

# **IMPACT – Strategic Development of Chalmers Master’s Programmes**

**2007–2009**



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Layout & production: Photo and Graphic Design, Chalmers  
Photo: Jan-Olof Yxell  
Tryck: Billes tryckeri AB

ISBN: 978-91-633-6202-6

*The IMPACT project would like to  
acknowledge the support given by our  
sponsor, the Chalmers Foundation*



# IMPACT GOALS

**The IMPACT goals were developed by Vice Heads of Departments in a bottom-up process in Lökeberg 2006. The main objective of the project was to assist developing the Master's programmes to be competitive on an international level and be attractive for both national and international students. The specific goals are presented below.**

- Develop internationally competitive Master's programmes with clear goals for improving the knowledge and competence of students.
- Coordinate the Master's programmes with Bachelor-, Bachelor Engineering- and other Master's programmes and with graduate schools in a clear and well structured way.
- Improve the connection within programmes by means of well defined learning outcomes and more visible common themes in the programmes.
- Deliver all programmes and courses in English, using a pedagogy designed for active and life-long learning.
- Ensure that the issues of diversity and sustainable development are considered in the delivery of the Master's programmes.
- Strengthen the teachers' competence in terms of pedagogy and English communication.
- Provide new learning resources in English that are more than mere translations of existing material.
- Set up a format for feed-back from important stakeholders.
- Design a system of assessment for the Master's programmes to be used in long term quality assurance.
- Set up common arenas for experience sharing and/or other means of support for the promotion of pedagogical development.
- Institute adequate administrative routines for programme support and, for example quality assured admissions.



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# Executive summary

In 2005 Chalmers University of Technology, was the first university in Sweden to revamp its educational system according to the Bologna model, consisting of a first-cycle (undergraduate programmes) of 3 years and a second cycle (Master's programmes) of 2 years. Within the second cycle, it was decided that all teaching should be carried out in English, which is in accordance with the Chalmers aspiration to become recognized on the international education arena.

Such an ambitious reform posed great challenges and Vice Heads of Departments decided unanimously to seek extra resources from Chalmers Foundation for the development and adaptation of existing courses into the new Master's programmes' format. The IMPACT project was granted SEK 30 million for the time period 2007-2009 to be divided between departments. The aim of the project was to facilitate development of the Master's programmes in becoming competitive on an international level and attractive to both national and international students.

The organization of the project consists of a leadership group, a steering group and a reference group. From these three groups a project leader, a vice project leader and a chairman have been operationally responsible assisted by the groups.

The project has had a number of deliverables, the top two being funding for over one hundred development projects and English courses to support teachers in adapting their course material and teaching style to an international student-population. In addition, workshops for sharing best practices and new insights within Chalmers have been initialized throughout the project. However, external communication, such as conference presentations and scientific papers, has also been part of the project.

Quality assurance of the project has been performed through questionnaires with Master's programmes coordinators, project leaders of the pedagogic projects, departments' vice heads and the students. The result clearly shows that the project has had significant impact on the development and implementation of the Master's programmes at Chalmers. The result was reinforced by the evaluation by two pedagogical

experts, clearly stating that the project has indeed contributed to the development process on several levels.

Putting project IMPACT into perspective, the main achievement lies in the earnest commitment from all departments which brought tremendous strength to the project, enabling Chalmers Master's programmes to develop in close cooperation which in turn has ensured high quality. The quality of the IMPACT project has been confirmed by the student questionnaire which reports the students' appreciation of the teachers and the overall improvements in the programmes.

The Master's programmes ability to compete internationally has been confirmed by the ever rising number of applications to Chalmers Master's programmes, both nationally and internationally.

This report documents and develops the key elements of project IMPACT, including personal input from participants, the projects and pedagogical methods developed, the quality assurance work and external as well as internal communication. Altogether, the key elements have had a positive and transformative effect on the development of Chalmers Master's programmes.

Looking forward, a foundation for the continuous improvement of the Master's programmes has been established by the methods and knowledge exchange approach developed during the IMPACT project. ■

AVANCEZ!

Per Svensson, chairperson, steering committee  
Claes Niklasson, IMPACT project leader

# Project leadership 2007–2009



The project group, Patrik Jansson, Claes Niklasson and Per Lundgren together with Per Svensson, chairman of the steering committee.

## Project group

Claes Niklasson, project leader,  
Department of Chemical and Biological Engineering

Patrik Jansson, deputy project leader<sup>1</sup>  
Department of Computer Science and Engineering

Per Lundgren, deputy project leader,  
Department of Microtechnology and Nanoscience

## Steering committee members

Per Svensson, chairperson,  
Department of Technology Management and Economics

Eva-Karin Akar, Office of Student Services, 2008–2009

Marie Arehag, Office of Planning, 2007

Karin Glader/Jonas Pedersen, Student Union representatives

Lennart Löfdahl, Dean of Education,  
Department of Applied Mechanics

Inga Malmqvist, Department of Architecture<sup>2</sup>

Gert Persson, Department of Materials and Manufacturing Technology

Johan Piscator, Doctoral student section

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<sup>1</sup>) Steering committee member 2007.

<sup>2</sup>) Deputy project leader 2007.



# Introduction



# A steering committee chairperson view

Chalmers has long competed in the international research arena. With the introduction of the Bologna model and Master's programmes taught in English, Chalmers now competes on an international education arena as well. We can attract talented students from Sweden and abroad and we can lose talented students to other universities.

Thus there is a strong requirement for excellence. We need Master's programmes with a reputation for high quality in regards to content and pedagogy; we need Master's programmes that utilize Chalmers research; and we need Master's programmes highly relevant to the students' potential employers.

To maintain a position as a top-notch university there is a need for continuous improvement. The IMPACT program is a start; it has financed part of the initial development of the Master's programmes. The IMPACT project will now end; the challenge for Chalmers is to find ways to continuously improve the competitive position of our programmes. This is now the responsibility of the departments and the teachers as well as of the First degree and Master's programmes committee (GUN) and the Commissioning Organization.

The IMPACT project has contributed in a number of ways to the initial development of our Master's programmes. As chairperson of the steering committee it has been a pleasure to work with all the dedicated persons involved in this effort. The project management group with its project leader Claes Niklasson has led the work efficiently. Most of the project has been a decentralized effort based on work done by the departments. This has required close cooperation between departments and the projects were mainly channeled through the Vice Heads of Department. The decentralized definition of development needs has been integrated through the group of Vice Heads of Department and through a number of workshops with everyone involved. I am confident that this is the start of a continuous development process as a decentralized but still joint Chalmers effort in the future.



Per Svensson

***“The IMPACT project will now end; the challenge for Chalmers is to find ways to continuously improve the competitive position of our programmes.”***



I want to thank the Chalmers Foundation for financing IMPACT. I also want to thank everyone involved at the departments, the project management group and the steering committee. ■

Good luck with the future development of our Master's programmes!

Per Svensson

Chairperson of the steering committee of IMPACT

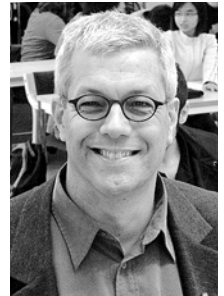
# A project leader view

IMPACT started as a project idea generated by the Heads of Department of Chalmers together with the Chalmers management when 44 new International Master's Programmes at Chalmers (and introduction of the Bologna structure) were about to start and be implemented in 2006.

In 2006 an application for funding was sent to the Chalmers Foundation by a group of Vice Heads supported by all departments at Chalmers. The application granted 30 MSEK for three years with the aim of developing internationally competitive, top quality Master's Programmes.

The ambition and support was great from the beginning from all parts of Chalmers. Luckily the project got a very good start with the workshop in Lökeberg in October, 2006. There the aims and goals of the project were developed in a bottom up process. From this, the project evolved through project applications, reports and English teaching courses combined with parallel workshops for distributing the results. In total more than 110 pedagogic projects, courses and conference presentations to distribute the results have been carried out up to now.

All indicators showed the project being somewhat a success story. Questionnaires to the Vice Heads, Master's programme coordinators, an external evaluation report and finally in May 2009, the student questionnaire, all show positive feedback to the project. The student questionnaire shows significantly that the students liked and appreciated the masters programmes but also fulfilment of learning outcomes, the teacher's pedagogic and English speaking abilities, the student centre, program administration and so on. A summary of the result<sup>1</sup> of the questionnaire is included in the report. The success of the Master's Programmes can of course, not completely be attributable to the IMPACT project, but interviews with project leaders and Master's coordinators clearly show that the contribution from IMPACT to this development process was significant.



Claes Niklasson

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<sup>1</sup> Please see Chalmers Master's Programme Student Evaluation in chapter 4/Follow up for a summary of the evaluation, page 63.

As a project leader of such a large pedagogic project, I have found the possibilities of failure of different kinds not to be negligible, but so far they can be counted on one hand. For example, that fewer teachers

***“If we accept the argument that success or failure of the larger IMPACT project depends on how well the sub-projects were managed and carried out, and the quality and effect of their outcomes, we can conclude that IMPACT has been a successful, well managed pedagogical development project.” M. Christie and L. Lundgren, 2009, External evaluation – IMPACT.”***

than expected attended the English courses might indicate that the work situation for many teachers is strained. This is not something that should be underestimated when working with competence development for faculty. The project and sub-projects have been presented on a number of occasions nationally and internationally and received attention and appreciation (sometimes also jealousy) on many levels. Chalmers will, in this context,

emphasize the undergraduate programmes as very important for the total success of the University and stand out as a teaching and learning University with a focus on sustainability.

My time with IMPACT has been very rewarding in so many ways and most of all I have had time to work with and get to know so many clever, ambitious and hard working people at Chalmers. I truly appreciate all the work we did together. My deepest thank's to Per, Patrik, Per och Inga in the leadership group and all the members of the steering committee.

A special acknowledgement must in this context go out to the Chalmers Foundation, and especially Director Stig Ekman, for their strong support, encouragement and guidance in this project. ■

Take care and keep up the good work.

Claes Niklasson

IMPACT project leader 2007-2009

# Project member views



# The influence of IMPACT on the development of Chalmers Master's programmes

In January 2006 the largest re-organization of the education system in Chalmers' history was initiated. The goal was to start forty-four new Master programmes in the autumn of 2007, and Chalmers would be one of the first universities in Europe to fully adopt the so-called Bologna structure. Existing final year programmes, international Master's Programmes and about twenty new programmes would be integrated into the Chalmers' programme structure. This endeavour was monumental; however with fantastic support from Chalmers Foundation, the departments and many dedicated teachers; we can look back today, and realize that we have achieved a fantastic result with forty-nine well operating Master programmes and many satisfied students. The latter was clearly confirmed in an evaluation which was conducted by the Quality Committee and IMPACT during spring 2009.



Lennart Löfdahl,  
Dean of Education

My first contact with IMPACT was in early 2006, when as Dean of Education, I was asked to be the representative of First Degree and Master's programmes committee (GUN) in the steering committee of the project. This has been interesting work giving me other perspectives of Chalmers Master's programmes. Even though the funding of IMPACT is a considerable amount of money it is relatively little when compared to the total sum invested by Chalmers for the development of the new master programmes. One could say that the intention of the Chalmers Foundation was to "lubricate the wheels", and provide an opportunity for long term strategic investments that were not possible within the ordinary budget.

From the start IMPACT was well organized with a transparent structure. Its activities cover a broad spectrum of questions, however, there are three key phrases that I would like to focus on: environmental sustainability, progressive education and ethnic diversity. During the three active years of IMPACT, more than 100 projects have been partly or fully funded, some topics have been more favoured than others, but the total number of projects is remarkable. Being responsible for all Master's programmes, I am particularly satisfied with the new methods developed for progressive education and for improved collaboration between different disciplines and departments. Another important element is the continuous development of our teaching staff; to lecture in English

is one thing, but to express and illustrate different concepts requires a more advanced rhetoric and the courses introduced by IMPACT have been instrumental in their development.

It is important that we take advantage of the experiences gained from IMPACT and incorporate them as we develop our Master's programmes, making them more appealing to students. ■

Lennart Löfdahl  
Dean of Education

# Learning from IMPACT

The IMPACT project has given me the chance to explore the full breadth of Chalmers Master's education offering, both in terms of subjects and pedagogical methods. My main responsibility in the project group has been Quality Assurance and in addition to questionnaires and report reading I have tried to meet with the leaders of sub-projects three times per year to make the review more personal. Through these meetings I have collected many ideas about Master's education but I have also tried to distribute these ideas to other sub-projects groups to "cross-breed" approaches developed in different parts of Chalmers. Here are just two ideas which could be worth considering for the future:



Patrik Jansson  
Deputy project leader

## Write more books!

I have seen many examples of really good course material developed by individuals or groups of teachers, but only a few cases when this has been polished into a "real publication". I'm convinced Chalmers could export more knowledge in terms of course literature to an international audience. Very often this last polishing step is missing due to lack of time and I would suggest that Chalmers start an internal funding scheme for writing sabbaticals where a teacher could get funding (read: time) to finish a book in peace. I have heard many teachers complain about the lack of good literature for the subject they are teaching and I have tried to encourage using IMPACT funding to buy time to write to help fill that gap.

A few examples of books are "Utforskande arkitektur" (2006) and "Bostadens rum" (2007) that were translated to become course literature in the project Housing Investigations 2008<sup>1</sup>. The "Housing" project also resulted in a NordicBaltic Research Network. "Sustainable Business Development", edited by Sverker Alänge and Mats Lundquist, is an ongoing book project at the Department of Technology Management and Economics and also part of the larger project "Sustainability in Action".

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<sup>1)</sup> Gromark, S. & Nilsson, F., (red.) (2006). *Utforskande arkitektur – situationer i nutida arkitektur*. Stockholm, axl books and Nylander, O., Gromark, S., Nilsson, F. & Redvall, C., (red.) (2007). *Bostadens rum – Chalmersarkitekter om bostadens kvaliteter*. Göteborg, Chalmers, Institutionen för Arkitektur.  
For more information please see Architecture in chapter 5/Department documentation, p. 83



## **Learning from international collaboration**

One of the really inspiring aspects of Chalmers new Master's education is the large inflow of young bright minds from all over the world. The IMPACT project has supported many sub-projects about diversity and most Master's level teachers have had to adapt their teaching to the new international student body. Teachers have had to adapt their teaching to the new international student body. At times it can feel overwhelming to find time to make all the intended changes. But we are not alone; projects like IMPACT are carried out in many other universities in many other countries and I'm convinced we could learn more from international collaboration. I would recommend that Chalmers identify a few "sister programmes" for each master's programme and establish contacts between teachers and students at other sites. A few examples of international collaboration projects within IMPACT are:

- Chalmers Interaction Design Challenge
- Physics diversity – recruitment network for international students
- Study trips for Master's programmes

## **Final words**

In project applications and reports, evaluations and interviews, I have learned about these and hundreds of other developments and ideas. I know that the teachers involved will continue the never ending quest to perfect Chalmers education. ■

Patrik Jansson

Deputy project leader

# Teaching in English interventions 2007–2009

Acting on a project report from 2006 regarding preparing teaching faculty for teaching in English, the IMPACT board has requested two courses for teachers delivered by the Centre for Language and Communication – teaching in English I and II. The initial plan involved a third course which has not been requested over the three-year period. Additional activities and seminars have also been organised. All activities have been free of charge but the departments have been expected to staff teaching faculty to enable participation.

## Teaching in English I

Teaching in English I is a three-credit course and the first in a planned sequence of three steps towards preparing teaching faculty at Chalmers facing the task of teaching in English. To date it has been delivered five times. The course is a language course oriented towards teaching in English at the various Master's programmes at Chalmers. It is offered to 20 participants and runs over a quarter with four-hour sessions once a week for a total of 6 weeks plus individual supervision. The format of the course involves seminar discussions as well as time for individual supervision and individual work in the language lab. The course also includes reading, writing, and presentation assignments and it requires a fair amount of time outside of the scheduled sessions. On completing the course, participants receive a 3-credit certificate outlining the course and its scope.

## Teaching in English II

Teaching in English II is a 4,5 credit course with a possibility of receiving a 3-credit recognition of prior learning in the 15-credit higher education diploma issued by Professor Michael Christie with the Centre for Competence and Knowledge Building in Higher Education (CKK) at the IT-University. The course is offered as a term-long seminar oriented towards teaching in English and adapting teaching and learning activities at the various Master's programmes at Chalmers. With the overall context of teaching in English to non-native speakers of English, the course content is geared towards constructive alignment in a learning perspective; revising and communicating objectives, assignment design, and assessment schemes. The content specific discussions also include self and peer assessment, critical reading, writing-to-learn,



Magnus Gustafsson,  
Centre for Language  
and Communication

peer learning, lecturing, supervision, feedback, and teacher-teacher support. It is, consequently, not a proficiency oriented course and therefore requires prior participation in Teaching in English I or good English proficiency.

### **Strengths and weaknesses of the Teaching in English activities**

The two-strand organization of the activities is their main strength. A transition to delivery in English obviously involves promoting teacher confidence and quality by supporting language development but the pedagogical revision of courses and learning activities is equally or more important. It is also an advantage that the activities are facilitated by teachers who are familiar with the teaching situation at Chalmers and, importantly, also teach the same category of international Master's students in English. Another significant strength of the course is that it offers an opportunity and a forum for problematising the notion of translation of Swedish courses into English and focuses instead on the educational development dimension of taking on a genuine learning perspective. While individual faculty will enhance their courses, the synergy effects between faculty represent the real value of the TIE efforts at Chalmers.

The major weakness of the activities is the stressful work situation the participants experience in combination with the level of ambition of Chalmers move to delivery in English. Not being able to pursue a course, not being able to prepare properly and read up as planned because of the teaching and / or research one has to do really only creates frustration for the participants and reduces the potential impact of the activities.

### **Connections and overlap between TIE and MSc activities**

The TIE activities do not exist in a vacuum and the course development for 2009 and the future draws on facilitator research backgrounds and on the Centre's experiences in the elective courses for Master's students. So, there are excerpts of student writing and their commentary about course descriptions as well as writing assignments. Another component of the Centre's activities in the MSc that holds a potential for TIE activities is Chalmers Open Communication Studio (CHOCS - <http://wiki.portal.chalmers.se/CHOCS>) and the activities of the tutors in it. In 2009, CHOCS tutors pursued inquiries into the many Master's programmes as to the use of writing or the differences in learning cultures from the students' home institutions. Naturally, this information is useful for teachers in the programmes.

### **Closing remarks and recommendations**

The courses and activities the Centre for Language and Communication has facilitated over the three-year period have been successful. However, we have struggled with attracting participants for the respective courses and activities. The main challenge for Chalmers thus remains to provide a work environment that promotes personal and

professional development in terms of 'teaching in English'. As an individual centre there is little we can do about the negative spiral of work environment that faculty experience at Chalmers and the way in which it affects staff development work. More importantly, TIE activities and TIE-related activities over the three-year period have repeatedly indicated how much work is needed at Chalmers before we can claim that Chalmers really has made the transition to an international learning environment at the MSc level. Consequently, it will be necessary for 2010, to further experiment with other more flexible and possibly less ambitious formats for TIE efforts.

For 2010 and onwards, we have four main recommendations for the University:

1. Set up the current two TIE courses on a regular basis with a minimum number of seats per course to run it and a maximum number of seats per course over the year. This fixed setup should also include a contract with departments for them to allocate time for the teachers elected to take the course. This is important for faculty as well as for deputy heads for planning purposes and for us for developing and delivering the courses.
2. Develop TIE-support to enable subsequent one-to-one language studio tutorials to TIE I participants as well as an ongoing TIE-action learning seminar to Chalmers faculty as a means to increase awareness of the TIE-issues that need addressing.
3. Allocate a sum of money for course teams or programme teams to apply for in order to run a 'TIE III-project' in collaboration with the Centre for Language and Communication as well as with the Centre for Competence and Knowledge Building in Higher Education.
4. Consider aligning TIE efforts with the efforts and visions of Chalmers Learning Centre. ■

# Reflections on IMPACT from Chalmers Student Union



Jonas Pedersen,  
Chalmers Student  
Union

The adaption to Bologna and the introduction of the Master's programmes has meant a great deal of organizational transitions for Chalmers. The establishment of the Master's programmes also makes great demands on the engagement, time and skills of the people involved.

Although access to economic resources is an important prerequisite for the Master's programmes, and the people involved, the resources also make it possible for them to develop and be able to provide students with a world class education. An education in which we students will be able to join international research, dedicated businesses and a challenging society.

In terms of economic help, Chalmers Student Union is confident that IMPACT has been a significant support for the Master's programmes, and many of the projects that have been carried out would probably not have been possible without IMPACT. At the same time, the role of IMPACT as an inspiration and as a platform for exchange of experience should not be underestimated.

The objectives of the IMPACT projects show a fairly good picture of the challenges that many departments have been facing during the past few years with the new Master's programmes. Hopefully IMPACT contributed to Chalmers getting closer to meeting these goals by supporting the projects undertaken at the departments.

The joint ventures Chalmers implemented, such as language courses and education courses, have likely contributed to an upgrading of skills among Chalmers' employees.

There is, however, according to Chalmers Student Union, a risk that Chalmers and the departments have not yet identified all the challenges within the Master's programmes. This could, for example, be language problems, the integration between different student groups, recruitment, effectiveness of programs, or the programs' international competitiveness. It is therefore extremely important to remain attentive and to take advantage of feedback from the previous student surveys and use these as a basis for further development of Chalmers Master's programmes. Students have the right to a world class education and Chalmers Student Union is convinced that Chalmers can give us that. ■

# Specific Projects



# Advanced learning through “Individual preparation course”

**“Attracting students with different disciplinary backgrounds, within a field as diverse in its implementation as Acoustics, demanded an unconventional curriculum”, says Wolfgang Kropp, project leader of the “Individual preparation course” at the Department of Civil and Environmental Engineering. “Students come into this programme with knowledge from different disciplines and their interest in the area springs from that background”, he continues. How does one ensure that students can approach Acoustics from their interests but with a base of knowledge required to understand the field?**



Wolfgang Kropp  
Civil and Environmental  
Engineering

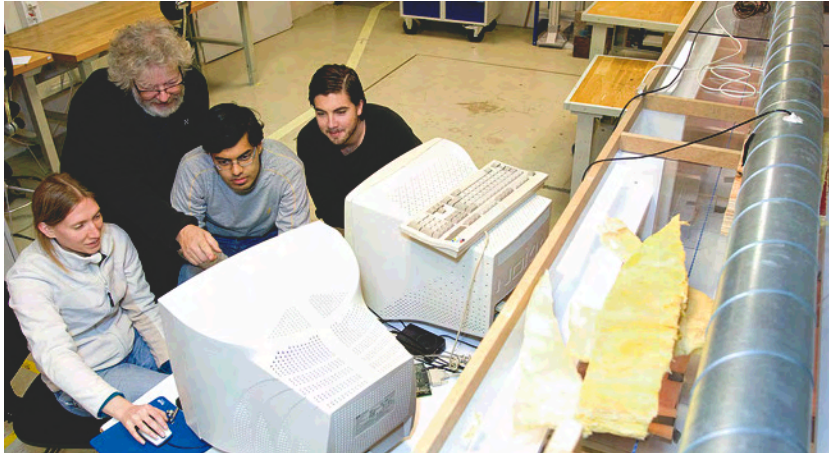
“Sound and vibration is part of our daily life”, Wolfgang explains, “to feel and listen is an essential part of perceiving our environment”. Beyond this basic shared experience, Acoustics is an interdisciplinary subject incorporating fields as diverse as physics, mechanics, physiology, signal processing, material science, psychology, music, and electrical engineering. Consequently the area attracts highly motivated, interested people with very different backgrounds (e.g. electrical, mechanical or civil engineering, architecture, engineering design, or psychology).

## Closeness

Sound and Vibration is one of the smaller programmes and the whole programme structure is designed for close contact between students and personnel at the division of Applied Acoustics. As Wolfgang points out. “The students study in the division’s building, have access to all facilities, both social facilities (e.g. kitchen) as well as experimental facilities. This means that the pedagogic focus is more rather on individuals than groups”, which is often the case.

*“ We find it to be essential that the programme is focusing on fostering students’ individual interests and curiosity in the subject and that it helps students to develop their own learning style, initiating a motivation for self-education and lifelong learning ”*





The whole programme structure is designed for close contact between students and personnel at the division of Applied Acoustics.

Using diversity over the years, the faculty has encountered two main problems. First, although the diversity of backgrounds of people working with Sound and Vibration enriches the field substantially it also poses a substantial pedagogic challenge to ensure that all students independent of their background are equipped to follow the programme.

Limiting admission to the programme to just one category of students (e.g. mechanical engineering students) is not a solution, as Wolfgang sees it: “Diversity is essential to develop the interdisciplinary field of sound and vibration. A limitation would not solve the problem of students needing help to fortify to their educational background to the field, in this case with, for instance, signal and processing and relevant mathematics”, he states.

### **Learning for life**

Secondly, Sound and Vibration is such a broad field with an immense number of application areas, that it is impossible to include the entire field into a curriculum covering 1.5 years. Therefore it is essential that the programme focuses on fostering students, individual interests and curiosity in the subject and helps students develop their own learning style, motivating them towards self-education and lifelong learning.

### **Integrating function**

Today the Individual preparation course is a central part of the compulsory block of the programme, taking place during autumn. It has an integrative function, linking the content of different courses together. It is also a very important resource for the students, giving them the chance to gain knowledge, skills and insight into different areas. This will allow them to follow our programme without being hindered by the shortcomings of their individual backgrounds.

## **Dignostic tests and study packages**

Part of the Impact project was developing diagnostic tests. Diagnostic tests are supposed to start a process of awareness of individual needs. In addition modules or study packages containing problems and solutions in mathematics, signal processing, and programming were developed in the Matlab. All modules are adapted to the needs in the programme, but contain different levels from novice to advanced. The advanced level might not be essential for the programme, but we think it would be useful knowledge for an engineer in the field.

## **Responsibility for one's own learning**

The course has no exam, but uses poster sessions, tasks, experimental demonstrations carried out by students, etc. The different part of the course aim to foster in individual students the insight that education is a shared responsibility where satisfying their own (educational) needs is more important than marks. "The idea itself and its implementation are hardly new from our point of view. However, what might be new in this context is the fact that a programme 'dares' to spend one whole course for a curriculum, which does not focus on educational programme, contents but rather on needs of individual students", Wolfgang states.

## **The importance of the Individual preparation course**

According to course evaluations, the course has an important function and is considered very worthwhile by many students. However, they also showed that a minor group of students often ask for higher demands from the course.

According to the programme evaluation carried out by the student union in the spring for all MSc programmes at Chalmers, more than 50% of the students at Sound and Vibration estimate their time spent on the programme to be more than 50 h/week while in the rest of Chalmers average only 20 % of other students report this time effort. It is important to add that we have very few classroom exercises in the programme. At the same time the majority (30%) is satisfied or very satisfied (60%) with the programme and believe it has met their goals for learning. "This might from a teacher's perspective indicate that the students are working intensively, enjoying their study time and getting the most out of their work", Wolfgang says continuing, "however, that might be a teacher's perspective". In any case, one can certainly wonder if this very positive response in the evaluation is only due to the IPC and the Impact project. "Definitely not", says Wolfgang, but, he continues, "one could argue that considering the diversity of students and the broad scope of the field, such a programme would hardly be successful if it did not help students prepare for the programme and motivate them to take responsibility for their own education". ■

# Managing student heterogeneity in projects



Magnus Holmén  
Technology  
Management and  
Economics

**Getting students to apply book knowledge through tackling complex problems in projects is a challenge to every teacher, especially when students come from different engineering backgrounds and from all over the world. “The students’ future careers depends especially on their ability to manage disciplinary boundaries and cross-cultural negotiations”, says Magnus Holmén, project leader for StudVAR.**

The scene is not uncommon. A group of students have merely divided the work between the group members and have difficulty making progress without supervisor or support. Magnus Holmén explains: “For a long time, faculty and senior students involved in the three master programs Management and Economics of Innovation, Quality and Operations Management and Business Design have felt that there are systematic problems in how students worked in groups. It is a major problem since almost all courses contains substantial amounts of project work, often up to half of the entire course load.”

In the Master’s programmess, students come from very different engineering backgrounds and from all over the world. “We had to improve the ability of students to manage cross-cultural and cross-disciplinary settings to foster individual learning. To deal with these issues, we initiated several projects, including StudVAR”, Magnus says.

## Waste of time and energy

The problems were evident in at least two ways; slow progress for projects, at least without explicit support of supervisors, and insufficient group interaction in terms of problematizing the project assignments. The normal approach was to make a simple division of labour, without much effort to formulate the problem to be solved. Often this poor effort to figure out the nature of the problem was followed by a

*“The most successful excercises were the ones where we managed to integrate actual course content with self-reflection”*

too simplistic approach to integrate the findings. “The situation was not something we could take lightly. Our students must learn to apply book



Our students must learn to apply book knowledge through tackling complex problems in projects.

knowledge through tackling complex problems in projects. It is a necessary approach to real life learning. The faculty felt that the obstacles caused students to waste a lot of time and energy and not learn what the exercises aimed for.” Magnus continues “Students are pretty good at saying the right things about projects on exams but demonstrated far less proficiency in real life. We were in a situation where we did not fully grasp what the students learned, and despite our best efforts, the feedback from the students tended to be vague and ad hoc at best.”

### **Integration is key in StudVAR**

Project StudVAR took on the challenge by embarking on a range of activities. Some were complex undertakings, such as group norm discussions and problem identification exercise workshops that the students had to manage themselves. Other examples were of a simpler nature, including cultural exercises such as “What would you do?” questions aiming to explore difference across cultures. Magnus explains: “The most successful exercises were the ones where we managed to integrate actual course content with self-reflection. If this integration was not achieved students thought that the module was just an add-on to the “real” course content. Some of us think this is because the students’ world consists of the current courses, rather than thinking in terms of learning required for the base of an entire Master’s programmes.”

### **Better insights into student project work**

Another feature of project StudVAR was workshops, where students had to work with problems they had faced in previous projects and workshops. “We run that as part of a methods course. This helped the students to learn the method of the workshop but also provided important lessons on how to manage projects better in the future”, Magnus says. To check out the validity of the findings this was supplemented with course and program evaluations, informal student feed-

back as well as individual interviews. Taken together, this gave the faculty insight into the nature of student projects in a much better way than before.

### **Focusing on individual learnings with IndLÄR**

One of the main issues that arose during this period was the importance of figuring out what individual students learned during their project work. “That’s why we started the IndLÄR project. It dealt with evaluating and ensuring individual learning in projects. The faculty, and sometimes the students, stated that there were problems with free-riders, that is students who only got good grades on project and maybe even

entire courses simply because they signed up with a group where others did all the work”, Magnus explains. He adds “At the same time, project supervisors often discovered that they themselves were the only ones who actually

*“One approach to ensure that all students learn is to make the student presentations much more active and realistic”*

understood and knew what various projects were about.” This highlights the problem that if students focus too much on details without spending time integrating the various parts, they will not benefit all that much from working on complex tasks in a group environment. The new task was to make sure individual students learned what the projects are supposed to teach.”

Across a range of courses, various “best practices” were investigated in how to ensure individual learning in projects. “One approach to ensure that all students learn is to make student presentations much more active and realistic. The ‘traditional’ student presentation has tended to consist of a presentation where the students told the audience what they had done. The new assignment was set so that the students had to explain so that the other students would understand. In some cases, the audience was also to give feedback to the presenters about what they understood from the presentation,” Magnus explains. He concludes, “The most important aspect of IndLÄR was that we have been systematic in terms of involving the faculty and students in discussions and workshops to identify and evaluate problems. Based on these findings we have made changes in some but not all courses.” ■

# Connections with industry in Radio and Space Science

**The Master's programme Radio and Space Science covers a wide range of subjects, from research in cosmology to practical aspects of satellite communications. "By highlighting industry connections in the programme, we want to show prospective students that our programme has engineering content relevant to industry," says Magnus Thomasson, project leader of Connections with industry in Radio and Space Science.**



Magnus Thomasson  
Radio and  
Space science

Faculty experience from meetings with prospective students is that they often have very vague conceptions about the content of the master's programme in Radio and Space Science. Many think it is all about astronomy or space research: looking at stars and galaxies or developing theories about black holes. Students tend to think that studying such subjects is most likely preparation for PhD studies, which is not what a majority of Chalmers students are interested in. However, this view of the Master's programme is incorrect, or at least not the whole truth.

## Three tracks in Radio and Space Science

The programme starts with four compulsory courses that provide basic knowledge in both engineering (e.g. space techniques and microwaves) and science (e.g. astrophysics and spectroscopy). Then students choose one of three tracks: Astrophysics, Earth Observations, or Technology.

"We want to attract different types of students. Ideally we'd like to attract a range of students, from those who are interested in fundamental research and are considering an academic career, to those who are interested in engineering and are planning a career in industry" says Magnus. He continues, "A large part of the programme is engineering subjects, and studying Radio and Space Science can definitely

*"We thought that improved connections with industry would lead to better and more up-to-date courses, and at the same time give the students better insight in how the techniques are used in industry"*

be a preparation for a job in industry. There are many commercial applications of the technologies in the programme."

## **Linking up with industry**

Initially, four possible aspects of involvement of industries in teaching were considered: visits to industries, guest lectures, laboratory experiments and student projects, and help from industry to define course contents. “We thought that improved connections with industry would lead to better and more up-to-date courses, and at the same time give the students better insight in how the technology are used in industry,” Magnus explains.

Three courses were selected within the technology track: radar systems and applications (including surveillance radar, traffic radar, radar altimeters, scatterometry, etc.), satellite positioning (GPS and similar systems for navigation, weather forecasting, time distribution, etc.), and satellite communications (a systems view of communication using satellites). The teachers in the courses contacted local companies and discussed options. The response was positive, and resulted in incorporating both visits to companies and guest lecturers in the courses.

“Unfortunately it was not feasible to organize laboratory experiments and students projects at the different companies” Magnus says. On the other hand the guest lecturers successfully covered “practical” aspects of the subjects, which had not been taught before, but which students had requested.

## **Great enthusiasm and teacher involvement**

In the course Radar systems and applications two study visits were organized, to Saab Microwave Systems and Volvo Technology, by Lars Ulander and Leif Eriksson, respectively. Four guest lecture were given, by representatives from Saab Microwave Systems and SMHI (the Swedish Meteorological and Hydrological Institute).

The Satellite positioning course organised by Jan Johansson was supported by four guest lectures, by representatives from Lantmäteriet, SP Technical Research Institute of Sweden, and RUAG Space, as well as a visit to RUAG Space.

The students attending the Satellite communications course visited RUAG Space. Rüdiger Haas who is responsible for the course also arranged with RUAG to give lectures on “The World of Satellite Communications” and “Products and Economy in Satellite Communications Industry”.

## **Unexpected challenges**

One unexpected, and negative, experience was that visits to industries did not always attract many students. –“We do not think that this is because the students are uninterested, but perhaps they prefer to stay at home and study,” Magnus says. “Since it takes time and effort to organise company visits, it is a huge disappointment when few students show up”, he continues. “We believe the visits enable students to better understand how to apply theory in practice. Therefore, we will make



“The guest lectures broadened the scope of the programme. Overall we think that the IMPACT project has been successful. It has improved our teaching and we will continue our cooperation with industry.”

them compulsory or have exam questions directly related to the visits”, Magnus concludes.

### **Close cooperation the way forward**

“We feel that the IMPACT project has led to better contact with industries working in the field of our master’s programme, and it is now easier for us to show to prospective students that what they learn in the programme has practical applications” Magnus says and continues. “The guest lectures, have broadened the scope of the programme. Overall we think that the IMPACT project has been successful. It has improved our teaching and we will continue our cooperation with industry.” ■



# Chalmers interaction design challenge



Sus Lundgren  
Computer Science and  
Engineering

**“ChiC is both a course and a design contest. It is co-arranged with Eindhoven University of Technology, hence it features international collaboration between teachers as well as between students”, says Sus Lundgren, project leader of ChiC. The course is project-based with students divided into groups of four, with two students from each university in each group. Students meet one week in Eindhoven at the start, attend a few lectures on the subject and start their projects. They continue to work at their respective universities, communicating online. In the last week of the course, students meet again at Chalmers to finalize and present their project.**

Interaction design is a comparatively young field of research and in ways homogenous in Sweden. Therefore the faculty, after having brainstormed the idea of a course including a contest, set out to find a university outside Sweden to partner with. “Throughout the course students have the possibility to see how interaction design is taught

elsewhere,” Sus says. She continues, “Since the course features a contest, students’ on their project becomes more realistic in the sense that they work towards a real and specific goal.

*“Since the course features a contest, students’ project cooperation becomes more realistic in the sense that they work towards a real and specific goal”*

The contact with students and teachers from another culture will hopefully broaden both their knowledge and network.” “I saw the same advantages for me as a teacher and as a researcher.”

## Using cultural differences in the learning process

The choice of partner fell upon Eindhoven University of Technology. “There are two interaction design-related groups there”, Sus recalls. “The group contacted is strongly rooted in psychology and HCI (human-computer-interaction). Interaction design is the discipline of de facto designing interactive products. HCI is the discipline of analyzing such artifacts and their use, as well as making pre- and post studies of the use and users. So whereas interaction design is a creative discipline,

HCI is more traditional in its approach”, she continues. As it turned out this was a very good match. “By cooperating with a group quite different from us, focusing on HCI, we got insights from a rather different view on interaction, and we in turn could give them different insights”, Sus points out.

## Meeting in person

A delegation from the department went to Eindhoven and met the teachers there for the purpose of planning the course and finalizing the project task and topic. “I think this visit was important, because we teachers got to meet in person and we could get to know the university and the environment,” Sus says.

A couple of cultural differences were encountered, in the sense of different views on the topic, which turned out to be important in planning the course curriculum. “For instance my

*“A couple of cultural differences were encountered, in the sense of different views on the topic, which turned out to be important in planning the course curriculum.”*

co-teacher and I started a, for us, typical idea-generating session on the project topic, which totally confused the Eindhoven teachers that never deal with idea generation at all”, Sus recalls. “We had a couple of laughs over that, but also realized that we are very different and hence work differently, and we hope that the students will realize the same thing, in a likewise positive manner”, she continues. The episode, easy-going as it was, brought forward an understanding that made the teachers add a lecture on cooperating in groups to the schedule.

## Going to Eindhoven

Using a method where students were asked to estimate their skill-set, groups were created containing two students from Chalmers and two from Eindhoven. All groups but one had two male and two female students. “We tried to create as heterogeneous groups as possible, mixing skills to maximize the learning process”, Sus explains. The first week of the course, the students spent collaborating online on two literature assignments. The second week the students and teachers from Chalmers went to Eindhoven for a week where students got introductory lectures on the two key subjects in the project (aesthetics of interaction and persuasive technology). “This week was very successful and the Eindhoven students were really involved in this and spent most evenings with our students” Sus explains.

## Geography part of the challenge

The interesting outcome for us will be to see how the students will tackle the fact that half of the group is located in Eindhoven and the other half in Gothenburg. “We will strive to extract strategies on how to run project courses online which we can continue to adapt”, Sus says. In the process some groups will probably find more effective way of working together than others. And this poses another issue, the fact that grading the course will be more complicated than normal as Sus



Eindhoven University of Technology

Sus Lundgren



Sus Lundgren

By cooperating with a group quite different from us, focusing on HCI, we got insights from a rather different view on interaction, and we in turn could give them different insights

sees it. “There’s a lot at stake for the students since we hand out a prize to the best project and this depends partly on the cooperation between the students”, she explains.

### Squeezing it in

A the course and its curriculum, Sus and her colleagues have gained other valuable experience relating to the overall planning process. One consideration is time frames. “If I could decide, I would have run the course late fall of 2009 or rather early spring of 2010 but due to the the overall IMPACT project deadline, we had to squeeze the course in to early fall 2009”, Sus describes. By the time they were granted money and the arrangements regarding the course were set, Sus and her colleagues had a schedule pressed for time. “The time frame was narrow, especially since the whole course curriculum was to be developed in cooperation since with a new international partner and travelling was necessary,” Sus says and continues. “This is something to bear in mind when arranging a project like IMPACT. The time frames for the application period and the overall project duration need to incorporate the project’s implementation ability.”

### The importance of partners

Cooperation with Eindhoven has been very successful. “I think the challenge of co-arranging a course with another university is more or less general, regardless of subject. One needs to establish a contact, agree on subjects for the course, meet to plan it and work it through,” Sus explains. “We were fortunate in finding a committed person as speaking partner. Without having someone on the other side prepared



The second week the students and teachers from Chalmers went to Eindhoven for a week where students got introductory lectures on the two key subjects in the project.

to go beyond their usual work commitment, the chance of success is diminished,” she continues. A major outcome of the project is that Sus and her colleagues have established a relationship with the research group in Eindhoven. They are currently discussing the possibility to write something on the course together. The visits between students might also continue to expand. Eindhoven has an international course where their students go abroad and take related courses at other universities. “Since our visit we are part of their suggested list of universities to attend, so in the future we may get some extra students,” Sus concludes. ■

# How to utilise diversity among students in the classroom situation



Magdalena Svanström  
Chemical and  
Biological Engineering

**Previously diversity in student background, knowledge and culture has often been seen as a problem, and different perspectives have therefore not been seen as an asset. “If we could instead use these differences to enrich learning, this could lead to fewer problems brought into the classroom, related to student diversity, and better learning for sustainable development”, says Magdalena Svanström, project leader of Diversity.**

“In our discussions within the faculty on learning for sustainable development, it became more and more evident that an ability to shift perspectives is an important learning skill for students. These different perspectives can be disciplinary, geographical, cultural, generational, related to scale and so on”, says Magdalena. She continues, “The ability is important for students to better understand the different considerations that need to be made when developing technology in a global

market but for specific local situations”. “Furthermore”, she adds, “in order to be able to communicate and be more effective with different stakeholders, the ability to shift perspective is a necessary tool”.

The diversity of student and their interests in the Master’s programmes at Chalmers provide an opportunity to improve learning if it can be utilized to enhance teaching and learning activities.

***“ The ability to shift perspective is important in order for students to better understand the different considerations that need to be made when developing technology on a global market but for specific local situations ”***

## **State of the art knowledge to drive change**

In the course Global Chemical Sustainability, the idea of utilize student diversity in learning for sustainable development had been an idea brewing for some years, and some activities had been changed in order to better address this. “However, previous development work did not rely on state-of-the art knowledge, and efforts had not been evaluated”, Magdalena says. The project aimed at an initial literature study,



interviews with students in order to better understand the different perspectives that are involved, evaluation of existing course activities, course development, and evaluation of new course activities. “Greater focus has been put on evaluation of student learning than what was anticipated at the start, partly because this area was underdeveloped and needed extra focus”, Magdalena continues.

### **Conceptual maps as a tool to evaluate learning**

“Due to good contact with UPC (Universitat Politècnica de Catalunya) in Barcelona, and because a PhD student, Jordi Segalàs, at UPC was interested in the same issues, collaboration was started in the area of assessment of student learning” Magdalena recalls. The method utilises conceptual maps to evaluate students’ learning for sustainable development in terms of how broad their understanding is of the different perspectives that are involved, and also how complex their understanding of the connection between these different areas is. “We are using the maps to assess course learning, and these results will be compared to how students perform in different activities in the course and in the written exam”, says Magdalena and continues. “This is partly to understand better when the desired learning actually takes place and also if today’s examination methods relate to this learning at all. Final results will be collected after this year’s course, which ends in October this year.”

### **Impact at all levels**

“The problem described above is common to Chalmers’ educational programmes and the expected outcomes of the project can be useful for all programmes”, says Magdalena. “I will continue to be the course examiner in the future and I will therefore continue to develop this course and discuss these ideas with other teachers,” Magdalena says and continues. “For the students in the course, this course now prepares them better for their future professional role in the context of sustain-



This project will produce recommendations on how teaching and learning methods can be customized to address the ability to shift perspectives, using the diversity among students in the classroom, and will also give recommendations on how this learning can be improved.

able development. For the programme, it reinforces what is promised in the name, Innovative and Sustainable Chemical Engineering. For Chalmers, this can be a resource for teachers in all areas, and the publications will show activity in the field of learning for sustainable development, which is an area that is important for Chalmers.”

### **Breaking new ground**

“I thought that it would be easier to find literature in this field than it was. If other teachers are working with the same ideas in their courses, they are not publishing material on their work”, says Magdalena. As of today, the project has been presented at different IMPACT seminars and at seminars for teachers active in the field of education for sustainable development.

Some of the teaching and learning activities have been documented as part of Chalmers’ collection of good practices in the education for sustainable development area. Results from the first phase were reported at the conference Engineering Education in Sustainable Development 2008 in Graz. The results will also be published in a scientific paper after the project is finished and in the conference Engineering Education in Sustainable Development that will be held at Chalmers on 19–22 September, 2010.

The project has also been presented in many other situations in connection to the ESD (education for sustainable development) project at Chalmers, e.g. at a SIDA financed course for educators from Africa and Asia. “Since I am also the director of Chalmers Learning Centre, I will also make sure that the results are spread internally and externally and that this area is continuously improved at Chalmers, and that the knowledge on effective methods continues to be built up,” Magdalena concludes. ■

# Internship Applied Mechanics

**There is a need to make sure that all students have relevant thesis projects, preferably in cooperation with industrial applications. A new challenge is how to best support foreign students with industrial contacts. “Could there be prospects to work out a more structured collaboration with industry in terms of an internship model with thesis work which then develops into possible continuation”, asks Peter Folkow, project leader of Internship Applied Mechanics.**



Peter Folkow  
Applied Mechanics

The Department of Applied Mechanics comprises educational and research activities ranging from applied to purely theoretical aspects of mechanics. “Among the several different branches of industries that are collaborating with us, the automotive field is of special importance”, says Peter Folkow, project leader of Applied Mechanics. The department conducts two international Master’s programmes: Automotive Engineering, with the aim to prepare students for a professional career within the automotive engineering field. The second programme is Solid and Fluid Mechanics, which focuses on modeling, computational and experimental issues in applied mechanics.

## **A tradition of industry cooperation**

“Ever since the preparation of the two international Master’s programmes to comply to the Bologna structure, there have been frequent discussions with industry concerning work integrated learning,” Peter explains. The Automotive Engineering programme, in operation for ten years and directed towards the automotive industry, has for years had extensive cooperation with companies on many levels. These contacts comprise guest lectures, field trips, industrially relevant course problems and manufacturing support in project courses.

For the newly started and more theoretically oriented Solid and Fluid Mechanics programme, a functional but less comprehensive industrial network is gradually being developed. In order to support closer interaction with industry, both programmes have recently set up programme advisory teams with representatives from industry, faculty and students.



## Thesis need industrial applications

One topic that has given rise to many discussions, both within faculty and in contact with industry, deals with thesis projects (master's thesis, bachelor's thesis, candidate's thesis). The main question concerned the number of projects concentrated during spring term; the department has about 80 master's thesis projects, 15 bachelor's thesis projects and 10 candidate's thesis projects. "How could we make sure that there were relevant projects for all students? How should we support all foreign students with industrial contacts? Could there be opportunities to work out more structured collaboration with industry in this field, which would benefit for all parties (industry, department, students)", Peter asks. He continues, "Moreover, would such collaborations positively affect the recruitment for the Master's programmes involved"?

## The internship idea is born

"One year ago Chalmers former president, Jan-Eric Sundgren, now at AB Volvo, expressed in the media his ideas of an internship system between industry and university" Peter states. In such a system, the Master's students will have the opportunity to continue their industrial Master's thesis work with an internship of up to one year. "This would

probably attract foreign students in particular, resulting in an increase in competent international engineers at Swedish companies", he continues. Since this general idea

*“The number of students applying for an internship is likely to depend to a great extent on the adopted internship model.”*

would be a possible way to deal with some of the questions addressed at the department, the current IMPACT project was developed.

In the application for an IMPACT project, several goals were initially stated. Peter explains, "We needed an overview of the existing collaboration with AB Volvo at the department. We also wanted to initiate discussions with the company on how to establish forms of internship collaborations. Thirdly we felt it essential to formulate a formal agreement with AB Volvo on internships".

## Hit by financial reality

"It was our conviction that such a project would be of direct interest to industry, and therefore should result in committed and vivid discussions with AB Volvo on how to realize the internship idea," Peter explains. The expected outcomes were numerous. For the students, thesis projects would be offered in an organized manner. But also the possibility that such a project could continue in the form of an internship that could result in employment.

For the department it would mean generally closer contact with industry, which could result in enhanced industrially oriented research activities. For industry, it would provide a possibility retain up excellent young foreign engineers that otherwise would leave the country after completion of their Master's theses.

Industry could also use internships as an inexpensive way to look into specific problems more in detail, possibly with the guidance of academic experts. In addition, they would have better insight into and influence on the structure of the Master's programmes involved, something that both the department and industry would benefit from. "However, things would not progress as straightforwardly as one would hope", Peter concludes.

### **From idea to reality**

"Jan-Eric Sundgren (former president at Chalmers) was contacted about our interests in developing internship collaboration with AB Volvo", Peter explains and continues. "In order to prepare for a prospective internship agreement, we were asked to present information on cooperation activities between our department and Volvo (past, present, future)". A dozen teachers at the department were selected to present such lists. During this process, the financial situation in the western world was growing worse in general and in the automotive industry in particular. "At the time that we presented our results to AB Volvo, there were frequent reports that employees were being given notice about termination of employment. Hence, we were informed that all discussions on internships with AB Volvo had to be postponed for the time being", Peter says.

### **Overview brings clarity**

"It was natural to take the opportunity to investigate collaboration with Volvo companies in a broader sense, including both AB Volvo and Volvo Cars, as the latter company is also an important partner for us", Peter continues. A questionnaire was constructed that covered all cooperation activities since 2007, including name of contact person, company and division. The types of collaboration were split up into ten levels involving both research and education activities. "After summer we once again contacted AB Volvo, mentioning our quite comprehensive survey of cooperation activities involving AB Volvo and Applied mechanics", says Peter. AB Volvo replied that discussions on the internship idea unfortunately had to wait until the turn of the year since priority must be given to other issues.

### **Looking towards the future**

"Our work towards Volvo Cars seems more promising though," says Peter. He continues, "At the first department advisory team meeting after summer, several industrial members were now more positively oriented towards the internship concept, mainly due to a more stable economical situation. Especially the members representing Volvo Cars were interested in further discussions". The major activity during the fall semester will concern the Volvo Cars track. Hopefully these discussions will result in meetings between industry and academics that eventually will produce an internship agreement. Perhaps some of the other companies represented in the department advisory team could also be of interest here.

Of course, AB Volvo will still be of interest when discussions may continue next semester. “Regardless of how these collaborations proceed, the department will continue work on surveying collaboration with Volvo through the information from the questionnaire,” Peter says. The results will be compiled with regards to different aspects in order to give an overview of cooperation activities on various levels. “Another topic that ought to be studied more closely is the various alternatives for internship projects. It can be anything from a short term project employment with salary, to a one year extended Master’s thesis. Probably something in between is most suitable, provided it complies with laws and regulations. The number of students applying for an internship is likely to depend to a great extent on the adopted internship model,” Peter states.

The project group will continue to work in close connection with the Chalmers Automotive and Transportation Academy. There will also be investigations concerning receiving financial support through government funding of strategic research areas within transportation, to increase the cooperation between Chalmers and Volvo through internships. ■

# Small-scale line production system (MINI-FAB)

**Is it possible to substitute a real production system with a small-scale system? “We wanted to address industrially relevant problems in a small-scale manufacturing environment” says Björn Johansson and Hans Sjöberg, project leaders for MINI-FAB. Typical questions for students at the Master’s programme in Production Engineering to address concerns design, sustainability, performance measurements and continuous system improvement.**

At the Master’s programme in Production Engineering, students have possibilities to study production systems during company visits. However, the ability to interact with the process and study its consequences is very limited. The department used to have a real factory in the laboratory, but it was too complex to use for teaching purposes. “We wanted to build something inside the controlled environment of Chalmers which would be less expensive, easier to use and take up less space,” says Björn. “We thought it would be advantageous if we could make a small-scale system out of something easy to manage which would not jeopardize the students safety,” Hans adds. “Industrial robots and turning, milling machines are not ideal tools to use for learning-by-doing, LEGO is friendlier in that aspect,” Björn says with a smile.

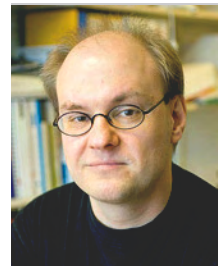
## Bringing the factory to the table

Students needed a small-scale laboratory exercise which reflected the real world manufacturing complexity as well as possible, covering the design, evaluation and improvement work of the factory. “The questions we wanted to answer when using the small-scale factory were the same as in the real world, full-scale factory,” Björn explains.

Using a small-scale factory has many advantages. It fits on a table in the laboratory and in a cabinet when not in use. It’s definitely cheaper than a full- scale factory, easier to replace if something goes wrong and easier to expand. Furthermore it mimics reality perfectly since it is real, but with smaller physical dimensions. The students can change the small-scale factory to verify their ideas without disturbing real production.



Björn Johansson  
Product and Production Development



Hans Sjöberg  
Product and Production Development



“The questions we wanted to answer when using the small-scale factory were the same as in a real world, full-scale factory.”

### Three important aspects

For the Master’s programme in Production Engineering the learning outcomes involve three aspects of industrially relevant problems: namely physical, human and model views. The physical aspect represents the real world perspective with physically present machines connected to form a manufacturing system. “In our case this is represented by LEGO bricks combined to form real small-scale machines,” Björn explains. The second, human, is the human mind’s ability to take action in controlling, initiating and monitoring production flow. And the third, model views, concern decision logic and rules of how the flow should work in terms of software, video sequences and simulation models used to predict, evaluate and control the LEGO-factory.

### Learning by doing

“From IMPACT we got funding for the material but we could not devote a lot of time to realize the project”, says Björn. This meant that the bulk of the project was performed by students, resulting in a bachelor’s thesis. “The students also contributed extensively with their own ideas along the project” he adds. Building the factory proved to be quite challenging. It is difficult to build robust machines with LEGO

***“Industrial robots and turning, milling machines are not ideal tools to use for learning by doing. LEGO is friendlier in that aspect ”***

since they tend to disassemble themselves. LEGO was tested as well as similar materials such as MEKANO. “We simply used an experimental approach, testing to build many different machines,” Björn explains.

### Contributing pedagogically

“We started out with a project plan which was built on and used what we already knew”, Björn says and continues. “The LEGO control

language and LEGO CAD designer were new to us and caused some extra learning activities”. The team also used components such as literature surveys, internet, design theory, discrete event simulation, trial and error for testing, CAD-models, video equipment, computers, and software programming within the project. Evaluation has been conducted through interviews and the validation of the factory has been performed by letting other students test the equipment. “The new pedagog contribution is how it enables us to allow the students to create, use, evaluate, schedule, improve, and analyze manufacturing systems hands on, as they would in real industry without needing full-blown production system,” Björn says.

### **Scaling up**

“Making a small test factory and producing anything as long as it is reasonably realistic was our first goal,” Hans describes. That goal has already been reached and they are now aiming the second round at increasing the robustness and the design of the machines themselves along with producing pedagogical training exercises to use in Chalmers courses. “In the short term, the project got a lot of attention and positive response, much more than we ever expected. However we need more time than half a year to set the scene for courses to utilize the results”, says Björn. At the moment the factory is used in a laboratory exercises but plans are to expand this idea a lot more. “In the long term, we plan to utilize it to present, convey and experiment for both educational, research and presentation purposes,” Hans explains. ■

# Sustainable Development – Integrated



Thomas Eriksson  
Signals & Systems

Communication Engineering offers specializations and career opportunities covering a wide range, from medical areas through traffic safety to communication in space. Engineers with sustainable development as a distinct part of their knowledge framework would have a tremendous impact on society. “Communication is a really important question when it comes to saving the environment, and new technology in the area of communication can have a great impact on, for instance, increase CO<sub>2</sub>-production”, says Thomas Eriksson, project leader of Sustainable Development.

“I realized earlier that while Communication Engineering was seemingly unrelated to the environmental questions, I could see connections in basically every course,” Thomas explains. The field of Communication Engineering relates its work towards the whole of society and as such it needs to evolve with society’s needs. Acting on what he saw as both a necessity and an opportunity, he launched a shift in the curriculum for the Master’s programme Communication Engineering. “I wanted to implement “sustainable development” into every single course in my program, and also into the program vision and the learning outcomes”, he continues.

## Individual planning for change

The project idea was introduced to the faculty through small seminars beginning with the Master’s coordinators connected to the programme.

*“ Perhaps the concept that sustainable development is visible in every single course, as a red line, can be considered as a new way of thinking ”*

As project leader Thomas has also met every teacher responsible for a course individually. “I planned meetings with the teachers to discuss with and support them on how

they could introduce sustainable development in their own course,” he explains. Thomas continues, “I also planned and carried out follow-up meetings with every participant”.

## Challenges within

“We met some challenges when discussing the involvement with teachers, who to some extent were unwilling to make changes in their courses,” Thomas explains. The field of sustainable development is a rather new field of research and is debated extensively when it comes to the dangers that may or may not lay ahead. “Some teachers felt that the question itself was of no interest, and that it is only an over-hyped issue,” Thomas continues, a notion that is not uncommon in today’s debate. Whatever the early differences, the faculty agreed on embarking upon the project and has followed through. “The strongest outcome is definitely that the project has made an impact on the course curriculum of many courses within the program,” says Thomas.

## Introducing sustainable development

When changing course curriculum, each course has incorporated research on sustainable development relating to each specific course subject. For example the introductory course has been given a section on “the role of communication in terms of sustainable development”. A few courses have introduced projects focusing on sustainable development where, for instance, one course has a project based on sensor network communication, where the sensors measure environmental variables. Other courses have focused on how their subject area can become more sustainable and still others have focused on how their subject can assist in developing sustainable methods, products, services and so on. “The advantages are obvious; a more environment-friendly master program, leading to more environment-friendly engineers”, says Thomas.



When changing course curriculum, each course has incorporated research on sustainable development relating to each specific course subject.

## New goals

The course in which sustainable development was introduced still have it on their agenda and the others are in the process of introducing it. The programme also has a new vision where sustainable development is part of the framework. “The fact that sustainable development is a part of the programme goal, means that it will continue to affect the choices made in the future development of the programme” says Thomas. Since the programme and the courses have changed their goals, the Director of the Master’s programme and the individual teachers are responsible to live up to these goals. “From a pedagogical point of view, I don’t know if my project contains anything new”, says Thomas. “But perhaps the concept that sustainable development is visible in every single course, as a red line, can be considered as a new way of thinking”, he concludes. ■





# Follow up



# Quality Assurance

**Quality assurance is a broad topic and even when restricted to the Master's education at Chalmers there are quite a few components involved. This section will focus on the activities conducted directly within the IMPACT project, but we will also present information about the context – programme accreditation and course evaluation – to provide a more complete view.**

## **Programme accreditation and course evaluation**

Before the IMPACT project started, a central committee reviewed all MSc programme proposals in 2005. The MSc programme curricula should follow a common format with six compulsory and six elective courses (all 7.5 ECTS) followed by a 30 ECTS MSc thesis. The programme descriptions had to conform to a CDIO-inspired template (CDIO = Conceive, Design, Implement, Operate) with learning outcomes for the programme and for all courses indicating where different parts were Introduced, Learned, or Applied. All material had to be in English so that local and foreign students have a common ground. For more details on this process, see Malmqvist and Arehag, 2007.<sup>1</sup>

Chalmers education in general has a continuous course evaluation process where student representatives and teachers meet three times: twice during the course and once to review a final questionnaire after the course. There is also a general programme evaluation process which we will not described here.

## **Goal refinement**

To assess quality we need to know the goal of the project. For IMPACT, the initial top level goal was to "improve MSc education" and at an early stage this was broken down into the 11 sub-goals describe in section.<sup>2</sup> These goals were then further specified to around 40 project templates which were used as the base for sub-project applications over the three years. Each sub-project application had to describe goal,

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<sup>1</sup>) Malmqvist, J. and Arehag, M., Experiences from using Integrated Program Descriptions to Support Program Development, Proc. 3rd International CDIO Conference, MIT, 2007.

<sup>2</sup>) For a detailed list of IMPACT Goals, please see page 5.

method, added value and evaluation and the final reports were later read and commented on by the IMPACT Steering Committee.

### **Involving many for lasting change**

IMPACT has focused on relatively small, teacher driven projects, to get many people involved. One reason for this is these projects mainly affect the people actually involved in the sub-projects. With many teachers involved this investment in competence increasing activities remains within Chalmers and will affect future courses, programmes and projects in a positive way.

### **Quality Assurance of IMPACT**

The IMPACT project is documented and evaluated in several ways:

- The sub-projects' reports and applications (23 in 2007, 50 in 2008, 38 in 2009). All these projects are mentioned in other parts of this report.
- The Steering committee evaluated and commented on all the reports.
- In December 2007 and 2008 all the vice heads of the departments answered a questionnaire about project development. The results strongly support the project group and steering committee:

<b>Question (abbreviated)</b>	<b>December 2007</b>	<b>December 2008</b>
IMPACT improved MSc programme's competitiveness.	82 %	100 %
Resources have been used effectively.	91 %	100 %
Information in IMPACT was most satisfactory.	100 %	93 %
IMPACT contributes to the fulfillment of its goals.	91 %	100 %

These results influenced the direction of IMPACT's focus in the project application procedure later on.

- In mid-2008 IMPACT initiated a self-evaluation of all the Master's programmes where all programme directors answered around 20 questions modelled around the IMPACT goals. The results of the self-evaluation have been used in the yearly follow-up meetings with Chalmers' engineering education and in the group interviews (see below). The same self-evaluation was conducted in 2009, and shows that we are moving in the right direction. The accumulated answers and an analysis have been collected in a report (in Swedish) with a summary below.
- All sub-projects 2008 and 2009 are quality assured through group interviews with project leaders, Vice Heads of Departments and IMPACT management (Patrik Jansson). The projects are grouped by department and for each project, a short description of the project, possibilities and strengths, problems, the contributions to IMPACT's top-level goals and possibilities of knowledge transfer to other parts of Chalmers is discussed. For each department, we go through the self-

evaluations of the associated Master's programmes and in 2008 we discussed the application for projects 2009 while in 2009 we discussed the documentation (this book). The interviews identified many opportunities for new collaboration and worked well as an arena for pedagogical discussions. We also identified three (out of 91) projects where work had not been started (due to personnel moving or being occupied with other tasks). The two departments involved returned the money in accordance with the contract.

- IMPACT has pushed for a yearly university-wide Master's student questionnaire and the first run has just finished with very positive overall opinions and many free-text answers (which have been analysed by the programme directors). Please see the Student Evaluation section (page 63) for a summary of the evaluation.
- IMPACT workshops with teachers and programme directors have been used to identify common goals and projects ideas and as an arena for exchanging pedagogical development ideas. See the Workshops & seminars section (page 71) for more details.
- A final external evaluation of the whole IMPACT project is included in Chapter 6/External evaluation.

### **Results from the self-evaluation 2008**

(questions – Q and answer summaries – A)

Q: What was the most positive aspect of IMPACT?

A: Many mention “buying time” for development, more contacts between teachers, coordination and collaboration and that the project has a simple and clear structure.

Q: What was less good with IMPACT?

A: Around 30% had no remark, 20% had remarks about different kinds of extra work (application, reporting, workshops, questionnaire, ...), 16% thought the sub-projects were too narrow and the rest had mixed comments.

Q: IMPACT's contribution to planning?

A: Around 30% think IMPACT contributed a lot (>50%), 20% emphasize contributions to diversity and sustainable development, 20% say that much was done before IMPACT started, 20% had other comments: teacher meetings, programme development, course development and 20% no comment. (The sum is > 100% because the alternatives overlap).

Q: IMPACT's contribution to implementation?

A: About 15% say marginal or no effect, 73% some effect (English, learning goals, course development, pedagogy development, examination forms) and 12% don't know.

Q: IMPACT contribution to programme evaluation and renewal?

A: About 40% say no or marginal effect, 51% some effect (contacts with industry, alumni, international contacts, English, etc.) and 10% don't know.

### Self-evaluation trend indicates real IMPACT

When the same evaluation was carried out in 2009 the free-text answers were similar, but the overall satisfaction was improved. Out of the 17 questions of type “0–100% satisfaction”, the average answers over all the Master’s programmes changed as follows:

- one third remained unchanged (within  $\pm 3\%$  points)
- one third improved with around 7% points
- one third improved with around 14% points:

No	Question	2008	2009
A4	Coordination with the engineering programme	59%	74%
A5	Diversity & sustainable development	46%	59%
B5	IMPACT's contribution to implementation	25%	38%
C2	Follow-up and further development of programmes	47%	62%
C4	Routines for administrative support for admission etc.	47%	62%
Ö1	Potential own goals	51%	64%

# Student Evaluation 2009

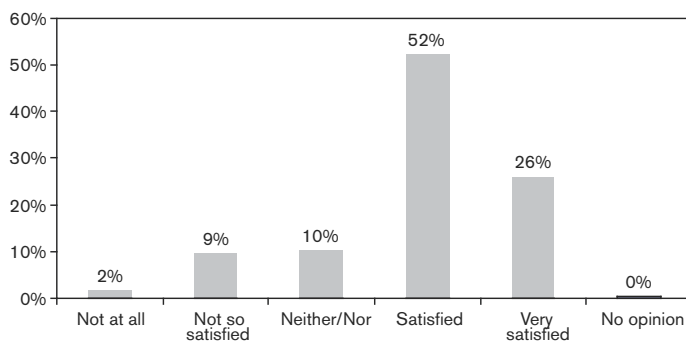
**Chalmers Master's Programme Student Evaluation 2009 was conducted during the spring of 2009 and targeted all current Master students. The purpose of the evaluation was to get a good understanding of the student's view of the Master's programmes. This knowledge could serve as the foundation for future post-IMPACT initiatives and help prioritize between activities aiming at improving the quality and perception of the Master's programmes.**

The evaluation was performed using a multiple-choice questionnaire consisting of a total of 33 questions covering the areas: Background and Introduction (7), Your own effort (1), Goals and goal fulfillment (4), Programme layout/structure/design (3), Programme administration (2), Study climate (8), Experience and suggestions (4), Master thesis and future (5, only applicable for students entering the programme in 2007). Here we summarize the main findings of the evaluation.

## **Summary of results:**

- Out of 2254 students receiving the questionnaire, 1284 (57%) choose to respond. For the multiple-choice questions, the maximum number of non-responders for a specific question was 30. The responders seem to be representative for the whole population of Master's students, at least with respect to sex (28% female and 72% male), year of entering the programme (44% in 2007 and 56% in 2008) and location for Bachelor degree studies (52% at Chalmers and 48% outside). Our interpretation is that the material collected is fairly robust and lends itself to interpretation despite 42% non-responders and the fact that no further analysis of non-responders was performed.
- In general the students are satisfied with the Master's programme so far, with 78% expressing positive opinions.  
A majority are satisfied with the programme directors (69%) and the support from the Student centre (69%).
- Most students have seen the goals of the Master's programme before (69%) and a majority thinks the goals are reasonable (72%), although some (32%) would like the goals to be expressed more clearly. Only

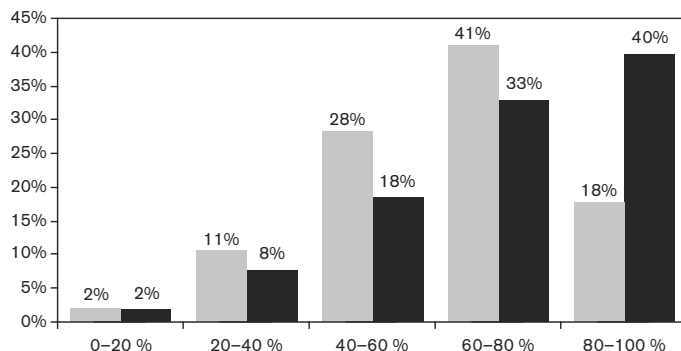




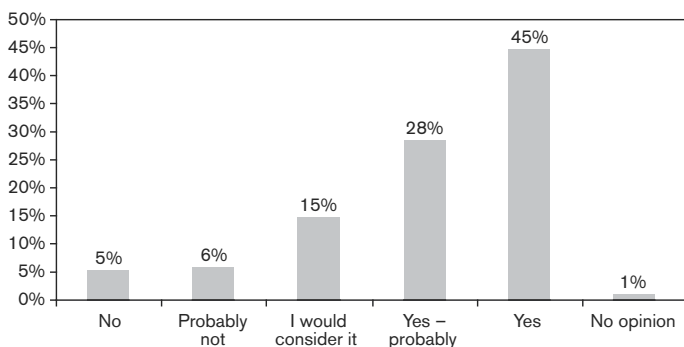
How satisfied are you with the Master's programme so far? (1277 responders)

a small minority (3%) thinks the goals are not at all fulfilled, while most students think they are almost or definitely fulfilled (59%).

- The programme curriculum is generally well received by the students and 65% are satisfied or very satisfied with it. However, 42% of the students would like to add some subject or course to the programme and 58% would like to revise or even remove at least one course. With that in mind, about a third of the students (36%) believe that the student opinions and course evaluations definitely have significant impact while only a minority (6%) believe they do not at all. The core courses are perceived as developing and deepening the student's knowledge, but the extent to which they do varies.
- In general the students are satisfied with the teachers at the Master's programme both with respect to their pedagogical ability, their ability to teach in English and the opportunities to come in contact with them.
- A vast majority (79%) think that their knowledge from their Bachelor degree is sufficient to attend the programme, while only a small fraction (6%) believe they had poor or very poor background knowledge. This lends the majority of students (68%) to spend between 30-50 hours/week studying at the programme. Only 10% spend less than 30 hours/week, while 21% spend more than 50 hours/week.

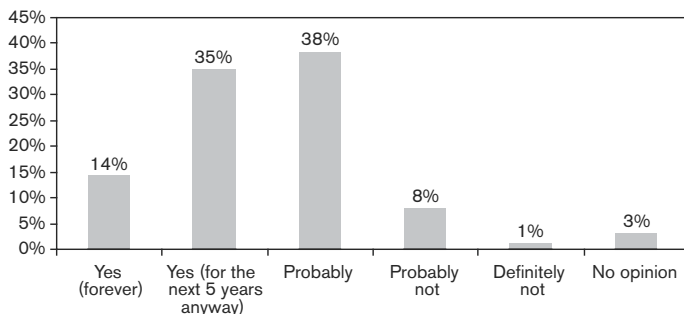


How large percentage (%) of the teachers in the core subjects within the Master's programme has:   
■ A good pedagogical ability (1261 responders)   
■ A good ability to teach in English (1269 responders)

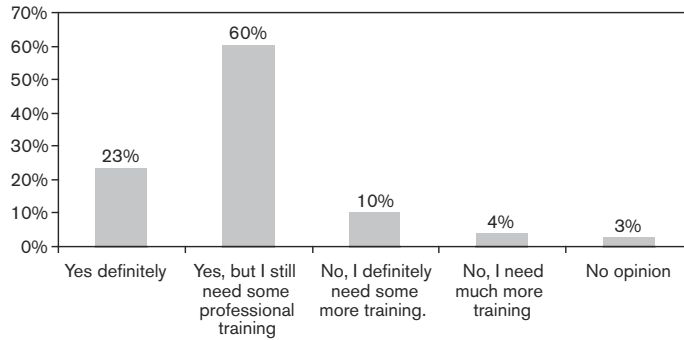


Considering your experiences from this programme, would you choose this programme if you could turn back time? (1272 responders)

- A majority of the students were satisfied with the information they had about the Master’s programme when they applied (64%) and the most common source for important information was the web (68%) followed by presentations by Master’s programme directors and teachers (29%), friends (28%) and other presentations/information within Chalmers (21%). This pattern seems reasonable given that about half of the students have their background outside of Chalmers.
- The first days of welcome by Chalmers and the staff at the Master’s programme when the students start is well perceived and 68% report they felt definitely welcomed or even thought the welcome was excellent.
- Most students (78%) are satisfied or very satisfied with the cooperation between themselves and their fellow students.
- When asked whether they would choose their Master’s programme again based on their experiences so far, 45% of the students say they would and 28% say they probably would, while only 11% report they would not or probably not.
- For 60% of the students, finding a suitable Master’s thesis seemed to cause no real obstacle, but 17% say that it was difficult, especially in industry. The quality of the supervision of the Master’s thesis is appreciated by the students and 59% are satisfied or very satisfied, while 12% are not so or not at all satisfied.



Do you think you will work in the same area as your Master’s programme?



Do you at this point feel prepared (from the Master's programme) for a professional career?

- The future after finishing their program was unclear to many students and 42% did not know what to do in the fall of 2009 and 22% had not yet decided. 18% of the students had already gotten a job while 19% were going to stay at Chalmers, either attending further studies (13%) or doing research (6%).
- The vast majority of the students think they will work within the same area as their Master's programme in the future and overwhelming majority (84%) feel prepared for a professional career, although 60% acknowledge the need for some professional training. ■

# Economic report 2007–2009

**This parts describe how the money was used for the project and how the resources was spread according to aims and goals of the project.**

Activity	Budget				Budget 2010	Total
	2007–09	2007	2008	2009		
Chalmers Foundation	30	10	12	8	–	30
Ingoing balance last year	–	–	0.6	1.1	0.5	–
<b>Total</b>	<b>30</b>	<b>10</b>	<b>12.6</b>	<b>9.1</b>	<b>0.5</b>	<b>30</b>
Development of MP (44)	22	7.9	9.8	6.85	–	24.55
Project leadership and administration	4	0.8	0.95	1	–	2.75
Information – Knowledge transfer	1	0.1	0.15	0.1	0.05	0.40
Evaluation – Quality assurance	0.5	0.05	0.15	0.1	0.15	0.45
<b>Steering committee priority projects</b>						
Competence development – English	1.5	0.3	0.25	0.3	0.25	1.10
Travelling – Spreading of results	0.4	0.05	0.05	0.10	0.05	0.25
Workshops	0.4	0.1	0.1	0.15	–	0.35
Reference group	0.2	0.1	0.05	–	–	0.15
<b>Total</b>	<b>30</b>	<b>9.4</b>	<b>11.5</b>	<b>8.6</b>	<b>0.5</b>	<b>30</b>
<b>Outgoing to next year</b>		<b>0.6</b>	<b>1.1</b>	<b>0.5</b>	<b>0.0</b>	<b>–</b>

## Distribution of project resources 2007–2009

<b>Resources divided into aims and goals of the project</b>	<b>%</b>	<b>MSEK</b>
Develop internationally competitive Master's programmes with clear goals for improving the knowledge and competence of students.	16	4.9
Coordinate the Master's programmes with Bachelor-, Bachelor Engineering and other Master's programmes and with graduate schools in a clear and well structured way.	15	4.5
Improve the connection within programmes by means of well defined learning outcomes and more visible common themes in the programmes.	14	4.1
Deliver all programmes and courses in English, using a pedagogy designed for active and life-long learning.	11	3.5
Ensure that the issues of diversity and sustainable development are considered in the delivery of the Master's programmes.	10	3.1
Strengthen the teachers' competence in terms of pedagogy and English communication.	6	1.9
Provide new learning resources in English that are more than mere translations of existing material.	4	1.1
Set up a format for feed-back from important stakeholders.	9	2.6
Design a system of assessment for the Master's programmes to be used in long term quality assurance.	3	0.9
Set up common arenas for experience sharing and/or other means of support for the promotion of pedagogical development.	10	3.1
Institute adequate administrative routines for programme support and, for example quality assured admissions.	1	0.3
<b>Total</b>	<b>100</b>	<b>30.0</b>

# Conference presentations

**IMPACT activities have been presented at different national and international conferences and workshops. In some cases the topic of presentation has been the set-up, organization and execution of IMPACT as a whole, and on other occasions the focus has been on specific sub-projects. The talks at the Quality Conference arranged by the Swedish National Agency for Higher Education concern the entire IMPACT project as does the contribution to the annual SEFI conference in 2009.**

## **Presentations during 2008**

- European Workshop on Microelectronics Education, Budapest  
*“A New Master’s Program in Integrated Electronic System Design”*  
Per Larsson-Edefors, Department of Computer Science and Engineering.
- Engineering Education in Sustainable Development, Graz  
*“To utilize student diversity to train the ability to change perspectives – experiences from a master level course on sustainable development”*  
Magdalena Svanström, Department of Chemical and Biological Engineering.
- Ingenjörsutbildningarnas utvecklingskonferens, 26-27 nov, Stockholm,  
*“IMPACT: Establishing the Bologna Structure with Master’s Programmes at Chalmers”*  
Claes Niklasson, Department of Chemical and Biological Engineering;  
Patrik Jansson, Department of Computer Science and Engineering;  
Per Lundgren, Department of Microtechnology and Nanoscience.

## **Presentations during 2009**

- Swedish National Agency for Higher Education Quality Conference, Stockholm  
*“A Facilitation Vehicle to Promote Master’s Programme development”*  
Per Lundgren, Department of Microtechnology and Nanoscience.
- European Society for Engineering Education (SEFI) annual conference, Rotterdam  
*“Pedagogical development of Master’s Programmes for the Bologna Structure at Chalmers – IMPACT”*

- Claes Niklasson Department of Chemical and Biological Engineering;  
Patrik Jansson, Department of Computer Science and Engineering.
- 42nd International Union of Pure and Applied Chemistry World Chemistry Congress, Glasgow  
*“Generic capabilities and diversity issues in a master’s level coordination chemistry course”*  
 Lars Öhrström, Department of Chemical and Biological Engineering.
  - International Conceive-Design-Implement-Operate Conference, Singapore  
*“Experience of and improvement of writing skills in a lecture based course in polymeric materials”*  
 Maria Knutson Wedel, Department of Materials and Manufacturing Technology.
  - Ingenjörutbildningarnas utvecklingskonferens, 2-3 dec Lund,  
*”Erfarenheter av PBL inom försöksplanering vid Chalmers”*  
 Claes Niklasson, Department of Chemical and Biological Engineering.  
*”Utvärdering av Chalmers nya Mastersprogram – Studentsynpunkter”*  
 Claes Niklasson, Department of Chemical and Biological Engineering;  
 Patrik Jansson, Department of Computer Science and Engineering;  
 Per Lundgren, Department of Microtechnology and Nanoscience
  - SPUCK, Lerum Aspenäs, Aug 2009  
*“Establishing the Bologna Structure with Master’s Programmes at Chalmers”*  
 Claes Niklasson, Department of Chemical and Biological Engineering.

# Workshops & seminars

**A series of workshops and seminars was initiated already before the official start of IMPACT, and at the end of the project eight gatherings of this kind had been conducted. The meetings were arranged by the project and were primarily targeted at the project leaders<sup>1</sup> participating in IMPACT. The foci have of course been the actual content and execution of the various sub-projects, providing an opportunity to discuss and share experience regarding all that pertains to running an IMPACT development project. During the course of IMPACT, the meetings have also been given a topical flavour depending on what was currently high on the agenda for the whole project. The meeting formats range from informal discussions during poster sessions to plenary talks by invited speakers. The ensuing description gives a short chronological exposition of all eight workshops and seminars.**

## **23–24 October 2006, Lökeberg**

This meeting was arranged before the first call for applications for funding of sub-projects within IMPACT. A large part of the discussions and work with the general IMPACT application to Chalmers Foundation had occurred during the meetings of all departmental vice-heads for undergraduate education, but this workshop was the first big gathering with exclusive focus on getting IMPACT going. Out of the 25 participants many were vice-heads.

The text of the approved application to Chalmers Foundation constituted the starting-point for formulating target areas for eligible sub-project applications. Most of the work was conducted in small groups with presentation of results for the whole meeting. The outcome of this meeting is directly reflected in the format for applying for IMPACT sub-projects. During this meeting, Marie Arehag contributed highly relevant conclusions from previous strategic development of the undergraduate education at Chalmers. This had particular impact on the discussion regarding quality assurance for IMPACT.

The constitution and management of IMPACT was consolidated at the meeting and the importance of transparency in overall project conduct was thoroughly stressed.

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<sup>1)</sup> i.e. Vice Heads of Departments and teachers responsible for sub-projects.



### **7 May 2007, Ullevi**

The commencing work meeting was characterized by the start up of IMPACT. Several invited speakers shared experience from previous work with getting international master's programmes up and running, including dealing with issues of cultural diversity, as well as describing preceding endeavours to integrate sustainable development as a serious topic within the frame of an engineering education. There was still plenty of time to discuss these issues in smaller groups. The number of participants was 26.

### **22–23 August 2007, Stenungsund**

In Stenungsund IMPACT attracted a crowd of 27 stakeholders comprised of sub-project leaders to engage in intense dialogue regarding ongoing projects presented in 16 posters. Admission to the new programmes and Chalmers' official view on international recruitment of students were topical issues of focus that were addressed. Time was set aside for informal discussions and sharing of the challenges and rewards of educational development.

### **3 October 2007, Chalmers**

In view of the explicit targeting of student diversity and sustainable development during the ensuing second year of IMPACT, this meeting was arranged to help inspire and support new project ideas and proposals within these areas. Magdalena Svanström conducted a seminar to promote project planning for sustainable development and Helena Danielsson was responsible for a similar seminar to support the upcoming project dealing with diversity in the student population.

### **22 April 2008, Chalmers**

52 IMPACT projects were on poster display on Chalmers Johanneberg campus at a meeting with sub-project leaders, departmental vice-heads for undergraduate education and other guests. The Vice-President for Undergraduate Education at Chalmers, Sven Engström, stressed the strategic importance of the Bologna process for Chalmers in the opening address, and Dr. Erik De Graff from the Technical University of Delft in the Netherlands was invited to talk about their work with development of pedagogic projects. The workshop also comprised three seminars on sustainable development, diversity and the link to industry in the Master's programmes. Selected projects were presented at the seminars.

### **26–27 August 2008, Särö**

At the Särö workshop, a thorough overhaul was carried out instigated by the first assessment of IMPACT in the form of participants' self-evaluations and interviews conducted by IMPACT management. During the work in small groups suggestions for future IMPACT priorities were extracted in view of the outcome of the entire project so far in comparison to the original project description. Master's thesis projects

and synergetic collaborations are two examples of areas that emerged during this scrutiny.

### **23 April, 2009, St. Jörgen Park Resort**

Approximately 50 participants arrived in time for lunch on this beautiful spring day. Besides collective information concerning the upcoming need for work with the final project documentation (in particular this very book) the day was devoted to group discussions in two different permutations, with a change of groups midway in the session. One of the main items to discuss was the selection of particularly relevant and interesting projects for further promotion in terms of spreading information (not the least as part of this very book). Another important issue was suggesting topics for the final IMPACT workshop in November.

### **23–24 November, 2009, Sjöbacken**

The final meeting revolved around “the life after IMPACT”, where four main points were targetted: remaining challenges for the Master’s Programmes, current pedagogical needs in the undergraduate education as a whole at Chalmers, critical aspects for the success of the new Chalmers Learning Centre, and finally securing the appropriate weight of professionally relevant general engineering skills and capabilities in the engineering education. The first three issues were introduced by Professor Lennart Löfdahl (Dean of Education), Clara Tholin (head of the Unit for Educational Affairs of the Student Union at Chalmers), and Associate Professor Magdalena Svanström (director of Chalmers Learning Centre), respectively. Before the fiftysome participants engaged in group discussion there were presentations of three selected projects, including a display and demonstration of the LEGO mini-fabrication unit from the MINI-FAB project. During the second day of the workshop accounts of IMPACT assessment were presented, and the final discussion was hosted by Chalmers Vice President, Professor Sven Engström. ■



# Department documentation



# Department of Applied Mechanics

Vice Head of Department Peter Folkow

## Introduction

The Department of Applied Mechanics comprises educational and research activities ranging from purely theoretical to applied aspects of mechanics. Among the several different branches of industries that are collaborating with us, the automotive field is especially important. The department consists of five divisions: Combustion, Dynamics, Fluid Dynamics, Material and Computational Mechanics, Vehicle Safety. We are hosting two international Master's programmes: *Automotive Engineering* and *Solid and Fluid Mechanics*.

- *Automotive Engineering* has been operating in different versions for a decade. The aim of the programme is to prepare students for a professional career within the automotive engineering field. There are three tracks within the programme (Powertrain, Safety and Vehicle Dynamics), and the staff involved in the programme courses are mainly from the divisions of Combustion and Vehicle Safety.
- *Solid and Fluid Mechanics* was introduced in 2007 and focuses on modeling, computational and experimental issues in applied mechanics. The programme comprises three tracks (Computational Solid Mechanics, Fluid Dynamics and Structural Dynamics) and the courses are generally developed and taught by teachers from the divisions of Dynamics, Fluid dynamics, and Material and Computational Mechanics.

For the last three years, both programmes have maintained a constant level regarding the number of students; on average about 40 students each. Automotive Engineering has a more international environment with approximately 50% foreign students, while Solid and Fluid Mechanics has only 20% foreign students.

## Collaboration

In 2005 three former departments (Machine and Vehicle Design, Applied Mechanics, Thermo and Fluid Dynamics) were merged into one new department, Applied Mechanics. This resulted in collaboration activities within the department in general, and during development

of our new Master's programmes in particular. In the latter case, the interests from the three former departments had to be taken into careful consideration when developing the two Master's programmes. Consequently, each new programme now involves tracks related to at least two former departments. It is therefore natural that much of the IMPACT projects have been directed towards programme development. Various sorts of collaboration activities were held during the programme development process:

- Meetings among teachers within each programme.
- Meetings among teachers within each track.
- Meetings with relevant industrial representatives for each programme.

Among our IMPACT projects, two have been directed towards collaboration issues, TillMek-expdesign and INTAM. The former dealt with cooperation between two departments, while the latter considered cooperation with industry.

### **Program development**

As mentioned above, programme development has been the main issue at the department. The IMPACT projects in question are TillMek-07, TillMek-08, MPAUT09, TillMek-FA2, and AktivLabb-Fas2. The three first considered development of:

- Both programmes in general (TillMek-07).
- Automotive Engineering programme (TillMek-08).
- Safety track within Automotive Engineering (MPAUT09).

The TillMek-FA2 project dealt with installing new laboratory devices, which was further developed in AktivLabb-Fas2.

### **Diversity & internationalisation**

Both programmes dealt with these issues at different levels, such as developing project courses where students from different cultures work together. This is particularly the case for the Automotive Engineering programme where much of the courses involve working in groups. Moreover, the student group is diversified with more than half of the group coming from abroad. The IMPACT project TillMek-GM1 carried out within the Vehicle Dynamics track at the Automotive Engineering programme considered cultural aspects related to traffic safety.

### **Important results**

The major impacts from the IMPACT projects are:

- Development of new programmes with contributions from all teachers within each field.
- Initiating and construction of new laboratory devices used at bachelor, master and research levels.
- Enhanced contacts with industry, especially concerning Master's theses (internships).

## Future development

The department will continue improving the two Master's programmes. Recently, both programmes have set up programme advisory teams with representation from industry, faculty and students. In addition, each programme is continuously working on improvement of the programme descriptions; especially concerning the choice of focus within each track.

The laboratory projects initiated through funding from IMPACT have acquired new premises, financially supported by the department. There are ongoing activities to enhance the course involvements in this laboratory. The INTAM project concerning internship will continue to develop. ■

## Project table

Year	kkkr	Project title
2007	360	Projektansökan, Tillämpad mekanik (Programme development). TillMek-07
2008	240	Programutveckling, Tillämpad mekanik, TillMek-08
2008	100	Aktiv vibrationsstyrning Labb, TillMek-FA2
2008	100	Breaking cultural barriers in automotive education – (Auto-Culture), TillMek-GM1
2009	200	Aktiv vibrationsstyrning Labb – Fas 2, AktivLabb-Fas2
2009	100	Automotive09 (Programutveckling), MPAUT09
2009	200	Utveckling av simulator för optimering av motorrigg i form av problem-baserat projekt – samutnyttjande över institutionsgränser av befintlig kurs i försöksplanering, TillMek-expdesign
2009	200	Internship Applied Mechanics, INTAM
<b>Total</b>	<b>1500</b>	



# Department of Applied Physics

Vice Head of Department Göran Wahnström

## Introduction

The Department of Applied Physics is active in teaching on all levels. We offer three Master's programmes, Applied Physics (AP) and Complex Adaptive Systems (CAS), and Nuclear Engineering from 2009. The latter has not been involved in the IMPACT project. We are also involved in one of the specializations in the Biotechnology Master's programme.

The department is also active and strong in research. We are major participants in the Nano and Materials Initiatives at Chalmers and contribute to the Energy Initiative. The international environment is natural for us and the gender balance at the department is very good.

## Collaboration

We have close collaboration with the University of Gothenburg (GU) and the two Master's programmes are in practice carried out jointly with GU. All Master's courses are run both at Chalmers and at GU and essentially identical programmes have been constructed at the two universities. We have a well developed system for sharing teachers among the two physics departments at Chalmers, Applied Physics and Fundamental Physics, and with the Department of Physics at GU. This is managed via "Fysicum". Teachers from Applied Mechanics and Energy and Environment are also involved in the CAS programme.

We have developed shared courses for the two Master's programmes and some of the courses are also used at the doctoral education level. Many of our elective courses now attract a substantial amount of students from other Master's programmes and we are responsible for one of the specializations in the Biotechnology programme. In collaboration with the Chalmers Centre for Computational Science and Engineering (C3SE) we have developed a course for both Master's programmes to increase awareness of the power of computational tools.

## **Programme development**

The Master's programme Applied Physics was new. We have put effort into creating attractive courses and establishing a consistent focus on the engineering perspective of Applied Physics.

A team of teachers has been involved in planning and developing the programme. We have strengthened laboratory and computational elements in several courses and developed a course in nanotechnology for sustainable energy. Creative problem-solving (TRIZ), project planning and entrepreneurship have been introduced in two new courses during the second year, jointly for the two Master's programmes. The number of students in the Applied Physics programme has substantially increased during the first three years and we now view this as a highly competitive Master's programme.

The Complex Adaptive Systems (CAS) programme was an established, successful international Master's programme with clear focus on complex systems and an interdisciplinary touch. The programme has been further strengthened and developed and we have made use of the possibility to give courses jointly within the two programmes. The number of students is very good as well as the mixture of national and international students. We have recently been successful in creating an Erasmus Mundus Master's programme in Complex Systems together with Warwick, Ecole Polytechnique, and the University of Gothenburg. This will further strengthen the programme.

## **Diversity & internationalisation**

The diversity and internationalisation of the Complex Adaptive Systems programme is well developed. We would like to further strengthen the internationalisation of the Applied Physics programme by making use of our international contacts in research to establish fruitful collaborations with other universities at the Master's level.

## **Important results**

By creating attractive courses and establishing a consistent focus on the engineering perspective of the Applied Physics programme we have been able to develop a very competitive Master's programme. We have created a team of teachers which has been involved in planning a full programme, not separate courses, on the Master's level. We have been successful in creating an Erasmus Mundus Master's programme in Complex Systems together with Warwick, Ecole Polytechnique, and the University of Gothenburg. This will attract good international students to the Master's programme Complex Adaptive Systems.

We have strengthened laboratory and computational elements in several courses and developed a course in nanotechnology for a sustainable energy. Creative problem-solving (TRIZ), project planning, and entrepreneurship have been introduced in two new courses during the second year, jointly for the two Master's programmes. An effective

administrative support has been created and we have been able, in practice, to hold our Master's programmes jointly with the University of Gothenburg.

### **Future development**

In the future we want to develop better contact with relevant industry and other activities outside academia and create better feedback to our Master's programmes. We would like to make more use of our international contacts in research to establish fruitful collaborations with other universities at the Master's level.

### **Conclusions – recommendations for the future**

We would like to continue and further develop our Master's programmes. The economy put pressure on the number of courses that can be given. It is and will be important to collaborate actively with other Master's programmes. ■

### **Project table**

<b>Year</b>	<b>kkkr</b>	<b>Project title</b>
2007	360	Programutveckling, AP och CAS
2007	8	Akut rekryteringsinsats
2008	140	Industri och experiment TF
2008	140	Samverkan
2008	100	Internationalisering
2008	100	Hållbar utveckling
2009	200	Det avslutande året
<b>Total</b>	<b>1048</b>	

# Department of Architecture

Vice Head of Department Inga Malmqvist

## Introduction

Architecture has from the start had only two Master's programmes and a huge number of students. Therefore a central idea for one project each year has been to develop collaboration between the two programmes. Thus these three projects are presented together.

- Master's programmes in Architecture - ArchMas (2007).  
Project leader Inga Malmqvist
- Cooperating Master's programmes in Architecture - CoArchMas (2008). Project leader Inga Malmqvist
- 4 Master's programmes in Architecture - 4arch (2009).  
Project leaders Sten Gromark and Jaan-Henrik Kain

## Collaboration

Within the department the two programmes were in focus during the whole time of IMPACT projects. The first year the project also included a study of collaboration with the Design Construction Project Management programme. New courses have been developed to facilitate this collaboration.

## Programme development

The programmes Architecture and Design for Sustainable Development have been continuously developed as mentioned above. For 2009, two new Master's programmes have been introduced, Interior Architecture and Architecture and Technology.

### ***Development of Sustainability in different contexts – Desus (2008)***

Project leader Björn Malbert and Jaan-Henrik Kain

A concretization of Chalmers' goals, ecological and social as well as economical, was done. The aim to increase the international exchanges was achieved. For the implementation speaker experts outside Chalmers were invited. The added value is that it strengthened Chalmers' profile of sustainable development and its international exchanges relating to the subject.

### ***Housing Investigations – Visions of Residential Futures – Housing (2008)***

Project leader Sten Gromark

The objective was to develop the direction of Housing issues and also strengthen interconnection with postgraduate studies in the Department of Housing. Implementation was achieved by translation reorganization of the literature, and the development of the Nordic/Baltic Research Consortium Residential spaces and home culture.

### ***Urban futures – Ethnical diversity – Urban 2008***

Project leader Knut Strömberg

The goal of Gender and Diversity is increased collaboration between students from different cultures in the Master's programmes within Architecture. We developed a curriculum that works for students with diverse backgrounds in ethnicity, culture and even topic focus. The added value is students' understanding of content and knowledge objectives for the various stages. The combination of Master's programmes benefits teachers', course managers' and students' understanding of how the various elements interact to build stronger professional skills up through the examination.

### ***External stakeholders – ASE (2009)***

Project leader Jaan-Henrik Kain and Inga Malmqvist

The objective of this project has been increased understanding of program content, increased number of participants, developing greater choice and flexibility to develop and stabilize the networks essential to our practice of close teaching, including theses. Implementation will progress through teachers' identification and description of the network and forms of collaboration necessary for proper development of the departments' Master's programmes. The outcome we strive for is better value-added contacts with customers, engaging and structured theses and better cost-efficiency.

### ***Design for sustainable development – DSD09 (2009)***

Project leader Jaan-Henrik Kain

In this ongoing project we are currently developing a studio in the suburb of Hammarkullen. We aim to operationally integrate gender and postcolonial issues into the Master's programme during the academic year 2009-10. Implementation takes place, in the studio, in the form of networking. Concrete cooperation activities with University of Gothenburg include the development of course curriculum in the form of teachers' literature studies and development of course modules that include gender theory and postcolonial theory. Added value will be developed through interaction with University of Gothenburg, deeper exchange of knowledge and greater opportunities for dialogue among students.

### **Diversity & internationalisation**

As there were only two programmes to cover all the different issues and fields within the area of architecture, they are in themselves

diversified. In addition, one programme is open for students with backgrounds outside of Architecture or civil-engineering, adding to the skills diversity among students. More than 50% of the students are international students and many of them come from other European countries. Hence all student-groups are mixed in a way that takes into account educational background, nationality and gender.

### Important results

Strong connections in the architecture programme are achieved with common aims and visions. Active and life-long learning has been established in courses. The process of inventing relevant course material is ongoing. Aspects of sustainability regarding ecological, financial and social dimensions are in focus for all coursework at the department, as well as in research, and the social dimension includes the gender aspect. Feedback forms from different stakeholders or interests in society are evaluated and developed during the ongoing project this year.

### Future development

The development of programme collaboration is an ongoing process, and organization must be constantly evaluated. An external person with good insight has been engaged to go through all parts of our Master's programmes and suggest ways to improve organization. The form for evaluation of architectural education, the so called "critics", is a subject for research at the Department of Pedagogy, University of Gothenburg, and will be presented later this year.

### Conclusions – recommendations for the future

We need to ensure the competence of teachers both regarding pedagogical issues and language. Developed arenas for sharing of knowledge are established. We find that support is needed not only from engaged teachers but also from University management. ■

### Project table

Year	kk	Project title
2007	140	Masterprogrammes in Architecture
2008	240	Cooperation masterprogrammes in Architecture
2008	100	Desus – Development of Sustainability in different contexts
2008	200	Housing Investigations - Visions for residential Futures
2008	100	Urban Futures – Ethnical Diversity
2009	200	4 Masterprogrammes in Architecture
2009	200	Stakeholders – Studios – Diploma Work
2009	200	Design for sustainable development
<b>Total</b>	<b>1380</b>	

# Department of Chemical and Biological Engineering

Vice Head of Department Claes Niklasson

## Introduction

The Department of Chemical and Biological Engineering (CBE) is the largest department at Chalmers with over 200 PhD students and about 60 faculty and 35 administrative/technical staff. Our research ranges from fundamental Chemistry and Biotechnology through more applied sciences such as Food Science, Surface Chemistry, Forest Products, Environmental Sciences and Chemical Engineering. The overall department activities are research dominated (about 85% of financing) but have a long tradition of undergraduate and graduate teaching in a number of First degree and Master's Programmes (MP) at Chalmers. The department offers four different Master's programmes (MP enrollment 2007/2008/2009).

- Biotechnology (35/53/45)
- Chemistry and Bioscience (8/21/21)
- Innovative and Sustainable Chemical Engineering (40/39/36)
- Materials and Nanotechnology (16/24/39)

The Master's programmes range from fundamental research-based to more applied chemistry, biotechnology and chemical engineering subjects in collaboration with industry. The percentage of international students is about 40 % on average for all 4 MPs (ranging from 33-48 %, 2008).

The Department of Chemical and Biological Engineering has implemented 15 projects financed by IMPACT over the past three years. The projects have had diverse focus areas but initially the development of new English course material and the development, coordination and implementation of the programme structures were prioritized. Coordination and improvement of courses included in several programmes was also on the agenda. Due to the large number of international students in our programmes, diversity and sustainability issues have become fundamental for many projects in all stages of IMPACT.

## Programme development

Collaboration between the programmes/courses (project 2, see project table below) and MPs at other departments and with the University

of Gothenburg became an important issue on the agenda throughout the development and implementation of our MPs. Collaboration with industry in applied subjects was developed in several projects, combining teachers from industry with applied problem-solving for example, in the area of Process Analytical Technology, PAT (8). In this course AstraZeneca contributed actively in developing and implementing a highly relevant subject such as sensor technology.

The invitation of companies, teachers and students to Master's thesis project generation workshops has been successful and appreciated by the students. One very effective project managed to produce cooperation around the subject of medicine and pharmacy by allowing student with different backgrounds coming from different MPs within the department to enter the same end track of their MP studies (7).

Historically the Biotechnology Master's programme had very little cooperation with industry, however some new collaboration concepts were developed and implemented. In this programme specialists from industry became involved in relevant courses. This presented new areas of research and knowledge and has been a successful strategy. Financial support from IMPACT was the necessary catalyst for this process. Arenas for collaboration within and between teacher teams were also developed in a number of projects.

#### ***Teacher competence in terms of pedagogy and English communication***

A number of projects dealt with developing course material to increase deep learning for students often using nontraditional teaching methods. This not only increases the quality of course content and the learning outcomes connected to the examination procedure (testing to measure acquired knowledge and competence through constructive alignment) but also functions as a forum for competence building for the teachers involved.

Much material had to be translated into English in the beginning. Native English teachers within the department were used for this translation and transformation processes in a number of courses (1). The majority of teachers in our department were from the beginning quite good at English communication so teaching in English was not considered a prioritized area for projects in our department.

#### **Diversity, internationalisation and sustainable development**

In the area of sustainable development, several projects were successfully executed. Realistic examples with implications for sustainability were introduced using nontraditional approaches both externally and through problem solving techniques and training (3, 9).

The use of heterogeneous groups with a well planned learning strategy was developed and implemented in several projects (4, 6, and 13). The two first courses in one of our Master's programmes implemented the integration strategy of mixing groups with great success. The use of diversity among student groups resulted in increased learning for



everyone; it is a known strategy that is frequently used. Evaluation of these projects conducted through questionnaires and interviews shows good results.

Alternative forms examination for different student groups was examined as a learning strategy in a project in the area of Chemical Reaction Engineering. This is very promising since all student groups will benefit from it.

The introduction and development of a Mentor program in MP Chemistry and Bioscience was also an effective way to integrate international students into the Swedish university and course system.

### **Future development**

The Master's programme at the department was evaluated through a large questionnaire resulting in a very good assessment on a number of questions such as English teaching, pedagogic methodology of our teachers, programme content and planning/implementation, as well as the number of industry cooperation projects.

All in all, the IMPACT projects have in general been very successful and have significantly contributed to the total quality assurance and performance of our Master's programmes. The ambitious level of work our teachers have put into all these projects is impressive. The department is very fortunate in having so many brilliant educators within our faculty. The teachers have presented the results at a number of international conferences all over the world. The IMPACT project has certainly put Chalmers (and CBE) on the map as one of the leading learning universities in the Nordic countries.

### **Conclusion – Future work**

Project resources have been efficiently used for the development of quality assured competitive programs at the Department of Chemical and Biological Engineering. Without these resources many of the projects would never have existed. On national and international levels, our Master's programmes are very competitive. So far so good, but the work must continue. The department would especially like to work with the issue: Master's thesis work (6–12 months) in direct cooperation with research groups and industry. Further cooperation between existing programmes/courses must also be emphasized. ■

## Project table

Year	kkkr	Project title
2007	360	Översättning av kursmaterial till god och pedagogisk engelska (1)
2007	360	Programutveckling KB (2)
2008	100	Hållbar utveckling i kurser ingående i mastersprogrammet "Materials and Nanotechnology" (3)
2008	100	Heterogena studentgrupper ett potentiellt mervärde för inläring av hållbar utveckling inom koordinationskemin (4)
2008	100	Införande av mentorprogram och seminarierier på mastersprogrammet för kemi och biovetenskap (5)
2008	100	Kartläggning av mångfald för utformning av undervisning som gynnar lärande för hållbar utveckling (6)
2008	280	Samordning av utgångar på mastersprogrammen "Chemistry and Bioscience" och "Materials and Nanotechnology" (7)
2008	100	Utformning av generiska projekt som stöd för röda trådar och industrikoppling inom ett masterprogram (8)
2008	100	Lärar och kurssamverkan som stöd för Hållbar utveckling (9)
2008	280	Masterprograms samverkan med näringsliv (10)
2009	100	Vad vill industrin med mastersprogrammet "Materials and Nanotechnology" (11)
2009	200	Alternativa examinationsformer – "A learning strategy" för heterogena studentgrupper (12)
2009	100	Att utnyttja mångfald i studentgrupper i undervisningen (13)
2009	200	Chemistry and Bioscience: Programutveckling/avnämarperspektiv (14)
2009	200	Strategic development of the master's program Innovative and Sustainable Chemical Engineering – strengthen the product and global positioning (15)
<b>Total</b>	<b>2680</b>	

# Department of Civil and Environmental Engineering

Vice Head of Department Björn Engström

## Introduction

The Department of Civil and Environmental Engineering is active with research and education within planning, design and operation of the built environment. The activities are related mainly to one branch, the sector of the built environment, but the research field is broad and represents various different competences, such as geo and water engineering, structural engineering, building technology, applied acoustics and construction management. Today environmental care and sustainable development are of major concern in research as well as in education. Our activities are carried out in close interaction with companies, authorities and other organisations in the construction branch. The department is organised in six divisions, each consisting of two research groups. There are four Master's programmes within the field of Civil Engineering and these are closely related to the various research profiles at the department. The Master's programmes are:

- Design and construction project management
- Geo and water engineering
- Sound and vibration
- Structural engineering and building performance design

The department has close cooperation with the departments of Architecture, Energy and Environment, Applied Mechanics and Technology Management and Economics and those departments also contribute with courses to our Master's programmes. In total about 180 students study in the four programmes in each grade every year, including international exchange students. About one third of the students are international students, admitted to the programmes or exchange students.

During the period 2007–2009 no fewer than 11 IMPACT projects have been carried out at the department, with a total budget of about 2,5 M SEK. The first year the projects were related to development of the first semester consisting of compulsory courses. Projects during the second year were directed towards development of pedagogy and quality work and interaction within teachers' teams. During the third year projects were used for evaluation, quality assurance and consolidation of the

Master's programmes. In addition, it has been possible to realise a number of smaller projects proposed by individual teachers. Every year each of the four Master's programmes has been involved in at least one IMPACT project.

## **Collaboration**

One individual project (BoM-VÄG) concerned national collaboration and coordination of education in the field of "road and traffic". Here collaboration was a main goal of the project. The idea was to coordinate development of course material and profiling at different universities, but also to offer a range of specialised courses to students at other universities through distance learning, movable teachers or movable students.

Several other projects have involved extensive collaboration across different types of organisational borders, even if this was not the main goal of these projects. Through the projects BoM-BAS, BoM-ped and BoM-Q teachers from different courses came together, interacted and developed common approaches for development of programmes and pedagogy. In BoM-BAS and BoM-Q teachers from different research groups, from different divisions within the department and from different departments interacted.

During the whole development period there have also been regular meetings between the Vice Head of the department and the directors of the Department's Master's programmes. Common problems have been discussed and solutions have been worked out together. Hence, there has also been organised collaboration between the Master's programmes. IMPACT projects have been discussed and also proposed within this group. In this context there has also been regular contact with the staff at the supporting Student Centre 'Olgas trappor'. The projects BoM-QA and BoM-AIL, from the past year, have mainly been carried out by the programme directors. However, these projects have been coordinated and managed through meetings with the programme directors.

## **Programme development**

Programme development has been of major concern at the department and most of the IMPACT projects have been used for this aim. During the first year BoM-IPC and BoM-BAS were used for development of the first semester of compulsory courses. Two quite new introductory courses were developed: "Modelling and problem solving in civil engineering" for the programme "Geo and water engineering" and "Building in society" for "Design and construction project management". In the "Sound and vibration" programme packages of course material for individual studies were developed for the "Individual preparation course". In the programme "Structural engineering and building performance design" interaction between the four compulsory courses was planned with several links between the courses and common activities.

During the second year, through the project BoM-Q, the teachers' team in the programme "Geo and water engineering" worked with implementation of "sustainable development" in the programme. Within the same project, the teachers' team in the specialisation "Building performance design" worked with the identity and profile of this branch, recruitment of students, progression in the programme, links between courses and information material.

In the project BoM-ped the teachers' team in "Design and construction project management" worked with development of the pedagogical approach in the programme, "action based learning", and documentation of their experiences. The same project was used to develop the pedagogy of the course "Room acoustics" in "Sound and vibration". The course was developed to fit an international competition for student projects and at the same time architectural students were invited to take part in the course and the project work.

During the past year, the project BoM-QA has been used to evaluate all four Master's programmes, in order to learn from experience, correct mistakes and initiate further improvements. There has been interaction with students, companies, teachers in the teachers' teams and the programme descriptions have been reconsidered, discussed and developed further. In parallel, through the project BoM-AIL, all programmes have developed a strategy and plan with regard to learning for professional work and this strategy is incorporated in the programme descriptions.

Most of the individual projects also concerned development within the Master's programmes. In BoM-DSSU the teacher developed and tested a discussion forum as an educational tool in his course 'Steel structures'. The learning platform "Ping-Pong" was used for the first time and the course became one of the pilot courses at Chalmers for implementation of "Ping-Pong". In the course "Environmental analysis of water" the project BoM-EWA was used for course development with regard to "sustainable development". In the project BoM-FEM one teacher arranged student projects with computer exercises concerning finite element analysis in a chain of four elective courses within the specialisation "Structural engineering". The idea was to relate the projects to each other in an organised way in order to attain progression in learning. In the project BoM-KTlab one teacher planned for experimental work in the same courses, also arranged with regard to progression and continuity between the courses.

### **Diversity and internationalisation**

Over several years the department was involved in the old types of 1.5-year international Master's programmes. Especially in the old programmes "Sound and vibration" and "Structural engineering" we had very good experiences of mixing international and Swedish students. Therefore the department had no doubt in supporting the

decision to develop new two-year Master's programmes with teaching in English and admittance of international students. Of course there are some disadvantages with teaching in English, but the advantages of an international study environment are more important. According to our experiences both teaching in English and the international study environment are appreciated by the students. In all our Master's programmes we have up to now succeeded in having a considerable group of international students. The teachers and Swedish students are very concerned about keeping a sufficient amount of international students also in the future.

None of the IMPACT projects have been directed towards diversity and internationalisation, mainly because we had experience already from the previous period.

### **Important results**

To develop new Master's programmes where courses are arranged in chains according to a programme idea, to develop new courses, and to adopt previous courses to the new situation within a limited period of time have all been a major challenge for the department. The most important value of the IMPACT projects has been the extra resources, which made the transition easier to carry out. People involved got more time for preparation and interaction. Through the projects it was also possible to increase the ambition and add values to the programmes. The most important results are well developed Master's programmes and increased interaction within the teachers' team and between programme directors. This is a valuable basis for further development in the future.

The projects have mainly been related to IMPACT goals "Development of competitive programmes"(1), "Improved connections between courses"(3), "Pedagogical approach in programmes"(4), "Methods for evaluation and development"(9) and to some extent to "Implementation of sustainable development"(5).

### **Future development**

Even if we have the feeling that the programmes now are under our control, it is necessary to work with continuous development in the future. Programme development has started successfully, but not ended. What goals must be fulfilled with regard to the MSc degree in Engineering and what should the Master's programmes deliver to the five year Civil Engineering programme, especially in transformation to a unified 3+2 year system? The learning outcomes of the programme and the learning outcomes of courses can be better related and developed. Programme descriptions and learning outcomes can be further developed with regard to the "CDIO" concept. Furthermore, interaction with companies is necessary for developed learning for professional work. Not least in regard to "sustainable development", interaction with companies is needed. How will the market react to future challenges in this respect? This information is necessary to motivate students and avoid

an overly academic approach. Moreover, the courses can be further developed with regard to ‘constructive alignment’.

### Conclusions – recommendations for the future

The IMPACT projects have supported the department in developing the new Master’s programmes and have added values to the programmes. In general the IMPACT projects have been quite necessary in order to encourage the teachers to carry out the necessary work.

The transition to the new education system has been successful, but development must continue in order to achieve competitive programmes of high quality also in the future. We have many ideas for further development, but resources are needed. In this context it is important that the role of the programme directors as ‘programme leaders’ is recognised and that more time can be allocated to this leadership. Also the administrative support of the programme directors needs to be developed. ■

### Project table

Year	kkkr	Project title
2007	180	Advanced learning through ‘Individual preparation course’, BoM-ICP
2007	540	Introductory block as a basis for further studies, BoM BAS
2008	280	Development of pedagogy that stimulates student’s learning, BoM-ped
2008	280	Programme development for improvement of quality, BoM-Q
2008	100	Discussion forum as a supporting tool in education, BoM-DSSU
2008	100	Integration of the concept ‘sustainable development’ in the course ‘Environmental analysis of water’, BoM-EWA
2009	100	Integration of FEM-projects in a chain of courses, BoM-FEM
2009	200	Quality assurance of master’s programmes at Civil and Environmental Engineering, BoM-QA
2009	400	Learning for professional work within master’s programmes at Civil and Environmental Engineering, BoM-AIL
2009	100	Integration of laboratory work in a chain of courses, BoM-KTlab
2009	200	National coordination of education at master’s level within the field of ‘road and traffic’, BoM-VÄG
<b>Total</b>	<b>2480</b>	

# Department of Computer Science and Engineering

Vice Head of Department Christer Carlsson

## Introduction

The Department of Computer Science and Engineering (CSE) at Chalmers is alive with research activity, characterised by its high quality and breadth of scope. Our research ranges from software to hardware, with a vibrant interplay between theory and practice, and interactions with many branches of science and engineering. When it comes to technology we're right there on the cutting edge. The department has a truly international flavour, with teachers, researchers and PhD students from 30 different countries. This forges a dynamic and open minded research environment, and we have research groups of international repute in many fields. We offer the following six international Master's programmes:

- Integrated Electronic System Design: "Why does a cellphone run out of battery?"
- Networks and Distributed Systems: "Getting 100 computers to work together in vehicles of the future!"
- Secure and Dependable Computer Systems: "Can you trust computers?"
- Computer Science: Algorithms, Languages and Logic: "How does Google find the links so quickly?"
- Software Engineering and Technology: "Why does software crash?"
- Interaction Design: "Creating the interactive systems of tomorrow!"

The Department of Computer Science and Engineering has led nine pedagogical IMPACT-projects (totaling almost 3 M SEK) over three years. The projects can be sorted according to three themes: Collaboration, Programme Development and Diversity & Internationalisation.

## Collaboration

With six Master's programmes and hundreds of students, we have spent quite some effort on collaboration in several levels. We have worked on

- Collaboration between Master's programmes, developing shared courses both in the compulsory and the elective part of the programmes;



- Collaboration between the Master's and the doctoral education levels, identifying and developing the overlapping curriculum;
- Collaboration between academia and industry, inviting companies, teachers and students to Master's thesis project generation workshops;
- Collaboration between teachers within and between teaching teams.

*The subprojects are*

- 2007; CollabCSE; Collaboration between CSE Master's programmes.
- 2008; CollabIESD; Collaboration for programme development.
- 2009; UELF; Increased support for students, teachers and companies in the Master's thesis process.

### **Program development**

We have also worked on pedagogy and didactics in terms of course and programme development within these three projects:

- 2007; ProgreCSE; Pedagogical Progression for the CSE Master Curriculum.
- 2008; SolveIT; Concepts for Problem-Solving Training on Different Levels.
- 2009; ChiC; Chalmers Interaction Design Challenge.

The first project enabled three of the programmes to spend extra time (in workshops, course and programme development) on adopting the CDIO (Conceive, Design, Implement and Operate) concept. The second project focused on effective learning for heterogeneous student groups and on improving students' problem-solving skills. The third project is about a project course carried out together with another university.

### **Diversity & internationalisation**

With around 40% of our Master's students coming from abroad, the diversity aspects have become very apparent. We ran three projects within this theme:

- 2008; Diversity@EDIT – the quality of being different.
- 2009; StuMP; Study trips for Master's programme development.
- 2009; RNIMPS; Recruitment Network for International Master's Programme Students.

Diversity, or different points of view, is a powerful pedagogical tool which can lead to deeper learning and better coverage of a subject. But too much diversity leads to confusion and misunderstandings. We have developed rules, guidelines and recommendations for those aspects of diversity we had problems with earlier. We are also using study trips to learn from successful programmes at other universities and we are building a network of contacts for long-term recruitment, to counter the upcoming fees for higher education in Sweden.

## Important results

The most important results from our IMPACT projects:

- The broad pedagogical discussions that have taken place at the department, involving a majority of our teachers and concerning not only issues in the IMPACT projects.
- Creation of strong collaboration between our Master's programme and development of shared courses with a large number of students.
- Development of exercises and self-tests for heterogeneous student groups, that take in to consideration backgrounds, study goals, levels of mathematical knowledge, etc., for a number of courses.
- Development of legible, uniform policies and procedures concerning Master's theses for all our programmes.
- Increased collaboration with programmes at other departments (Communication Engineering, Engineering Mathematics, Bioinformatics and Systems Biology).
- The necessity to mix Swedish and foreign students in project groups.
- Creation of common and legible programme launches.

## Future development

Starting up six international Master's programmes means hard work. The IMPACT-projects have made it possible to give special attention to certain pedagogical issues. Some of these issues have been considered for all programmes, while only one or two programmes have paid attention to others. The experiences and conclusions will be utilized for all our programmes.

In some projects, certain objectives were not reached, partly due to insufficient funding. The department must further strengthen its collaboration with the industry. This will be done in cooperation with the newly formed ICT Academy. Also, the department has to increase efforts to build networks of contacts with other universities, national and international, for long-term recruitment.

## Conclusions – recommendations for the future

The programmes at the First degree level must be changed and developed with the existing Master's programmes in mind.

To have a ongoing broad pedagogical discussion, it is necessary that Chalmers permanently allocate means for pedagogical projects, to which teachers, programmes and departments could apply. ■

## Project table

Year	kk	Project title
2007	540	Collaboration between CSE Masters programme
2008	420	Samverkan för programutveckling
2009	200	Utökat elev, lärar och företags-stöd vid examensarbeten samt förtydligande av den administrativa processen för att genomföra ett exjobb.
2007	540	Pedagogical Progression for the CSE Master Curriculum
2008	420	Concepts for Problem-Solving Training on Different Levels
2009	200	Chalmers Interaction Design Challenge
2008	300	Diversity@EDIT – the quality of being different
2009	200	Studieresor för utveckling av masterprogram
2009	100	Recruitment Network for International Master Programme Students
<b>Total</b>	<b>2920</b>	

Student count: HT 2008: ~300 M1 and ~220 M2 (M1 = first year Master, M2 = in the second year)

Thus, IMPACT provides around 2k SEK / student / year. (The total MSc education budget at CSE is around 58 kkr / student.)

# Department of Energy and Environment

Vice Head of Department Erik Ahlgren

## Introduction

The Department of Energy and Environment consists of six divisions. Research within the department covers a wide field within the areas of energy and environment/sustainable development, from a global perspective to industrial, building, and product scale. The research fields include energy technology and energy conversion, both experimentally and theoretically; and development, use and evaluation of methods and tools for analysis of technical systems, regarding environment/sustainable development and energy. Another field is complex systems, with theory and applications ranging from biochemical systems to social systems. We also give courses in these and related fields.

The department offers the following four international Master's programmes:

- Industrial Ecology – for a sustainable society (IE)
- Environmental Measurements and Assessment (EMA)
- Electric Power Engineering (EPO)
- Sustainable Energy Systems (SES)

The Department of Energy and Environment has led eight pedagogical IMPACT-projects. They are in the following categories *Collaboration*, *Program development*, and *Diversity and internationalization*.

## Collaboration

The objective of the SNAVS project was, without establishing new courses, to provide students with a better selection of eligible courses. This implied an investigation of courses given at the other department Master's programmes, in Master's programmes at other departments and doctoral courses. The idea behind the project was that the quality of the applicable part of the programmes should be improved if students have more information on how certain courses or course packages fit into the Master's programme curriculum.

## Program development

EMMA was the only project carried out by the department during the first year of IMPACT. It was also a typical first year project which covered a number of issues of more general character that needed to be addressed quickly in order to provide high quality education.

Three of the four Master's programmes at the departments receive student with varying educational backgrounds. This means that the issue of prerequisites is central. The EMMA project contributed to the work of, in different ways, making it possible to accept students with different educational backgrounds. This concerns both teaching and course material which needed to be modified in order to suit students with different educational backgrounds.

Since most Master's programmes were not developed from scratch, they built on previously existing material and since teachers sometimes tend to focus mainly on their own course and not on the entire programme, it is central to address programme progression. This was also part of the EMMA project. In order to work with programme progression, teacher teams are needed in order to discuss different matters of common interest regarding course content and programme development. This was in particular an important aspect of the early programme development and also of the EMMA project. If teachers do not already know each other, this is of even higher importance, and this was the case at the department since the department was formed only in 2005 and consists of six divisions which used to belong to five different Chalmers schools.

The department has been pursuing the idea that when two Master's programmes can use the same course or modules without sacrificing quality, this should be done in order to save resources and thus contribute to overall quality within education. Therefore, during programme development the possibilities for co-utilisation of courses and educational material were pursued. It led to utilization of some courses by more than one Master's programme in particular during the first programme semester.

Research at the Division of Electric Power Engineering relates closely to sustainable development but the courses given by the division within the Electric Power Engineering Master's programme were not influenced by these sustainability aspects. Thus, the objective of the Sustainable electricity project<sup>1</sup> was to include sustainability aspects in teaching on electric power. The project has caused particular sustainability aspects related to wind and solar power and hybrid electric cars to be included in courses in the programme and, further, inclusion of more research experience. In addition, PhD students with any educational background in sustainable development will have the chance to build

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<sup>1</sup>) Hållbar el.

on this either through taking one of the courses where sustainability aspects have been included or through teaching of the courses.

Student experience of the Master's programmes is probably the best source for improving of the courses. Course evaluations are carried out and analysed, entire programmes are also sometimes assessed through programme evaluations. However, feedback from former students about their programme and its actual value on the labor market can be very valuable in helping to improve courses. Thus, in the REMi project, a questionnaire was created and distributed to a number of former students in three of the department's old Master's programmes (prior to the re-organisation of the Master's level education in 2007). The objective was to gain information from different fields regarding knowledge about career opportunities after graduation. Another objective was to assess if former Master's programme students are still satisfied with their Chalmers education. This information can be used not only for programme development but also for marketing purposes and in assessments of student's applications.

Handling educational practicalities can be extremely time consuming and thus eat up scarce resources that otherwise should be used for education and educational quality development. This is particularly true when it comes to educational activities with small groups of students and, thus, this concerns thesis projects. Students almost always regard the amount of time that the supervisor can devote to thesis supervision as insufficient and, it is therefore of utmost importance to minimize all other time consuming activities related to the thesis project to provide quality thesis supervision. In the Ratex project, a structure for handling administrative tasks practicalities regarding the carrying out of a thesis project has been developed. This has been supplemented by a structure for information flow at different stages of the thesis process. This is believed to save considerable time for both teachers and students and, due to clarification of administrative issues, to remove some frustration related to the thesis process.

One of the largest problems regarding course planning is the uncertainty regarding the number of students that will attend the course. If the number of students is considerably smaller than what is expected, this leads to inefficient use of resources which in turn implies underfunding of other educational activities. If the number of students is considerably larger than what is planned, this leads to pedagogic problems and the risk of lower educational quality. In the PEVARIS project, issues related to difficulties due to varying number of students that has been addressed in general and in particular issues related to pedagogy and educational quality. The main conclusion of the project is that some steps can be taken to be prepared for the uncertainty related to varying number of students. However, in general, at the Master's programme level, where most teachers are using more intensive pedagogic methods, it is very difficult to prepare for large last-minute variations of

the number of students. It also concluded that it is important for course quality that any such large last-minute variations should be avoided.

### **Diversity & internationalisation**

In courses on applied subjects, there is a risk that the examples used in the courses are much more familiar to some students than to others and therefore some students are probably favoured in the learning process since they can more easily relate to problem formulations. This is true in the energy area where certain technologies are more widely used in certain areas of the world than others and students from some countries thus might already be familiar with the technology. Basic technologies are, of course, of general use worldwide and therefore this should normally not be a problem. However, in courses based on the application of systems studies, problems arise due to the different student cultural backgrounds. In e.g. Sweden some energy issues are widely discussed and even used in basic education while they are completely unknown to students from e.g. India. One could talk about different “cultural energy backgrounds”. In one of the courses in the Sustainable Energy Systems Master’s programme, the energy systems modeling and planning course, most of the examples built on district heating systems as the basic case in focus. This is not ideal when the course attracts students who probably never even heard of a district heating system. Therefore, in the projects APEX and APEX 2, other kinds of examples have been developed to better fit a diverse group of students. Two additional examples have been developed and these focus on biogas and on energy issues for a particular developing country.

### **Important results**

The projects have addressed different aspects of issues related to the development and teaching of Master’s programmes. Most issues concern different aspects of quality in education and thus they are related to the IMPACT objectives. Different IMPACT objectives have been addressed in different projects and in total most of the objectives have been addressed. The issues addressed have merely developed from an analysis of critical concerns rather than from a wish to find any general methodology or general conclusion. The main conclusion is probably that IMPACT was essential for bringing collaborative aspects into programme development but the bulk of development had to be done without the extra funding provided by the project.

### **Future development**

The programmes have now reached a certain level of maturity, they are running and are getting good student reviews. Thus, there is no immediate need for any particular further programme development. However, at the same time, due to the large resources, funded and non-funded, that has been put into programme development, the general pedagogic discussion has not been prioritized. Now, it is time for this kind of prioritization.

## Conclusions – recommendations for the future

Some issues that perhaps have not been sufficiently addressed in IMPACT but ought to be considered in any future educational development project are:

- How to give teachers sufficient time for course development, development of course material, and development of new pedagogic methods?
- How to stimulate the pedagogic discussion at programme and department levels?
- Are we in a situation where the focus on course evaluations is coming into conflict with the quality of education and where pedagogic development is being suppressed? ■

### Project table

Year	kkr	Project title
2007	720	Energi och Miljö MAsterprogramutveckling, EMMA
2008	280	Rekryteringsunderlag för mastersprogrammen på institutionen för Energi och Miljö, REMi
2008	100	AnPassning av EXempel till en mångfaldssituation, APEX
2008	100	Införande av hållbar utveckling i masterprogrammet Electric Power Engineering, Hållbar el
2008	280	SamverkaN runt AVSlutande paket & master/doktorandkurser, SNAVS
2008-9	140	PEdagogisk utveckling med bibehållen kvalitet vid VARlerande Student antal, PEVARIS
2009	100	AnPassning av EXempel till en mångfaldssituation 2. APEX 2
2009	200	Rationell hantering av exjobb för höjd kvalitet, Ratex
<b>Total</b>	<b>1920</b>	



# Department of Fundamental Physics

Vice Head of Department Göran Nyman

## Introduction

The Department of Fundamental Physics consists of three research groups: Subatomic Physics, Mathematical Physics and Elementary Particle Physics. The scientific activity is focused on basic research covering advanced theoretical and experimental studies of elementary particles, exotic nuclei and forces in the universe. The department is highly regarded internationally and conducts and participates in front-line research at many world-leading facilities, institutes and networks. The staff members are strongly involved in education and are responsible for six courses in the Engineering Physics programme (year 1 to 3), Bachelor's thesis projects, twelve courses in the Fundamental Physics MSC programme, Master's thesis projects and a doctoral programme.

Also the commitment in outreach activities and teacher education programmes is profound. Three IMPACT projects involving four courses have been performed by the department, of which one is still in progress. In one case a completely new experimental course (Modern Subatomic Detection and Analysis Methods) was developed and attracted many Master's students from both Chalmers and the University of Gothenburg.

The number of Master's students in courses supported by IMPACT is listed below:

Course	No of Students		2008		2009		PhD
	CTH	GU	CTH	GU	CTH	GU	
Modern Subatomic Detection and Analysis methods	0	3	3	5		1	
Astroparticle Physics and Cosmolgy	10	0	8	5		–	
Advanced Quantum Mechanics	5	6	12	2		–	
Advanced Subatomic Physics	6	8	4	4		–	

## Collaboration

Close and rewarding cooperation was established between Chalmers, especially the CAS programme, the University of Gothenburg, the University of Oslo and the Technical University Darmstadt.

## **Programme development**

The work supported by IMPACT covers both development of a new experimental course and extensive revisions of existing courses. In all cases the aim has been to adapt to the most modern experimental techniques and theoretical approaches relevant for today's front-line research in particle and nuclear physics. The motivation is to increase the competitiveness of the Master's programme in Fundamental Physics with focus on basic research carried out at international facilities like LHC-CERN and FAIR-GSI.

## **Diversity & internationalization**

Due to the international nature of the research carried out at the department, the Master's programme attracts students from a broad international base. Establishment of a tuition fee might lower the number of foreign applicants but on the other hand the recently proposed tuition waiver programs could generate qualified applicants from developing countries. Regarding gender diversity, we are actively pursuing new recruiting techniques in order to increase the (unfortunately still low, 20%) number of female applicants.

## **Important results – methods**

Given the novelty of the courses and the relevance to the IMPACT project, a number of new pedagogical methods were tried, most notably weekly group work where students were encouraged to think creatively about specific problems. "Seminar style" additional lectures were also added, to expose students to the current style of research. Some examinations were in the form of specially designed take-home problems that encouraged collaboration amongst students and creative thinking.

## **Future development**

The results of the three IMPACT projects form a solid foundation to build upon. The ultimate goal is to further develop the already competitive Master's programme by introducing new courses and also courses that are of interest for students from other Master's programmes. The course content should approach the very front lines of research in fundamental physics and will continuously be developed to incorporate new research results. For example, planned satellite-based astrophysical experiments which provide a glimpse into the early universe and the fundamental theories of physics that were at work in that extreme environment.

## **Conclusions**

In conclusion, the IMPACT projects have contributed to a revitalization of some of the courses within the Master's programme in fundamental physics and to the creation of a new course. The resulting courses incorporate several building blocks: new pedagogical ideas, contact with cutting-edge research methodology and results (both experimental and theoretical), and international collaboration. ■

## Project table

Year	kkkr	Project title
2007	180	Programutveckling Fundamental Fysik
2008	140	Advanced Quantum Mechanics
2009	100	Advanced Subatomic Physics
<b>Total</b>	<b>420</b>	

# Department of Materials and Manufacturing Technology

Vice Dean of Department Gert Persson

## Introduction

There is a wide variety of expectations and needs as we discuss teaching in English and preparations for new Master's programmes. In the project *Eng*<sup>1</sup> led by Gert Persson, we designed a workshop sequence that accommodated individual teachers' specific issues respectively. Therefore, the outline offered activities explicitly geared towards educational development as well as more predictably language-oriented activities.

There were two points of departure of importance for the project *MMT*<sup>1</sup>, led by Rodney Rychwalski:

- Trying to tackle a real problem may provide the motivation needed to learn the new concepts, and master the knowledge required to solve it, and this is better done in a group instead of individually.
- Variation in teaching format may be effective for a class with diversified experience, background, and learning styles.

In *DIVA*<sup>+3</sup>, led by Maria Knutson Wedel, a new introduction has been created for the Master's programme Advanced Engineering Materials. The main goal has been to create a good start for all students irrespective of different pre-knowledge in different areas of materials science. The key concepts would be "a warm welcome creating positive group dynamics" and "mutual peer instruction".

## Collaboration

Within the work of the three projects, quite some effort has been spent on collaboration:

- Close cooperation with the Centre for Language and Communication.
- Collaboration extensively engaged the teaching structure/hierarchy/administration in the Department of Materials and Manufacturing Technology including: lecturers/directors of the departmental Master's programme (present and previous) – the deputy head of department for teaching.

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<sup>1, 2, 3)</sup> See project table for full name of project.

- Collaboration with CDIO took place (writing papers, conference attendance).
- Contact was made with the University of Liverpool to learn more about an activity they had for new bachelor students called “WIMO – what’s it made of”.
- Contact was also taken with Patrik Cannmo at Jönköping University to study their general introduction for new international students.
- The Parallel IMPACT project at Electrical Engineering at Chalmers was also studied.

## **Programme development**

Development took place according to the project plan including:

- A three-day workshop was designed where the teachers brought a specific issue, set of questions, course-related tasks or assignments that he or she wanted to work with.
- Setting goals: using two learning projects running for eight years in two courses given by the Department, goals towards better teaching outcome were set: (i) to build on previous experience; (ii) to prepare an adaptable teaching aid package.
- Defining the working platforms: two such platforms were defined: (i) topic to study (TTS) and additionally diary.
- Defining the targeted teaching project requirements: (i) TTS is a polymer science and engineering exercise, (ii) TTS can have various forms: e.g. compilation of existing knowledge, (iii) TTS is not meant to be an in-depth mini-publication, (iv) TTS is not a report with innovative ambitions towards new business, (v) TTS reporting should be analytical.
- Evaluation of TTS and diary by students 2000–2008: courses evaluations were used for this purpose. Conclusions were drawn.
- Critical issues for the project (MMT 1) were defined: (i) a 10/90 construction was decided (10% project, 90% transfer of knowledge teaching), (ii) experience so far confirmed that project-based learning in the present courses was less positively judged by the students than the course on the whole, (iii) HSV and Dublin descriptors were of importance to bear on the project (MMT-1).
- A survey went out to all current students at the Master’s programme to get their opinions on possible activities and capture new ideas on how to welcome our new students.
- One of the lecturers cut down on a part of his course and used that time during the first week for introduction activities.
- An interactive homepage was created at the student portal Ping-Pong at Chalmers. Its purpose was to help students identify their strengths and weaknesses in relation to the programme learning objectives and their expected level of proficiency in materials science. In addition this would establish an early connection to the newcomers.

- An individual welcome letter was sent out as soon as the admission procedure was finished in June. The purpose was to make the students feel welcome and show them the link to the interactive Materials Science homepage. They were all given temporary CID and passwords to Ping-Pong by the Ping-Pong support group.
- An introduction week was created.

### **Diversity & internationalisation**

- See above – the main idea with the DIVA+ project was to take advantage of diversity and have the students appreciate their different cultural and disciplinary backgrounds.
- Project (MMT-1) results were presented at the 5<sup>th</sup> Int. CDIO Conf., Singapore Polytechnic, Singapore, June 7–10, 2009.

### **Important results**

An important result is an increased understanding of learning oriented assessments and communication in English.

- Based on two advanced level courses offered in the department of Materials and Manufacturing Technology during 2001–2008, an adaptable teaching aid package has been developed to improve teaching & learning of course projects.
- A conference paper was prepared.
- It was possible to follow the log at the welcome page in Ping-Pong. Out of 36 international and 15 national students, 25 had logged in which is about 50%. The information of admitted Swedish students was received later and these students did not get their welcome letter and log-in until one week before start which was not optimal.
- An unexpected result was that the number of international students that arrived increased substantially – 61% compared to 40% previously (track record over many years).
- There was a strong correlation between the students who had logged into Ping-Pong and who arrived; all those who logged in arrived except one. The line of communication was established and the number of student e-mails to the programme director increased substantially.
- The development of the MIP experience is an important addition to the learning activities in MPAEM. They are actively formed through peer instruction and have correlated to their professional role as materials engineers [impact goal 4, 7, 2]<sup>4</sup>.
- The need for an English Help-Desk for teachers is very limited but on the other hand a two-three days workshop focusing on individual projects is very effective.

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<sup>4</sup>) For a detailed list of IMPACT Goals please see page 5.

## Future development

- There is a four-fold implication of results from the MMT-1 project:  
(i) the developed teaching aid package is currently used in two courses given in our department, (ii) the teaching aid package has been published on the departmental homepage and thus is available to our lecturers, (iii) the package will be used in a course given by our department ordered by another department at Chalmers, (iv) dissemination of results has also taken place internationally. The developed teaching aid package is not a closed chapter, it is rather a living document. A question relating to the package has been added to the standard Chalmers course evaluation for two current courses. It can be expected that improvements will take place based on lecturer's experience and student feedback.
- There are a number of ways to improve the Ping-Pong page further. One suggestion would be creating chat rooms where the new students can discuss problems in advance.

## Conclusions – recommendations for the future

A main conclusion is that project reports and oral presentations in courses where the developed teaching aid package is used by the lecturers are generally of higher standard, thus the teaching & learning process has improved.

One conclusion is that a Ping-Pong page like ours actually would help in estimating the number of students coming, facilitate the work of placing the students in groups in advance and possibly also work as a marketing tool in the future of tuition fees when we need to survive in competition with other universities. ■

## Project table

Year	kkkr	Project title
2006	180	Övergång till undervisning på Engelska, Eng (1).
2007	140	Amping-up course moments/projects, MMT- (2).
2008	200	Turning an apparent disadvantage into DIVERsity Advantage, DIVA+ (3)
<b>Total</b>	<b>520</b>	

# Department of Mathematical Sciences

Vice Head of Department Sven Järner

## Introduction

The Department of Mathematical Sciences is a joint department between Chalmers and the University of Gothenburg which covers a wide field of research in pure and applied mathematics. Beside a huge volume of basic level education in mathematics and mathematical statistics, the Department offers three Master's programmes of which two belong to Chalmers:

- Engineering Mathematics and Computational Science (ENM).
- Bioinformatics and System Biology (BIS).

The Department has led four IMPACT projects over three years, three of them belonging to the theme "Programme development" and one to the theme "Collaboration". The projects and their acronyms are listed below.

## Collaboration

In the project ENM08, we focused on collaboration between the Bachelor's programme in Engineering Mathematics and, not only our Master's programme Engineering Mathematics and Computational Science, but also a number of other Master's programmes. This resulted in a number of course packages in the Bachelor's programme, designed to prepare for certain Master's programmes. Even in the project Applimat described below, collaboration, this time with other departments, is a very important ingredient.

## Programme development

The project Applimat was devoted to strengthen the connection to engineering applications in the Master's programme Engineering Mathematics and Computational Science. Three of the courses in the programme (Applied Optimization, Computational Science and Engineering modelling and Computer Intensive Statistical Methods) were redesigned with the purpose of including new engineering applications.



The MV-BIO project was mainly devoted to the implementation and planning of pedagogical moments in many different courses in the Master's programme Bioinformatics and System Biology. Besides these efforts, we have also examined the content and design of our homepages.

In MV-Bio 3 there were three objectives. The first was to integrate the teaching activities of Jens Nielssen's recently recruited research group in Systems Biology in the courses in the Bioinformatics and System Biology programme. Focus was on two courses in the second and fourth study periods. The curricula and detailed contents have been thoroughly revised in both. Secondly, scenarios for a broader computational/statistical program, still covering Bioinformatics and Systems Biology as tracks, have been developed. Finally, a team of Master's students participated in iGEM as the first Swedish team. ■

### Project table

Year	kkr	Project title
2006	180	Development of the Bioinformatics and systems biology program, MV-BIO
2007	180	Tillämpning av matematik, Applimat
2008	140	Kraftfull samverkan av masterprogram med kandidatprogram, ENM08
2009	140	Strengthening of Bioinformatics and Systems Biology through collaborations, MV-BIO3
<b>Total</b>	<b>640</b>	

# Department of Microtechnology and Nanoscience (MC2)

Vice Head of Department Sheila Galt

## Introduction

The Department of Microtechnology and Nanoscience (MC2) has a 1000 m<sup>2</sup> state-of-the-art cleanroom nanofabrication facility at its core, but the expertise and research at the department spans from fibre-optic system performance to theoretical modelling of quantum computing. The undergraduate education conducted at the department is almost exclusively within Master's programmes. Besides the three Master's programmes that are hosted at MC2, we are also strongly involved in the Integrated Electronic System Design programme. Our programmes are:

- Nanoscale Science and Technology
- Wireless and Photonics Engineering
- Microtechnology

MC2 has hosted six (and a half) IMPACT-projects (summing up to over 1.5 MSEK) over three years.

## Collaboration

The IMPACT project has facilitated important collaborative efforts for MC2 within Chalmers. Our external collaboration does not rely on IMPACT support, but is certainly augmented by the presence of this dedicated resource for work on the master level of education. We have important educational interfaces to many departments; the following are perhaps the most essential: Applied Physics, Chemical and Biological Engineering, Computer Science and Engineering, Fundamental Physics, Materials and Manufacturing Technology, Radio and Space Science, and Signals and Systems. IMPACT has most definitely resulted in an increase in the attention that MC2 has paid to the interplay and interrelations between programmes with related and overlapping content. One IMPACT project has been dedicated to collaboration between Radio and Space Science and MC2 where the delivery of microwave technology content is concerned. Some of the challenges when developing new Master's programmes naturally require sound collaboration between groups within the department, and several of

the IMPACT projects that we have run are of this character. In this way IMPACT actually helps developing a better internal working climate and increased collegiality among the faculty, based on common interests in education.

### **Programme development**

The three different Master's programmes at MC2 are facing significantly different challenges. The programme in Nanoscale Science and Technology has been strongly affected by its relationship to graduate education (doctoral education) and how it relates to other "nano education" programmes in Europe. It started many years ago as a one-and-a-half year international Master's programme here. Programme development has resulted in substantial changes in its syllabus with stronger coherence within MC2 and with a better defined interface towards other programmes at Chalmers. For the Microtechnology programme there has been a fundamental restructuring from a production oriented syllabus to one with a focus on technology, all with the perspective of increased coherence within the MC2 programmes. The programme in Wireless and Photonics Engineering has gone through a fusion process where a very focused and industrially driven programme in Hardware for Wireless Communication has been married with a photonics oriented course track with a long history.

### **Diversity & internationalisation**

The MC2 environment is diverse with respect to nationalities represented and also in the span of activities from those with a very sophisticated experimental character to purely theoretical work. External collaboration is essential for most of our research and plays a significant role in this higher education, e. g. through the Erasmus Mundus programme on Nanoscience and Nanotechnology where we are one of the partners. This is also the case for EC-supported dialogue between other partner universities in work towards enabling students to exploit more of the options for a cross-institutional education within the field of nanotechnology.

### **Important results**

Besides generally improving the content and delivery of our courses, the explicit IMPACT target of inter-programme coordination has been given substantial attention, e. g. in dedicated collaborative projects between MC2 and R2, as well as coordinated activities among MC2's three programmes. A large effort has been devoted to crafting a coherent syllabus for the new combined Wireless and Photonics Engineering programme, in line with the third of the stipulated IMPACT targets.

### **Future development**

We have been able to establish some very important educational elements in our Master's programmes within the IMPACT framework. However, at present it is very hard to assess the long term implications

of this development. We do not know what forms of education and funding schemes will be applied nationally and internationally in a five year perspective, and even if we do know of some imminent changes, we cannot predict their ramifications reliably. Maybe there will be no room for undergraduate education at all at MC2 a few years from now.

## Conclusions – recommendations for the future

The IMPACT project has made a significant difference in our ability to carry out our Master’s programmes in line with our ambitions and intentions. The total budget for running the programmes during these three years amounts to about 20 MSEK, and the IMPACT project budget adds a very substantial extra of about 8% of resources for undergraduate education at the department. Although most of the content in the programmes predated the inauguration of the new Master’s programmes at Chalmers, the transition has not been without challenges. Lacking larger courses with substantial funding, the vast majority of courses delivered at MC2 are given much more attention and value than the department is paid for, so any additional means for funding educational activities are sorely needed.

For the future we can only hope that we can find a robust paradigm for the organization of undergraduate education at Chalmers, one that leads to instruction that is internationally competitive and compatible, and which acknowledges the value of offering high quality content with equally high quality teaching. Relying on research funding and faculty devotion to provide state-of-the-art content to appropriately small student groups is not at all in line with sustainable world-class performance. ■

## Project table

Year	kkkr	Project title
2007	360	Programme (syllabus) development
2007	140	Development of teaching (methods)
2008	200	Easy Photolithography
2008	420	Course development and adaptation
2009	200	Student project pool at MC2
2009	200	Semiconductors for everyone
2009	100	Collaboration between Radio and space science Wireless and photonics engineering
<b>Total</b>	<b>1620</b>	

# Department of Product and Production Development

Vice Head of Department, Göran Gustafsson

## Introduction

The Department of Product and Production Development (PPD) at Chalmers consists of the three divisions Product Development (PD), Production Systems (PS) and Design & Human Factors (DHF). Each of them hosts an international Master's programme:

- Product Development (at PD)
- Production Engineering (PS)
- Industrial Design Engineering (DHF)
- PPD has run seven IMPACT funded projects (2+2+3 over the three year IMPACT period)<sup>1</sup>. Three of the projects have been managed by PD, three other by PS and one by DHF.

## Collaboration

Teams of teachers from different programmes have worked together to improve the coordination and alignment of courses. Software has been standardized and is now used in different courses. Students' working spaces have been altered to become more flexible through "compact living" and this has led to improved collaboration within and between student project teams.

## Programme development

The department has improved coordination and alignment of courses as part of the IMPACT projects.

## Diversity & internationalization

The department has worked with the development of an introductory teambuilding activity for Master's students.

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<sup>1)</sup> For a detailed list of projects please see project table below.

## Important results

- Goal 4: Active learning with a miniaturized factory.<sup>2</sup>
- Goal 5: Sustainable development taught at the Master's level.
- Goal 10: More flexible working spaces for students.

## Future development

We strive to further improve our Master's programmes and to make them internationally competitive when, in a few years from now, students from outside the European Union will no longer study for free in Sweden. The IMPACT projects have helped us make a good start towards that, and the work will continue.

## Conclusions – recommendations for the future

With additional and targeted funding from the IMPACT project, things can be done earlier and faster than would otherwise have been the case. It would therefore be beneficial to the Master's programmes if the IMPACT programme was extended or succeeded by something similar. ■

## Project table

Year	kkkr	Project title
2006	540	Pedagogy and Learning in Industry-based Student Projects
2006	180	Progression of Courses at the Undergraduate Level
2007	280	Efficient Work Spaces for Project Teams
2007	280	Sustainable Development for Product Realization
2008	200	Miniaturized Factory Analysis
2008	200	Pedagogy in Industry-based Student Projects
2008	100	Development of "Advanced design materials" to an Advanced Course in Sustainable Development with Material and Strategy for Product Development
<b>Total</b>	<b>1780</b>	

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<sup>2)</sup> For a detailed list of IMPACT Goals, please see page 5.

# Department of Radio and Space Science

Vice Head of Department Magnus Thomasson

## Introduction

At the Department of Radio and Space Science, our research is driven by the curiosity to learn more about the universe and our Earth. The development and use of radio and microwave equipment is a common ground, but we also do research in related fields like plasma physics and optical remote sensing of the earth. The department hosts Onsala Space Observatory, the Swedish National Facility for Radio Astronomy.

In our Master's programme in Radio and Space Science, we share our research experience with the students. The first semester of the programme has four compulsory courses presenting the basic physics and technologies required for the later more specialized courses. After the first semester, students can choose freely among a set of elective courses but are recommended to follow one of three tracks: Astrophysics, Earth Observations, or Technology.

The Department of Radio and Space Science has carried out four IMPACT projects over three years.

## Collaboration

The master programmes "Radio and Space Science" (in particular the technology track) and "Wireless and Photonics Engineering" (in particular the microwave part) partly overlap each other. There should, or could, be a possibility for cooperation between the two programmes, leading to a better use of resources, and better coordination of the elective courses. In our 2009 IMPACT project, we investigated possibilities for better future collaboration between our programmes.

## Program development

Most of our efforts in the IMPACT project have been to develop the courses in our Master's programme.

Our 2007 project had several different parts: development of two remote sensing courses so that they can be followed by both Master's and PhD students; development of radio astronomical observation

exercises for the Onsala telescopes, and a laboratory exercise in optical remote sensing; development of the courses in “numerical methods” and “electromagnetic waves and spectroscopy” to make them useful for all students, independent of which track they follow; and finally development of mini-projects for the course in “space science and techniques” to increase student awareness of how all parts of a space project depend upon each other.

In one of our projects in 2008, we worked on improving our programme’s connections with industry and other organisations outside Chalmers. Several courses in the programme now cooperate with local industries in the form of, e.g., guest lectures and visits. In the second project in 2008, we strengthened the sustainable development content of a few courses in the programme.

### **Diversity & internationalisation**

We have not worked explicitly with these subjects.

### **Important results**

Our IMPACT projects have mainly focused on IMPACT’s goal 1 and 4<sup>1</sup>, developing good courses and pedagogical teaching methods for a high quality Master’s programme. We have also worked on cooperation with one other Master’s programme, and with our research school (goal 2). The improved connection with industry touches on goal 8 – we discuss the course contents with our partners in industry. Aspects of sustainable development are now included in the programme (goal 5).

### **Future development**

The IMPACT projects have contributed to the development of many courses in our Master’s programme. In particular, we believe that the strengthened connection with industries and other organisations outside Chalmers will be important when recruiting students. A common question from students is “Are there any non-academic jobs in this area?”. Now we can easily show that the subjects we teach are of interest also for companies. We also think that the cooperation with the Department of Microtechnology and Nanoscience (MC2), which started during our 2009 IMPACT project, will continue in the future, strengthening both our programmes.

### **Conclusions – recommendations for the future**

IMPACT has made it possible to add something extra to the development of courses and programmes, in addition to what is possible within the otherwise very tight course budgets. Projects like IMPACT will be important for the teaching at Chalmers even in the future. ■

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<sup>1)</sup> For a detailed list of IMPACT Goals, please see page 5.



## Project table

Year	kk	Project title
2007	180	Utveckling av undervisningen i Radio- och rymdvetenskap
2008	100	Hållbar utveckling i Radio and Space Science
2008	140	Förbättrad industrianknytning inom mastersprogrammet Radio and Space Science
2009	200	Samarbete mellan "Radio and space science" och "Wireless and photonics engineering"
<b>Total</b>	<b>620</b>	

# Department of Shipping and Marine Technology

Vice Head of Department Birgitta Oscár

The Department of Shipping and Marine Technology is organizing coherent research and education within a wide knowledge area with its origin in programs at Chalmers for education of ship officers and naval architects. These activities in operation and design have been complemented with courses dealing with logistics/economics, maritime environment and human factors. Education and research within the department is therefore generating knowledge and people equipped to help shipping become an integrated part of future safe, efficient and environmentally friendly transport systems.

The department has previously developed a cargo handling simulator (Cargo Operations Studio, COS). The COS is primarily intended for use in training and education of ship officer students as well as active ship officers. However, in a survey of the functionality of COS, it was found that it is also very suitable for education within the Master's programme MPNAV (naval architecture). The aim of the MPNAV-COS project is to develop four different exercises in COS, that will be part of four different courses for the MPNAV programme. The project leader is Martin Schreuder.

## Collaboration

The composition of the department is to a large extent affected by the composition of the shipping industry and to a lesser extent by traditional academic disciplines. This means that the scope of both education and research are very broad and that the teachers have different academic and professional backgrounds. In this project there has been close collaboration between teachers from different research groups that together teach in all six programmes of the department.

## Programme development

Through this project, the students of MPNAV will gain important knowledge of the design of ships from the operator's perspective. COS will also work as a pedagogic platform where the student will learn about different ship types and corresponding systems for cargo handling. In each of the developed exercises there will be a clear coupling to the theories developed in the original MPNAV courses.

## Diversity & internationalisation

The diverse educational and professional background of the teachers involved in the project will be beneficial for the students as well as the teachers in terms of different viewpoints on the subjects involved.

## Important results

Through the present project there will be an enhanced exchange of knowledge between different programmes at the institution, particularly between theoretical and practical knowledge, with a clear benefit to the students. The developed COS exercises will also improve connections within the MPNAV programme; COS will work as a pedagogical platform where several major subjects of the programme can be introduced and exemplified. The project will furthermore strengthen the teacher's competence in terms of pedagogy and English communication.

## Future development

When the outcome of the project is implemented there will be an exchange of teachers between different programmes at the institution. In addition to better education for the students this may also lead to more cooperation between teachers and generation of new pedagogic projects.

## Conclusions - recommendations for the future

This project will have a positive impact on the content of the MPNAV programme as well as on communication and collaboration between teachers with different professional and academic backgrounds. It is recommended that further collaboration possibilities are explored, especially between teachers from different programmes and regarding new applications for existing simulation facilities both within education and research. ■

## Project table

Year	kkkr	Project title
2009	200	Integration of Cargo Operation Studio in MPNAV

# Department of Signals and Systems

Vice Head of Department, Tomas McKelvey

## Introduction

The Department of Signals and Systems is involved in education at all levels ranging from the bachelor level to the PhD level. On the Master's level, the department offers three programmes which all have a close link to the research activities in the department.

- Biomedical Engineering
- Communication Engineering
- Systems, Control and Mechatronics

The programmes have attracted significant amount of both Chalmers undergraduate students as well as students with an international bachelor's degree. The three programmes have, in total, annually attracted around 150 students. All programmes as well as the research at the department build upon a foundation of core electrical engineering competences. During the last three years the Department of Signals and Systems has led seven pedagogical development projects financed by IMPACT (a total sum of 1.4 MSEK). All projects have had a focus on further development of the Master's programmes particularly in areas outside the more common work associated with course and programme development. A brief summary of the results are given for each project below:

### **Project 1 (Teori och praktikkopplingar samt branchinvarianta metoder)**

This project allowed us to integrate industry interaction, teamworking, and branch-invariant methods in the design of the new Master's programmes Communication Engineering and Systems, Control, and Mechatronics. Courses were developed in close collaboration with professional developers from Ericsson, Qamcom, and Prospero. As a result, industry visits, guest lectures, and professional teamworking are now integrated in these courses, including an extensive group project that simulates a development project in industry. In the new hands-on laboratory assignments, the students learn to use common methods in different applications, under different real-world impairments and in different team constellations, which allow them to put their education into a broader context.

### **Project 2 (Samverkan)**

Discussions and coordinating with the Master's programmes in Biotechnology, Automotive and Communication have been part of the programme development. Cooperation has been initiated with the Franklin W. Olin College of Engineering, Boston, the University of Alberta, and Czech Technical University in Prague. We have received input in the process of developing the programme and courses from the following companies: Elekta AB, Astra Tech AB, TietoEnator Healthcare and Welfare, Autoliv AB, Research Mentice AB, Micropos AB, Samba Sensor AB, Neoventa AB, Ortivus AB, and Medfield Diagnostics AB. Extensive discussion with the Sahlgrenska University Hospital and the Sahlgrenska Academy regarding the Master's programme and the courses has been initiated. A platform for the exchange of diploma students and guest lecturers has been created and activities have started. Work has been initiated to convert all the courses to the English language.

### **Project 3 (Vidarutveckling av mastersprogram Biomedical engineering tillsammans med medicinteknisk industri)**

A number of meetings focusing on the possibility to redevelop the Master's Programme in Biomedical Engineering together with biomedical engineering industry and health care providers were held. The group was convinced that this is not only possible but also highly desirable. We see that there are many potential advantages of such development. Industry partners can ensure that the curriculum is kept current from the perspective of industrial needs. Potential financial advantages of involving industry partners were also envisaged. Collaboration with industry and health care providers was not considered to be ethically problematic if the formal course responsibility is kept under the control of Chalmers.

### **Project 4 (Research perspectives and student – research group interaction)**

The aim of the RESPECT (Research perspectives and student – research group interaction) project has been to develop the relation between students and central research groups within the MPSYS programme. The first phase of the project established a number of activities, such as information meetings, get-together meetings with the teachers, seminars and company visits. Among the first year's results was also establishment of a framework for 60 hp Master's thesis projects.

### **Project 5 (Integrering av "hållbar utveckling" i masterprogrammet MPCOM)**

The idea with this project was to introduce "sustainable development" as an integral part of every course in the Communication Engineering programme, and also as an overall goal of the programme. The most important results can be summarized in a few points:

- Many courses in the programme introduced "sustainable development" at different levels: in projects, in lectures, in exercises, and the

changes found their way into the course syllabus and the learning outcomes. A few courses already had sustainable development on the agenda; these were not changed.

- The programme as a whole changed its vision, leading to an increased focus on programme level learning outcomes related to “sustainable development”.
- Together the changes lead to a more environment-friendly Master’s programme, leading to more environment-friendly engineers.

### **Project 6 (Nya handledningsformer och förstärkning av handledningskompetens)**

With this project, the intention was to substantially increase the supervisory competence of a small group of teachers, and to spread the increased competence to other teachers in the department or in Chalmers. The project is not finished yet, but so far it has led to a different view of supervision among the teachers involved, and as a consequence a different way to supervise. It remains to see how the competence can be spread to other teachers; a lesson learned is that this kind of “coaching” towards successful supervision cannot be taught by lecturing, but there is discussion about whether the teachers involved can take the role as coaches for a new generation of “improved” supervisors.

### **Project 7 (Research perspectives and student–research group interaction)**

Focus of the follow-up project RESPECT-2 has been to consolidate previous activities in the MPSYS programme, and to strengthen the involvement of the students in planning and arranging activities. To facilitate the latter, a student has been appointed to gather volunteers and to take the first steps in this direction. One of the aims has been to strengthen the contacts between students during their first and second year, respectively; this has proven to be a student priority of. Other activities from last year have continued. Additional work with 60 hp thesis projects and a MPSYS common project course remains.

### **Important results**

The IMPACT project has led to development activities which both go across research groups as well as across Master’s programmes. This has enabled a cross fertilization of ideas which will further improve our future undergraduate teaching and programme development. ■

## Project table

Year	kkkr	Project title
2007	360	Teori och praktikkopplingar samt branchinvarianta metoder
2007	180	Samverkan
2008	140	Vidarutveckling av mastersprogram Biomedical engineering tillsammans med medicinteknisk industri
2008	280	Research perspectives and student – research group interaction
2008	100	Integrering av "hållbar utveckling" i masterprogrammet MPCOM
2009	150	Nya handledningsformer och förstärkning av handledningskompetens
2009	200	Research perspectives and student – research group interaction
<b>Total</b>	<b>1410</b>	

# Department of Technology Management and Economics

Vice Head of Department, Lars Trygg

## Introduction

The industrial realization of technology is what dominates the research at the Department of Technology Management and Economics (TME) at Chalmers. This research has three main, closely interrelated themes: change, innovation and interaction. We approach them using our understanding of engineering and technology, while relying on theories taken from primarily economics, social and behavioral sciences. This research is also strongly reflected in the set up and content in our four international Master's Programmes:

- Business Design – BD
- Management and Economics of Innovation – MEI
- Supply Chain Management – SCM
- Quality and Operations Management – QOM

The Department of Technology Management and Economics has conducted 10 IMPACT projects over the past three years within various focus areas. However, these projects can be clustered into four main themes: programme development, learning, diversity and sustainability.

## Programme development

The earliest projects focused on the programme development of our four Master's programmes, with  $50+50+60+65 = 225$  seats. Some of the following areas were addressed:

At first we focused on the teaching teams in each programme. The aim was to establish a common view in the teams, common structures regarding teaching goals, pedagogical forms and examination forms. We held a number of workshops with teachers involved to identify the “red thread” and the logic in the programmes.

We developed cross-division courses early on in the programmes in order to manifest the integration between teachers involved. In total we developed 8-10 new courses for the programmes including teaching material in English.

We have evaluated our programmes in many different ways in order to further develop them and we have also, together with the student



center Origo, examined the student's need of elective courses, how the student's select their elective courses and, based on that, identified suitable elective courses for each programme.

The sub-projects are:

- 2007; UPROG-I; Utveckling program I
- 2008; SAMÖI; Samordning av masterprogram över institutionsgränser
- 2008; USCOQ; Utveckling av MPQOM och MPSCM

## **Learning**

We have had two projects with a special emphasis on different aspects of learning:

- 2009; IndLär; Säkerställande av individuellt lärande genom mätande av lärandemål i projektgrupper
- 2009; SjälvLär; Självreflekterande lärprocesser

The first project focused on how to measure learning at the individual level when work is carried out in project form. The goal was to identify ways to give the students objective and differentiated grades based on their individual performance in group work.

The second project's main focus was to develop examination forms that could handle the strong diversity and heterogeneity regarding backgrounds in education and culture. The vehicle was to involve students in their own learning processes by having them reflect on and share their own learning experiences with respect to the eventual difference in background.

## **Diversity and gender**

We have had two projects that have addressed the issue of diversity. One on how to cope with diversity differences among student groups and one focusing on how to use diversity to build brand identity and brand image for a company.

- 2008; BrandM; Brand management
- 2009; StdVar; Hantering och utnyttjande av studentvariation

The BrandM project developed a new course that will give a better understanding of what values are linked to brand identity, how such values are created and communicated and how they can be managed in a way that leverages the brand for an organization. The second project focused on how to handle and utilize differences in age, gender, nationality, culture, especially in project work situations.

## **Sustainability**

Finally, the department has had three projects within the area of sustainability:

- 2008; TFFHF; Teknologiernas fördjupade förståelse för hållbarhet i försörjningskedjor

- 2008; SusA; Sustainability in action
- 2009; SusA2; Sustainability in action – Hållbarhet i praktiken

The aim with the first project was to identify how to match Chalmers goals regarding, ecologic, social and economic, sustainability in general with sustainability in existing supply chains. The project identified where and how to build these important considerations into the programme plan for the Supply Chain Management programme and in its courses. The last two projects focused on how to integrate sustainability as a natural part of the other existing Master's programmes in line with Chalmers initiative: "Innovation for a sustainable society". The goal is to develop course literature in English that can also be used in other Master's programmes.

### Important results

The ten projects at the Technology Management and Economics department have all been linked to goals set up by IMPACT. Especially goals 1, 2, 3, 4, 5, 7, 9, 10 and 11<sup>1</sup> have been clearly addressed .

### Future development

With the programmes up and running there is always room for continuous improvement. We need to develop more elective courses and develop our pedagogical skills further.

### Conclusions – recommendations for the future

The conducted projects have helped to shape our four Master's programmes to be highly attractive to national and international students. We have on average a 4:1 application ratio, and we run the programmes with all seats taken and with approximately 25% international students. ■

### Project table

Year	kkkr	Project title
2007	540	Utveckling program I, UPROG-1
2007	100	Brand Management, BrandM
2008	280	Hantering och utnyttjande av studentvariation, StudVar
2008	280	Sustainability in Action, SusA
2008	100	Teknologiernas fördjupade förståelse för hållbarhet i försörjningskedjor, TFFHF
2009	200	Samordning av masterprogram över institutionsgränser. SAMÖI
2009	280	Utveckling av MPQOM och MPSCM, USCOQ
2009	200	Självreflekerande lärprocesser, SjälvLär
2009	200	Sustainability in Action – Hållbarhet i praktiken, ,SusA
2009	400	Säkerställande av individuellt lärande genom mätande av lärandemål i projektgrupper, IndLär
<b>Total</b>	<b>2580</b>	

<sup>1)</sup> For a detailed list of IMPACT Goals, please see page 5.



# External evaluation



# External evaluation summary

**The External evaluation was conducted by Professor Lennart Lundgren and Professor Michael Christie, two very experienced educators and pedagogic experts. Both of them have been evaluators on a number of internally and externally pedagogic projects as well as served as pedagogic experts in appointment processes at various universities.**

In general there was a very positive response to the IMPACT project<sup>1</sup>. This evaluation is not able to provide specific evaluations for each of the sub projects and some of them in the third phase are not yet concluded. However, judging from the responses we have had in interviews concerning the sub project application and implementation process and the results of the reports we have been able to peruse from the two summary workshops which have been conducted so far, it is possible to say that the sub projects, to this point, have achieved their particular aims and outcomes and can be deemed a success. If we accept the argument that success or failure of the larger IMPACT project depends on how well the sub projects have been managed and carried out, and the quality and effect of their outcomes, we can conclude that IMPACT has been a successful, well managed pedagogical development project.

*“The project, which was dubbed IMPACT, was therefore driven by the Vice Prefects themselves. It was they who formulated the aims of the project and decided how the resources should be shared ...”*

In 2005 Chalmers University of Technology decided to make a complete change to the Bologna model in terms of its educational programmes. This involved that 44 masters programmes that were to begin in 2007 should be two years in length and that all teaching should be carried out in English. In order to carry out such an ambitious reform and achieve a high quality result without any extra resources seemed to be an insurmountable project for the various Departments. This was certainly how the Vice Heads in those departments summed up the si-

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<sup>1)</sup> For the full evaluation report, please see Appendix, page 154.

tuation and they were unanimous in their decision to seek extra resources from Chalmers Foundation. The Foundation agreed fund a project worth SEK 30 million that should be shared among the departments over a three year period. The project, which was dubbed IMPACT, was therefore driven by the Vice Heads themselves. It was they who formulated the aims of the project and decided how the resources should be shared – a decision that had both advantages and disadvantages. The administration and leadership of the project was very cost effective and the channels of communication between the project leaders and their

***“In total 11 aims for the project were formulated which covered most aspects of the development of the new international masters programmes.”***

steering committee clear, a factor that lead to quick and sound decision making. A contributing factor here was that the project leader sat on both the steering and reference

groups. Central administration on the other hand did not have much influence which meant that an overarching view that took into account central administrative issues were missing.

In total 11 aims for the project were formulated which covered most aspects of the development of the new international masters programmes. These aims, however, were so general that not all of them could be implemented given the limited amount of resources allocated to the project. Lack of time was another obstacle. Some aims received almost no resources. The project would have benefited by concentrating its resources on fewer aims.

The IMPACT leadership decided to divide the project into three phases, each comprising one year of the project. In the first year departments were guaranteed their share of the first year budget if their projects achieved the stated aims. Vice Heads were responsible for the application and applications were processed in an interactive way. This entailed project leaders assisting with advice to ensure high quality applications.

In phase two the project enabled individual teachers to also apply for money. In total SEK 6.2 million was distributed to departments according to the model used in phase 1 and SEK 3.5 million distributed to individual teachers. In phase three the application was opened up so that it was possible for anyone connected with the Master's programmes to apply for projects within IMPACT's main themes. Two external experts helped judge the quality of the applications. This was an interesting and effective way to ensure that all the departments had a chance to share the resources while at the same time allowing for the support of good, individual sub projects. A disadvantage, that was remarked on by some teachers, was that it was not possible to apply for sub projects that were longer than one year in duration. Under phase 3 there is however the possibility to apply for an extension of a sub project that was carried out in phase 2. The way IMPACT has distributed resources is an exemplary model for this sort of internal project.

Of the total IMPACT resources 85-90% went to the pedagogical development project and the skill development of the teachers. A reserve of 10-15% of the resources were earmarked for administrative purposes such as the application process and the reporting and presenting of sub projects at plenary workshops, for example the workshop at the end of each phase 2. According to a number of those who were interviewed this procedure was a success.

Because the project is not yet completed we recommend that the IMPACT website be available for Chalmers teachers and that it can be easily accessed via Chalmers homepage. We also recommend that money be set aside for updating the website and that the results from the various sub projects be made accessible.

Some conclusions that could be relevant for future projects of this sort:

- Make sure central administration is involved
- Create more flexible timetables for sub projects within the larger project
- Enable programmes to also apply for funding

## Sammanfattning<sup>1</sup>

IMPACT har mottagits mycket positivt i Chalmers organisation. Denna utvärdering kan inte specifikt utvärdera alla delprojekt eftersom en del inte är helt avslutade. Dock kan vi utifrån de intervjuer som genomförts rörande delprojektens ansökningar, implementering, rapporter och de övergripande workshops som genomförts att delprojekten har genomförts framgångsrikt gentemot uppställda mål och "learning outcomes". Om vi accepterar argumentet att framgången hos IMPACT kan bedömas utifrån de genomförda enskilda delprojekten kan vi konstatera att IMPACT varit ett framgångsrikt och väl genomfört pedagogiskt utvecklingsprojekt.

*“Projektet, som fick akronymen IMPACT, blev på detta sätt producentdrivet, där viceprefekterna formulerade målen och fördelade pengarna – på ont och gott.”*

Chalmers beslöt 2005 att göra en fullständig övergång till Bologna-modellen i sitt utbildningssystem. Detta innebar att samtliga 44 mastersprogram, som startade ht 2007, skulle omfatta två år och att all undervisning skulle hållas på engelska. Att genomför en så stor reform med god kvalitet utan att extra resurser tillfördes institutionerna är svårligen genomförbart. Detta insåg också viceprefekterna och man beslöt enhälligt att begära extra resurser från Chalmers stiftelse. Stiftelsen beviljade ett anslag på 30 Mkr att fördelas till institutioner under en period av tre år. Projektet, som fick akronymen IMPACT, blev på detta sätt producentdrivet, där viceprefekterna formulerade målen och fördelade pengarna – på ont och gott. Administration och styrningen av projektet blev på detta sätt mycket kostnadseffektiv. Beslutsvägarna

<sup>1</sup>) This is a translation of the summary above to Swedish.



mellan styrgrupp och projektledningen blev smidiga. En bidragande orsak var också att projektledaren satt med både i styrgrupp och i referensgrupp. Den centrala administrationen å andra sidan fick mycket lite inflytande, vilket gjorde att övergripande Chalmerscentrala aspekter ofta föll utanför ramarna.

Totalt 11 mål formulerades dessa kom att täcka in de flesta tänkbara aspekter rörande utveckling av masterprogrammen. Målen blev dock så omfattande att alla inte kunde förverkligas med de resurser, som fanns tillgängliga och den tid som stod till förfogande. Några mål fick nästan inte några resurser över huvudtaget. Projektet hade tjänat på att koncentrera resurserna mot färre mål. Projektledningen beslöt att dela upp projektet i tre faser om vardera 1 år. I den första fasen garanterades institutionerna pengar, om delprojekten uppfyllde de uppsatta målen. Viceprefekten var ansvarig för ansökan och den genomfördes genom en interaktiv process, där projektledningen var behjälplig i ansökningsprocessen. I fas 2 öppnades möjligheten för enskilda lärare att söka pengar. Totalt fördelades 6,2 Mkr enligt samma modell som under fas 1 samt 3,5 Mkr till enskilda lärare. Under fas tre genomfördes fri ansökning med två externa bedömare som evaluerade ansökningarna. En intressant och effektiv metod att både se till att alla institutioner fick del av resurserna och att goda individuella projekt kunde stödjas. En nackdel var, som några lärare kommenterade, att man inte kunde söka pengar för delprojekt med längre varaktighet än 1 år. Dock fanns möjligheten att under fas tre söka vidareanslag på redan avslutade delprojekt under fas 2. En eftersträvansvärd modell för resurstilldelning vid interna projekt.

Målsättningen från projektledningen var att 10-15 % av de erhållna projektpengarna (innebär att 85-90% av resurser går till pedagogiska utvecklingsprojekt och kompetensutveckling av våra lärare) skulle användas för administrativa ändamål såsom ansökan, rapportering och presentation av delprojekten vid den gemensamma workshopen (fas 2). En eftersträvansvärd procentsats som också infriades enligt de interjuver som gjordes. Eftersom projektet ännu inte är avslutat rekommenderar vi att hemsidan görs lättillgänglig för Chalmers lärare och att den lätt nås ifrån Chalmers startsida. Vi rekommenderar också att pengar sätts undan för uppdateringar och att projektresultaten blir lätt tillgängliga.

Några avslutande kommentarer inför framtida pedagogiska projekt:

- Se till att också involvera den centrala administrationen/ledningen
- Möjliggör för flexibla projektperioder inom den totala projekttiden
- Gör det också möjligt för civilingenjörsprogrammen att söka pengar ■

# Appendix



## Strategisk utveckling av Chalmers nya masterprogram

Införandet av masterprogram (och kandidatprogram) inom Chalmers enligt Bolognastrukturer med bibehållen civilingenjörsutbildning kommer att kräva en exceptionell ansträngning och arbetsinsats av hela Chalmers. En sådan genomgripande strukturomvandling och grundutbildningsutveckling motiverar ett långsiktigt stöd från Chalmers stiftelse. Denna radikala förändring av vår utbildningsstruktur är sannolikt den största och mest omfattande utbildningsförändring som Chalmers upplevt under sin tid som teknisk högskola.

Projektet söker inledningsvis medel för 3 år, 30 MSEK och förväntas behöva lika stora resurser under nästa 3-årsperiod för att kunna genomföra projektet fullt ut.

Målsättning med projektet är att utveckla masterprogram med en kvalitet som är långsiktigt internationellt konkurrenskraftig. Stöd från stiftelsen innebär att Chalmers kan förstärka och utveckla den konkurrensfördel ett tidigt genomförande av Bolognas utbildningsstruktur innebär. Chalmers kommer att med stiftelsens stöd få ett förstärkt försprång framför jämförbara tekniska högskolor i landet och även stärka positionen internationellt. Det är av avgörande betydelse för Chalmers varumärke som helhet och specifikt för både nationellt och internationellt söktryck att masterprogrammen håller hög kvalitet från början.

### **Projektets Mål - Stiftelsens stöd borgar för förstärkta insatser (uppfyllda mål) inom följande områden – Mervärde (utöver vad en ordinär masterutveckling skulle medföra):**

- Utvecklade konkurrenskraftiga masterprogram med klara mål för studenternas kunskap och kompetens.
- Kraftfull och koordinerad samordning av masterprogram med kandidatprogram (civ.ing.) högskoleingenjörsprogram, andra masterprogram samt med forskarskolor.
- Förstärkt koppling inom sammanhållna (målstyrda kurser-program) utbildningar och områden – förstärkt röd tråd i utbildningarna.
- Pedagogisk (aktivt och livslångt lärande) upplagda program/kurser med engelska som undervisningsspråk.
- Säkerställande att genusfrågor och frågor som rör hållbar utveckling beaktas i masterprogrammen och dess struktur.
- En kraftfull kompetensförstärkning vad gäller undervisande personal (pedagogik och språk)
- Väl utvecklat kursmaterial anpassat för undervisning på engelska (inte enbart översatt).
- Utvecklade former för feedback från viktiga avnämare.
- Uppbyggda former/metoder för utvärdering/uppföljning av masterprogram samt av utvecklingsprocesser baserade på dessa utvärderingar
- Utvecklade arenor för kunskapsöverföring och annat liknande stöd för pedagogisk kunskapsshantering.
- Väl fungerande administrativa rutiner för programstöd – kvalitetssäkrad antagning osv.

Projektledning och styrgrupp kommer att prioritera olika aktiviteter och deras inbördes form/tyngd/struktur i tid och efter olika programs uttryckliga och föränderliga utvecklingsbehov. Chalmers strategier och prioriteringar kommer att vara viktiga faktorer i dessa avväganden.

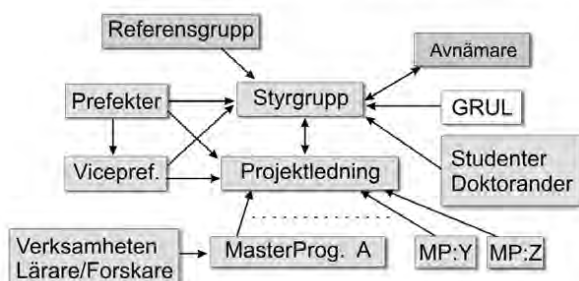
Programmet skall utnyttja det utvecklingsarbete som redan genomförts och utvärderats på Chalmers inom bl. a. C-SELT. Projektet skall också aktivt samverka med det projekt rörande

hållbar utveckling som för närvarande drivs vid Chalmers och verka för att genusfrågor prioriteras i utveckling och genomförande av Chalmers masterprogram.

Metoder för utvärdering av projektet och av masterprogrammen skall utvecklas tidigt av projektledningen med stöd av CKK, Chalmers avdelning för planering och uppföljning och studenterna. Nödvändig extern expertis kommer att behöva adjungeras till utvärderingsgruppen. En första beskrivning av denna utvärderingsprocess kommer att utvecklas till stiftelsens beslutsmöte i september. Vissa kvalitetsparametrar och mätetal kommer att behöva tas fram kontinuerligt för att säkerställa projektets kvalitetsmässiga uppföljning. **Projektet skall successivt följa upp de konkreta resultaten ur ett ämnes-, ett student- och ett avnämarperspektiv. Planeringen för projektet anpassas till resultat av denna uppföljning.**

**Projektet drivs gemensamt av alla institutioner med prefekterna som huvudmän.** En projektledning organiseras med viceprefekt Claes Niklasson (Kemi- och bioteknik) som projektledare och viceprefekt Per Svensson (Teknikens ekonomi och organisation) som styrgruppens ordförande. Projektledare är ansvarig för rapportering till styrgrupp (verksamhet och ekonomi). Projektledare och styrgruppens ordförande rapporterar till stiftelse. Ansvariga för genomförande och rapportering till projektledning för masterprogrammets olika utvecklingsprojekt kommer viceprefekter/prefekter (eller av dessa formellt utsedda) vid Chalmers institutioner att vara. Enbart av Chalmers institutioner ägda masterprogram/kurser äger rätt att söka/erhålla utvecklingsmedel från detta projekt.

### Projektorganisation



Bilaga 1: Mer detaljerad projektbeskrivning

Bilaga 2: Styrgruppens och projektledningens sammansättning

## Bilaga 1: Projektbeskrivning

# Strategisk utveckling av Chalmers nya masterprogram

## A Projektbeskrivning

### Bakgrund

Införandet av Chalmers nya masterprogram är en långsiktig strategisk satsning. Om programmen faller väl ut kommer de att profilera Chalmers som en attraktiv och dynamisk högskola där grundutbildning står högt på agendan; blir de inte bra kan Chalmers renommé och varumärke urholkas. Utvecklingen av de drygt 40 masterprogram som nu är beslutade kommer att innebära en kraftigt ökad arbetsinsats för högskolans lärare, och ekonomiska resurser för att driva utvecklingsarbetet kommer att vara avgörande för programmens kvalitet. Chalmers har ett stort försteg (tidigt initierad Bologna process) jämfört med andra tekniska högskolor i Sverige. Om detta försprång skall behållas och förstärkas är det av yttersta vikt att kraftiga insatser görs med utveckling och profilering av dessa starkt konkurrensutsatta masterprogram

Chalmers har aktivt och på flera olika nivåer arbetat för att civilingenjör- och arkitektutbildningarna skall bli 5 åriga. Den 23 februari beslutade riksdagen att civilingenjör- och arkitektutbildningarna skall förlängas vilket är en stor framgång för Chalmers och en god start för vår nya utbildningsstruktur. Detta beslut underlättar väsentligt den fortsatta processen.

Införandet av masterutbildningar på Chalmers är en mycket strategisk och viktig riktningförändring, som innebär att stora arbetsinsatser kommer att krävas utöver dagens lärarinsatser. Förändringen från svenska som undervisningsspråk till engelska kommer på vissa håll att vara mycket arbetskrävande under en längre tid. Detta kommer att kräva utbildning av lärare och omfattande insatser vad gäller översättning/modifiering av kursmaterial och pedagogiska utbildningshjälpmedel. Det aktiva och livslånga lärandet kommer att sättas i fokus vid denna förändring. Detta är en stor utmaning för Chalmers anställda på många nivåer. Säkerställande av undervisnings och utbildningskvalitet blir en prioriterad del i detta projekt. De nya masterprogrammen skall också underlätta en övergång till forskarstudier med den avslutning i form av ettåriga examensarbeten och forskningsorienterade kurser som kommer att kunna erbjudas inom programmen. Arbetet med att utforma de nya masterprogrammen måste ske i ett nära samspel mellan de masterprogramkoordinatorer, som institutionerna utser, och de ansvariga för de arkitekt-, civilingenjör- och högskoleingenjörprogram som ämnesmässigt är kopplade till masterprogrammen. Över huvud taget behövs en utvecklad och nära samverkan mellan institutionerna och grundutbildningsorganisationen inom ramen för detta projekt.

Det internationella inslaget av studenter kommer att kräva en anpassning av program och kurser för att alla skall kunna tillgodo göra sig utbildningarna på ett tillfredsställande sätt. Vissa program kommer t.ex. att behöva utforma anpassade preparandkurser.

HSV har nyligen genomfört en utvärdering av Chalmers civilingenjörprogram. Preliminära resultat visar på behov av åtgärder när det gäller målformulering på program- och kursnivå och kring pedagogiska frågor. Resultat från denna utvärdering innebär att våra nya masterprogram kommer att behöva utvecklas med liknande måldokument (både kurs och programnivå). Detta kräver ett omfattande arbete av masterkoordinatorerna och

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masteransvariga i en kontinuerlig utvecklings-, implementerings- och utvärderingsprocess.

Måluppföljning och avnämarperspektiv kommer att bli viktiga ingredienser i en kontinuerlig uppföljning av programmen ur ett internationellt student och avnämarperspektiv.

Programmet skall utnyttja det utvecklingsarbete som redan genomförts och utvärderats på Chalmers inom bl. a. C-SELT. Projektet skall också aktivt samverka med det projekt rörande hållbar utveckling som för närvarande drivs vid Chalmers och verka för att genusfrågor prioriteras i utveckling och genomförande av Chalmers masterprogram.

En ekonomisk satsning från Stiftelsen Chalmers tekniska högskola på utveckling av masterprogram kommer att förmedla ett budskap om betydelsen av goda masterprogram inom grundutbildningen både internt och externt. Det är rimligt att anta att den publicitet som en sådan satsning ger Chalmers grundutbildning kommer (om Chalmers hanterar informationen till media på ett effektivt sätt) att bidra till ett ökat intresse för Chalmers utbildningar från studenter såväl från Sverige som från omvärlden.

### **Syfte - Visioner**

I Chalmers strategidokument står det att läsa:

*”I samklang med en hållbar samhällsutveckling och i samverkan över gränser skall Chalmers tekniska högskola vara förstahandsvalet för forskning, utbildning, bildning och innovationskraft.”*

För att ovanstående visionen skall uppfyllas fordras mycket stora ansträngningar vad gäller utformningen av masterprogrammen. Denna uppgift är sannolikt den strategiskt viktigaste som Chalmers står inför under de kommande åren. Chalmers kommer att vara först ut med masterprogram (anpassad till en Bolognastruktur) bland de tekniska högskolorna i landet, och man kan räkna med att dessa kommer att dra till sig stort intresse. Det är därför oerhört viktigt att de från början blir av hög kvalitet. Om programmen har uppenbara svagheter från början riskerar de att få en stämpel av tillkortakommande vilket absolut måste undvikas. I detta tänkande är det viktigt att man har en helhetssyn på Chalmers masterprogram. Dessa kommer, då Bologna-reformen är fullt genomförd för högre teknisk utbildning, att profilera Chalmers som ett starkt lärandeuniversitet. Det blir den samlade kvalitén på programmen som kommer att styra det rykte som Chalmers får, snarare än kvalitén hos individuella program. Det är därför allas vår angelägenhet att de masterprogram som kommer igång under perioden 2007-2009 redan från början är väl fungerande och att ingående kurser håller hög kvalitet och sammanfaller med den målbeskrivning som existerar för programmet.

Chalmers utbildningar på masternivå skall vara förstahandsval för svenska studenter och attraktiva för välkvalificerade studenter från hela världen.

Programmen skall vara baserade på

- ett modernt, teknikorienterat, dynamiskt och varierat kursinnehåll
- målstyrda utbildningar och utbildningsplaner ”capability driven curriculum”
- hög och bred internationell anställbarhet för våra studenter

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- lyhördhet och vilja till förändring gentemot att ny kunskap växer fram och att avnämarnas behov förändras
- engagerade lärare med fokus på livslångt lärande och aktiva undervisningsformer
- engelska som undervisnings och pedagogiskt språk
- en kontinuerlig kvalitetssäkring
- en öppen och kreativ miljö
- könsmässig och etnisk jämställdhet
- en tydlig koppling till kvalificerad forskning
- en styrning mot hållbar utveckling
- samverkan med universitet och industri i Sverige och i omvärld
- stöd av innovativa processer

### Mål

Huvudmålet för projektet är att utveckla de beslutade nya masterprogrammen så att de får högsta internationella kvalité. Programmen skall bli internationellt konkurrenskraftiga och vara attraktiva för både nationella och internationella studenter.

De olika delmålen kan sammanfattas i följande lista:

- Utvecklade konkurrenskraftiga masterprogram med klara mål för studenternas kunskap och kompetens.
- Kraftfull och koordinerad samordning av masterprogram med kandidatprogram (civ.ing.) högskoleingenjörsprogram, andra masterprogram samt med forskarskolor.
- Förstärkt koppling inom sammanhållna (målstyrda kurser-program) utbildningar och områden – förstärkt röd tråd i utbildningarna.
- Pedagogisk (aktivt och livslångt lärande) upplagda program/kurser med engelska som undervisningsspråk.
- Säkerställande att genusfrågor och frågor som rör hållbar utveckling beaktas i masterprogrammen och dess struktur.
- En kraftfull kompetensförstärkning vad gäller undervisande personal (pedagogik och språk)
- Väl utvecklat kursmaterial anpassat för undervisning på engelska (inte enbart översatt).
- Utvecklade former för feedback från viktiga avnämare.
- Uppbyggda former/metoder för utvärdering/uppföljning av masterprogram samt av utvecklingsprocesser baserade på dessa utvärderingar
- Utvecklade arenor för kunskapsöverföring och annat liknande stöd för pedagogisk kunskapsshantering.
- Väl fungerande administrativa rutiner för programstöd – kvalitetssäkrad antagning osv.

### Aktiviteter

Projektet kan delas in i följande områden och aktiviteter:

#### 1. Utveckling, målformulering samt system för genomförande och utvärdering

Utveckling av program och kurser pågår och skall intensifieras under 2006/2007.

Målsättningen är att utveckla ett koncept för lärande och examination mot välformulerade program/kursmål för masterutbildningar, vilket bl.a. medför ett stort arbete med målformuleringar för programmen. Detta gäller för både befintliga och nya kurser och program.



Under utvecklingsarbetet krävs en kontinuerlig nationell och internationell återkoppling från industri, akademi, samhälle och studenter. Varje masterprogram (eller flera masterprogram tillsammans) behöver bilda grupperingar, som har den nödvändiga kompetensen för att kunna bedöma programmens och ingående kursers kvalitet trots att utbildningsprogrammen inte är fullt genomförda.

## 2. Samordning av kursutbud/masterprogram – synergieffekter

Samordning av masterprogrammen med befintliga kandidatprogram/högskoleprogram måste ske i samråd med ansvariga för civilingenjörs- och högskoleingenjörsprogrammen. Samordning måste också ske med de forskarskolor för vilka masterprogrammen kommer att vara naturliga ingångar till fortsatta doktorandstudier.

Masterprogramkoordinatorerna kommer under 2006-2009 att arbeta intensivt med samordnings- och anpassningsfrågor på både program- och kursnivå. Här skall projektet ge dem mer resurser men också idéer till stöd för samordningen. Arbetet är främst inriktat på

- relationer till kandidatprogram/kurser
- relationer till forskarskolor/kurser
- relationer mellan masterprogram

för utbildningar som ges av Chalmers. Även frågeställningar som berör andra utbildningssamordnare/universitet/högskolor kommer att behöva hanteras.

## 3. Övergång till undervisning på engelska/pedagogisk utveckling

Övergången till undervisning på engelska kommer att kräva speciella insatser för att säkerställa utbildningskvaliteten. Speciellt viktiga punkter är

- fortbildning av lärare/engelska som undervisningsspråk
- översättning av kursmateriel
- strategi för värnande av svensk nomenklatur
- pedagogisk utveckling/active learning/life-long learning

Förutom den direkta språkliga konverteringen kommer många undervisningssituationer kräva en förändrad pedagogik eller förändrat arbetssätt. Särskild uppmärksamhet bör ges åt förändringen av den pedagogiska kvalitén under de första terminerna så att eventuella åtgärder snabbt kan sättas in.

## 4. Projektledning – utvärdering och uppföljning

Projektet kommer att utveckla former för kontinuerlig utvärdering och uppföljning av masterprogrammen.

Uppföljning sker i form av

- avrapporteringen (varje program)
- självvärdering (varje program)
- extern värdering (programgrupperingar)

Till projektledningens stöd i detta arbete skall det finnas en styrgrupp samt en branschöverskridande referensgrupp. Självvärderingen involverar Chalmers studenter och lärare, ansvariga för forskarskolor osv.. Den externa värderingen är av största vikt för att säkerställa att utbildningens kvalitét och konkurrenskraft når de mål som Chalmers och omvärlden förväntar sig. Näringsliv och andra utbildningssamordnare skall ges möjlighet att värdera utbildningsprogrammen. Detta blir speciellt viktigt ur ett internationellt perspektiv.

##### 5. Stödfunktioner – samarbeten och finansiering

Projektet avser att utforma olika stöd för masterprogrammets utveckling och medverka till att grundutbildningens befintliga stödresurser anpassas till den nya situationen.

Det är viktigt att det finns en helhetssyn på arbetet inom ramen för projektet. Olika program kan under arbetets gång lära av varandra, och det måste finnas arenor för kunskapsöverföring. Projektets ledningsgrupp/styrgrupp förutsätts säkerställa detta. Viceprefektgruppen kommer att vara en informationskanal för projektets genomförande.

De funktioner som kommer att krävas för ett effektivt och framgångsrikt genomförande av de nya masterprogrammen förväntas få administrativt stöd av befintliga resurser på institutionerna och inom Chalmers centrala grundutbildningsorganisation. Detta gäller inte enbart normal administrativ och ekonomisk verksamhet utan även stöd inom pedagogik, IT, lingvistik, etc. Stödfunktionernas arbetsätt kommer att påverkas av den nya utbildningsstrukturen och det kommer att krävas att medel avsätts inom projektet för den nödvändiga anpassningen. Optimeringen av stödfunktionerna i förhållande till program mål är angelägna bidrag till studenternas helhetsintryck av utbildningarna. Programmet skall utnyttja det utvecklingsarbete som redan genomförts och utvärderats på Chalmers inom bl. a. C-SELT. Projektet skall också aktivt samverka med det projekt rörande hållbar utveckling som för närvarande drivs vid Chalmers och verka för att genusfrågor prioriteras i utveckling och genomförande av Chalmers masterprogram.

För att detta projekt skall kunna genomföras med framgång föreslås att Chalmers ledning säkerställer dessa resursers medverkan i projektet och klart uttrycker att sådana resurser i rimlig utsträckning skall ställas till projektets förfogande.

##### **Projektbudget**

Varje programkoordinator/viceprefekt får ett basbelopp till sitt förfogande för utvecklingen av institutionens program och svarar för rapportering av projektgenomförande gentemot projektledning/styrgrupp. En mera detaljerad modell för fördelning av medlen utvecklas i takt med att behoven preciseras. Pengarna skall i första hand användas till att köpa tid fri så att aktuella lärare kan lägga tid och kraft på kurs och programutveckling. Huvuddelen av medlen går till detta ändamål. Om det sökta beloppet tillstyrkes kommer således vart och ett av masterprogrammen att ha till förfogande en betydande summa pengar för utveckling av sitt program under treårsperioden 2007-2009. Tidigare erfarenhet rörande nyutveckling av internationella masterprogram pekar på ett behov inte understigande 1 M SEK (snarare för vissa 2 M SEK) för varje program. Institutionerna åttager sig att bidra med motsvarande personals arbets- och kompetenstid under hela projektets varaktighet 2007-2012).

Denna budget är preliminär och kan behöva justeras allteftersom planerna preciseras.

Utveckling av Masterprogram (44 st Chalmers)	23,0	M SEK
Projektledning inkl. Administrativt stöd	3,5	M SEK
Information – Kunskapsöverföring	1,0	M SEK
Utveckling av utvärderingssystem/kvalitetssäkring	0,5	M SEK
Styrgruppens pott för särskilda satsningar	1,0	M SEK
Resor – Presentationer	0,4	M SEK
Workshops	0,4	M SEK
Referensgrupp	0,2	M SEK
<b>Totalt</b>	<b>30</b>	<b>MSEK</b>

**Totala behovet av projektstöd från stiftelsen uppskattas till ca 60 MSEK**

### **Informationsplan - Projektrelevans**

Information och avrapportering kommer att ske halvårsvis till stiftelsen och till Chalmers ledning från styrgruppens ordförande och projektledare. Löpande information till Chalmers utbildningsorganisation, GRUL, kommer att skötas av GRULs representant i styrgruppen. Information och förankring hos institutionerna kommer att genomföras inom viceprefektgruppen. Information till studenterna och till doktorander om projektets fortskridande sker genom deras representanter i styrgruppen.

Projektet och dess resultat kommer att presenteras vid nationella och internationella pedagogiska och utbildningsorienterade konferenser.

### **Förväntade effekter och resultat**

Projektet medför att väl fungerande masterprogram med hög kvalitet och god efterfrågan snabbt kan utvecklas. Projektet strävar efter att uppnå effekter för hela Chalmers i form av förstärkt utbildningsprofil och attraktionskraft. Detta ger Chalmers ett försprång gentemot andra tekniska högskolor i Sverige och en möjlighet att långsiktigt befästa sin position som ett av de främsta svenska universiteten när det gäller både nationell och internationell rekrytering. Långsiktig skall projektet bidra till att skapa förutsättningar för Chalmers att vara ett av Europas bästa universitet såväl inom utbildning såsom inom forskning/forskarutbildning.

### **Uppföljning och utvärdering av projekt/projektprocess**

Resurser kommer inom projektet att tillföras för att långsiktigt säkerställa utvärderings och kvalitetssäkringsprocessen. Framtagning av vissa kvantitativa nyckeltal för utvärdering av nya masterprogram kommer att bli en viktig del i detta projekt. Internationellt och nationellt söktryck, interna självvärderingar/studentutvärderingar, och referensgruppens input kommer att vara delar i en bedömning om projektets framgång. Ytterligare förfining av instrument/metoder för projektuppföljning kommer att utvecklas kontinuerligt av projektledning och styrgrupp.

Metoder för utvärdering av projektet och av masterprogrammen skall utvecklas tidigt av projektledningen med stöd av CKK, Chalmers avdelning för planering och uppföljning och studenterna. Nödvändig extern expertis kommer att behöva adjungeras till utvärderingsgruppen. En första beskrivning av denna utvärderingsprocess kommer att utvecklas till stiftelsens beslutsmöte i september. Vissa kvalitetsparametrar och mätetal kommer att behöva tas fram

kontinuerligt för att säkerställa projektets kvalitetsmässiga uppföljning. Projektet skall successivt följa upp de konkreta resultaten ur ett ämnes-, ett student- och ett avnämarperspektiv. Planeringen för projektet anpassas till resultat av denna uppföljning.

Det är av största vikt att den här typen av omfattande projekt får en tydlig ledning, samtidigt som projektresurser inte får avsättas till att bygga upp en omfattande projektadministration. En liten projektledningsgrupp får i uppgift att formulera delmål, för samtliga områden och program, som förslagsvis avrapporteras kalenderårsvis.

### **Långsiktig finansiering av Masterprogram.**

Projektet föreslås existera under sex år som en enskild och avgränsad utvecklingsinsats. Denna ansökan omfattar primärt de tre första åren. Driften av masterprogrammen ligger utanför projektet. Detta kommer att bli en del av Chalmers grundutbildningsåtagande med finansiering efter gängse modell. Projektet är således en extra och nödvändig satsning för att institutionerna på ett tillfredsställande sätt skall klara den ökade arbetsbelastning som införandet av dessa masterprogram kräver. Den långsiktiga driften av masterprogrammen skall efter projektet kunna genomföras inom de ramar den löpande finansieringen medger.

Efter två år kommer en långsiktig uppföljning och en kvalitetsbedömning av uppnådda resultat i utvecklingsarbetet att genomföras. Baserat på denna kommer en plan för det fortsatta arbetet att utformas.

## **B: Administration**

### **Projektets organisatoriska placering**

Projektet placeras administrativt och ekonomiskt vid institutionerna Kemi- och Bioteknik samt Material och Tillverknings teknik men projektet ägs av samtliga institutioner vid Chalmers.

### **Projektledning och styrning**

Projektet drivs gemensamt av de sökande institutionerna med prefekterna som huvudmän. Projektet skall ha en styrgrupp bestående av tre viceprefekter (utsedda av prefekterna och sammankallande väljs av dessa), projektledare, en doktorandrepresentant, en teknologrepresentant och en representant utsedd av grundutbildningens ledningsgrupp (GRUL). Styrgruppen har till uppgift att se till att projektets mål uppnås. Styrgruppen disponerar och fördelar de ekonomiska och personella resurser som projektet erhåller. Prefektgruppen utser en projektledningsgrupp, som skall bestå av tre viceprefekter; en projektledare och två vice projektledare med tydliga ansvarsområden. Sammantaget bör medlemmarna i styrgruppen och projektledningsgrupperna väljas så att en så bred och balanserad representation som möjligt erhålls, dvs. att så många som möjligt av institutionerna över hela Chalmers (2 campus) blir representerade. Projektledningsgruppen rapporterar till styrgruppen. Projektledningsgruppen/Styrgruppen skall också hålla prefektgruppen fortlöpande informerad om hur arbetet avlöper. Pedagogisk, språklig och annan expertis skall kunna adjungeras till projektledningsgruppen och till styrgruppen för speciella uppgifter och större insatser av dessa bör kunna finansieras av Chalmers centrala utbildningsorganisation. Som ovan nämnts är det av yttersta vikt att arbetet inom projektet drivs i nära samverkan mellan institutionerna och grundutbildningens ledningsgrupp. Styrgruppen bör inrätta en

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industriell/samhällelig branschöverskridande referensgrupp, vars uppgift är att ge kontinuerlig feedback på det föreslagna projektet och dess struktur.

En mindre del av medlen går till projektledning, styrgrupp och administration. Insatsen gäller

- projektledning (tre personer på 20-30 % av heltid)
- styrgrupp (tre personer med 5-10 % av heltid)
- information/administration/ekonomi (50 % av en heltidstjänst)
- uppbyggnad av system/metoder för utvärdering och uppföljning
- arbete med arena för kunskapsöverföring

## Tidplan

I denna ansökan anges en ram för de aktiviteter som skall genomföras i projektet. Vilka dessa aktiviteter kommer att bli och när de kommer att förläggas i tiden kommer successivt att beslutas. En första precisering kommer att ske före beslutet i september i stiftelsens styrelse. Efter stiftelsestyrelsens beslut kommer det stora planeringsarbetet att inledas. Projektledningen utformar då en detaljerad projektplan omfattande utveckling, genomförande, implementering och utvärdering – i detalj för 2007 och översiktligt för de två andra åren. Denna skall vara klar vid årsskiftet 2006/07, och skall då vara förankrad i prefektgruppen och godkänd i styrgruppen. Följande detaljplaner kommer sedan att utarbetas baserat på uppföljningen av resultaten av utvecklingen och på bedömda behov.

Nedan skissas en preliminär uppläggning för de första åren:

2007	Formering av lärarlag/studentmedverkan Utveckling av program/kurser 2 dagars workshop för projektledning/styrgrupp/viceprefekter Utbildning av lärare och uppföljning av behov i samband med övergång till ny struktur Översättning av material Samordning av masterutbildningar Samordning med kandidatprogram/civilingenjörsutbildningar/ högskoleutbildningar Upprättande av masterprogramkommittéer bestående av lärare, studenter och externa representanter Utformning av målformulerade programplaner – koppling till kurser Start av masterprogram Utveckling av system för utvärdering och uppföljning
2008	Fortsättning av införande av masterprogram Utbildning av lärare Översättning av material Samordning av utbildningar Kontinuerlig feedback från studenter och externrepresentanter Revidering av målformuleringar – utveckling och uppföljning Utveckling av system för utvärdering och uppföljning

- 2009           Fortsättning av införande/revision av masterprogram  
Fortsatt samordning av utbildningar och kurser  
Utvärdering av masterprogram, i första hand i form av värdering gjord av studenter och industriella referensgrupper  
Utveckling av system för utvärdering och uppföljning

I anslutning till årsskiftet 2008/2009 kommer en utvärdering av uppnådda resultat av projektet och kvarstående behov att ligga till grund för en ansökan för en fortsatt utveckling under åren 2010-2012. Det kommer då att vara möjligt att sammanfatta resultaten av en hel kursomgång (däremot inte av de avslutande examensarbetena) sett från både ett ämnesperspektiv, ett studentperspektiv och ett företagsperspektiv (alltså markanden för studenterna).

### **Samarbetspartners och medfinansiärer**

Chalmers prefekter äskar gemensamt i denna ansökan totalt 30 MSEK för treårsperioden 2007-2009 för utveckling och implementering av nya masterprogram. Omfattningen på utvecklingsuppdraget är så stort och långtgående att vi redan nu vill poängtera att om man avser att fullfölja hela projektet i alla dess beståndsdelar kommer det att behövs ytterligare tre års utvecklingsarbete för tiden 2010-2012.

Projektet innebär en tidsbegränsad insats i utveckling och kvalitetssäkring av Chalmers nya masterprogram och får inte långsiktigt innebära en utveckling mot alltför ”kostnadskrävande” program. Långsiktig driftfinansiering av utvecklade masterprogram kommer inte att finansieras av detta projekt utan måste ske med ordinarie grundutbildningspengar.

Chalmers institutioner kommer att bidra i projektet med befintlig infrastruktur och genom att säkerställa nödvändig kompetens och resurser för projektets genomförande, huvudsakligen i form av kvalificerad lärartid som köps loss för detta ändamål. Utöver de medel som stiftelsen ställer till förfogande kommer institutionerna att satsa i storleksordningen samma summa på utvecklingen av masterprogrammen från löpande grundutbildningsmedel.

## **C Riskanalys**

En typ av risker handlar om huruvida Chalmers satsar tillräckliga medel för denna stora förändring. När Chalmers nu genomför en så radikal grundutbildningsförändring måste nödvändiga ekonomiska och personella resurser tillföras. Risken är annars överhängande att Bolognaprojektet (specifikt masterprogrammen) inte når/blir den förväntade profilering och konkurrensfördel som Chalmers avsett med förändringen. Stiftelsens medel kommer att spridas över en lång tid (3 + 3 år) och de utvecklingsåtgärder som dessutom finansieras av löpande grundutbildningspengar är av naturliga skäl inte möjliga att göra mycket större i början. Man kan därför ifrågasätta om inte de satsningar som görs av stiftelsen de två första åren är för små. Detta motverkas av att institutionerna och de medverkande lärarna vet att resurser kommer att satsas under en följd av år från stiftelsen, resurser att lösa problem kommer att tillföras under en 6-årsperiod.

En annan typ av risker handlar om att medlen inte används på ett effektivt sätt, de kan exemplifieras med:

Förslag till stifteslesatsning inkl bil 1 o 21.doc

- Risken att medlen används för att finansiera delar av tjänster utan tydlig koppling till masterprogramutvecklingen. Detta motverkas av att institutionerna själva driver utvecklingen genom projektet som ställer krav på programmen och följer upp kraven.
- Risken att det som utvecklas inte används. Detta motverkas genom att utvecklingen i allt väsentligt görs av de lärare som skall genomföra programmen.

En tredje typ av risker handlar om att omvärlden förändras. Avnämarnas krav, konkurrerande högskolors program och/eller teknikutvecklingen kan kräva stora oförutsedda ändringar. Detta motverkas av att projektet löpande avser att anpassa utvecklingen av programmen mot relevanta delar av omvärlden.

**Ansökan stöds av prefekterna vid samtliga institutioner vid Chalmers**

Stefan Bengtsson, Mikroteknologi och nanovetenskap  
Gunnar Elgered, Radio- och rymdvetenskap  
Carl-Eric Hagertoft, Bygg- och miljöteknik  
Krister Holmberg, Kemi- och bioteknik  
Per Jacobsson, Teknisk fysik  
Bo Johansson, Matematiska vetenskaper  
Anna Dubois, Teknikens ekonomi och organisation  
Björn Jonson, Fundamental fysik  
Hans Lindgren, Arkitektur  
Per Lövsund, Tillämpad mekanik  
Lars Nyborg, Material- och tillverknings teknik  
Olle Rutgersson, Sjöfart och marin teknik  
Jan Smith, Data- och informationsteknik  
Arne Svensson, Signaler och system  
Rikard Söderberg, Produkt- och produktionsutveckling  
Lennart Vamling, Energi och miljö

**Krister Holmberg**  
**Prefekt KB**

**Lars Nyborg**  
**Prefekt MoT**

**Claes Niklasson**  
**Vice Prefekt KB**

**Gert Persson**  
**Vice Prefekt MoT**



## **Bilaga 2**

### **Projektledning**

#### **Projektledare**

Claes Niklasson Vice Prefekt Kemi- och bioteknik

#### **Vice projektledare**

Inga Malmqvist Vice Prefekt Arkitektur

Per Lundgren Vice Prefekt Mikroteknologi och nanovetenskap

### **Projektets styrgrupp**

#### **Samman kallande**

Per Svensson Vice Prefekt Teknikens ekonomi och organisation

#### **Medlemmar**

Patrik Jansson Vice Prefekt Data- och informationsteknik

Gert Persson Vice Prefekt Material- och tillverknings teknik

Lennart Löfdahl GRULs representant

Doktorandrepresentant

Studentrepresentant

Claes Niklasson Projektledare

## Till styrelsen för Stiftelsen Chalmers tekniska högskola

### Komplettering till ansökan om verksamhetsstöd till ”Strategisk utveckling av Chalmers nya mastersprogram”

Arbete med att utforma den specifika styrningen av projektet pågår och intensifieras efter Stiftelsens beslut. Ett antal möten genomförs under hösten före projektstarten vid årsskiftet med projektledningen, styrgruppen och viceprefekterna (dvs. ansvariga på respektive institution). Under hösten kommer alltså en process för att i detalj definiera projektet att genomföras.

Viktiga punkter i detta arbete är:

- Precisering av projektets mål (enligt ansökan) och kriterier för målpåfyllelse på ett sådant sätt att målpåfyllelsen kan mätas. Detta kräver en strukturering av projektet i delmål och delprojekt som kan värderas utifrån olika typer av kvalitetskriterier.
- En uppläggning av projektet med tydliga projektdelar med rutiner och mallar för dokumentering av genomförda aktiviteter såsom språkläroinbildning, tema work shops osv
- Utnyttjande av tidigare erfarenheter och utvärderingar av olika slag som t.ex. HSV – utvärdering av Chalmers civ.ing.-utbildningar, Chalmers utvärderingar av våra ”gamla” Internationella Mastersprogram, erfarenheter från tidigare pedagogiska utvecklingsprojekt vid Chalmers såsom C-SELT mm – Självvärderingar och projektrapporteringar.

Initierande av en kvalitetsgrupp vilken har till uppgift att följa projektet med kvalitet och utvärdering som fokus. Gruppen träffas årligen minst en gång men någon i gruppen bör ha en mer kontinuerlig uppföljningsfunktion. Gruppen skall ha till uppgift att säkerställa att en utvärdering sker enligt projektförslaget men också vara ”bollplank” för projektledningen för bedömningen av avrapporteringen från och utvärdering av delprojekten. Kvalitetsgruppen rapporterar till styrgruppen varje år. Gruppen föreslås bestå av representanter från:

- Planering och uppföljning Chalmers
  - Pedagogisk utveckling, Chalmers
  - Lärare från Chalmers
  - Det externa vetenskapssamhället, alltså någon extern person med stor erfarenhet av pedagogiska utvecklingsprojekt
  - Projektledningen
- En utvärdering för de 3 första åren med externa utvärderare föreslås ske i form av en workshop med projektledning och andra intressenter på Chalmers. Kanske kan detta ske i samband med Chalmers pedagogiska dag då troligen i december 2009. Utformningen och genomförande av denna utvärdering skall vara en kontinuerlig process under hela projektets genomförande.
  - Former och rutiner för öppen dokumentation av projektet utvärdering skall säkerställas
  - Avrapportering av kvalitetssäkring och utvärdering sker löpande efter Stiftelsens rutiner och eventuella specifika önskemål.

Ett speciellt problem med utvärderingen som kommer att beaktas i uppföljningen är att en stor andel av effekterna först kan utvärderas senare. Utvärderingen skall alltså vara en kontinuerlig process och fortsätta efter projektet. Dock kommer stor möda att läggas på att hitta ”indikatorer” på effekterna redan i slutet av projektet.

# External evaluation report

## International Master's Project at Chalmers University of Technology 2007–2009

Professor Lennart Lundgren and Professor Michael Christie

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## 1. Introduction

In 1999 the Ministers of Education from 29 European countries signed an accord at the University of Bologna which became known as the Bologna Declaration. This Declaration or Accord has set in motion what we, today, call the Bologna process. The process seeks to create a single European higher education area ‘in which standards and quality assurance of university education is comparable and compatible throughout Europe’ (Wikipedia). Chalmers University of Technology (hereafter Chalmers) was one of the first Swedish Universities to embrace this reform. In order to be part of the process Chalmers needed to undertake one of the most demanding and challenging educational reforms that it has faced in its 173 year history. As the IMPACT project notes on its own website, in order to succeed in this endeavour all parties at Chalmers had to agree on a way forward and work together ‘to ensure that Chalmers remains a competitive and highly regarded institution of higher education’.

A key factor in being part of the Bologna process was the ambition to change a domestic masters program, given in both English and Swedish, into an international masters program, offered in English. Chalmers decided to go with a completely English language program from the outset rather than make gradual changes. Chalmers had already begun to give some of its Masters courses in English but the Chalmers decision had ramifications for a large number of masters level teachers, whose course notes and literature were to a large extent in Swedish. In one of the interviews conducted in this evaluation an informant noted that many teachers felt very stressed by the new arrangements. They felt they were expected to radically change their masters offerings but that there seemed to be no support in terms of time and resources to carry out a change. This was a feeling shared by the vice prefects who met in 2006 at Lökeberg conference centre. They decided that they must seek resources from the Chalmers foundation if a successful transition was to be carried out. It was in this way that the IMPACT project was born.

Chalmers foundation has been an active supporter of pedagogical improvement at Chalmers. For example, in 2000 it earmarked up to SEK 50 million for a project called the Chalmers Strategic Effort on Learning and Teaching (hereafter referred to by its acronym C-SELT). For a variety of reasons only two phases of the project were completed at a cost of SEK 23 million. The project leader for IMPACT was active in C-SELT and lead one of its largest sub projects. From interviews with him it is clear that he and his colleagues took note of some of the criticisms of C-SELT that were raised in an external evaluation of that project, which was carried out in April 2006. The evaluators noted in that report that it was not easy to see who ‘owned’ C-SELT. At times it seemed that external consultants lead and steered the project and ‘internal support in the form of conscious leadership and supportive structures was missing’. In the phase 1 an external pedagogical expert, Professor John Bowden, ‘influenced to a great degree the direction and

structure of the project'. The evaluators go on to say that 'it was questionable if the large sums of money used for external consultants was an optimal use of resources' and their advice that participants submit 'research reports' was not appropriate for a developmental project (Utvärdering av projektet C-SELT. De externa utvärderarnas rapport, april 2006, p1 and 4).

From the beginning of the IMPACT project the directors decided not to repeat this mistake. In both C-SELT and IMPACT money has been distributed to fund 'sub projects'. Applications for such funding have undergone an evaluation process but in C-SELT's case these evaluations were carried out by external experts whereas in the case of IMPACT internal Chalmers experts were responsible for judging the quality of the applications. On the basis of interviews and questionnaires undertaken in this evaluation we find that the latter practice is more appropriate for a pedagogical development project. Different strategies for judging the quality of applications have been used for different phases of the project and we believe that the rationale presented by the project leaders for this is sound. In fact one of the strengths of this development project is the conscious choice of different strategies to judge applications and the decision to withhold a sufficient amount of the funding for sub projects until the projects were completed and the results documented in a well written report, presented in a public workshop.

## **2. Evaluators' mandate**

Tuve Science<sup>1</sup> was commissioned to carry out an evaluation of IMPACT in which the following questions were addressed:

- What were the stated aims and objectives of the IMPACT project?
- To what extent were these aims and objectives achieved?
- Were there any particular strengths and weaknesses in the implementation of the project?
- How could the project have been improved?

These key questions encompass a number of sub questions. For example how effective was the project leadership, were resources used appropriately, did teachers and students think that sub projects, in which they were involved, helped improve teaching and learning at the master's level and how well were the results from the project disseminated?

### **2.1 Methodology used in the evaluation**

This evaluation aims to be formative in so much as it intends not only to provide a judgement concerning the success or failure of IMPACT but make recommendations that could be useful for future projects of this kind. The benefit that the project leaders gained from the earlier C-SELT evaluation is a good example of this. Most of the information

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<sup>1</sup>) The principal of Tuve Science, Lennart Lundgren, is a former employee of Chalmers and has extensive experience of its undergraduate and postgraduate education system.

upon which we base our assessment of IMPACT comes from the following sources:

- Information on IMPACT's current webpage [<http://www.chem.chalmers.se/impact/index.htm>]
- Self evaluations by IMPACT's leadership
- Questionnaire carried out by Evaluators
- Interviews carried out by Evaluators
- Other relevant reports

## **2.2 Information on IMPACT's current webpage**

This includes background material such as the documents from Chalmers including notice of the Foundation's possible allocation of funding in 2007 (C 2006/953) and the minutes of the Foundation that recorded the allocation of SEK30 million to the Impact project for 2007-2009 with the possibility of a further review in 2009; the aims of the project; the administrative structure of IMPACT; and applications and reports from the various sub projects including presentations at internal, national and international gatherings. Although some material from the website has been attached to this report the evaluators recommend that readers of this report also look at material on IMPACT's homepage.

## **2.3 Self evaluation by IMPACT's leadership**

This refers to such material as the two online surveys that were sent out in 2007 and 2008. These surveys were addressed to the vice prefects of the 17 departments at Chalmers. The first survey was open for responses from 11 November 2007 until the end of January 2008 and the second from 9 December 2008 until the end of February 2009. Eleven vice prefects responded to the first survey and 15 to the second. Patrik Jansson, one of the project leaders, also carried out a survey that was open online from the 21 April to 31 October 2008. This survey was addressed to all 44 master coordinators and all but two of them responded. Their responses were collated into a 22 page report.

## **2.4 Questionnaire carried out by Evaluators**

This was a small online questionnaire addressed to all program leaders in the international masters courses which asked if they had heard of IMPACT, how they had heard of it, how they were involved with IMPACT, what they thought was best with the project and how did they think it might be improved. The survey was only open from 18 May until 3 June 2009 and of the 44 coordinators 28 responded, a respectable percentage given the time of year and shorter time to respond.

## **2.5 Interviews carried out by Evaluators**

In total 18 interviews of between one to one and a half hours were carried out and the results summarised and used as evidence to answer the key questions given above. For ethical reasons the information provided by informants is cited anonymously and notes made during and

after the interviews are stored safely in a special archive. The interviewees have been selected from a range of interested parties including someone from the Chalmers foundation, administrative personnel, the project leaders, the steering group, the reference group, and people who have received money for project and those who have not. A balance with respect to genus was achieved among the interviewed persons. The opinion of students was canvassed by means of an interview with one of the student representatives on the project. A detailed list of the interviewed persons can be found in attachment 9.2. The interviews were performed in an open and informal way where some key questions were prepared in advance but others were left open so that it was possible for the interviewees to discuss important aspects of IMPACT from their own perspective.

## **2.6 Other relevant reports**

The evaluation team has made use of other relevant reports. The report from a survey of all international Master's students held in May 2009 is important. A total of 1284 out of 2400 students replied to this online survey and some of their positive comments can be directly linked to projects carried out by IMPACT. We have also made use of reports from experts asked to judge the quality of IMPACT applications for sub project funding in phase 2 and 3. The final reports and presentations from the sub projects themselves have been another valuable source of data as have reports from relevant Chalmers committees (GUN for example). We have already demonstrated in the introduction that evaluations of similar projects have been useful in drawing comparisons between this and other pedagogical development projects at Chalmers. Finally reports relevant to international masters education in engineering science have been used as background material for this evaluation.

## **3. Leadership, aims and strategies**

In this section we report on how the project was initiated, who undertook responsibility for the leadership of the project and the aims and strategies that were adopted to carry out the project successfully. Information for this section comes mainly from the project's own documents and interviews involving the project leaders.

### **3.1 Initiation of project 2006**

As already indicated above the project was a response to a difficult situation created by an executive decision at Chalmers to replace its mainly domestic masters programs with international masters programs that fulfilled the requirements of the Bologna agreement. A key aspect of the Bologna agreement was that all programs should be amenable to credit transfer. Another was that they should be open to students from European and international universities and this meant that courses would have to be given in English.

In the IMPACT program it was very clear from the start who owned the project. Vice Prefects with responsibility for educational programs

at Chalmers were agreed that unless funding was provided to help masters teachers it would be extremely difficult to rework their Swedish teaching material and redesign, reduce, combine or expand current courses into the required thirty international masters programs that were proposed by management. If help in terms of time and money were not available the transition from a domestic to an international masters at Chalmers would be not only stressful but very possibly unsuccessful.

In this climate a meeting of interested parties agreed that an application for funding from the Chalmers foundation should be prepared and that the following people would take leadership roles in both formulating the proposal and implementing the project if funding was obtained.

### **3.2 Leadership of the project**

The following list of project leaders, members and people co-opted to a reference group is taken from the IMPACT webpage.

#### **Leadership Group**

Claes Niklasson, *Vice Prefect, Chemical and Biological Engineering*  
E-mail: claesn@chalmers.se (Project leader)

Patrik Jansson, *Vice Prefect, Computer Science Engineering*  
(Vice Project leader)

Per Lundgren, *Vice Prefect, MC2*

#### **Project or Steering Group Members**

Per Svensson, *Prefect, Technology Management and Engineering*  
(Chairperson)

Inga Malmqvist, *Vice Prefect Architecture*

Gert Persson, *Vice Prefect Materials and Manufacturing Technology*

Lennart Löfdahl, *Masters Program coordinator*

Johan Piscator, *Doctoral Representative*

Karin Glader/Jonas Pedersen, *Student Representatives*

Eva-Karin Akar, *Student Centre, ORIGO*

Claes Niklasson, *Project Leader*

#### **Reference Group**

Lena Peterson, *Educational Coordinator*

Birgitta Carlsson, *Planning and evaluation*

Erik Ohlsson, *Student Representative*

Carl-Eric Hagentoft, *Dean of Department, Civil and Environmental Engineering*

Claes Niklasson, *Project Leader*

The leadership of the project was organised in such a way as to include three key roles, namely project leader, vice project leader and chairman, a triumvirate that could meet quickly and effectively and take executive decisions. They were supported by a wider leadership group



or steering group whose members included important stakeholders in the project. This group included representatives from the administration, from the departments and from the doctoral and undergraduate student associations. There was also an external reference group. The project leader, Claes Niklasson, was a member of all three groups. At least one person from each group was interviewed and according to their responses it seems that the reference group did not really function as intended. It met a number of times during the first year of the project but the resignation of the chairperson because of time commitments hindered its operations. This person was not from Chalmers and was a key player in the introduction of the Bologna system at the Masters level in Sweden. Her position was taken by someone from Chalmers so the external perspective of the group was diminished. This was something that was seen as a weakness by the person who was interviewed from that group. In general most of those who were interviewed felt that since the project was largely an internal Chalmers development initiative the need for external expertise was not so necessary. The fact that IMPACT was a topic at all the meetings of the vice prefects at Chalmers provided another, informal reference group.

According to those we interviewed from the respective groups the collaboration between the project leading group and the steering group was excellent. Collaboration between IMPACT and Chalmers leadership and administration was not as obvious. The IMPACT project was, in essence, a vice prefects' project and the lack of influence from the central administration (vice rector for undergraduate education for example) was something that was raised in interviews. A new vice rector was appointed after the funding for IMPACT had been won and this was offered as one explanation. As we note below, under 3.4, the aim to institute adequate administrative routines for programme support does not appear to be well funded and judging from an interview with an administrator the links between the project and administration were not as strong as they might have been.

### **3.3 Goal and specific aims for the project**

The overarching goal of the proposed project was to develop the prescribed new masters programmes so that they exhibited the highest possible international quality and were competitive at both the national and internal level. This goal was in line with Chalmers strategic vision.

The goal was broken down into more specific aims, namely to:

1. Develop internationally competitive Masters' Programmes with clear goals for improving the knowledge and competence of students.
2. Coordinate the Masters' Programmes with Bachelor-, Bachelor Engineering- and other Master's Programmes and with graduate schools in a clear and well structured way.

3. Improve the connection within programmes by means of well defined learning outcomes and more visible common themes in the programmes.
4. Deliver all programmes and courses in English, using a pedagogy designed for active and life-long learning.
5. Ensure that the issues of diversity and sustainable development are considered in the delivery of the master's programmes.
6. Strengthen the teachers' competence in terms of pedagogy and English communication.
7. Provide new learning resources in English that are more than mere translations of existing material.
8. Set up a format for feed-back from important stakeholders.
9. Design a system of assessment for the Master's programmes to be used in long term quality assurance.
10. Set up common arenas for experience sharing and/or other means of support for the promotion of pedagogical development.
11. Institute adequate administrative routines for programme support and, for example quality assured admission.

The eleven project aims covered nearly all aspects of developing the Master programs. In interviews informants pointed out that in reality there were too many aims to accomplish given the amount of money and time that was available. In the questionnaire that the evaluators sent out to Master coordinators one respondent implied that the aims were too ambitious because there was 'Too little money...when Impact projects are too small or have short time spans it becomes difficult to make them effective'. An informant from one of the interviews felt that too little attention was paid to some of the aims. It was this person's opinion that it would have been better if there had been greater congruence between the aims and their implementation. Other interviewees argued that if more money had been given to fewer individual projects there would have been a better result.

Since this evaluation is based on an assessment of how well the stated aims were achieved it is important to make two points. When interviewed, the project leader agreed, in hindsight, that the general aims could have been broken down into more specific project outcomes. Some were so broad that it is very difficult to evaluate their success or failure. For example the overarching goal does not specify the criteria by which one might judge what constitutes a master's programme of the highest international quality. Even some of the more specific aims suffer from being vague and difficult to evaluate.

The problem is that many aims include elements that require better definition. For example what constitutes 'clear goals' (aim 1) or 'clear and well structured' coordination (aim 2); how will clearer learning

outcomes and more visible themes improve the connection between programmes (aim 3); in what way will diversity and sustainability be 'considered' and what does this mean (aim 5); and, what are the criteria for 'adequate administrative criteria' for programme support (aim 11)? At least in the last case one example of adequate administration is given, namely, a form of quality control for the admission of candidates.

The project leader indicated that many of the aims were in fact a rough sketch for possible sub projects or themes for sub projects. For example, funding would be made available for projects that aimed at revising current teaching material and reworking it so that it could be provided in English (aim 7). In this case a criteria is mentioned – funding will not be available for mere translations. In the light of this clarification the evaluators have focused more on how sub projects have helped achieve the essence of the stated aims - namely, improved student knowledge and competence (aim 1); better coordination and connection across all programmes (aims 2 and 3); better English resources and delivery, more diversity, active teaching and learning methods and life long learning (aims 4-7); provision of an arena for teacher collaboration (aim 10); and, quality assurance in terms of feedback to stakeholders, assessment of courses and administrative support (aims 8, 9 and 11).

### **3.3 IMPACT as a strategic curriculum development project**

In interviews with both the leaders of the project and those who participated in the sub projects the question of IMPACT as a strategic curriculum development project was discussed. As mentioned in the introduction IMPACT was born as a reaction from teachers and coordinators to a decision to switch to the Bologna system and replace the Swedish masters programme with 30 international, 'Bologna style' masters programmes. In fact, due to a number of factors, 44 such programmes were allowed to start.

Some informants saw the failure to insist on 30 programmes as a weakness at the central level and a strength at the departmental level. Some departments that already 'owned' masters programmes managed to resist the central initiative and some programmes that should have been collapsed into a single new programme managed to survive. Despite clear strategic aims on the part of management it is not always possible to enforce educational reform because of internal politics. The existence of 44 programmes is now seen as a problem given the fact that Chalmers and other Swedish universities attract large numbers of international students because such education is free here but quite expensive at universities in other countries. Since the government only pays for a set number of places an over subscription to courses can cost Chalmers money.

When IMPACT gained the funding it sought, it saw the need, according to the IMPACT leaders who were interviewed, to involve all the departments in the project. There were two ways of doing this. One was to give the resources directly to the departments and then let them de-

cide how to use the money. The other approach was to create a system where individuals or individual Master's programmes could apply for support. The final choice of the project leaders lies somewhere between both options. In the first phase (year one) support was given to the department via an interaction process where unsatisfactory applications were returned to the departments for revision. In the end all departments were given a fair amount of the money. In the second phase pedagogical, environmental and multicultural themes were identified and money was widely distributed between the departments but on the advice of internal experts in those three areas. In the third phase (year three) the applications were ranked by a group of evaluators including project leaders from the steering committee and two internal experts from Chalmers. These different ways of handling the applications was considered to be a good choice according to those we interviewed.

### **3.4 Information about and use of resources**

IMPACT is a vice prefect project and the vice prefects became the natural conduit for any information to flow within or across the various departments. A questionnaire from the evaluators (2009); two self evaluative surveys sent out to vice prefects by IMPACT leadership (2007 and 2008); a survey sent to all 44 masters coordinators (2008); and a large survey of International Masters student in 2008 have all provided data about people's perception of IMPACT. The other source of data comes from interviews. The surveys give us a good insight into how the IMPACT project was advertised and what people think of the way the resources were used. Unfortunately the interviews do not provide much evidence of the extent to which IMPACT reached individual teachers and researchers across Chalmers. They do, however, give some useful insights into how key players think the resources were utilised.

In the evaluators' questionnaire that was sent to coordinators of the Chalmers master programmes 28 out of 44 responded. All respondents said that they had heard of IMPACT. They nominated various sources, namely, from the IMPACT project leaders themselves (17); from their Vice Prefects (15); from a Chalmers colleague (12); from another Masters Coordinator (6); from the IMPACT homepage (4); and from Chalmers News (2). Clearly word of mouth was more effective than an announcement in the Chalmers online news site or the IMPACT website. Of the above respondents all but six had been involved in IMPACT projects. Eight had worked with one sub project; seven with two and another seven with three sub projects. Of the twenty two involved with IMPACT nineteen out of twenty two had been sub project leaders.

In the two self evaluations that are mentioned above vice prefects from all departments were asked about their opinion of various aspects of IMPACT (see appendix 8.1 for the English names of the departments). The first survey was sent out in 2007 and 55% of the vice prefects responded. In the 2008 survey the response rate was 75%. It was stated in answers to both questionnaires that the departments had a high degree

of influence on the performance and accomplishment of IMPACT -75% of those who replied gave that answer. Two thirds of the departments that responded were very satisfied with the information flow from the project leading group. Three quarters of the respondents also felt that the resources have also been well used. While the response rate from the vice prefects is good for this type of online survey the fact is that 45% in 2007 and 25% in 2008 did not respond.

Given how important the vice prefect role was in this project it is important to say that the spreading of information and the appropriate use of project funding depended greatly on the engagement of these people. Vice prefects are changed on a regular basis and so it is possible that the original consensus achieved in 2006 might not have been sustained over the three year life of the project. In an interview with the project leader it was pointed out that vice prefects meet four times a year and this provided a forum for the discussion of IMPACT and the chance to update any new vice prefects about its aims and objectives. Nevertheless in interviews with individuals a teacher who obtained funding in phase 3 said that she had not known about IMPACT until after phase 2. In making the above observation the evaluators feel that in terms of information IMPACT made every effort to be visible on Chalmers webpage and in its news columns and that the leadership via workshops, regular meetings with vice prefects, surveys and personal communication endeavoured to spread information about the project as widely as possible. Some responsibility must be placed on individuals to inform themselves, as they do regularly when it comes to applications for research funding.

Respondents representing administration, Chalmers leadership, the Chalmers foundation and the reference committee felt that more money should have been allocated to aim 11. One respondent said that 10% of the funding could have gone to administrative projects. For example quality assurance and quality assurance support projects for the international masters' programmes could have been an effective use of IMPACT resources. Two other respondents had a different perspective on the use of resources. They felt that spreading the resources across departments meant that, in their case, there was too little money to warrant the effort involved in writing applications. Both respondents came from departments that were already well financed by research projects and their problem was not lack of money but lack of time to do anything other than core research.

#### **4. Summary of outcomes**

In general there was a very positive response to the IMPACT project. This evaluation is not able to provide specific evaluations for each of the sub projects and some of them in the third phase are not yet concluded. However, judging from the responses we have had in interviews concerning the sub project application and implementation process and the results of the reports we have been able to peruse from the two summary workshops which have been conducted so far, it is possible

to say that the sub projects, to this point, have achieved their particular aims and outcomes and can be deemed a success. If we accept the argument that success or failure of the larger IMPACT project depends on how well the sub projects have been managed and carried out, and the quality and effect of their outcomes, we can conclude that IMPACT has been a successful, well managed pedagogical development project.

#### **4.1 Achievement of aims and objectives**

The response to an extensive evaluation survey that was sent out to all masters students in came be viewed in the light of vice prefects opinion of the role of IMPACT in developing the new international masters. Respondents rated IMPACT's role in three areas and concluded that IMPACT, in terms of percentage, contributed 30% to program planning and 22% and 21% respectively to program realization and program development. When one considers the rather limited budget for IMPACT there are impressive figures and backed up, it could be argued by the very positive response of the students to their new programmes. Students were positive in terms of how the programmes' has improved their knowledge and competence in their chosen area (aim 1).

Evidence provided in section 5 below clearly demonstrates that IMPACT has led to better coordination and greater connection across the programmes (aim 2 and 3) and reports from courses in English that were funded for Master's teachers suggest strongly that teachers have been assisted in making the transition from Swedish to English in their delivery of master programmes (aim 4). Similarly a number of project reports clearly show that they have delivered important and measurable outcomes in terms of aims 4-7. These include projects that targeted improvement in English delivery and course materials, active and life long learning, increased awareness and provision for diversity and innovative programmes that incorporated sustainable development across the curriculum.

It is very clear from both the sub projects and from evidence provided in interviews and surveys that IMPACT provided an arena for teacher collaboration and the exchange of ideas, material and support. The workshops that IMPACT arranged each year is a clear example of this. The same sources however are not as convincing when it comes to the success of IMPACT in terms of quality assurance and support. Those who were interviewed from Chalmers administration and leadership had some critique both the way in which IMPACT defined its stakeholders and the extent of feedback to them (aim 8). Although this was a minority view it did serve to highlight certain weaknesses of the project, in particular, in terms of its carrying out of its support for and implementation of aims 9 and 11. A number of informants pointed out that although the project aimed at designing 'a system of assessment for the Masters' programmes to be used in long term quality assurance' (aim 9) there were not sufficient sub projects funded to help realise

that aim. It is true that IMPACT did assist with the large scale student evaluation that was undertaken in 2008 and some projects included elements that could be used when planning a more overarching system. Finally the project was criticised in terms of its aim to 'institute adequate administrative routines for programme support and, for example, quality assured admission (aim 11).

#### **4.2 Strengths and weaknesses**

Based on the data sources mentioned above a number of strengths and weaknesses were identified in the IMPACT project. Some have already been mentioned and will not be repeated here unless the information adds to the discussion. It was clear from both interviews and surveys; from an examination of all applications in phase 2 and 3 of the project; and from sub project reports and the national and international presentations that have been given based on them, that the strengths of IMPACT far outweigh the weaknesses.

One of the most important strengths of IMPACT was that it was a grass roots project that empowered vice prefects, master programme coordinators and teachers within the new international master's programme at Chalmers. It provided incentives for all these stakeholders to set about a major reform rather than feeling disempowered and stressed for lack of time and money. The aims may have been better formulated but they were aims that had been hammered out in a meeting of vice prefects and they were in the first instance student oriented. The results of the student survey conducted in May 2008 emphasised many positive aspects of the new international masters program.

IMPACT's first aim was to help create an internationally competitive Masters' Programmes with clear goals for improving the knowledge and competence of students. In the survey an impressive 26% said they were very satisfied, 53% said they were satisfied, 10% were non committal and only 9% and 2% respectively said they were not so satisfied or not satisfied at all. When asked if they felt the goals of the Masters programme were reasonable 72% answered positively. Only 2% respectively felt the goals were set too high or too low. There were 15% who had no opinion and 9% who felt the goals were a bit too low. Although IMPACT cannot take full credit for such a good result there is no doubt from evidence provided by vice prefects, master's coordinators, teachers and students that the project assisted in the difficult transition from a national to an international masters programme. There is another positive outcome from this survey that IMPACT can claim some credit for, given the fact that it funded sub projects aimed at improving pedagogy and the use of English in the masters programmes. Just on 60% of all student respondents thought that the majority of master's teachers (50-100% of them) were good teachers and 72% felt that a similar percentage of teachers had good English.

Some of the comments from coordinators were that IMPACT allowed them to develop and implement pedagogical strategies for the master's

programmes rather than simply scrambling to get their material updated and put into English. This was a theme that was raised by a number of respondents. Others felt that IMPACT gave ‘sanction and authority to improve pedagogy and teaching at Chalmers’. Another respondent said that ‘It sends a signal that pedagogical development is a natural part of running the programme’. There was an interesting comment concerning IMPACT’s link with the Chalmers centre for competence and knowledge building in Higher Education (CKK).

The IMPACT leadership actively sought and paid for advice and assistance from CKK. This included CKK recognising any prior learning (RPL) achieved by teachers who undertook sub projects themselves or who participated in courses set up and funded by IMPACT, for example the sub project ‘Teaching through English’. CKK agreed to undertake the work entailed in giving RPL to teachers who took this course but also agreed that teachers who carried out, wrote a report and presented their results to colleagues were eligible for RPL for the CKK course TLC101 Pedagogical Project. One coordinator noted that the project he did was a ‘Good basis for my work in the pedagogical project course’. Most importantly of all the sub projects and the workshops where results were reported created a forum for pedagogical discussion. In summary IMPACT achieved that what many universities strive for but find hard to achieve: a voluntary and informed exchange of pedagogical ideas across departments and subjects.

Most coordinators commented on the importance of the financial support that IMPACT provided. Despite the couple of comments mentioned above in 3.4 people felt that IMPACT provided the means for teachers ‘to get some time and money to increase the quality and content of the master programmes’. Another aspect of IMPACT that was appreciated by the coordinators was the opportunity it gave ‘To meet teachers from other departments’ and ‘to increase coordination between the programmes and also to involve the Student Centre’. Another respondent emphasised how the sub projects had helped initiate good contact with industry, another aim of IMPACT.

One person said that the project provided the possibility to improve the program and course plans and to evaluate and change parts of the program that were outdated or badly designed. In an honest appraisal one of the coordinators said: For me the projects applied for in IMPACT have mainly been part of the work that is needed to be done anyway and of course it has been great to be able to get extra funding for this. It has also helped to point out specific needs and in some ways helped solve them’. One optimistic note was sounded by the person who said that for him IMPACT provided ‘Funding to try things that would have otherwise been impossible’. There was also a comment that can be taken as a positive evaluation of IMPACT’s organisation as well as a wry admission of the importance of extrinsic motivation. ‘When you have promised, in writing, to do something, then you really have to carry out what planned’.



In the various interviews and surveys there were a number of comments that pointed out weaknesses in the IMPACT project itself but also in having to do a sub project. We have noted already that some people would have liked to see fewer projects with more resources but it is the evaluator's opinion that the benefits for more projects, mentioned above act as a counterweight to this suggestion. There was an astute comment that funding a specific project could mean that both management and teachers neglect 'the demands for general development of the programme'. The implication is that when asked what is being done to generally improve the international master programmes leadership can point to the fact that has funded a special project. The comment that 'the support (for master programme development) has come too late in the process and the project time has been too short' is an example of this danger. Some coordinators felt that there could have been more 'information from other projects'. This person said that the 'exchange of information should be intensified'.

In reflecting on the project there was a general criticism not of IMPACT but the circumstances in which IMPACT projects had to be carried out. For instance one person said 'The activities compete with everything else. Even if we receive money, all professors are heavily occupied with everything else. It is hard to find devoted time, unfortunately'. In a similar vein another person noted that 'It is difficult to get the necessary time considering other duties'. One of the coordinators agreed that that there is too little money and time but was positive about the fact that IMPACT projects allowed for the possibility of 'enlisting 'outsiders' with links to our education, such as previous PhD students or course assistants, to help us with quality improvement'. To do this effectively, he felt like some others that there needed to be more money and a longer time frame for the projects.

There was a general comment that the project was somewhat 'unfocused'. Given the clarity of the webpage this might be unwarranted but in elaborating on this comment the informant pointed out that 'It feels like the projects are made one by one and there is not so much overlap and collaboration among different projects'. This person and others stressed the need for quality assurance in the project. They wanted to see the results and know whether or not the projects affected 'the specific programme or course and how can this help other programmes and courses'. Some of our informants felt there had to be 'Serious evaluations of financed projects' a demand that hopefully this report helps meet. In general most dissatisfaction has less to do with IMPACT and more to do with a general lack of time and money to develop high standard courses. One person would have liked the funding to be rolled into the general funding for bachelor and master course development so that at the department level there were not different pots of money and more work involved in applying for such funds. In a final comment on the nature of such pedagogical development projects one respondent simply said that research continues to have a higher priority.

In summary the strengths of the IMPACT project were that IMPACT:

- had broad support among vice prefects and masters' course coordinators
- helped improve the quality of the Masters' courses
- sent a signal that pedagogy was important
- enabled practical pedagogical improvements to the courses
- helped finance an update of content and course materials
- provided assistance in developing new skills needed to give the courses

The weaknesses that were mentioned in the interviews tended to focus not so much on IMPACT itself but on the level of funding for IMPACT. In other words some respondents felt that there should have been fewer, more focused and better financed sub projects.

#### **4.3 Possible improvements**

Although there was some debate about the role of an external reference committee and the extent to which it might or might not benefit the project we consider that the continuation of the first year model with a strong external chairperson was desirable. Since connection with industry and the international community is important representatives from these sectors could have been involved without having to always meet physically.

Key questions, ideas or initiatives raised by the reference committee could have been canvassed by email, in the way that CDIO currently is negotiating the possibility of adding the thirteenth standard concerning 'internationalization and mobility' to their charter. Another improvement that comes out of the interviews and surveys is the proposal that there be a clearer link between management of the project and Chalmers management. A third improvement is that the aims of the project be more clearly defined. Perhaps a general aim followed by more specific intended outcomes would have been a better model to follow.

### **5. Sub projects funded by IMPACT**

Most of the information in this section is drawn from IMPACT's own website and details of the sub projects that are mentioned here can be found there. In this section we briefly describe the application process for the three phases of the project and provide basic details about the projects that were funded. The evaluators have gone through the applications for phases 2 and 3 and provide some judgements about their quality and how they might be improved in the future. In the interviews and surveys most respondents indicated that they were satisfied or more than satisfied with the application process. Of the twenty two masters coordinators who replied to the evaluators' survey 54% or 12 out of 22 were in this category. Of the rest, 36% (8 people) were non-committal and only 9% (2 people) said they were not so satisfied.

### **5.1 The first phase 2007**

The first phase of IMPACT the leadership group decided that the most effective way of spreading a third of the funding among the various Chalmers departments and masters programmes they ran was to 'clearly delegate responsibility to the departments'. The idea was that vice prefects would open up a discussion within their department as to how they would prioritise spending their particular allocation. Each department could apply for SEK 180 000 per master's programme. Their application for this funding had to follow the template prepared by IMPACT and should advance the aims of IMPACT. In what appears to be a reference to C-SELT the leaders said that this decision was based 'on experience from earlier Foundation development projects where the failure to optimise funding sent the wrong signal to teachers'. They went on to point out that 'resources for teaching and the way they are used are crucial for the success of the masters programmes so it is essential to provide teachers with positive signals in their endeavour to make their courses internationally competitive'.

The application process was simple and straight forward and the effect of delegating responsibility for the first set of applications resulted in an effective organisation of proposals that were both prioritised and kept to the format laid down in the IMPACT instructions for the application process. These rules said that the application must cover one of the six areas of interest that had been worked out at the Lökeberg meeting (23-24 October 2006). These were pedagogical and programme development, English as a language of instruction, equity issues, sustainable development and cooperation within Chalmers and with industry. The application should indicate clear aims and outcomes that were as measurable as possible, the activities to be undertaken and any added value of the sub project over and above the specified aims. A contact person was to be nominated to allow IMPACT leaders to give quick feedback on the proposals. This feedback included asking for clarification or requiring modifications to the proposal. It was indicated that applications should be short and concise. When asked about this phase all the vice prefects and most of those we interviewed were quite satisfied with the process.

### **5.2 The second phase 2008**

In the second phase it was decided to steer the process centrally and open up applications to individuals without using vice prefects as gatekeepers. Their role in this round was to inform their department and encourage the most useful applications. The key funding areas that had been identified at the start up meeting of vice prefects and advisers at Lökeberg conference centre provided the framework for the applications. These had been further refined and discussed during vice prefect meetings that were held regularly throughout the 2007. The project leaders and their steering committee, in keeping with the advice they had received, announced that for 2008 individuals and

teams could apply for money (SEK 9.7 million) for projects that helped advance IMPACT's goals for improved pedagogy, teaching in English, sustainable development and multicultural and equity awareness. Three experts from Chalmers in the areas of pedagogy, equity issues and sustainable development were asked to assist the leadership group in selecting successful applications.

The evaluators have read the applications for this round of funding and feel that the quality of applications was patchy. The complaints about lack of time mentioned above were evidenced in what appeared to be some hastily prepared applications. Although very clear guidelines were laid down for how one should apply for funding it seemed that many applicants did not make sufficient effort to apply the criteria outlined in the application announcement. For example too few applications showed how their proposed project would evaluate. In quite a number of cases other criteria were ignored or glossed over. The best of the applications referred to the criteria but there were many that did not. The latter neglected to show how the sub project involved students, made use of external competence, spread the results, cooperated with other departments or masters programmes or indicated how the sub project would be evaluated. Very few mentioned the news worthiness of the sub project or how it implemented new pedagogical solutions that could benefit Chalmers. This was not the fault of IMPACT whose guidelines were very clear.

## **5.2 The third phase 2009**

The third phase is not concluded so the evaluators will only comment on the application process. The evaluators have been able to look at all the applications for this phase of the project and there appears to be a development in terms of their quality. Many applicants continued to pay insufficient attention to the criteria mentioned above. For the most part they focused on describing the goals, the activities and the value (rather than the added value) of the sub project.

What was different from the second phase was that some applications from some departments were of a consistently higher quality than others. From interviews it appears that vice prefects played an important role here. In some cases there were excellent applications from a number of individuals in the department while in others it appeared that applications had been put together at the last minute. In a few of the former cases the vice prefect did not appear as an applicant whereas in some of the latter he or she was the only applicant. It is not possible to draw any rigorous conclusions here but our observations underscore how important the vice prefects were for the smooth running of IMPACT. They could act as very important channels of information or, for lack of time, resources or other reasons fail to encourage the master's coordinators and their teachers to apply for sub projects and thereby make use of the available funding. Although two experts were used to judge the quality of the applications their role was to make

recommendations to the leading group who also acted as judges of the proposed sub-projects.

## **6. Documentation and dissemination**

The documentation approach for this project has been straightforward and effective. The projects homepage serves as a repository for key documents such as the initial application stage of the project, the call for applications for funding, the names and key details of the sub projects and the way in which results are spread through Chalmers wide, regional, national and international workshops.

### **6.1 Within Chalmers**

Documentation and dissemination within Chalmers was carried out via its web system including the projects homepage and Chalmers news. Regular workshops were held and IMPACT did its best to ensure that reports were submitted on time and posters presented at workshops by withholding between 10–15% of each sub project's budget and making that sum payable on receipt of the report and the presentation of a poster.

Some of those who were interviewed felt that workshop and poster session that was held in 2008 did not really achieve its aim since people were free to browse among the posters at will and it appeared that not all took this opportunity. This is a common problem at international conferences and some, like the Active Learning in Engineering and SEFI conferences try to overcome it by having people facilitate these sessions, requiring participants to make comments on post-its and organising plenary discussions. It was decided that in 2009, when individuals and teams reported on the previous years sub projects, that posters would be replaced by interactive sessions. From feedback from the participants this was seen to be a better format. From the survey sent out to the vice prefects in 2008 several respondents had asked for more focused workshops where there could be greater information flow between the projects. The IMPACT leadership acted on this advice and the workshop held on neutral ground at St Jorgen's Park was considered to be more successful than that held at the Chemistry department in 2008.

The project leader, Claes Niklasson has actively spread information about IMPACT via a number of PowerPoint presentations. For example he has presented material to staff at the workshops mentioned above in October and December 2006, October 2007 and May 2009. He has also briefed to the former Committee for Undergraduate Education (April 2007) and informed a gathering of Coordinators for Masters Programmes in May 2009.

### **6.2 Nationally**

The leaders of IMPACT presented the results from the first two years of the project at the annual Quality Conference organised by the

Agency for Higher Education in Stockholm in November 2008 and May 2009. In an interview with him he said that the information had been well received and that it sparked a discussion concerning the Bologna process and its implementation at the Masters level.

## **6.2 Internationally**

The project leader took every opportunity to spread information about IMPACT internationally. He presented material to gatherings of Engineering Educators in Kuala Lumpur at the University of Malaya and at the University Rajah Made, Jogjakarta, Indonesia in January 2007. The vice leader of IMPACT, Patrik Jansson reported on the first and second phase of the project at SEFI2009 in Rotterdam, Netherlands. Leaders of sub projects have reported their results at various international gathering, for example at the EESD2008GRAZ conference in Austria (Magdalena Svanström); at the European Workshop on Microelectronics Education in Budapest in May 2008 (Per Larsson-Edefors); at IUPA2009 in Glasgow (Lars Öhrström); and, at the CDIO meeting in Singapore in 2009 (Maria Knutson Wedel).

## **7. Recommendations**

- The next IMPACT workshop should be devoted to information flow within Chalmers. The workshop should focus on reports from phase three, but briefer reports from all projects from all three phases should be presented. Ideally sub project leaders should present, but if there is any reason why this cannot occur, then a summary of the reports should be included to give a complete picture of the whole project.
- On conclusion of the project we recommend that the IMPACT homepage remains available to all Chalmers teachers and researchers and that some money is set aside to pay for an annual update. We further recommend that reports from sub projects be made available on the World Wide Web (Chalmers publication library for example) and that an abstract of each funded sub project be archived on the IMPACT website.
- The May 2009 student evaluation of Chalmers International Masters programmes revealed a high degree of satisfaction with these programmes. Judging from interviews carried out in this evaluation IMPACT did not only make a contribution to the success of these programmes but also contributed to the design and implementation of the May 2009 survey. We recommend that the Chalmers Foundation fund a new strategic development project that focuses on the quality assurance of the international Masters programmes. This project should build on and make use of expertise developed in IMPACT. We further recommend that the new project be a joint administrative and teacher initiative.
- In the light of criticism concerning a lack of time and money to carry out IMPACT projects we recommend that similar projects in the future provide more time and money and greater flexibility in using

these resources. IMPACT showed the way with its three phase application process but three years and SEK 30 million was not enough for a project aimed at making Chalmers masters programmes internationally competitive.

## **8. Attachments**

### **8.1 List of Chalmers Departments**

At Chalmers the implementation of education and research takes place within 17 departments in research groups of varying size. The Vice Prefect in each department played a significant role in the IMPACT project.

- Applied Information Technology
- Applied Mechanics
- Applied Physics
- Architecture
- Chemical and Biological Engineering
- Civil and Environmental Engineering
- Computer Science and Engineering
- Energy and Environment
- Fundamental Physics
- Materials and Manufacturing Technology
- Mathematical Sciences
- Microtechnology and Nanoscience
- Product and Production Development
- Radio and Space Science
- Shipping and Marine Technology
- Signals and Systems
- Technology Management and Economics

In the departments, a departmental advisory team exists made up of external and internal members and equipped with an external chair to be consulted on issues of strategic importance. Department heads are responsible for providing departmental operational leadership. A pro and a deputy head of department, as well as an administrative head, assist the departmental heads. In this evaluation we use Vice Prefect instead of deputy head since it is closer to the Swedish term that is used in the IMPACT website.

## 8.2 Schedule of interviews

<b>Type of meeting</b>	<b>Location</b>	<b>Time</b>	<b>Participants</b>
Interview	KRT/KAT	2009-04-29 13.30-14.30	Claes Niklasson Lennart Lundgren
Interview	I-section	2009-05-03 10.30-11.30	Per Svenson Lennart Lundgren
Interview	Einstein	2009-05-06 11.15-12.15	Sven Engström Lennart Lundgren
Interview	Villan	2009-05-12 14.00-15.00	Stig Ekman Lennart Lundgren
Interview	S2	2009-05-15 0915-10.00	Tomas McKelvey Lennart Lundgren
Interview	S2	2009-05-15 10.15-10.30	Yngve Hamnerius Lennart Lundgren
Interview	Studentcentrum Origo	2009-05-15 11.00-11.30	Eva-Karin Akar Lennart Lundgren
Interview	S2	2009-05-15 13.00-13.30	Mikael Persson Lennart Lundgren
Interview	EDIT 7329	2009-05-18 13.00-13.30	Jonas Pedersen Lennart Lundgren
Interview	EDIT 6125	2009-05-19 11.00-11.45	Patrik Jansson Lennart Lundgren
Interview	E20	2009-05-29	Per Lundgren Lennart Lundgren
Interview	X2000	2009-06-04	Björn Engström Lennart Lundgren
Interview	TM	2009-06-12 13.00-13.45	Lennart Löfdahl Lennart Lundgren
Interview	Mölnadal	2009-06-17	Sus Lundgren Lennart Lundgren
Interview	EDIT 4128	2009-08-28 09.00-10.00	Lena Peterson Lennart Lundgren
Interview	A 2245	2009-09-02 11.00-11.30	Inga Malmquist Lennart Lundgren
Interview	Energiteknik	2009-09-03 13.00-13-30	Erik Ahlgren Lennart Lundgren



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(in alphabetical order)

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Löfdahl, Lennart (Ch. 2: The influence of IMPACT on the development of Chalmers Master’s programmes)  
Malmqvist, Inga (Ch. 5: Architecture)  
McKelvey, Tomas (Ch. 5: Signals and Systems)  
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