Evaluation of the strategic area Medical Technology

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Strategic area idea, concept and process

Medical Technology was chosen as one of the strategic areas (SA) at the Norwegian University of Science and Technology (NTNU). The concept of forming this strategic area came in place to strengthen already existing collaboration in between medicine/biology and biomedical engineering built on e.g., excellent activities in Doppler blood flow monitoring and ultrasound from the 1970´s and concomitant activities in magnetic resonance imaging. From an organizational point of view the process has been facilitated by the fact that NTNU has taken the unusual step in including both the faculty of science and technology and medicine within the same strategic effort.

We believe that the creation on the strategic area Medical Technology has been an excellent move by NTNU to take advantage of the combined expertise in engineering, bioscience and medical research. It is also an important step for NTNU to reach recognition as a university with broader strong biomedical engineering activities. The creation of the SA has been important for being able to attract large national funding of research centers as that for Medical Imaging Laboratory for Innovative Future Helath Care (MI Lab).

Medical technology vs Biomedical Engineering
The English term of the SA , Medical Technology is somewhat different in relation to other comparable international activities. The established term might in stead be biomedical engineering or bioengineering. To be able to attract students or researchers on an international arena Biomedical Engineering could be a stronger brand. If the researchers and active members within the SA want to show that they have a larger scope then biomedical engineering an alternative name would be Engineering in medicine

The strategic area Medical Technology consists of two main focus areas and a number of additional sub areas.

The two main focus areas are:

A. Image-based diagnostics and intervention with Ultrasound and Magnetic Resonance
B. Medical Biotechnology

These two areas were the starting entities for forming additional sub groups/areas, which are:

1. MI lab
2. Bioinformatics
3. Health informatics
4. Biomedical optics
5. Biomechanics
6. Bio-nanotechnology
7. Societal aspects of new technologies
8. Future operating room
9. National Centre of Competence for 3D ultrasound in minimal invasive surgery
10. Medical simulation center

The list of the focus areas/subgroups listed above gives the immediate impression that the wording/names are somewhat disparate. Some of them have a descriptive name (7, 8 and 9) while others need more insight information to be understood (1). There is also some ambiguity and over lap in the interest fields that the various areas are covering. Examples of these overlapping entities are A, 1 and 9. In order to avoid the described problem we suggest a rephrasing/name change for some of the listed areas and that some of them also are brought together in that same process.

General comments
MI lab is impressively large and has shown scientific excellence and commercial success. It can be pointed out that that the present dean has his own scientific background within the framework of this activity.

Some areas (e.g., biomechanics) are small and may have a future potential but may not meet the critical mass to let the research flourish or even survive.

Another area, biomedical optics, has world leading competence but may not presently show so high activity locally in Trondheim, due to the fact, that the leading researcher performs activity as a visiting scientist in the US.

Beside these scientific sub areas there are also substantial investments in infrastructures, such as the “Operating Room of the Future”, which certainly will contribute in particular in the teaching field for many categories in medically related training.

Particularly we would like to point out the concept of integrating the research aspect into the clinical daily activity as it is presented in the new construction of St. Olav’s hospital. This arrangement is extremely unique for almost all countries in Europe as well as globally. This means that the scientific activities are merged into the clinical activity geographically as well as on the level of the personnel. The intention is to let all chief

doctors be scientific advisors by dividing their working hours in between scientific and clinical activity.

The Annual Report 2006 is certainly meant to be a public short description of the achievements. However, the various sub areas are very disparately described. Representatives from some areas give a well and thorough description while other areas are only fragmentally presented. This might reflect inconsistent directions and quality control from the leadership together with misunderstanding from the reporters. Unfortunately, this comment may also be valid in the context of the general standard of written documentation sent to us evaluators.
On a direct question from us concerning the process for technology transfer we got the answer that there is a technology transfer strategy via SINTEF, NTNU and the Hospital.

Focus/sub group areas
Image-based diagnostics and intervention with Ultrasound and Magnetic Resonance/National Centre of Competence for 3D ultrasound in minimal invasive surgery and MI lab
Leader: Olav Haraldseth

This area has the critical mass of very good researchers and the scientific production is excellent. There is a good number of PhD students. The activity can be chosen as *The success story* in which a true connection in between basic science, clinical research and industrial bonds have been fully connected. This activity can be recognized as one where biomedical engineering research at a high theoretical and experimental level combined with clinically applied research has led to a very successful industrialization (GE Vingmed). This example should be used as a raw model for bringing technology and medicine to commercial product, which is a road filled with a lot of obstacles, including rising venture capital.

This focus/sub area is the only one in the annual report which has a strategic plan and outlook for the coming period.

From a publication/scientific production point of view the number of published full papers exceeds 300 during a period 7 years. Most of the papers are published in well recognized journals. There are approximately 80 scientific talks listed but the type of these presentations (invited, key note lectures, conference presentations) is not given so therefore the impact of these cannot be evaluated.

Medical Biotechnology
Leader: Berit Johansen
This area has the critical mass and very good scientific production with more than 300 full papers during the 7 years. We were presented interesting research on functional genomics of cancer and cardiovascular disease, biocatalysis in synthesis of drugs, designing antibiotics and work on medical application on polysaccharides. In the self evaluation report and the annual report we have not found any description of the research strategy in the area.

Biomechanics
Leader: Bjørn Skallerud
This area is a new one and so far a small area addressing biofluid flows and is interaction with soft tissue. This area seems to exhibit promising research potential and there is a potential for cross fertilization between this area and the MI-Lab.

Biomedical Optics
Leaders: Lise Randeberg and Lars Svaasand (presently visiting professor at University of California at Irvine)
Biomedical optics is a part of the electro optics group at the Department of Electronics and Telecommunications. The group consists of one professor (Lars O. Svaasand), one postdoc (Lise L. Randeberg), and two PhD students.. Associate professor Astrid Aksnes and one of her PhD students also deal with problems related to medical technology and optics, without being defined as biomedical optics.

The main focus of the group has been on light/tissue interactions, light dosimetry and optical diagnostics as wellas on nonlinear optics with two-photon excitation microscopy and spectroscopy.. The group has always had a close relation to the St. Olav´s hospital and depend on clinicians to be able to carry out clinical studies. The group is located at the Faculty for Informatics, Mathematics and Electrical Engineering.
The scientific outcome from the group consists of 32 fully peer-reviewed papers 2000-2006. We miss an actual description of activities within the area.

According to the group leader Lise Randeberg Biomedical optics is a small and scattered field at NTNU. All the groups have traditionally had a good cooperation with St. Olav´s hospital and with international partners. However, there have been few joint projects between the individual groups within engineering. It has been very important for the researchers within such a small field to be able to state that medical technology is a strategic area at the University. This has been especially important when the individual groups have applied for external funding. The strategic area has been important in connection with getting funding for a Strategic University Program (SUP) within the field, and also for individual researchers when they apply for grants. The strategic area has provided natably small amounts of money (up to NOK 20 000) for individual researchers at important points in time. Although few money, it has been essential with these contributions according to Randeberg to be able to start new research activities. It has also been provided grants for recruitment campaigns towards students, and to pay for student attendance at national conferences. The strategic area has also given funding for visiting professors, PhD-students and postdoc positions, but the positions have been too few and the competition to get a position has been even tougher than with the research council. At the moment one of the PhD students within biomedical optics is funded by the strategic area.

Weakness. An important issue we would like to draw the attention to is the weak organisational structure for Biomedical Optics. The whole field, which has proven to have internationally very high level, is led by a talented scientist (Dr. Lise Randeberg) who only has the position platform at NTNU as a postdoc. This will in the long run strike

back either on this reseracher´s possibility to continue high level scientific activity or on the management of the group/area.

Bioinformatics
Leader: Finn Drabløs
The reseach is organised and funded via the National Functional Genomics (FUGE) programme,and is a national platforms for bioinformatics, microarray technology and plant genomics. Reserachers and scientists within the area have published 77 journal papers during the evaluation period. From the material supplied to us we are not able to make any real evaluation of the area. Goals and plans for the area are not found in the material.

Health informatics
Leader: Arild Faxvaag
The activities of the Health Informatics Program is centered around the Norwegian Centre for Electronic Patient Records. The group of researchers is recognized in the Scandinavian research community in the flied. They have 32 journal publications 2004-2006. The material supplied does not permit any further analysis of the activities in the area. We miss a research plan and a more detailed description of the area.

Bio-nanotechnology
Leader: Thomas Tybell
Interesting ongoing activities were presented to us but we miss material actually describing the area. Nor is it clear to us if Tybell or Sokorsky is the leader of the area. They have published, if we count correctly, 8 journal papers during the 7 year period.

Societal aspects of new technologies
From the material we have it is not clear who the groupleader is. The group has published 33 scientific journal papers during the last 7 years. The material does not allow any further evaluation.

The operating room of the future
Leader: Hans Olav Myhre
This area is actually more of a very interesting infrastructure that has been created in a cooperation with St. Olav´s Hospital and SINTEF Focus is on ultrasound-guided, minimally invasive surgery, mainly within laparoscopic and endovascular therapy. We did not found the list of publications.

Medical simulation center
Leader: Petter Aadahl
The supplied material is not sufficient for an evaluation.

Specific Comments for the Strategic Area of Medical Technlogy

Presented strategies of the total strategic area and sub areas
The total strategy of the SA is too vaguely described. We find a very strong strategy described for the Ultrasound/MRI area but we miss real strategies for the other sub areas.

Selection of the sub areas
We will not make any specific judgement on the issue if a certain sub area fits into the SA or not. The SA should however judge if each sub area has the necessary strength, strategic importance and if it fits into the common strategy of the SA. Preferably research activities in a certain sub area should be complementary to that of other sub areas for the SA to be able to work on certain research teams (se below).

Identification of common research themes with potential of excellence
We have found areas with excellence and critical mass and sub areas that are of interest in itself. There are also a number of areas that fit well together from a strategicall point of view.

We suggest that the SA identify certain research themes/projects which take advantage of the collected expertise of the SA. The themes would have the potential to give added value to the SA taking advantage of its combined set of expertise. These themes would also facilitate for the less strong areas to reach excellence.

Appropriateness of Strategic Areas as means to achieve the goals and vice versa

How to lead the strategic area
The area is presently led by a board chaired by the dean of the Medical Faculty and with representatives fore each of the faculties and one representative from St Olov´s Hospital. The present dean has the advantage to be active in the SA and the leadership seems to be efficient. However, it should be observed that there might be a conflict between an efficiently working board and a larger board that might involve stronger scientific competence. This might be solved by having a scientific advisory board reporting to the board. Such a board should preferably involve also external experts. As pointed out above strategies for the whole SA and its sub areas has to be formulated. We suggest that the proposed scientific advisory board will have the task to work out a strategy document for the whole SA and the sub areas. We also suggest that the advisory board will be responsible for the continuous evaluation of the SA.

We do believe that there might be a conflict of interest to be booth dean and leader for an SA. We therefore suggest that a separate director/chairman of the board is appointed.

It is unusual that biomedical engineering is put under the Medical Faculty rather then the Falulty for Engineering. We believe though that the present organisation works well and is well accepted by engineering, biomedical and medical scientists. However, the leader of the SA should ensure that good engineering, biological and medical researchers should have the same opportunities to flourish as scientists

Importance of the economic strength of the area
The SA should have large enough economic recourses so that implemented strategies should have impact on the research. Presently the allocated budget is to small for the SA to really have an impact on the directions of the research that is going on at NTNU. For the larger sub areas the money is too small to influence directions and for the small sub areas the recourses added might not be large enough to be able to develop the area to one with excellence and critical mass.

To encourage cooperation between the sub areas we suggest that a separate budget is allocated to theme projects that combine the research competence from several sub areas. We believe that a smart choice of team projects would really create added value to the SA and would be a way for NTNU to reach excellence in a larger number of biomedical engineering areas. By bringing the right competences together it is our opinion that it will not only result in added strength but also in multiplicative effects. As pointed out above this will also be a way to bring less strong sub areas into team projects reaching excellence.

Lund and Linköping Oktober 16, 2007

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