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An Evaluation of CeTUSS

– A national centre for pedagogical
development in technology education
in a societal and student oriented context

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1 Sammanfattning och rekommendationer

Sammanfattning av resultat för CeTUSS

1. CeTUSS satsade på arbetsmodellen "professionell utveckling". Den gick ut på att arbeta med enskilda lärare för att utveckla deras undervisning.
2. CeTuss använde sin modell med framgång för att åstadkomma aktivitet bland de enskilda lärarna – konferenser med lokala och internationella talare, besök, nationella och lokala workshops, seminarier, kurser, publicering, e-postlista och webbplats.
3. CeTUSS uppdrag var mycket ambitiöst. Att lyckas med dess ambitioner fullt ut hade krävt flera omfattande förändringar av ingenjörsutbildning samtidigt. CeTUSS saknade den makt och inflytande som krävdes för att åstadkomma detta.
4. CeTUSS engagerade sig i ett nätverksbyggande, som till och med kunde beskrivas som en "community", som samlar motiverade akademiker som tänker i liknande banor. Normalt tar en sådan process lång tid att åstadkomma med den utvalda modellen, mycket längre tid än de tre års finansiering som projektet erhöll.
5. Färska rapporter som granskade ingenjörsutbildningar angav det nödvändiga sammanhanget för CeTUSS verksamhet. Däremot var det inte klart hur många av de berörda lärarna gick med på att de skulle behöva förändra sin undervisning och sina lärprocesser för att kunna angripa de utmaningar som utvärderingarna identifierade.
6. CeTUSS idéer och tillvägagångssätt var, på egen hand, inte tillräckligt slagkraftigt för att erbjuda ett uttömmande svar på alla de frågeställningar som kom fram i ingenjörsutbildningens utvärderingar.
7. CeTUSS har varit ett lyckat "kapacitetsbyggande" projekt. Som ett resultat har vissa ingenjörsprogram nu blivit bättre på att ta fram och införa pedagogiska förändringar som kan förbättra studentens lärande.

Rekommendationer för finansierade pedagogiska nätverksprojekt

8. Det är större sannolikhet att finansierade nätverksprojekt blir effektfull när de utvecklar följande inslag:
 - En egen administration
 - En rådgivande grupp som ägnar sig åt att utvärdera projektet
 - Kommunikationsstrategi
 - Effektiv koordination med akademiska och pedagogiska utvecklingsenheter
 - Stöd från ledningsnivå på lärosätena
9. Nätverksprojekt bör överväga att:

- Finansiera gemensamma projektarbeten inom nätverket
- Inkludera ett spår som fokuserar på frågor kring pedagogisk administration och ledarskap samt förändringsarbete.
- Bygga in utvärderingsmoment i alla processer och samla data under hela projektetiden.
- Inkludera en studentfokus, dels genom att ta med studentperspektivet i utvärderingsarbetet, dels genom en aktiv studentmedverkan på alla möjliga sätt.

10. I uppbyggnadsfasen bör finansierade nätverksprojekt ta fasta på vad som står i litteraturen vad gäller både projektets huvudområde och förändringsprocesserna inom pedagogisk utveckling och förbättring.

11. "Stepping Stones" kursen bör övervägas som en möjlig modell för andra ämnesområden eftersom den medför att ett nätverk, till och med ett partnerskap ("community"), kan byggas upp på relativt kort tid.

12. I framtida satsningar på pedagogisk utveckling bör NSHU eller dess efterföljare eller lärosätena själva fundera över följande saker:

- Hur mycket tid som egentligen krävs för att utveckla nätverk.
- Fördelar och nackdelar med att fokusera på ämnesbaserad pedagogisk förändring/utveckling.
- Möjligheten att utveckla olika nätverk och partnerskap ("communities") kring pedagogiska processer som utgår från det enskilda ämnet.
- Vikten av att utveckla en "scholarship" som fokuserar på studentens lärande.
- Vikten av att samtidigt ta sig an problematiken från flera håll för att kunna utveckla ett sammanhang för ett lyckat pedagogiskt förändringsarbete.
- Vikten av samverkan och internationell koppling för att nå bra resultat
- Vikten av att åstadkomma en så bred respons som möjligt från ämnesföreträdare inför nödvändigheten av betydande pedagogiska förändringar.

2 The commission to evaluate CeTUSS

In April 2007, Peter Gates, NSHU Senior Advisor, drafted an outline for the evaluation, which became the commission in June 2007. The document described CeTUSS, its focus on network building within the discipline, and asked for a consideration of the effectiveness of this approach.

“CeTUSS is a national center for educational development in engineering and technology in Swedish higher education based at the Department of Information Technology, Uppsala University.

(<http://www.it.uu.se/research/group/CeTUSS>) According to their manifesto CeTUSS aims to

“improve the alignment of technology education with the needs of society and students in a way that increases both motivation and participation among the students with a clear aim to improve learning. The methods by which the center will accomplish this mission will be to identify, develop, and disseminate ideas that make technology education personally meaningful, socially relevant, interdisciplinary, and based in collaboration (local and international).”

The ability to create and maintain networks is central to accomplishing CeTUSS’ mission.”

“The Swedish Agency for Networks and Cooperation in Higher Education (NSHU) is a new agency created in the beginning of 2006 with a specific charge to stimulate educational development in Swedish higher education through the use of networks and other forms of collaboration between institutions of higher education. Since it was the first network created specifically to support disciplinary educational development in a Swedish context CeTUSS collective experience represents a unique body of knowledge in a field that is vital for NSHU’s central mission. The purpose of this study is, therefore, to survey and evaluate CeTUSS’ network building activities with an eye to identifying good practice in establishing networks for educational development in the Swedish academic context.

The study should focus on how the CeTUSS network was built and on the impacts their particular approach to network building has had, and is anticipated to have, on educational development at the institutional, disciplinary and national levels. The network should be evaluated in regards to how it has helped CeTUSS carry out its direct mission and on how it has enabled CeTUSS to influence educational development within the targeted discipline.”

3 The methodology of the evaluation

3.1 Using RUFDATA

In preparing and shaping the evaluation, we decided to use the RUFDATA framework.

(Saunders. M (2000) Beginning an evaluation with RUFDATA: Theorising a Practical Approach to Evaluation Planning. *Journal of Evaluation*, Vol 6 (1): 7 – 21.)

- 1 Reason and purpose: To inform NSHU of good practice in establishing networks.
- 2 Uses: For NSHU
For the staff of CeTUSS
For the community of Information Technology, Information Systems and Computer Science specifically, and Engineering in general.
- 3 Focus: On the RHU commission – how far it had been achieved
On the CeTUSS manifesto – how far it had been achieved.
- 4 Data and evidence:
Documentary evidence:
 - The foundation contract from RHU
 - CeTUSS annual reports
 - CeTUSS internal evidence – internal reports, lists of participants, evaluations, reports to steering group.Interview evidence:
 - Information from Heads of Departments, Directors of Teaching and Learning in Departments, Educational Developers in Engineering universities.
 - Participants in CeTUSS activities.
 - The CeTUSS team.
- 5 Audience: NSHU & Peter Gates
CeTUSS organisers
The community around CeTUSS
- 6 Timing: August and September – phone interviews and collecting paper evidence
October – Interview with the CeTUSS team
November – present report and interview Peter Gates
- 7 Agency: Directly conducted by Per-Olof Thång and James Wisdom.

3.2 Documentary evidence

The aims of CeTUSS appear in the agreement with the Council for the Renewal of Higher Education (RHU) (040916), and from the annual reports for the first and second project years respectively, and from the planning report for the second year (2005/06).

We also read a copy of the contract between CeTUSS and RHU and NSHU respectively, which includes a paragraph which agrees that CeTUSS shall do a self evaluation of the project and run a seminar to present and discuss the experiences from the three CeTUSS years.

The formal documents generated by CeTUSS, such as annual reports, are short, descriptive and functional. They do not include extensive evaluative evidence. Nor is there evidence from within the project of internal evaluations such as feedback sheets on events, surveys of awareness and impact, or solicited guidance from participants about directions of development.

Evaluation of educational projects is a complex and difficult topic, as such projects are not usually capable of being measured by using simple data collection processes. A range of approaches have been deployed in recent years to help project teams gain insights during the progress of their work. Nevertheless, the fact that the CeTUSS team do not appear to have engaged with this area either in the design or the delivery of their project, has meant that there is not a foundation of evidence and consideration on which we as external evaluators were able to build.

3.3 CeTUSS documents

CeTUSS annual reports are more about what the project will do than describing what it has done. However, the annual report for 2004/05 describe on three pages the activities (and which universities were involved in those activities) during that year: eight presentations in different conferences (three international, two very local, and three Swedish conferences), seven visits to universities/university colleges, two workshops in collaboration with IEEE, one course (The Learning Perspective: Student Perspectives), with 11-15 participants. One project: ICT and Society, an internalisation project.

Taken together, an overview of CeTUSS activities would include:

- (a) "CeTUSS activities": 2 courses; including Stepping Stones (37 participants and 5 international lecturers/participants).
- (b) 5 workshops in Uppsala.
- (c) 7 local workshops/conferences. In total: 77 participants and 18 international lecturers/participants in all workshops.
- (d) 22 Conference presentations/Panels/working groups; Finland (5), Australia (2), Denmark (1), Sweden (7), USA (2), Tasmania (1), Italy (1), Turkey (1), Scotland (1) Germany (1).
- (e) 10 visits to different universities/university colleges (2 Chalmers, Lund, KTH, 2 Västerås, Karlstad, Linköping, Blekinge, Luleå).

3.4 This evaluation process

James Wisdom conducted 7 interviews with staff involved in educational development in five Swedish Engineering universities, in order to discover evidence of the impact of CeTUSS on departments in the Engineering faculty or on the institution as a whole. He also interviewed Sally Fincher, the organiser of the Stepping Stones project.

Per-Olof Thång discussed CeTUSS with six staff involved in educational development in five Swedish Engineering universities and corresponded with four people. He also read the CeTUSS background papers and the Swedish National Agency for HE reports.

Both evaluators interviewed the CeTUSS team for a day and attended the final workshop of the NSHU-funded project which discussed the issues of how CeTUSS had developed and how it might continue to be useful after the end of funding.

4 The CeTUSS Project

4.1 CeTUSS and the national context of engineering education

This section considers reports on Swedish engineering education in order to understand the context within which CeTUSS has operated. In 2003 the Swedish National Agency for Higher Education (Högskoleverket or HSV) evaluated all academic programs that offered Bachelor of Science in Engineering degrees (högskoleingenjörsexamen). Three years later the same agency evaluated all programs that offered Master of Science in Engineering degrees (civilingenjörsexamen)¹.

A Master of Science in Engineering degree is designed to prepare students to solve technical problems within a wide context. The Bachelor of Science in Engineering curriculum, which ordinarily does not include research training or training in the development of new technology, is more geared towards training students to maintain and develop existing industrial activity. Bachelors programs recruit more of their incoming students from their own immediate geographic vicinity than do Masters programs. In recent years most Bachelors programs have had to lower their maths requirements for incoming students.

In a short time the number of universities offering the Master of Science in Engineering degree has increased from seven to eleven. At the same time a number of new higher education programs have been introduced that overlap with the traditional engineering domain, for example construction, computer, electronic, chemistry and mechanical. More engineering courses are now being offered at the smaller higher education institutions where they lead a more precarious existence. Institutions that are new to the field of engineering may not have managed to acquire a reputation that can support their recruitment efforts. There are now 25 higher education institutions that offer approximately 200 separate educational programmes that all can lead to the Bachelor of Science in Engineering degree. This growth in capacity, which started in 1988, has subsequently reached its peak and is now declining.

In recent years, the general perception of what it means to be an “engineer” has evolved and been extended. Despite a high demand for educated engineers on the labour market, student interest in technical education has decreased.

In general, HSV has concluded that Masters and Bachelors programs in engineering generally maintain high standards at the same time as they are experiencing problems with maintaining their entrance qualifications. It is becoming difficult to recruit sufficient students, particularly women students, to fill available places in both Bachelors and Masters Courses.

The common opinion of HSV is that these difficulties not only concern recruiting methods, but also teaching and training methods and the general educational culture. To be able to offer students a better learning process and

¹ Högskoleverkets Rapport 2003:20R, Högskoleverkets rapport 2006:8R.

support a higher motivation to study, the Swedish National Agency for Higher Education points out that the different parts of theory and practice should be better linked together.

Student dropout rates are considerable. One reason for this is considered to be the variation in preparation of school students, many of whom appear to lack sufficient background in maths, physics, chemistry and foreign languages. Higher education institutions do not appear to be able to support the remedial education of these students well enough to ensure their later success.

While higher education institutions are constantly trying to improve their courses, there are two difficulties associated with this process. The first is that many courses are evaluated at the modular rather than at the programme level. The second is that, although many teachers and lecturers are highly committed to teaching, they are allowed little time to developing their pedagogic skills.

HSV has noted several methods of improving teaching skills in the domain of engineering education. Although all Higher education institutions must offer pedagogical training, in general, evidence of pedagogical competence is only required in connection with decisions to hire new teachers or promote teachers already in the system. Although HSV considers it to be good practice that lecturers learn and share experiences with colleagues from other disciplines, at the same time it thinks it is necessary for them to improve their skills within the discipline in which they work.

The Swedish national assessment and evaluation exercise made especial note of the CDIO-project (conceiving, designing, implementing, operating; www.cdio.org) as an attempt to change and renew engineering education and the students' abilities to use theoretical knowledge in technical situations. Amongst the approximately 20 institutions which have taken up this initiative world-wide we find a number of Swedish participants, notably Chalmers University of Technology (CTH), the Royal Institute of Technology (KTH), and Linköping University (LiU).

HSV writes, "for those teachers who are interested in questions of pedagogy there are several development projects, courses, conferences, workshops, mentorship and practice-oriented research" (2006, p. 32). HSV has also identified the problem of getting those not already interested to engage in the development process. "It is the already qualified who are looking to become even more qualified" (2006, p. 32). Studies have shown that students are aware of a wide variation in the pedagogical skills of their teachers, a much wider variation than they find in their teachers' knowledge of their discipline. The system makes few demands on lectures and teachers in Sweden to develop their own pedagogical skills. This may be something found more commonly in the élite universities in the USA, possibly because of the superior economic resources they enjoyed.

In its national evaluation of higher education institutions, HSV noted that – with a few exceptions – institutions did not have strategies for teaching and examination. It believes that institutions need to develop strategic approaches to pedagogy which can have a widespread influence.

In their national evaluation of programs offering Bachelor of Science degrees in Engineering HSV noted several good examples of the use of new pedagogy. While all institutions claim to use some form of project-based teaching, when scrutinized more closely it turned out that many of them only set more hand-in assignments to the students rather than having them do proper projects. Those good examples of project-based learning that do exist tend to be located within a limited number of programs or courses. This may be because the separate programs very rarely exchange experience amongst themselves.

The evaluation team also noted a considerable variation in the quality of final examination papers for the Bachelors degree in engineering, and observed that many papers did not use research-oriented methods, possibly because they approached problem-solving from a purely industrial rather than a research viewpoint.

The national evaluations did generate sufficient information adequately to inform a project such as CeTUSS and to suggest a number of priorities for its activities. CeTUSS had a potentially very rich context within which to work.

4.2 Teacher development

HSV found a high level of scientific competence among teachers and lecturers involved in the Masters programmes, but noted that few professors teach in the Bachelors degree programmes and, consequently, the academic level of those programme is assumed to be lower. In both cases, lecturers were taking time from their research and leisure activities to complete their teaching duties.

Teachers today find themselves in a very strained situation. At the same time it has been shown that collegial collaboration between different higher education institutions was much lower than HSV expected. Experience is not being shared, for example when it comes to developing ideas in pedagogy. It has been stated about the Bachelors programs that “the absence of teachers with research experience and good pedagogic knowledge is so low in some institutions that some lectures are taught by teachers from the outside” (2003, p.90).

Because of high work loads and a very tight economic situation, time is often not budgeted for academic development. HSV states that the boards of the different Higher education institutions must take more responsibility for the academic development of their teachers.

4.3 The “problem” of engineering education

CeTUSS was created in response to perceived problems with Swedish engineering education, and the twin notions of “difficulty” and “problem” are certainly present in the project’s rhetoric.

However, it is not clear whether there was any widespread agreement amongst the engineering education community over either what were the difficulties and problems, or whether they could be diminished by transforming teaching practice.

CeTUSS engaged with the idea of “problems” in engineering education through the analysis conducted in the Stepping Stones project, looking in particular at the attractiveness of Engineering to school students. CeTUSS used the same approach to its analysis of the process of undergraduate engineering education, suggesting that if it could be improved it would not only become more attractive but also retain more students on its programmes.

The question we are unable to answer is whether most or many engineering teachers and Heads of Departments had a shared view of the problems of recruitment and retention and then accepted the CeTUSS analysis that they could be ameliorated by enhancements to teaching. Some may have thought, for example, that if solutions were required it would have been better to make changes to university recruitment arrangements using such tools as differential funding or directing choice.

If Heads of Department (or even Vice-Chancellors) did in fact share the CeTUSS analysis, or even the analyses emerging from the Agency’s national evaluations, then this would have had implications for the way CeTUSS was designed. However, it appears that CeTUSS operated on the assumption that it would have to persuade many lecturers and managers that changes to teaching could improve the state of engineering education. The CeTUSS stance suggests that a large proportion of engineering educators did not share (or did not sufficiently share) the wider critique to enable CeTUSS to work from that position. CeTUSS did not think it was pushing at an open door.

When questioned, the CeTUSS team noted that they had moved away from the position of agents introducing change as a solution to problems and positioned themselves much more as colleagues able to support general professional development. We are sure the CeTUSS team took the best and possibly the only credible approach, but their approach has the disadvantage that it is a long-term one which requires significant changes to attitudes and practice, whereas other stakeholders (such as the RHU) may have been trying to work on a shorter time scale.

4.4 The early intentions of CeTUSS

When RHU advertised this venture, the application time was very short. However, the Uppsala project team was well prepared, as it already had plans to make an application for a development project like CeTUSS, and had started working to improve the pedagogy of Information Technology teaching.

Initially the focus of the invitation was on programme development, rather than pedagogical development of individual teachers, but that soon changed.

One of the elements which may have made CeTUSS's task harder was the alterations in the funding bodies which supervised it, especially if those changes were accompanied by variations in expectations of direction or emphasis. Successful work in the area of educational change is more likely to result from an environment of secure, stable and reasonably long-term funding.

The original aims of CeTUSS were very broad, possibly too extensive for the size of the project. The annual report 2004-5 and the activity plan 2005-6 include increasing the recruitment of students, stimulating an interest in technical and engineering education and integrating engineering education in a wider work and social perspective. The hope was that students' motivation would be increased by engaging with these wider perspectives.

One important intention of the CeTUSS project was to develop integrative learning. For such a reform to succeed it is necessary, but maybe not sufficient, to involve management and a broad based campus change. The effectiveness of curriculum innovation depends on the pedagogic development that supports it. In integrative learning the students focus on key areas and common or everyday problems, issues, themes, or tasks, with scientific and school-based knowledge in mind. There must be experiential strategies inviting the students to make connections between the course work and daily life in the community; connections between theory and practice, and to relate the content and message of the textbooks to contexts. While it is possible to develop this concept within a module or two, it has most impact when it is used to re-structure traditional teaching across the year or the programme.

In some sense all learning is integrative. Knowledge and ideas must in some way connect to prior knowledge and ideas. When focusing on integrative learning we intend to link domains of knowledge and ideas that are not normally or obviously connected to each other. The challenge is how to help students tie things together. In most theories of intellectual development, the ability to integrate knowledge is a sophisticated process over time. Considerable efforts and experiences are required to reach a more integrative capacity. One conclusion is that the students need multiple opportunities and varied experiences to understand and to practice the art of integrative learning. If this learning succeeds, it is valuable for the rest of their lives.

The size of this task (successfully developing integrative learning) is very great. It is obvious that many universities are not working in an integrative way with one and the same vision in common. The paradox is that universities may have strategic plans for integrative teaching and learning, but they do not practice an integrative way of cooperating inside the organisation. However, we live in a time of paradox.

The methods CeTUSS intended to use were to identify best practice and make it visible, and to give lecturers ideas about how to connect the teaching process and the students' learning to the world of work outside higher education. CeTUSS also wanted to improve examination and assessment processes, which is another large task. However, best practice has a contextual aspect or dimension. Transforming experience gained from one context or teaching situation into one's personal or local context is not straightforward. In some respects, compared to the students' ability to transform theoretical learning to the practical world of work, the development of reliable pedagogic change is a parallel process for teachers.

4.5 The methods of the CeTUSS project

From the very beginning CeTUSS wanted to network with international universities and researchers, to operate on a national level with international partners, as well as establishing a nation-wide network of teachers in engineering education who were interested in developing the teaching and learning process. The international ambition was obvious. There were 22 'external' activities like conferences etc (15 international) and 24 'internal' activities in CeTUSS.

In the long perspective it was very forward thinking from CeTUSS to connect a nation-wide network to an international community of engineering educators. HSV evaluations (2003, 2006) noted the low level of internationalisation in engineering programmes, and linked this to a lack of a research culture in the Bachelor programmes and the low levels of use of an international literature in English.

One method of establishing a network was to visit different universities and university colleges mainly during the first year (2004/05), but also during the second year with a focus on the smaller university colleges. The expectation was to create a community of teachers and researchers in engineering education with interest in educational development, and CeTUSS intended to intensify the relations with those who participated the first year during the two following years, and besides that recruit new participants.

Workshops, seminars and courses were other methods used by CeTUSS. The idea was that workshops and seminars should catch ideas and spread them. The courses were intended to be an instrument to spread the better worked-out ideas about teaching and learning in engineering education. The local activities (workshops and seminars) were intended to have a wider impact among the teachers about the message of CeTUSS.

CeTUSS argued that the visits should make pedagogical initiatives visible at each of the institutions. The visits to different institutions had a strategic value from a marketing point of view. It was a method for establishing a first contact and recruiting teachers with an interest in educational development.

The intention was to establish a web-site to support the network and the networking, as a natural meeting point for all those engineering teachers with

an interest for the didactics of engineering and different technical subjects, and a resource of publications and ideas.

An associated ambition was to publish conference and research papers from the CeTUSS participants. In this CeTUSS has been very successful. As a record of its events the web site is rich with papers and presentations, of a quality which is both accessible to new users within Engineering and which sets good standards for future work. There are two culture changes involved here. The first is to create and support the idea that it is a respectable academic activity to report on one's teaching in an academic and scholarly way. In this, CeTUSS has been successful. The second change is to gradually improve the standard of such reporting, setting individual activity within contexts and theoretical frameworks which make the published work significant to a wider range of readers. For CeTUSS this is a direction in which it is travelling, but it had not had sufficient time to, for example, have its output considered by international pedagogic refereed journals.

Over the three years the CeTUSS team made some pragmatic changes to their strategies. The web-site diminished in importance, as there was already so much similar material and information available. It is significant that CeTUSS rightly judged that a web-site did not, of itself, create the network. The intention to classify academic papers by criteria of quality and usefulness has proved to be too time-consuming. The programme of visits has been curtailed. However, a new and potentially very productive development has been the holding of seminars and workshops in different universities, where there is therefore a higher proportion of attendees from one department, thus increasing the chance of introducing changes based on the experience.

4.6 Participants and criteria for invitation

The recruitment of participants is of course of greatest importance. What kind of criteria were used, and to whom was the information sent? Initially the idea was to send the information about CeTUSS to all universities and university colleges with an engineering programme, but we think it possible that CeTUSS not use already existing networks within the Engineering education community. Some other departments in natural sciences also received the information. However, the strategy about to whom, within Departments or Faculties, the information should be addressed may have been ineffective. Building up accurate mailing lists can be a time-consuming task and relying on correspondents then to use the information properly (e.g. giving it wide circulation) is unreliable. It is possible that in, its early days at least, the CeTUSS team did not know how well news of their project had spread to their target audience.

CeTUSS assembled a list of latent participants. However, this list consisted mainly of different subject departments and the names of single teachers or administrators at different universities and university colleges. Most of the departments were in engineering, other technical subjects or natural science, but not all of them. On the list were teacher education, design, work science and architecture. In this part of the mailing list 15 universities and university colleges were represented. CeTUSS also constructed a list of academic

developers or “pedagogical consultants” as they are designated in Swedish academia. However, some of those people were not pedagogical consultants, but had other functions at the university and university colleges. In total 22 universities and university colleges were represented on this part of the mailing list. In all 25 universities and university colleges were represented in one way or another on the mailing list. Nine of those do not offer engineering education. This part of the mailing list was quite heterogeneous with people from many different subject areas and disciplines, some with no relation to engineering education. On the mailing list there were also representatives for research projects financed by the Research Council (18), the union for engineers (7), IEEE (5), NSHU (23) (participants in thematic meetings) and a list of 169 participants without any further identification.

All Swedish universities and university colleges with engineering education were invited to participate in CeTUSS. 18 of them were represented by at least one teacher in at least one activity or one occasion. 98 individual teachers have participated. Some participated in two or more activities, so the number of participants in total is 114. Statistics from HSV (www.HSV.se) indicate that in the 18 institutions in CeTUSS there are 1000 professors (96% in universities and only 4% in the university colleges), 1,266 senior lecturers and 970 junior lecturers. A little more than 3 percent of the population have been participants in CeTUSS. The statistical base is not the number of teachers at those 18 seats of learning, but the number of teachers belonging to the disciplinary domain of technology. There are four disciplinary domains of science in the statistics: medicine, natural science, social sciences / humanities and technology.

Besides the Swedish universities, departments and participants, 20 colleagues from 17 foreign universities participated in one way or another; from other Nordic countries, UK, the USA and Australia.

4.7 CeTUSS and external liaisons

The CeTUSS team did not employ an administrator, but used support within the department at Uppsala. This may have been sufficient to organise the events and make the bookings, but it may have held CeTUSS back in two other ways. The first is the implication of the previous section about who was invited and informed about the CeTUSS project through e-mail links. The CeTUSS brief was to influence the whole of the Engineering discipline, and although the team was strongest in its connections with the Computing and IT discipline it still needed to reach out to the many other lecturers in the associated disciplines. This is a major administrative task, but it is necessary to keep the project from becoming inward-looking. It is sometimes helped by traditional paper communications such as newsletters and “flyers”.

When CeTUSS began the team was already part of a set of relationships with educational developers. There was a unit at Uppsala but the CeTUSS team saw it as mostly focussed on teacher training. There was a new development called the Learning Lab, linked with KTH, but the CeTUSS team saw that as an expensive investment in e-learning. There were likely to be current initiatives in engineering education at other Higher Education institutions,

potentially good links for CeTUSS, which might have been picked up through a comprehensive programme of visits. There may have been previous projects in engineering education, or in other disciplines with common features, or projects in networking for change, with experiences of success or failure which would have been instructive. There were also educational development units at many other institutions, whose partnership would have been important in the introduction of ideas and innovation locally.

Saunders (2002), when evaluating the newly-formed Learning and Teaching Subject Network in the UK (which funded the 24 Subject Centres), noted:

Our first annual report also identified the most commonly deployed argument in favour of a subject-based approach as essentially a social or cultural one, emphasising the importance of disciplinary networks and peer groups.

Social and peer-group networks can exclude as easily as they can include. Further evidence from the English experience will be discussed later in this report, but this comment does reveal that there may have been social or cultural obstacles to the forming of a potentially valuable network of colleagues which could have added substantially to the CeTUSS project.

A third but linked aspect of this discussion is the absence of a steering, reference or advisory group. Many projects which have major and widespread cultural change as their purpose usually try to build a powerful network of supporters by inviting them to be associated with the project at an advisory level. It is often seen as essential that the Deputy Vice-Chancellor for Teaching should be the chair of such a panel. These panels bring messages from the wider constituency, and in some cases encourage the project team to commission evaluations to help it set directions and goals.

5 CeTUSS issues

5.1 A strategic decision

It was a strategic decision by CeTUSS to choose the “grass-roots”, or bottom-up, approach, which means to recruit personally motivated teachers from the universities and university colleges with engineering programs. CeTUSS wanted to draw the teachers’ attention to the teaching and learning problems in the education of engineers. So the idea was to support and equip the teachers with instruments and tools to manage those internal problems. Consciousness and change were two main concepts. By tradition the Swedish higher education teachers have had a strong influence on the ‘course management level’. But there has been a change in this respect during the last decade. More of the control of teachers’ working conditions is moving upwards in the organisation to the head of department, the dean or vice-chancellor. Some of the teachers to whom the national evaluation groups spoke have expressed a fear of being controlled, but so long as the responsibility for change lies only with the separate teachers the system is vulnerable. This is discussed further in section 5.3 of this report.

One of the intentions behind this choice of strategy was to raise the status of teaching, partly by generating enthusiasm for good teaching which might counteract some of the pressures which drive academics away from investing a lot of the time and effort into this area. One of the dangers of such an approach is described as “preaching to the converted” – in other words, CeTUSS may have attracted people who were already committed to improving their teaching. While the experience of CeTUSS may have deepened that commitment, it could also have had the effect of creating a defined but separate group. There are many examples from pedagogical development projects in the Swedish educational system at all levels, that the bottom-up approach mainly will recruit the teachers who are already motivated and engaged in those questions.

The conscious choice to avoid the top-down perspective in favour of the grass-roots level takes people on a very slow ‘road’ to making change. However, CeTUSS hoped that the grass-roots model would lead to long term results and effects. It seems to be a wise decision to work in a long term perspective, but on the other side we have to remember that CeTUSS was financed for a period of just three years, which may have been too short to achieve much cultural and behavioural change.

5.2 Creating the CeTUSS community

At the centre of the CeTUSS project was the idea of building a network, perhaps even of creating a community, of engineering teachers. One of the main ways of achieving this was to create national events, to bring colleagues out from their institutions to meet, and to support them with local events, first as a series of visits and latterly as local workshops or seminars. HSV writes that the university colleges offering Degree of Bachelor of Science in Engineering should try to develop ways of cooperating and networking with each other to a larger extent, and CeTUSS was fulfilling this ambition.

Many teachers who participated in these meetings had never met before. The contacts between as well as within Swedish Higher Education institutions are often limited and many resources are under-utilised. The national evaluation report (2003) writes that many good examples very often stay inside the program or the department without being exported, not even to sister programs (p. 81):

“Co-operating among teachers from different programs in the same seat of learning was shown to be much less than the evaluation group had expected. There are large possibilities for exchanging experiences, for example in pedagogical development, which are not used” (2003, p. 90).

The national events were constructed around themes, and involved presentations which can be characterised in two types. There were always keynote speakers, many of them from overseas, who were able to create a big picture, show high standard work and set expectations, and create enthusiasm. The local presentation speakers were usually offering material about activities they themselves were involved in, offering some new approach or handling an educational problem.

As the timetables of each event show they were quite full, it is possible that many of the sessions were fundamentally lectures and that the amount of interaction between participants within each event was limited. However, by scheduling two days with an overnight stay, there was plenty of social interaction and opportunity for follow-up.

This type of activity is one component of creating a community, and it is clear that some of the participants have made a significant commitment of time over the years of the project. However, these activities are also fragile, attendances can fluctuate, participation is not assured and it normally takes many years to build up a tradition of attendance amongst a sufficiently large number of colleagues to describe them as a community.

Another approach to community-building was the Stepping Stones project, which offers a successful process with a potentially wider application than simply engineering education alone. The model of gathering a group together to engage in a joint project, enabling them to define the project and engage in sufficient training to be able to achieve it, holding them together for a very long period while they were working within their various institutions, and returning for a final long meeting to consider the evidence and draft a report, appears to have been successful. It is a pity, though not surprising, that some participants were unable to complete, but even for them there were benefits to the experience.

The Stepping Stones model – of a mentored network constructed around a task – has been tested through its antecedents and is efficient in terms of its intentions. It is a model that is able to generate internationally publishable work. The principles behind Stepping Stones, if combined with the

enthusiasms generated by the national conferences (workshops), might have generated a number of working groups which could have addressed the issues of Swedish engineering education more directly.

However, despite the success of Stepping Stones and the enthusiasm behind the national events, it appears that the CeTUSS project has created rather a small community that may be too fragile to survive the ending of the funding.

It appears that the newly obtained knowledge from CeTUSS events was not anchored and properly tested. It has been very hard to find evidence of the impact of those events on local change-making. Almost all of the interviewed teachers answered that colleagues who had been involved with CeTUSS seemed never to discuss pedagogic subjects and that their attendance appeared to have little or no influence back in their institution. Teachers – like students - must actively use new experiences and knowledge together with well known methods, and they need to be able to debate these. They need continuity and time to be able to re-work ideas and deepen them for their own purposes. They may have a quick success if they can implement something within their own course. But if they require collaboration or support within a group, that is likely to require continuity, time and a re-working process.

5.3 Educational management and the process of change

Teaching in Swedish universities is very “decentralised” – individual lecturers are highly autonomous, and so gathering ideas from workshops, seminars and conferences seems to be a sensible approach. As Rust (1998) has shown, a high proportion of participants in well-run workshops do attempt to implement ideas gained in those workshops in their own practice. But in some cases the innovation requires a wider commitment, and the individual then has to change role and become, for a time, the educational developer for the group of colleagues or department. Often this turns out to be a more complex and difficult process than is first imagined, as the limitations and restrictions of the various frameworks (quality assurance, assessment policies, timetabling, equality of modules, allocation of staff time, political willpower, departmental leadership etc) can act as obstacles. In the most difficult case individual lecturers believe they are able to implement local change within their own control, but fails to read the interactions – particularly the complex interactions around the students – and are less successful than they expect to be. The limits of autonomy are reached, and the individual will look to collaborative or managerial approaches to deliver the support they need.

If the question is how to improve the experience of studying engineering as a whole, then the model of change which locates all the action at the individual level is likely to be inadequate. Similarly, a model of change which locates all the responsibility at the management level will be undeliverable. However, a model of change which focuses on frameworks and conditions and recognises the balance of variables within specific contexts may enable good quality improvements to be made.

It may be necessary to focus on process-oriented activities rather than insisting on a pre-determined outcome. It may be necessary to allow for a

slower (but hopefully more thorough) process of change than external circumstances demand. It will certainly be necessary to support and stimulate the front-line lecturers in attempting improvements. It is essential to foster a professional engagement and trust to support these processes of change within higher education.

Although there are enthusiasts within CeTUSS who are eager to bring about change, and although there are many groups and departments within Higher Education which are working successfully in this area, there are many obstacles. Issues like territorial prestige, resistance to disturbance or the difficulty of finding the time to invest can all work to ensure that any changes may have only a weak impact – like “rings on the water” after a splash.

How might change processes be integrated into leadership at the universities? There are always pitfalls and difficulties. Managers and leaders may perhaps show too much consideration for different interests, structures of power, territory, attitudes, feelings and so on, and therefore they back off from leadership responsibility. It is very common in knowledge organizations, like universities, that colleagues choose their leaders from among themselves, although external recruiting at some levels may be increasing. Another difficulty is working with too many processes simultaneously, where one lacks both experience and capacity. Devoting too much time and work on mapping the problems and the needs can be another obstacle when wants to get results. When innovating for pedagogical activity, the processes often demand time and another pitfall can be the lack of commitment, patience and perseverance. In the face of these and other similar difficulties it is not surprising that CeTUSS directed its attentions to individual teachers. However, one aspect of the network that most needed to be developed was the reflection on experience – including the experience of leadership – and the deployment of what was being learned.

Peter Drucker (1919-2005) once said that quality is what is coming out to the customers, not what the producers put into the system. In this respect CeTUSS made a relevant and fruitful choice of perspective, e.g. the students' learning perspective; the way they perceive and interpret their situation, their goals, visions and aspirations for their forthcoming professional life. Learning is first of all attention, consciousness and engagement. Quality management is a systematic way to work with quality aspects of any educational programme. A programme like CeTUSS could have been an ingredient in a system of quality management, but to do so it would have needed to incorporate a “top-down” management perspective with its “bottom-up” grass-roots approach.

The final element in this discussion must be the students. The CeTUSS project may have originated from high-level analyses of the condition of Engineering education, and it may have engaged with a number of forward-looking teachers who were looking for ways to change and improve, but the energy and dynamic for change must be rooted in the relationship between teacher and student. While some analysis of this was conducted within the Stepping Stones project, the single most effective direction the CeTUSS

project should have taken was to invest heavily – both directly and through its networked teachers – in research, evaluation, feedback and dialogue with its current generation of students.

6 Comparison with the English experience

There have been two long-running initiatives in England which focus on the use of discipline networks to support educational enhancement. The experience drawn from them may illuminate characteristics of CeTUSS.

The earliest is the Fund for the Development of Teaching and Learning (FDTL). In five phases since 1996 this has supported 167 projects in 63 subject areas. The funding is approximately £250,000 for a three year project (sometimes extended by £25,000 for a fourth year), which represents a budget of around SEK 1m each year.

The second is the creation of 24 Subject Centres (the Learning and Teaching Subject Network), which have each received approximately SEK 6.5m a year since 2000 and have continued through renewed contracts which are now due to expire in 2009. Subject Centres “provide support for the enhancement of the student learning experience”. The 24 centres – based in universities - encompass all the disciplines, and each has a staff of between 7 and 15 (in various combinations of full and part time work). They typically may have a Director and Deputy, a Manager and Administrators, Academic or Educational Developers, Academic Advisors, Researchers and IT staff.

HEFCE (2005) is an evaluation of these (and other) initiatives. The report noted that it has been hard to evaluate the FDTL projects. They were not set up to generate the sort of impact and performance data which would have made an evaluation straightforward. They were located in departments which had scored highly in the teaching quality assessment process, and their purpose was to disseminate their good practice through a consortium of departments and hopefully to their colleagues across the discipline. In most cases they built up an effective network (usually of 100 – 200 conference participants and e-mail contacts), through many of the same mechanisms as CeTUSS has used. However very few found a way of surviving as a network after the end of funding. They may have had an influence through the development of the staff involved, but where they generated materials or processes there are doubts over whether those have survived within that discipline community.

In a few cases FDTL teams successfully bid to become the core of a Subject Centre, and their expertise was continued in that way. In other cases the FDTL team was able to use the Subject Centres as a dissemination mechanism, and the network migrated to the Subject Centre’s larger activities.

The evaluation of the Subject Centres has also been instructive. The 2005 report cites evidence gathered a year earlier that, despite the substantial funding, 25% of heads of departments were unaware of their subject centre (para 1.16). It also found that 42% of respondents did not think the subject centre had made a contribution to their department’s work (para 1.17), although half said it was too early to expect full impact. This suggests that the model of change which until then many Subject Centres were using (like CeTUSS, a model which focussed heavily on the development of the

individual lecturer) is potentially very slow to have an effect. The 2004 evaluation was in part responsible for the Subject Centres being encouraged to work more through Departments.

Murray Saunders and his colleagues who conducted the evaluations of the Subject Centres used a “Stages of Impact” model derived from Hall, G and Loucks, S (1978). Slightly adapted, it looks like this:

Stage	Level of impact	Description	Suggested indicators of impact of Subject Centre-sponsored innovations
7	Disseminating at institutional level	Those who have engaged at any of levels 1-6 now spread the word within own HEIs or subject community.	Clients have disseminated ideas derived from Subject Centre. On questioning they link this activity to some Subject Centre contact.
6	Disseminating in Community of Practice	Those who have engaged at any of levels 1-5 now spread the word within own HEIs or subject community.	Clients have disseminated ideas suggested by Subject Centre. On questioning they link this activity to some Subject Centre contact.
5	Adapting and/or adopting (local)	Evidence of limited adaptation/adoption of new practices. The adoption/adaptation enhances the original.	Clients have adapted and/or adopted ideas suggested by Subject Centre On questioning clients trace this activity back to some Subject Centre contact.
4	Evaluating and exploring	As a result of a Subject Centre sponsored action, clients are considering the likely impact of taking up new practices; planning how to adopt/adapt; exploring difficulties.	Clients have taken up and perhaps appraised ideas (in the form of ideas from website, conferences, meetings, publications) and explored difficulties etc. On questioning they associate this activity with some Subject Centre contact.
3	Interested	Contact with Subject Centre through an activity or request for support.	Clients have had contact with Subject Centre staff, colleagues associated with an Subject Centre activity, named Subject Centre contact
2	Informed	Knowledge of Subject Centre role Knowledge of Subject Centre activities	Clients can describe the Subject Centre's role with some fidelity.
1	Aware	Recognition of Subject Centre	Clients say that they have heard of the Subject Centre
0	Not aware		

If we were to apply this model to CeTUSS, in the light of the interviews we have conducted, we would expect that most engineering lecturers were at level 0, with some at level 1 and a few at Level 2.

Saunders added a footnote to this model in his report:

The hierarchy of stages is conventional but practices are likely to be more chaotic. Innovations may make an impact at several levels at the same time. Impact may be out of sequence. Enthusiasts might go from stage 1, to 2, to 8, back to 3, on to 6 and thence to 4 and 5. That's the way change happens.

The CeTUSS team may know of examples of enthusiasts using these stages in a more “chaotic” way, but they are not visible in any of the evaluation material we have seen.

Many of the reports created by Saunders and his team consider the models of change in Higher Education, and whether the various UK initiatives (Subject

Centres, FDTL projects, National Teaching Fellowship Awards, institutional Learning and Teaching Strategies and Centres for Excellence in Teaching and Learning, amongst others) are themselves founded on models which might be effective.

Perhaps the most interesting outcome of these considerations lies in his report on the Scottish Quality Enhancement Framework (2006) with a paragraph (para 4) which reads:

There was a view that most could point to 'enclaves' of positive and exciting work in many institutions. Our own reports (see Deliverable 6) suggest that these enclaves of positive practice have little to do with whether colleagues are men or women, hold positions of responsibility, are older or younger or belong to particular disciplines. Where changes are happening, they seem to be more connected to being in active networks, having a history of particular interests in teaching and learning, working with like-minded colleagues, having material and professional support from senior members of institutions, participating in an environment in which moral, professional and systemic incentives to take teaching and learning seriously are present and finally, developing the capacity to balance seemingly oppositional claims on time and energy. We may look to these factors in an emerging theory of change.

Some of the main lessons we can draw from the English experience of FDTL Projects and Subject Centres is that networks take a long time to set up and become effective, that they are expensive to run and hard to convert to independent bodies, that educational change requires a more extensive model than the simple dissemination of ideas and examples of good practice, and that successful progress requires many other elements to be in place.

Two in particular are seen as very important – the visible and active incorporation of career and reward structures for teaching, and the creation of an active institutional strategic framework for the development of teaching, learning, assessment and curriculum reform. For the importance of the latter, a good summary is available in Gibbs (2005) *Being strategic about improving teaching and learning in research-intensive environments*, his keynote speech to the 2005 Conference of the Higher Education Research and Development Society of Australasia.

7 CeTUSS and Networking Issues

Part of the evaluation discussion with the CeTUSS team revolved around the notions of building a network or creating a community. Sally Fincher has drawn a useful distinction between “networking” as an activity and “building a network” as a product. Without doubt a great part of the value of CeTUSS has been the bringing together of like-minded lecturers at the workshops and seminars, and in that process much networking will have occurred. Building a network, as has been suggested in the section on the English experience, is harder, takes longer and needs to be carefully constructed to be sustainable. There may be a few engineering teachers who have formed such good links through CeTUSS that they feel they are part of a community. Such groups do not need to be large to have a lot of impact.

Another way of considering the CeTUSS work is that it has been an exercise in “capacity building” – bringing some new people into the discussions about educational improvement, and for those already engaged, assisting with more information and perhaps support and advice. For example, the fact that the team at Uppsala had already engaged with this work had given them the capacity to bid for funding when it was offered. CeTUSS has made nationally visible a range of work which might otherwise have been seen only locally. It has been part of the process of enhancing the status of teaching, and of researching into student learning, which has been supported with its international contacts. Building such capacity is a necessary precursor to being able to make good and valuable changes.

There are some aspects of networking which CeTUSS could have developed to strengthen its work. Membership of a network does not necessarily signify and level of activity, but networking presupposes common activities by participant. As of the ways of moving from a network to a community is by working together there might have been the opportunity to sponsor projects through which some of the hoped-for changes could have been tried out and tested. The shared-work element of Stepping Stones is an example of the value of this.

Another area might have been to devote resources to administration and to a communications process which progressively addressed the whole community of Engineering. The team was from one discipline within Engineering (IT), it had the outlines of a network within that discipline, and it was confident in working with that discipline. The brief of addressing the whole Engineering community was large. However, simply to let the network grow organically around the team was always likely to limit the boundaries if there was not a counterforce to extend them. Investment in electronic networking through the active development of mailing lists, and in paper communications to reach all staff, might have been such a force.

As we have discussed in this report, an important element of pedagogic change is the management of the process. Academic staff with management responsibilities are in some ways even more isolated than individual lecturers

implementing a new idea. A network process focussed on management and leadership requirements would have been an essential part of the project.

Another aspect of the change process is the partnership with those staff in institutions who do this work as part of their jobs. The educational developers (pedagogical consultants) have a national network (SWEDnet) and inside their institutions they have local networks, both of which could have been allied to the CeTUSS project in a beneficial way. These groupings are usually very familiar with the literature about organisational change and are contributing and drawing on the literature and expertise which is creating the community of practice of educational development. Although there is evidence of some interactions in this area, this was something that would have benefited from more active network building.

8 NSHU and Networking issues

This section will summarise the main elements which have emerged from evaluating the CeTUSS network. They have implications for how the RHU established the project, and they are in part a fulfilment of the brief to advise the NSHU for the future. Given the proposed future of the NSHU, we have attempted to signify the important elements which might play a part in any further proposals which might emerge from the Swedish higher education community on collaborative pedagogic change.

8.1 Time

It is almost impossible to build a self-sustaining network within three years if its purpose is to lead a process of deep cultural change amongst a large number of individuals with a previously low level of interest in this area. It might be possible to build such a network in that time if its purpose is to capitalise on existing developments, where the energy for those developments is already in the system. That would have required a different brief from the one CeTUSS finally adopted.

8.2 Culture

While the idea of discipline-based educational change is attractive, it is not straightforward. The implication of Saunders' comments (para 4.7) about the argument in favour of a subject-based approach being an essentially social or cultural one can apply as much within disciplines as between them. Scaling up from discipline to sector brings its own problems. Engineering is a large sector of Swedish higher education – do lecturers within IT automatically share effective social and cultural connections with all their colleagues? Are there well-understood disciplinary commonalities across Engineering on which one can base a pedagogic reform programme? For this approach to be successful it has to be closely examined and not taken for granted. The CeTUSS team had a very difficult task.

8.3 Teaching, learning and evaluation.

Much of the important work in recent years which is driving educational reform is closely focussed on the student experience of learning. Through its focus on evaluation and research it is generating a new and more scholarly approach both to developments in practice and to the publication of literature. The presentations at the CeTUSS workshop in October 2007 from the team at Lund University (Lund 2007) showed how effective this can be.

Although the quality of student learning is implicit in much of the work which focuses on teacher performance and improvement, in many cases the evaluation element is left until the end of the work, perhaps to “prove” that the change has been worthwhile. Networks which are driven from a scholarly approach to the student experience are more likely to be more effective, locally, nationally, and internationally, than those which are teacher-focussed and deal primarily with staff development.

8.4 The management of change.

The model of change adopted by CeTUSS was winning over “hearts and minds” at grass-roots level, and supporting individuals to make their changes – a professional development approach. But the impetus behind the short-life funding was to address problems in Swedish engineering education, identified by HSV evaluations. We have discussed elsewhere in this report the importance of managing the process of change well (through such things as academic structures, quality processes, funding and collaboration within departments). The professional development approach needs to be part of a wider context. Three key features of that context are the development and active use of institutional learning, teaching and assessment strategies (supported by funding to enable departmental developments within them), well-established units of educational developers, and a real career path of progression and reward for lecturers who invest their professional energies in teaching as much as or even more than research. Management development, institutional strategies and career progression are as much national as institutional issues.

8.5 National educational development

Both in Sweden and internationally there is a growing number of professional educational developers whose help to set up, run and evaluate change projects. They have a body of experience, international networks and a hinterland of publication. Discipline-based educational change project teams should draw on their experience and funding bodies should require at least an engagement with the literature.

As the CeTUSS project so successfully demonstrated, the use of national and international linkages and collaboration is an essential element in the raising of standards. In the absence of a national coordinating body, it will be in the direct interests of each higher education institution to ensure that its investment in educational change engages in national and possibly international collaboration.

As the CeTUSS project demonstrates, national investment in a full range of disciplinary change projects would be hard to afford. Investment at sector level embracing many disciplines (i.e. Engineering, Arts and Humanities, Medicine) raises questions about having to work across many cultures, what Tony Becher (2001) called “Academic Tribes and Territories” in his influential book in 1989. Educational enhancement projects that require networks and collaboration might be more productively conducted in collaboration with existing bodies – perhaps for Engineering this might be the local chapter of the Institute of Electrical and Electronics Engineers.

An alternative approach to national collaborative change might be to focus on educational processes – reforming assessment practice, reshaping the curriculum to develop skills for employability, enhancing peer learning between students, developing project work with companies and clients etc. Collaborative partnerships between higher education institutions around such themes, incorporating local disciplinary, departmental or faculty engagement,

would result in capacity building and change making on a scale worth reporting and publishing.

Given the 2003 and 2006 analyses of Engineering discussed in section 4.1 of this report, it is hard to conceive how the condition of nation-wide engineering education can be efficiently improved through the uncoordinated actions of competing higher education institutions. While it is relatively easy to correct temporary problems on a local basis, systemic enhancement and reform surely requires the development of many of the features discussed in this report. A focus on changes which lead to the improvement of the quality of students' learning has the capacity to disrupt existing systems and assumptions. At the very least, the process of handling this realignment requires institutional collaboration. It is important for Swedish universities to be able to devise mechanisms which enable them to respond to this challenge.

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