scientist, IHI
2006–2009	Vice President, NIMS, Japan
2009–	Special Senior Advisor, NIMS, Japan
2009–	Member of the VTT Scientific Advisory Board

Recipient of scientific awards from Japan Society of Mechanical Engineers, Society for Materials Science Japan, Iron and Steel Institute of Japan, and Japan Welding Institute, as well as a Commendation from the Ministry of State for Science and Technology.

Aija Leiponen

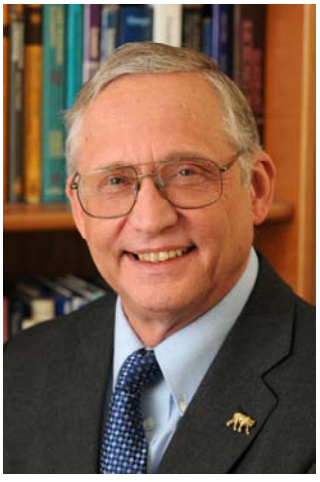
Associate Professor, Innovation and Entrepreneurship, Imperial College Business School, Imperial College London, UK

Associate Professor (on leave), Applied Economics and Management, Cornell University, USA.

Expertise:	Entrepreneurship, innovation strategy, organization

PhD, Helsinki School of Economics, 2000

1995, 1996	Researcher, International Institute of Applied System Analysis (IIASA), Austria
1995–2000	Researcher, The Research Institute of the Finnish Economy (ETLA)
2001–2008	Assistant professor, Applied Economics and Management, Cornell University, USA
2008–	Associate Professor, Innovation and Entrepreneurship, Imperial College Business School, UK
2006–	Member of the VTT Scientific Advisory Board



Richard A. Mathies

G.N. Lewis Professor and Dean, College of Chemistry, University of California, Berkeley, USA.

Expertise: Biophysical Chemistry and Biotechnology. High-speed throughput DNA analysis technologies, lab-on-a-chip analysis systems with applications to diagnostics, forensics, pathogen detection and space exploration.

PhD, Physical Chemistry, Cornell University, 1974

1973–1976	Helen Hay Whitney Postdoctoral Fellow, Yale University
1976–1982	Assistant Professor of Chemistry, U. C. Berkeley
1982–1986	Associate Professor of Chemistry, U. C. Berkeley
1986–	Professor of Chemistry, U. C. Berkeley
1997	Van Arkel Professor of Chemistry, Leiden Institute of Chemistry, The Netherlands
2003–	Director, Center for Analytical Biotechnology, College of Chemistry, U.C. Berkeley.
2008–	Dean, College of Chemistry, U. C. Berkeley
2009–	Member of the VTT Scientific Advisory Board

Recipient of numerous scientific awards, most recently the Chemical Instrumentation Award of the American Chemical Society's Analytical Chemistry Division.

Duc-Truong Pham

Professor, Director of the Manufacturing Engineering Centre, School of Engineering, Cardiff University, UK

Expertise: Manufacturing Engineering, Intelligent Systems

PhD and DEng, University of Canterbury, 1979 and 1995

1979–1988	Lecturer in Control Engineering, University of Birmingham, UK
1985–1986	Professeur Invité, École Centrale des Arts et Manufactures, Paris
1988–	Professor (Computer Controlled Manufacture), Cardiff University
1991	Visiting Erskine Fellow, University of Canterbury, New Zealand
2000–	FREng, Fellow of The Royal Academy of Engineering
2003–	OBE, Officer of the Order of the British Empire
2009–2010	Visiting Professor, King Saud University, Riyadh, Saudi Arabia
2010	Professeur Invité, Université de Metz
2009–	Member of the VTT Scientific Advisory Board

Josef Spitzer

Associate Professor, Graz University of Technology, Austria

Expertise:	Energy Systems, Energy Economics, Bioenergy, Energy and Climate Change

PhD, University of New Mexico, USA, 1971

1971–1975	Nuclear Reactor Designer, INTERATOM, Bensberg, Germany
1975–1982	Department Manager Energy Research, Battelle Institute, Frankfurt, Germany
1982–2009	Head of the Institute of Energy Research, JOANNEUM RESEARCH, Graz, Austria
2010–	Consultant for Energy and Climate Change, Graz, Austria
1990–	Associate Professor in Energy Economics, Graz University of Technology, Austria
1993–	Executive Committee of the IEA Bioenergy Research Network, chairman for 1999–2001 and 2008–2010
2006–2008	Advisory Group on Energy of the European Commission
2007–	Chairman of the Advisory Group for the Austrian Climate and Energy Fund
2009–	Member of the VTT Scientific Advisory Board

James C. Spohrer

Director, IBM Almaden, USA

Expertise:	ICT, service business and science, service development

PhD, Yale University, 1988

1978–1982	Product developer, Verbex (Exxon Enterprises)
1989	Visiting researcher, University of Rome, La Sapienza
1989–1998	DEST (Distinguished Engineer, Scientist and Technologist), Apple
1999	Director, IBM
2000–2003	Technology Manager, IBM, Venture Capital Relations Group
2004–	Director, IBM, Almaden Services Research
2006–	Member of VTT Scientific Advisory Board

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Author(s)
Yrjö Neuvo, Masaki Kitagawa, Aija Leiponen, Richard Mathies, Duc-Truong Pham, Josef Spitzer & James Spohrer

Title

VTT Scientific Advisory Board Final Report 2009–2010

Abstract

VTT Technical Research Centre of Finland appointed its second Scientific Advisory Board for the period 2009–2010 to continue the work started in 2006. The new Board had four meetings between January 2009 and August 2010, during which the members have become acquainted with a number of VTT's operations. This Final Report describes the key findings and recommendations to VTT from that time period. Due to the broad extent of VTT's activities this view is naturally somewhat limited. In spite of this the Board believes that the report contains valuable general guidance on how VTT can even better nurture its long term knowledge and competence bases.

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