Study trip to the USA 1998

visits to 6 universities

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CHALMERS 

What this report is and is not

This document has been created as an aid in the development of strategies for taking Chalmers University of Technology into the 21st century. It is a working document, the purpose of which is to provide input for the design and prioritization of our development activities. In this respect, it has already contributed to our work, both at the school/department levels and at the university as a whole.

It is not meant to be a "final report", but rather to remain a work in process. Each section reflects the strongest impressions made on the person responsible for that section. As a result, some overlap can be found between sections, as it can be essential to review these impressions from different perspectives. The intention has been to cover all subject areas; at the same time retaining the flavor of the individual or group contributions.

The English version of our report was made specifically for us to share some of our impressions and thoughts with you. It contains much of the learnings gleaned from the six U.S. universities that kindly hosted our whole group and shared with us from the wealth of their knowledge and experience. However, our report is also limited, as it does not include all the impressions we received during our visits and meetings. It is also possible that we may not have completely understood some points or that we have made observations that might have been interpreted differently, had we been part of or better acquainted with your university.

However, regardless of its shortcomings, we hope that our report can be of value to you as well, to see how some visitors from Europe perceive and experience your own and other leading US universities.

Sverker Alänge
Editor

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Introduction

In 1996, an exchange of experiences and ideas was initiated between the deans of the Schools of Architecture (A), Electrical and Computer Engineering (ED), Chemical Engineering (K) and Technology Management and Economics (I) and the President of Chalmers, concerning the strategic development of Chalmers and its schools.[1] During these meetings, the need for an analysis of current developments in the world was recognized, aiming at improved positions for the individual schools as well as for Chalmers as a whole.

In 1997, a trip to the USA was planned, the purpose of which was to harvest ideas and learn from the following prominent American universities: The Georgia Institute of Technology in Atlanta ("Georgia Tech", a state university that has climbed up the American ranking lists during the last decade), Motorola University in Schaumburg (a company "university", an increasingly common phenomenon among major American companies), Northwestern University in Chicago (a private national university that has placed high on the ranking lists for an extended period of time), Rensselaer Polytechnic Institute in Troy, N.Y.(the oldest university of technology in the USA- private), the University of Massachusetts Lowell ("UMass"- a regional state university that has undergone major transformation) and the Massachusetts Institute of Technology (MIT- the leading private national university of technology in the United States).

The basic idea was for several individuals from each school to be involved (a total of some 22 persons), since the knowledge and experience gained from the trip was to be put into practice. During the autumn of 1997, we therefore divided into four working groups responsible for: 1) development and leadership, 2) cooperation and focus in research and research education, 3) external and internal relations and 4) information technology in education. The different schools were represented in all groups (see Addendum 1) and were assigned to prepare questions within their respective areas of responsibility (see Addendum 2).

We visited the six universities between March 25 and April 5, 1998, and the four working groups were expected to cover the issues they had prepared. Three of the trip's days were earmarked for exchange of experience and reflection, i.e. the groups described the most interesting or thought-provoking features, suggested which elements might be put to use at Chalmers, and presented these reflections to the other participants.

After returning to Sweden, the groups have kept working on their analyses. Using notes from interviews and printed material, the groups have written reports on their observations and what they have learned in the United States. In these analyses, the groups' learnings are related to the present reality and recommendations for the future at Chalmers. These reports were presented to the Board of Chalmers on June 4 1998, and they have now been compiled in this document.

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[1] Some of the Chalmers Schools correspond to departments within the School of Engineering at a US university. Chalmers University of Technology can be regarded as a School of Engineering, a School of Architecture and a Business School (School of Technology Management and Economics). For additional information about Chalmers university, see Addendum 3.

Structure of the report

In this report, the working groups' contributions are presented in separate chapters. Each chapter includes sections describing observations and impressions, followed by sections in which these impressions are analyzed in the context of our conditions at Chalmers. The sections in each chapter end with recommendations for activities leading to change.

The working groups' contributions are presented as follows:

Chapter 1: Development and Leadership
Chapter 2: Renewal, Cooperation and Education in Research
Chapter 3: External and Internal Relations
Chapter 4: IT for Education and Learning

The chapters can be read separately but there is some overlap between the working groups' areas.

The following abbreviations have been used:

Georgia Tech	Georgia Institute of Technology (state)
MIT	Massachusetts Institute of Technology (private)
Motorola	Motorola University (company)
Northwestern	Northwestern University (private)
Rensselaer	Rensselaer Polytechnic Institute (private)
UMass	University of Massachusetts, Lowell (state)

1. Development and leadership

This chapter covers issues related to strategy and development, leadership and organization. It consists of five sections (the university´s role in society, development, leadership, organization and management, and the question of whether the university is a learning organization), each of which includes an analytical comparison with Chalmers and recommendations for change.

1.1 The university's role in society

That the world is becoming increasingly dependent on *technology* is a conviction shared at the six universities visited. However, their visions and perceptions of the university´s role in society differed.

At Georgia Tech and UMass Lowell, *regional* development goals in the global perspective were emphasized. Their respective roles were defined as "continually seeks opportunities to advance society and the global competitiveness of Georgia and the nation" and " UMass Lowell boosts the economy in its region and across the state".

The private universities MIT and Rensselaer were finding their positions in national and *global competition*. MIT´s attitude is illustrated by its President´s statement to the Entrepreneurship School, "I want you to be the premier global center for entrepreneurship, and to be recognized as such. (…) We must not only be the best, we must also serve as a model for others and ensure that, together, we all make a significant impact in this vital field." Thus, MIT defines its role in a global perspective, within a world-wide scientific society. Similarly, Rensselaer´s Lally School of Management and Technology defines its role as being directed toward the nation and the world, "..to educate future business leaders who will guide their organizations in the conversion of technical ideas into business, products, processes and systems."

The private or public status of a university, and its dependence on federal funds and rules for its operation, is of major importance in determining how the institution´s role is perceived, and what contribution it will make. It is obvious that the manner in which operations are financed governs perceptions of the universities´ roles in society. If a university is dependent, as is UMass, on local, regional and federal resources, a picture of the university as a "player for the region" emerges, a player that ".. integrates research, technology transfer and partnering at UMass Lowell in order to provide Massachusetts and the Northeast with a steady stream of useful ideas and profitable products ".

The situation is dynamic, however, one reason being that federal funds tend to diminish. In order to develop and expand operations, like Georgia Tech, re-direction and re-definition of the institution´s role in society are thus necessary. The vision is "to become a leader among those few universities of technology, the alumni, faculty, students and staff of which define, expand and communicate the limits of knowledge and innovation". The university "seeks to create an enriched, more prosperous and sustainable society for the citizens of Georgia, the nation and the world". This vision, of being one of the main players strengthening the competitive power of Georgia and the nation, has resulted in a concrete and measurable goal in the present era: the establishment of businesses.

The globalization of the economy strongly affects perceptions of MIT`s and Rensselaer´s roles in society. Rensselaer´s goal is to expand its presence in the world by providing courses and diploma opportunities. IT, "the enabler of the information age", has an important position in the defined goals. It is regarded as the most important force behind social change, "one of the largest and fastest growing industries in the global economy". Rensselaer´s ambition to become a global player is expressed thus, "We celebrate discovery, and the responsible application of technology, to create knowledge and global prosperity.". Both quality of life and commercial development are included in the concept of "global prosperity". IT is the important generator necessary to "…reshape Rensselaer and, through Rensselaer, the world (…) reshape Rensselaer´s research and educational programs". IT is to make Rensselaer excel at cooperating.

Rensselaer's Lally School of Management defines its role within the global context. In addition to its presence in the world through IT-supported educational activity, the goal is to "infuse the campus and curricula with a global perspective" and to "support global expansion of US industries". This is compressed into the goal for the distance learning program: "Any time-any place".

Closing remarks

After hearing how the six American universities define their visions and goals and how they perceive their present and future roles in society, it becomes quite clear that the following must be taken into consideration in a modern development strategy for Chalmers and other universities:

- The transforming potential and demands of information technology
- The globalization of the economy and culture
- Cooperation and alliances (inter-disciplinary, new interface with industry, internationally)
- Entrepreneurship (intellectual and economic)
- Competition for human and economic resources creates a need for resource-creating activities
- Interactive learning, new educational methods supported by IT (internal, local, regional, global)
- Visible leadership and organizational structure

In addition, a carefully considered implementation process involving large groups of the faculty, staff, alumni and various partners is essential if sustainable change is to occur.

1.2 Development of the university

This section begins with the most important impressions from each university and concludes with a summary.

Georgia Institute of Technology

The terms “entrepreneurship” and “interdisciplinary action” were used at all the universities we visited. At Georgia Tech, the importance of entrepreneurship among the staff was emphasized so often that it almost sounded like an invocation.

Georgia Tech has expanded very rapidly, partly as a result of major investments made by the state of Georgia. The number of new buildings on campus was striking (some were built in connection with the Olympics). These efforts have most likely contributed to Georgia Tech’s advancement to shared fourth place on the American ranking list of Engineering Schools.

The administration had gone to great pains to define strategic plans. There is an extensive description of the institute´s strategic context, mission and vision as well as its strategic goals on the world wide web. There is also a brochure with similar contents. The strategy is described, in an interesting manner, under the following headings:

- The Mission

Here Georgia Tech´s unique duty to the state of Georgia, in terms of education in all fields in which the university is active, is established. The faculty’s talent is emphasized, as is the fact that Georgia Tech is a prominent research and development center, and that the entrepreneurship which characterizes the founding of the institute still exists. There is a final statement regarding ethics and respect for intellectual rights.

- The Strategic Context

Under this heading, conditions-advantages and challenges-are described. Federal cutbacks up to 25% are among the latter.

- The Goals

A number of fundamental goals are defined, which might be summarized as aiming at “things being all right”. However, there is a specification in more concrete wording under the next heading.

- The Agenda

The following seven headings are specified into a number of concrete steps to be taken before 2010:

1. Enriching educational opportunities
2. Improving student life
3. Maintaining and enhancing research
4. Taking fullest advantage of educational and information technology
5. Improving the infrastructure
6. Identifying optimum size and composition
7. Expanding collaboration, linkages and economic development efforts

- The Future

The primary message under this heading is that the next 15 years will be critical and that Georgia Tech will, if the strategy is implemented, become "one of the pre-eminent research universities in America and the world".

Georgia Tech´s strategic definitions are somewhat grandiose, although it is evident that the administration attaches great importance to their formal existence. There is an almost complete lack of external analysis and no explanation is given in the www documents for the statement that the next 15 years will be critical.

During 1996, Georgia Tech participated in a national discussion on stress in the academic world (at the initiative of the National Science Board and the Government-University Research Roundtable), the result of which was a report. This work identified the existence, possibly due to the rapid expansion, of a number of problems within the university.

In order to create a basis for the discussions and the report, Georgia Tech arranged a series of internal workshops, in which faculty, administrators and administrative network staff participated. The conclusions of these workshops are compiled under the following 7 headings:

1. Priorities in research and education
2. Balancing research and education activities
3. Facilitating multidisciplinary research and education
4. Patterns of institutional support for research
5. Restoring a sense of community on campus
6. New partners in research
7. Additional stress-related issues identified at Georgia Tech

A number of stress factors are described, which have arisen due to the expansion, such as physical separation of faculty and other staff, reduced communication, increasing number of misunderstandings relating to distribution of responsibility, all of which contribute to a diminished sense of community.

The conclusion of the report is that existing problems and stress factors have been identified. It is not clear to me to what extent these problems have been solved.

An interesting comment made by someone during the visit was that change is considerably facilitated when expansion is in progress.

Northwestern University

The visit to Northwestern University took place during an afternoon and an evening buffet meal, and included information about one of the university's centers, IT in education, and a short presentation of strategic issues. The Vice-President for Research and Graduate Studies, Lydia Villa-Komaroff, a member of two minorities (woman and Hispanic) at the university, made the latter presentation.Vice-President Villa-Komaroff's presentation of strategic issues was somewhat limited

by the fact that she had recently been appointed, and consisted of a summary of research and research education strategies. She heads the Office of Strategic Initiatives (OSI). In her opinion, OSI's job was to generate a new way of thinking, diverging from previous tradition at the university. So far, this has resulted in the establishment of a new center for super-conductivity, the purpose of which is to create closer relationships with other universities and with industry. The increasing number of women and ethnic minorities were other main themes. It is likely that Vice-President Villa-Komaroff's joining the faculty has stimulated the university's reconsideration of these matters to a great extent. Northwestern has concentrated a lot of strategic effort in the area of IT in teaching. An Institute for Learning Sciences had been established for the development of IT aids. There were a few demonstrations of server-stored courses.

Motorola University

The nature of Motorola University was of great interest to the previously uninitiated visitor. Would it be a university or more like a training center for Motorola employees? The answer is that Motorola University is primarily devoted to company-specific problems. A number of basic technical courses are also offered, for which lecturers from universities all over the world are engaged.

Motorola's policy is, however, to approach society as well, resulting in cooperation with the local university. Courses have been created (for example "Design for Manufacturing") that are in use at several universities, and the institution has been responsible for the education of a large number of teachers/professors (100 from one university in a joint initiative in which IBM and other major corporations were involved with several other universities). Motorola University also organizes courses for its subcontractors and customers, as well as offering education for high-level managers at other companies which are in the process of introducing major programs for change, for example ABB. Since 1992, there has been direct cooperation between Chalmers and Motorola University, as one of the CHAMPS program's (TQMx) week-long courses is held at Motorola University.

As can be expected, Motorola turned out to have a very clear perception of its "Missions" and "Visions", some of which were:

- making the students best in their class at Motorola
- being a catalyst for change within the company
- being a part of Motorola´s product value chain
- being a major source of knowledge leadership at Motorola
- accelerating alternative learning technologies (IT)
- leading the development of human resources in order to reconcile the cultural differences at Motorola units all over the world

The company's visions, fundamental values and mission have been printed on a wallet-size card and distributed to all employees.

A large part of the activity at Motorola consists of management education. Since the company is involved in the branch with the most rapid technical development of all, issues concerning the learning process are a natural area of activity.

The clarity with which the management described its business idea left a lasting impression. All ideas related to strategy, leadership and methods were described using clear visual models. Another noticeable characteristic was the distinct awareness of the high rate of global change in the areas of economics and politics. Since all activities are financed by internal billing, the business mentality is evident throughout the organization.

Massachusetts Institute of Technology

MIT is characterized by an awareness of being the best. The university is currently number one on the list of American Schools of Engineering. Since MIT has chosen a non-growth strategy, there is the impression of a certain degree of prevailing conservatism, an impression reinforced by the somewhat aged premises, the halls of which bear the mark of the early 20th century.

Decisions, e.g. concerning hiring, are made in Academic Councils in which a surprisingly formal voting procedure is used. If a consensus cannot be reached, the matter is put to a vote with the following options:

- Yes absolutely
- Yes (can be argued)
- No (can be argued)
- No, over my dead body

The faculty's salaries are determined according to the normal distribution curve on a scale of 1 to 6, based on research, teaching and service, i.e. internal work. This latter factor was expected to demand 20% of the individual's working hours.

It was hard to obtain a uniform picture of MIT's views on future strategies. At the middle level, its mission was described as the creation of "engineering in a global economy" (Van der Sande), while Alex D´Árbeloff, the Chairman of MIT's Board of Trustees, underlined the difficulty of developing strategic thinking. Joel Moses, the Provost, pointed out that he and Charles Vest, the President of MIT, had formulated a strategy entailing more pronounced concentration on industry (due to federal cutbacks), internationalization, development of technologies for teaching (IT) and environmental issues. It was difficult to know the extent to which these ideas have been disseminated throughout the organization as a whole. Even if the administration obviously feels that such activity is important, discussions have probably been limited to individual offices until now.

MIT has started two extensive partnerships with Ford and Merrill Lynch, respectively. Interdisciplinary activities, via creation of centers, was described by Provost Moses as vital. The difficulty of terminating departments makes the creation of centers an interesting alternative from another, more pragmatic perspective as well. Provost Moses also pinpointed computer science as a rapidly growing strategic area at MIT.

MIT naturally has a strong group of students ("the best") and many prominent researchers in its faculty ("the best"). The latter might possibly be an obstacle to the change process at the university; on the other hand, MIT pointed out that they had confidence in the ability of these researchers to

generate renewal by taking new initiatives and adopting new approaches. According to this line of thinking, then, the recruitment process is crucial to the renewal process.

University of Massachusetts, Lowell

During recent years, UMass, Lowell, has been forced into extensive and apparently dramatic changes, the reason being weakened local industry, evidently creating problems similar to those in Sweden´s northernmost region. The university was forced to downsize staff and to adopt a new line of strategic thinking. Its "strong man", Chancellor W. T. Logan, who has a well-established network of local contacts, has apparently led the university into calmer waters by bold innovative thinking. An important ingredient of the transformation has been the creation of interdisciplinary centers and a broad interface with remaining local industry.

In his Chancellor's Report for 1997, Chancellor Logan presents an energetic and eloquent description of the university´s situation. Implicit in the report is a strategic discussion of the university's activities with a focus on regional economic development, the dynamics of local society, the necessity of what Chancellor Logan calls "real world research" and the needs of regional industry. Associated with the latter is "helping entrepreneuring companies proceed into the future", as it was expressed by someone in a discussion during our visit.

Much emphasis was placed on IT-based teaching, in this context primarily consisting of real-time-based courses. Twenty-five courses had been created and distributed to different companies in the region.

The Dean of the Engineering School had been externally recruited. Like all his co-workers that we encountered during our visit, he radiated great confidence and had a dynamic manner of thinking ("the product is learning; the customer is the student"). UMass, Lowell, was characterized by enthusiasm and is an interesting example of how a fresh start can evolve from threatening external circumstances.

Rensselaer Polytechnic

Despite its location in Troy, NY, a city giving the impression of decline, Rensselaer was the most interesting of the educational institutions we visited because of its simply worded, carefully considered and apparently firmly established strategy. The focus was on three areas: IT, globalization and interactive learning, at the junction of which academic activities were to be developed.

In addition to the creation of new IT-based methods for students on location, the institution also offers real-time-based courses, primarily in eastern Asia. The globalization concept thus refers to Rensselaer's own activities and it views the entire world as its market. The mission is formulated as follows: "Rensselaer educates the leaders of tomorrow for technologically based careers. We celebrate discovery, and the responsible application of technology, to create knowledge and global prosperity.". The significance of IT was emphasized by describing it as "the largest and fastest growing industry in the global economy".

Some final impressions

1. Strategic thinking including local (UMass, Georgia Tech) or global (MIT, Rensselaer, Motorola) aspects exists or is evolving (Northwestern) and is regarded as important at each university we visited.

2. IT-based teaching was a major component of the strategic thinking of all our hosts.

3. Entrepreneurial thinking was mentioned as an important ingredient of individual action and of innovation at most of the universities.

4. The creation of interdisciplinary centers was a solution to the problem of "waterproof barriers" between units in line organizations at all institutions we visited.

5. Recently, research in the USA has become oriented toward applied industrial problems, mainly due to decreasing allocations of federal funds.

6. MIT´s method of achieving first place in the American ranking: "Hire the best!"

7. A quote from Georgia Tech, "Make sure that visions are shared! People cannot fly around in all directions." At Chalmers, this means a much higher degree of focus on line managers participating in, influencing and sharing Chalmers' visions. This applies to the staff managers as well.

8. Change occurs via a "bottom-up" process. In most cases, however, the "bottom" was the boundary between faculty and other staff. Especially at MIT, one had the impression that students and non-academic staff had very marginal influence.

9. The strategic effort that has been started at Chalmers' ED school is appropriate and well- timed.

Proposals

One of Chalmers' strategic tasks should be to formulate a distinct vision of the university's future, including a basic inventory and revision of existing goals and strategies, taking the following into consideration:

- An external analysis of possible futures, for example using scenario technique
- Involvement of Chalmers' staff in strategy work (both bottom-up and top-down), in order to realize goals and strategies
- Strategy work at Chalmers can be partially based on the strategy work planned or in progress at the school (e.g. ED and K) level
- Some basic concepts which kept coming up in our analyses of the American universities' strategic orientation were: entrepreneurship, leadership, interdisciplinary, IT, globalization, interactive learning, cooperation and resources for creating resources

1.3 Leadership

This section mainly covers our impressions of five of the six universities we visited. Motorola University, a company-owned "university", differed greatly in terms of organization, etc and our short visit provided us with only slight opportunity to acquaint ourselves with its leadership structure. The following areas are covered: recruitment, education of academic leaders, leadership structure, administration functions, incentives for leaders and gender representation.

Recruitment

The President appoints the Deans. At MIT, the President is elected by the Board, and the Provost is appointed by the President.

Recruitment to leading positions, from Department Heads and up, is undertaken on a national basis at all universities. MIT pointed out that they also seek candidates abroad. The requirements are tough and there appears to be keen competition for the best leaders. The President of MIT comes from Michigan, where he preciously had been Provost. The Dean at UMass was recruited from Cornell. Rensselaer´s IT Dean was recruited from industry. Despite active external recruitment, internal career advancement via increasing responsibility (e g from Head of a Department to Dean), is not uncommon at MIT and Georgia Tech.

Leaders in all positions are chosen by means of thorough procedures, in which the faculty plays a vital role as an advisory body. The requirements are explicit and the rules of the game clear at the outset of recruitment. The leaders are expected to function as real leaders of the institution's activities.

The faculty also plays a most active role in the recruitment of new teachers. Clearly defined requirements when hiring new teachers are regarded as important at all universities! At Georgia Tech there is a mentor program for new faculty members, who, for example, receive help from experienced researchers when writing applications for funds.

Education of academic leaders

We heard nothing about compulsory specific education for leaders. The usual situation is that the candidate is a full professor and that a full professorship comes with the leadership appointment. To the best of our knowledge, no formal advanced education is arranged for the universities' leaders at any of the institutions that we visited. Both Deans and Department Heads are responsible for their own leadership education. According to the Dean at the UMass School of Technology, there is a national leadership development program for Deans. It was our impression that this program is organized for the state universities. Some leaders continue to teach and/or conduct research simultaneously with carrying out their leadership duties, but the majority function as full-time leaders. Deans at various levels at Georgia Tech have time-limited appointments (5 + 5 years); thus it is regarded as important for them to teach and conduct research parallel to their leadership tasks. Deans at Rensselaer are also appointed for 5-year periods. The other universities appoint leaders for unlimited periods, but subject to annual performance evaluations. At UMass, and evidently at the majority of universities, evaluation only occurs from the top down. Annual evaluations of faculty

performance (results) is apparently important at all universities except UMass, where the union is very powerful and university leaders seldom can offer rewards in excess of the union-negotiated salary raises. There is no union at Georgia Tech, despite the fact that it is also a state university.

At Motorola University, we heard about 360-degree evaluation of leaders, i.e. staff in subordinate and superior positions as well as peers evaluate each individual manager. It is not clear whether or not this evaluation procedure is in practice internally at Motorola University, but the technique was taught there!

Leadership structure

At MIT there is a Board of Trustees that appoints the President and plays an active role in the university's system of combined internal and external evaluation. Northwestern also has a Board of Trustees by which controversial decisions could be made, such as the termination of the School of Dentistry. There is no actual Board of Trustees at Georgia Tech, but it does have an Advisory Board of external representatives as well as a common Board functioning for all universities in Georgia. Each college also has an Advisory Board of industrial leaders, which also exists at various levels at the other universities.

The Academic Council at MIT consists of the President, Provost, Deans, Senior Vice-President of Admininstration, Faculty Chairperson and Head Librarian. In a corresponding manner, the Dean of Engineering calls the Heads of Departments to an Engineering Council every other week, at which issues concerning premises, economics and staff are handled. The Dean makes decisions, after an advisory vote among the Heads of Departments, the result of which is taken most seriously.

A high degree of delegation to the School level, resulting in a high degree of autonomy for the Deans, is practiced at all universities we visited. At Georgia Tech the Departments were also quite independent units, each responsible for its own budget and entitled to make decisions concerning hiring and construction.

For economic reasons, the management structure at UMass had been trimmed considerably. A Dean had no Vice-Deans and did all administrative work on his/her own. Each teacher was, however, expected to devote 20% of his/her time to department work!

Non-academic administrators were rare, except in the position of Senior Vice-President. When questioned directly about administrative support, we were told that there were secretaries as well as clerks at UMass, but their work was described as unqualified. At Georgia Tech, the Heads of Departments pointed out that they were indeed so-called administrators, but not particularly bureaucratic in nature, supposedly due to their origins as professors.

The administration's job

The administration seemed to have major influence on strategy, which was most evident at Georgia Tech, where people expressed surprise at us making this visit so close to the appointment of a new President, since this could lead to completely altered conditions at the university.

The administration's most important job is to keep its focus and to facilitate entrepreneurship and cooperation. This was expressed distinctly at all universities. There must be a balance between "top-down" and "bottom-up". Teachers' ideas must be put to good use and opportunities created for their development. The administrations at all universities apparently use seed money to encourage cooperation, to a lesser extent at MIT than at the other institutions. Teachers at MIT appear to be demanding more central leadership than they had previously.

Education is regarded as important and pedagogical issues were emphasized at all universities. MIT faculty is required to be best in the world not only at research but at teaching as well! At Northwestern, the administration felt that some of the faculty needed to be reminded of who the customer was, indicating that not everyone was committed enough to teaching.

At Georgia Tech, a Department Head expressed his leadership philosophy thus: "Treat everyone fairly, superstars as well as "ordinary" teachers.". He tried to avoid the question, so common in the United States, "What´s in it for me?, focussing instead on the development of the department as a whole.

Incentives for leaders

There is no economic incentive to be a Department Head at Georgia Tech, as this position is associated with a salary increment of about $2 500 per year. The incentive is the challenge and the opportunity to make one´s achievements public. A job well done could result in new leadership assignments at a higher level or the opportunity to continue research under favorable conditions. According to the Faculty Chairman at MIT, there is an economic incentive, as individuals in leadership positions are employed and paid 11 or 12 months a year instead of the usual 9 months. Normally, MIT faculty take vacation salary out of their external research grants.

Among students, an academic career is generally not at all attractive. At MIT, the extremely tough requirements were cited as an obstacle. Two quotes: "It´s no longer enough to be best in the world at research; now you have to be best in the world at teaching." "The tough economic conditions have taken the fun out of it."

Gender representation

There is a very small number of female leaders at all the universities we visited. MIT said that it was anxious to appoint women to leading positions. We met one woman at the Vice-President, or higher, level at Northwestern. The Faculty Chairperson at MIT is also a woman, who however stated that she has relatively little power in that position.

Analysis

MIT's structure is similar to that of Chalmers. There are groups corresponding to the President´s leadership team (HLG) and the Deans' Administrative Councils at the department level, and, just as at Chalmers, they have a purely advisory function, but great attention is paid to their opinions. This system encourages participation in leadership work.

Department autonomy at Georgia Tech is similar to that at Chalmers, making the job of Department Head attractive. It was our impression that this degree of autonomy is unusual at the department level; instead power is often situated at the next (School) level. The universities we visited did, however, differ widely in size. The entire School of Engineering at UMass is, for example, not much larger than the Chemistry department at Chalmers.

Applying for a leadership position, Department Head and up, opens up more obvious opportunities for a career as an academic leader in the US than in Sweden, where this is a more unusual career move. However, the external interest in applying for the position of President of Chalmers indicates that we are moving in this direction in Sweden as well.

Personal characteristics of leadership candidates are the most important factor in recruitment and a **great** deal of importance is attributed to this factor! Chalmers is moving rapidly in this direction, as seen in connection with the recruitment of the Dean of the School of Technology Management and Economics at Chalmers.

None of the visited universities offer internal education for their leaders. In this context, Chalmers appears to have advanced significantly with its courses, seminars and discussions arranged for Research group heads, Deans, Vice-Deans and other groups. There is also a need for more joint action at Chalmers and the universities we visited. The leadership development activities at Chalmers partially meet this need by creating contacts between leaders of different units within the organization.

The explicit way in which expectations on both new leaders and new teachers was expressed is striking. The annual evaluations resulting in ranking lists according to achievement must put great pressure on leaders and teachers. Evaluation of teachers was described but it was harder to get a clear picture of how and on what basis leaders were evaluated. It was clear, at least at MIT, that teachers did not evaluate their leaders, this evaluation was done from above. At Chalmers, we are increasingly approaching making explicit demands on leaders. For several years, the Deans (Department Heads) have been given assignments in writing and the Dean of the School of Chemical Engineering has begun to give the Research group heads (prefects) their assignments in writing (but this is not yet the case at other departments/schools).

The administrative support and service functions left a very vague impression. If Chalmers had hosted a visit on the scale of ours, several administrators from Chalmers' Central Admininstration and possibly also from the department level would most probably have participated. We saw almost no such staff. Administrators with non-science professional competence, working under favorable conditions should increase the quality of administrative activities. Perhaps there is qualified support staff but they apparently are not allowed to keep a very high profile.

Recruiting female leaders was difficult, even if several universities claimed that they would like to do so. 10% was a typical proportion of women in the faculties. It was difficult to recruit women to teaching positions, even at MIT. The situation as described to us seemed very similar to the Swedish one, despite the American tenure system. Members of ethnic minorities in leadership positions was also a rarity, as it is in Sweden.

Proposals

Direct application

1. Systematic review of how the situation at all leadership levels at Chalmers can become clearer, for example by emphasizing:
   - Requirements made on leaders
   - Re-organization with Administrative Councils at all departments
   - Assignments in writing for Research Group Heads

2. Annual follow-up of results (academic activities and economics) in each subject (research group level), in order to more rapidly obtain clearer information on developments within the School (department).

3. More extensive follow-up of results (academic activities and economics) at each School in order to more rapidly obtain clearer information about developments within Chalmers.

4. An appropriate set of key indicators, giving a quick impression of developments in the academic activities, should be identified. The nature of these indicators should permit retroactive calculation in order to make trends visible. This is more important than focusing on results for each individual year.

Long-term strategy

1. Investigate how Chalmers can make best use of the those leaders' resources, who have put a lot of effort into their leadership tasks at different levels and have thus not been able to remain in the front-line of research.

1.4 Organization and management

At most American universities, the leadership function has been divided between the President and the Provost. The President usually has a stronger external profile and the Provost a stronger internal profile, focusing on academic leadership and control of resource allocation (budget and budget follow-up). Both positions are important for contacts with potential external financiers. At most universities, there is also a third administratively oriented leader who is a member of the highest Administrative Council.

At MIT, the Chairman of the Board plays an active role. The Board of Trustees consists of some 70 persons, most of whom represent industry or the financial sector, supplemented with some academics, a few of which have recently (1-5 years) graduated from MIT. The Chairman, 6 other trustees and 3 internal representatives, make up the Executive Committee, led by MIT's President. The present Chairman of the Board, who started and developed a company manufacturing testing equipment for processors, Teradyne, is appointed on a half-time basis (previously, the Chairmanship was a full-time position and the Chairman was recruited internally). He devotes the other half of his time to work on the Boards of various new technology-based companies. At MIT, the Chairman of

the Board inspects internal activities via the active work of the Board of Trustees' Visiting Committees. This is one of his most important functions. He also has an external function in representing MIT, together with the President, a role that has increased in significance, as federal grants are cut back, since MIT must put more effort into acquiring funds elsewhere.

The Visiting Committees at MIT are one of the most important instruments for renewal and learning. There are 28 Visiting Committees at MIT, visiting departments and other important units at MIT on a biannual basis; i.e. 14 Committees are active each year. A Committee typically consists of 15 members: 5 Trustees, 5 Alumni and 4-5 are internally active individuals from other academic fields. After conducting an audit, the Visiting Committee makes an oral report directly to the Board, followed by a written report, first to the Executive Committee for approval, and subsequently to the rest of MIT.

Analysis

At Chalmers, we must put more effort into acquiring external funds. The central Administrative Council and the President´s function is of great significance in this context. In the future, the President can be expected to devote even more of his/her time to contacts with external sources; thus the traditional leader's role at Chalmers will undergo continuous change, and the demands will increasingly resemble those made on American university leaders. Might the American model, President and Provost, supported by an administrative leader, be useful to us? Lately, Chalmers has been moving in this direction, as seen by the division of labor between the President and Vice-president. When a new President is to be appointed, it will definitely be necessary to further analyze the need for more relevant structures and job descriptions, in order to lead Chalmers into the future.

MIT´s Visiting Committees are apparently a very important instrument for follow-up and renewal. At Chalmers we have a Foundation Board and a Corporate Board that appoint the Managing Director, i.e. the President. In addition, there are Boards at the department level that are comparable to daughter company Boards of Directors in an industrial concern, but with a more advisory function at the present time. One option is to involve Board members at different levels in this type of follow-up by Visiting Committees. An important aspect of these audits is that the auditing group must consist of both external members (trustees and board members from the industrial and finance sectors) and alumni (former technology students and participants in international Masters' programs) as well as internal members representing departments other than that being reviewed. These individuals are selected so that they have extensive knowledge, but are not a part, of the unit being reviewed, so that they have an unbiased view of the unit's activities and can present suggestions for improvement. It is especially important, when choosing participants in an audit group, to include people with the ability to see cross-disciplinary opportunities and openings. This means that it is probably inappropriate to include only external representatives on the Board of the department being audited; instead, representatives of other departments' Boards and Chalmers' central Boards should be considered. This leads to another dimension in Board work, and a higher degree of involvement and commitment to Chalmers' future (the review of Chalmers' leadership structure proposed below also entails the re-consideration of the present department Boards' roles, which should also be taken into account).

Proposals

1. Chalmers' leadership structure should be reviewed and the tasks assigned to the President should be distributed. Some of the issues to be discussed:
   - External-internal profile: who should do what?
   - Strategic-operative role: who??
   - Academic organization's leadership: what do we mean by academic leadership and what does leadership of the organization as a whole mean- who should do what?
   - Line vs support staff: what should their roles be?
   - President (central administration)- Deans (school administration)
   - The role of the Chairman of the Board
   - The role of the Boards (central and school level)

2. Establish some type of internal audit with an external base, such as MIT's Visiting Committees. Some of the issues to be discussed:
   - Who should initiate the establishment of the Visiting Committees?
   - How should they be put together? How often should they make their audits?
   - What kind of pre-work should be done by the unit being audited - self-analysis?

1.5 Is the university a learning organization?

Under this heading, we will discuss whether or not there is room for consideration/reflection and learning in day-to-day work. We were especially interested in finding out if there are well-planned ways to achieve learning at different systems levels, i.e. at the group, subject, department and university levels, as well as the individual level. We also wanted to find out if there are processes for sharing good and bad experiences and for sharing good ways to perform different tasks ("best practice").

Even if the answer to our question of whether the university is a learning organization remained unclear, we nevertheless identified many mechanisms for learning at the universities we visited.

The aforementioned Visiting Committees at MIT are an example of auditing, which can also be described as learning made possible by an outside person regarding an organization's activities with no biases, thereby being able to offer feedback both on things that function well and areas that can be improved.

Evaluation of individuals can also be the basis for reflecting upon one´s strengths and weaknesses and in which areas one might improve. Such evaluations are performed at all universities with varying degrees of rigor, primarily as a basis for hiring and salary determination. The manner in which this information is presented can, however, vary greatly even within the same university. For example, some individuals at Georgia Tech only receive the written information stipulated by law from their superiors, whereas others receive both written and verbal feedback resembling an evaluation and planning session. In connection with these individual-based evaluations, much use is made of different key indicators, such as the number of published articles in referee journals, teaching load, etc. At other institutions, such as UMass, the assessment is more subjective, but is not, on the other

hand, of any great significance for salary determination since the salary level is mainly regulated by union negotiations.

No evaluations of leadership of the type commonly performed in industry today (e.g. 360 degree evaluation) are made, however, except at Motorola University. We were told that someone at Georgia Tech was in the process of developing an instrument for this purpose.

At American universities, the sabbatical is an opportunity for professors to gather new strength and new learning by being released from teaching. The sabbatical usually takes place at another university, sometimes abroad. At MIT, there are also "internal sabbaticals", i.e. leave spent at another department, which is also beneficial to the cross-disciplinary process. Tom Allen, the Vice-Dean at the Sloan School of Technology Management is one example, spending half of his time during his sabbatical at the Department of Aeronautics and Aviation at the School of Engineering and the other half in Ireland. This type of "internal sabbatical" is an effective way of learning about other disciplines and bringing different parts of one´s own university closer together.

Meetings are vital to inter-individual learning. At MIT formal meetings end with an activity report, and the participants leave aware of everyone's responsibilities and of which decisions have been made. Meetings can also be informal, as when people bump into one another, take coffee breaks together, etc. The Sloan School´s "coffee machine phenomena" has been thoroughly explored but, according to Tom Allen (who pioneered this research), even this environment is becoming a bit too formal because "it takes so little to start a meeting". The need for meeting places has also been noticed at Georgia Tech, where this is taken into account when new buildings are constructed. There was, however; no faculty club on campus, which has given rise to many complaints. There was an attempt to establish one on the campus periphery but it did not work out and was discontinued. A central location is being looked for. One of the professors at Georgia Tech told us about another university where the offices in a new building were so small that no one wanted to sit there and read an article. There were, on the other hand, large common rooms with comfortable sofas. A woman professor regarded this building as the most energizing change in her career. "So far, I have never read an article in the sofa without someone coming by, and we always have an interesting discussion".

The computer provides special opportunities for meetings: via the Internet, interactive video, e-mail, conferences, etc. At MIT, this type of meeting occurs regularly and can be described as routine. Tom Allen, who has done some research in this area, emphasized that social contact between people who have actually met in physical space is a prerequisite for a well-functioning contact via IT-based systems. Thus, MIT´s program is designed with initial personal meetings followed by meetings via IT-based systems. Tom Allen also pointed out that companies that routinely use IT-based meetings need to re-establish social relationships on a regular basis. At Airbus, for example, every fourth meeting is physical.

At several of the universities, for example Georgia Tech and MIT, the fact is emphasized that professors' work situation has become increasingly stressful and that job satisfaction has decreased. Demands on performance are increasing, not just in research but also in teaching and other areas, such as acquiring funds. This major focus on performance and achievement (and competitive positioning) with accompanying stress is also an indication of insufficient space for consideration and

reflection (and sharing), and hence it can be questioned if the US universities are learning organizations in the sense described above.

Analysis

At Chalmers, courses are subject to evaluation by the students, who can of course assess the classroom performance and pedagogy but not the contents, since a student is by definition incapable of judging the value of a course's contents. Courses are also discussed in Boards of undergraduate programs, etc but more feedback from these discussions could be given to the teachers and teaching assistants responsible for the courses. It would also be wise to evaluate a course in progress in order to effect changes that might benefit current rather than just future students. In order to evaluate course contents, follow-up and assessment on the part of alumni is necessary, i.e. engineers who have been working for several years and thus are capable of judging the value of their education. The alumni organization CAIRN has recently evaluated Chalmers' international Masters' courses, and the ordinary engineering program should be evaluated by alumni on a regular basis as well.

During recent years, Chalmers has undertaken various types of self-evaluation, to be used as a basis for audits. However, the self-evaluation process at the School of Technology Management and Economics was of limited value because the purpose was unclear: to identify areas that might benefit from change (the logical purpose of an self-evaluation) or to provide a basis for a comparative assessment of different universities? The result was an insipid paper which avoids dealing with vital problem areas and thus does not function as a basis for learning and change; rather it is mainly a waste of resources.

The value of the recent external audit at Chalmers, at the initiative of the Swedish University Chancellor, remains to be seen. External audits can create pressure which may have a positive effect on the organization's development. Internal audits or self-evaluations that are initiated internally and carried out by the administration of the unit being evaluated (for example, the university as a whole or a department) can be powerful tools for learning and change. As proposed in a previous section, some type of Visiting Committee, as they function at MIT, might be an effective instrument for learning and creativity at Chalmers. This is an example of internal auditing with major external elements; i.e. responsibility for the process lies within the organization. Another possibility, not observed at any of the universitites we visited, is the use of one of the existing general instruments for self-evaluation, such as the Swedish Quality Award (corresponding to the Malcolm Baldrige National Quality Award in the US) or the European Quality Award, which have the potential to yield similar results if used correctly. At present however, there are only two individuals at Chalmers who are qualified to use these instruments.

For a long time, there has been a 10-point program for evaluating individuals' performance at Chalmers. There are departments/schools at which these 10 points are used as guiding principles, whereas the program is essentially unknown at other departments/schools. As is the case at the American universities, the practice of having regular evaluation and planning sessions with all employees varies greatly at different units at Chalmers. There is great potential for improvement here.

There is nothing at the American universities we visited that corresponds to the instrument for evaluating supervisors in use at the School of Technology Management and Economics, which is similar to instruments for evaluation of industrial leaders, but has been adapted to the supervisor-doctoral candidate relationship and constitutes a basis for discussion. Thus, it is a tool for the individual supervisor's learning and development but also functions as an aid in developing the relationship between supervisor and doctoral candidate, and might have a positive effect on the doctoral process at Chalmers if put into wider use.

The possibility of offering "internal sabbaticals" at Chalmers in order to achieve new interdisciplinary and cross-departmental connections should be investigated. Indeed, at present we are not aware if internal sabbaticals already exist at Chalmers.

The question of meeting places is essential and should be kept in focus in all contexts. There must, to some extent, be formal meetings, but there is a general impression at Chalmers that some meetings are unnecessary or incorrectly planned. Purely informative meetings are often viewed as a waste of time, as information can be distributed via e-mail. Within the Chalmers group, the point has been made repeatedly that there is a need for meetings at which different issues can be penetrated thoroughly and experiences can be exchanged. Thus, the Deans' seminars held during the past few years are highly appreciated because of the opportunity they provide for group discussion and reflection. The Chalmers group also provides a much-appreciated forum for meetings across the department boundaries at which experiences can be exchanged. Our learning trip to the USA, with our shared experiences, opportunities for group reflection and discussion are another example of the way in which meetings can be arranged, a model our American hosts had no experience of, but commented upon with great interest.

One observation about physical meeting places at Chalmers: The reconstruction of "Einstein", a university restaurant, into a more open structure has made it possible for spontaneous meetings to occur, as everyone visiting the restaurant is probably aware. The physical design of the meeting place is thus essential.

Tom Allen's and Jim Utterback's comments regarding the need for meetings in physical space in order to create favorable conditions for IT-based communication are memorable, and lead to the question of whether it is possible to establish new types of relationships exclusively via IT or if it is always necessary to meet physically. There are some research results (beside Tom Allen's own) that support the latter theory. Perhaps this is difficult for those of us who have grown up in physical space to determine, and it might be among the technology students that we will find genuine expertise in this matter.

There also seems to be a direct parallel between the rising stress level at American universities and other organizations and that in Swedish organizations. The work load is increasing at Chalmers; we endeavor to achieve a great deal and there are increasing demands concerning publishing articles, teaching technology students, tutoring tasks, contacts with and continuing education for industry. Do we have time for reflection? Can we afford to be in such a hurry, without the time to ponder our activities, choose our areas of focus and decide what to drop? Our impression is that there is a certain degree of awareness of this problem at the American universities as well as at the federal level (see, for example, the stress study in which Georgia Tech participated in 1996). With the exception

of the Dean of the School of Engineering at UMass, however, we did not observe any good examples of how this situation should be handled, corresponding to the use of learning cycles and problem-solving tools at some companies today. On the other hand, MIT's Chairman of the Board of Trustees commented that he had favorable experience from his own company and that he wanted to re-orient MIT from its "re-engineering focus", primarily consisting of cutting down on the number of employees, replacing it with an approach based on total quality.

Proposals

1.Test and evaluate different instruments for measuring performance in both individuals, dyads, groups and organizations, focusing on the following, among other issues:

- Course evaluations should be continuous, not just momentary
- Evaluation of leadership/tutorship and the doctoral candidate/supervisor relationship
- Elucidate which evaluation criteria are to be used, since they are to function as guiding principles, i.e. what is important to Chalmers?
- How are the evaluation results to be made public and followed up?
- Elucidate the purpose of self-evaluation if it is to occur; otherwise, risk of wasted effort

2. Put the question of meeting places on the agenda. Functioning meeting places are a prerequisite for renewal and dynamics. Noteworthy:

- Critical examination of formal meetings: purpose? Can they become more effective? When is more time necessary and when can they be shortened, or take place via alternate communication channels?
- Administration meetings with the power to make decisions, but with compulsory prior drafting and preparatory presentation to the larger group
- Informal meeting places; create time for opportunities and the unexpected.
- Meetings and routines for exchange of experience and dissemination of good examples

3. Develop routines and approaches that enable Chalmers to function as a learning organization.

- One basis for learning is experimenting/acting and then reflecting upon one's actions and achievements. Is there time and space for reflection?
- What do reflection and pondering in the daily work situation actually mean?
- How can we make use of what we learned (integrate and standardize)?
- How can we share with others what we have learned?

2. Renewal, cooperation and education in research

2.0 Renewal and cooperation – an introduction

During our visit, the discussions revolved around two main themes: How do new successful research areas develop? and How is a climate favorable to cooperation created?
The attitude concept and the prospects of influencing attitudes toward cooperation also played a central part in our preparatory discussions.

During our visit we identified a number of mechanisms for creating and stimulating renewal and cooperation in research, some of which were well-established at some universitities and some which were still being tested at others. The ability to cooperate was regarded as a most important evaluation criterion in connection with recruitment. Directed recruiting was used to locate the individual regarded as suitable to start up a new area or to function as a "bridge" between two established areas.

Positions were reappraised at the School level on a routine basis. Wide use of early retirement led to renewal and opportunities for reappraisal. So-called centers were established in order to create flexibility and to coordinate academic activities over the boundaries of traditional research areas. Seed money was offered to stimulate interdisciplinary research. Recurring evaluations were performed at the individual as well as the group level. The prevailing conviction at all universities is that it is essential to involve the faculty in all important decisions, and confidence in the members own ability to improve and reorient themselves was also evident during all six visits.

2.1 Recruitment and development of staff and termination of employment

2.1.1 Impressions

2.1.1.1 Recruitment

We identified two recruitment strategies. One is broad recruitment with a comprehensive description of the subject area, aiming at finding the most outstandingly qualified persons within a broad and rather unspecified subject field. The other faculty members expect their new co-worker to develop and promote the field according to his/her own ideas. This policy was especially prominent at MIT, where world-renowned individuals are hired and given a great degree of freedom. The "tenure-track" system, entailing continuous evaluations of the employees' performance, in which a permanent position is usually the result of several years of work, lowers the university's risk of misguided ventures. A person who does not live up to expectations cannot advance and will move to other universities or be bypassed. The system of broad recruitment was also in practice at Georgia Tech, where, however, there was also a long-term strategy for employees to remain and develop within the university. For example, attempts are made to find work for the employee's spouse. Expectations on the individual's initiative are substantial and extensive demands are made on his/her ability to cooperate.

The second recruitment strategy is directed recruitment, aiming at promoting the development of a new line of research or teaching. We found examples of "joint appointment", in which a new, often junior, staff member was hired to create a bridge between existing departments in order to encourage inter-departmental cooperation and renewal. Experience demonstrates that interdisciplinary top-down initiatives seldom are successful; collaboration is best established from the bottom with the participation of cooperative individuals.

The evaluation bases for recruitment vary from university to university due to differing profiles. MIT seeks out the top researchers and students from all over the world to an exclusive and relatively narrow institution. UMass, on the other hand, is deeply rooted in the local community of both teachers and students and offers a wider selection of courses as well. The main driving force at this institution is the market, i.e. the students' desire to study, and thus great import is attributed to the staff's social skills and ability to cooperate with students and researchers. Georgia Tech, which also offers a wide array of subjects, seeks to emulate MIT and has a very aggressive recruitment policy both for faculty members and doctoral candidates. MIT has no such recruitment policy; people apply there anyway, primarily in order to conduct research, not to teach.

The culture of constant evaluations results in a current formal ranking of an individual's qualifications, but, in addition, cooperation skills are emphasized. The question of how to test this ability is as yet unanswered. At Georgia Tech, we were told that candidates with good social skills and secondary interests are preferred over frontrunners in research with less impressive cooperation skills, since campus culture develops from social capacity and personality rather than from attitude change. At Georgia Tech, social skills are tested by providing candidates with the opportunity to interact with both researchers and students during the recruitment process.

The recruitment procedure deliberately involves all faculty members. At MIT and Georgia Tech, the faculty has substantial influence on the hiring process. At both institutions, important issues are put to a vote. In the past, if a decision has had inadequate faculty support, major problems have arisen. Individuals from other departments also help out in the hiring process, in order to achieve decisions which rest on a firm foundation.

The prevailing opinion is that it is difficult to re-direct resources unless a professor dies or retires. At UMass/Lowell the Chancellor and Deans redistribute resources between departments. Faculty members have no formal say in this matter.

2.1.1.2 Development of employees

The evaluation system at all levels of the universities, schools, departments and of individuals is the most important mechanism for change and development. At MIT, there are Visiting Committees that meet with students, teachers and other staff and assess the quality of ongoing activities. The Committees are composed of representatives from industry, alumni and of staff at other departments. The students are not represented. Each department and major research program is scrutinized in this way every other year.

The individual evaluations of each teacher/researcher, covering success in research, teaching and ability to attract external funds, are essential for career progress. There is both an annual evaluation which is the basis for salary determination and distribution of work within the department as well as a more long-term evaluation at every stage of the tenure-track system. At each career stage, both external and internal statements and letters are requested. Teaching ability is also very important in this process and students participate in the evaluation. If evaluation results are poor, the salary level freezes, the teaching load increases and clear signals are received that change is in order.

The apparent norm is the university assuming that personal curiosity and initiative are sufficient for individual reorientation and improvement. People are left alone to develop at their own pace, at the same time as powerful incentives for change are built into the system with the continuous evaluation of each individual's performance.

We observed an interesting method of facilitating individual development at MIT, where an internal sabbatical can provide an individual with the opportunity to work at another department at the university for some time. At Rensselaer, there is a defined policy of educating leaders in communicative and team-work skills, resulting in teachers also learning to be team players, a painful adaptation process for many former loners in research.

2.1.1.3 Downsizing of staff

The administration at several universities emphasized how difficult it is to terminate programs except in cases of retirement or death. Externally funded centers and research programs are automatically terminated if financing ceases.

There is no legally stipulated retirement age in the USA, and the faculty age structure is regarded as a problem at many universities. UMass and MIT have recently been forced to radically cut back on staff. Among other measures, favorable conditions for early retirement of older professors (80 individuals) was offered. Hiring of new staff reduces the average salary level and the total competence could be replenished. One interesting observation was that, after retirement, professorates could be reviewed within a broad subject area, such as engineering, opening opportunities for reviewing distribution of resources between schools and departments. This is how the Department of Applied IT was created at MIT, for instance. Similarly, the music program was replaced with computer science and electronics resources were distributed among regional continuing education programs at UMass. This was also a positive way to occupy older faculty who participated in "service courses", as part of the university's "third task" of informing its surroundings about accomplished research and development (UMass).

The existence of professors who are no longer particularly active at the departments is not just an economic problem, but also an issue concerning ethics and space. One way of dealing with the sensitive issue of older employees was to set up special high-quality premises with a high technical standard for working and receiving visitors, as the old premises were passed on to someone new; we observed this at MIT.

2.1.2 Analysis

There are two aspects of employee issues in which Sweden and the United States differ. First, there is no stipulated retirement age in the United States. An individual with a permanent position works as long as he/she wishes. Second, job market mobility is much greater in the United States. At Georgia Tech, staff turnover for natural reasons during a ten-year period was 50 %. Many universities regard rejuvenation of the staff as desirable. At the same time, interest in engineering education as well as research education is declining and students are no longer so attracted to the idea of an academic career.

One reason for this is that academic life has become more of a burden in recent years. At MIT, we heard, "Academic life isn't fun any more". New tasks are added, teaching loads increase, the "third task" is increased, etc, without other tasks disappearing. At MIT, 20% of staff time is at the Dean's disposal for meetings, inquiries, etc. At Chalmers the workload of all staff categories has increased considerably in recent years as well.

There are contradictions in the descriptions of increased qualifications and formal evaluation criteria evolving from interdisciplinary work. On the one hand, the desirability of this kind of activity is emphasized, but on the other hand the formal qualification system has not been fully adapted to this ambition. The evaluation of performance and the important ranking list on which career advancement is based are put together at one's own department where teaching load and salary are determined. There are no interdisciplinary ranking lists, either at MIT or at parts of Chalmers.

2.1.3 Recommendations

1. Create special facilities for professors emeriti, where older staff members' experience and wisdom may be utilized in a positive way.
2. Active review of positions at each new appointment, in order to create opportunities for redistribution of resources
3. Introduce the "internal sabbatical" and "internal postdoc" at Chalmers in order to encourage interdisciplinary collaboration between departments and Schools
4. Encourage "joint appointments", i.e. cross-department hiring

2.2 Establishment of centers

2.2.1 Impressions

Interdisciplinary cooperation and the need for such cooperation was strongly emphasized at all universities we visited. On the one hand, they stated that the most interesting research problems are the complex ones found in the borderland between traditional disciplines, and on the other hand that interdisciplinary collaboration was an explicit prerequisite for obtaining grants from "research foundations" and investments were often too large for one faculty member or department. At MIT, this was regarded as a question of survival since federal research grants had been cut back.

By “centers” we mean any type of formalized collaboration across traditional research area boundaries. The centers’ activities varied greatly in terms of size, formality and activity level, ranging from two colleagues (not members of the same research group) using the same stationery to organizations along the lines of Chalmers’ microelectronics building. Different terms, such as “laboratory” and “institute”, were used for the same type of center. Our collective experience was, however, that four to eight faculty members was the norm; each faculty member in turn involving 1-2 doctoral candidates in the research. It was apparently unusual for center participants to work on the same premises but more common for mutual equipment located in mutual laboratories to be used. Georgia Tech, where center participants often worked on the same premises, seemed to be an exception. The participants came from both science and engineering, with some participation from management subjects. However, academic participants from other universities were rare. Center activity almost exclusively consists of research, together with research education (courses and projects) and some company financed education, while all basic education was provided by the line organization. In some cases, such as Georgia Tech’s Logistics Center, company financed education was the main activity.

Our general impression is that research collaboration cannot be administrated into existence; one or more committed senior researchers are necessary “motors”, both for starting up and operation. This was expressed as, “The top can’t write research proposals”. Of course, this did not contradict the fact that research cooperation sometimes is initiated top-down, for instance by signals from industry being picked up at the top level. We found a number of examples of “meeting places” being created for faculty members in order to stimulate discussions which might lead to collaboration. UMass Lowell had created a database, consisting of research areas of interest, used for initiating discussion. Subsidized lunches were held at MIT in order to stimulate meetings etc.

When it comes to focusing on renewal in research and research education, as well as on attitude issues, the administration can facilitate cooperation by sending clear messages. We found examples of this at all universities. The willingness to say yes or no to initiatives from lower levels is important, as is stating that cooperation is the way to proceed. There were examples at all universities of reward mechanisms for individuals involved in cooperation, for instance lower administration fees, infrastructural support, full credential value for all co-authors of a paper and seed money for collaborative initiatives. By announcing the availability of seed money for specific purposes, such as cross-disciplinary research, one could influence the university’s research profile. Resources were used on projects that could generate resources.

Our general impression is that centers are used, both by administrations and individual faculty members, to attract external research funds. The point was also made that the center as an organization is relatively easy to create and possible to terminate without major trauma.

Everyone seemed to agree that faculty members’ attitudes were crucial to the cooperation climate and that many of the above-mentioned factors could be viewed as attempts to influence attitudes using “the whip and carrot”, steering behavior toward cooperation. Taking cooperative ability into account at recruitment was also discussed.

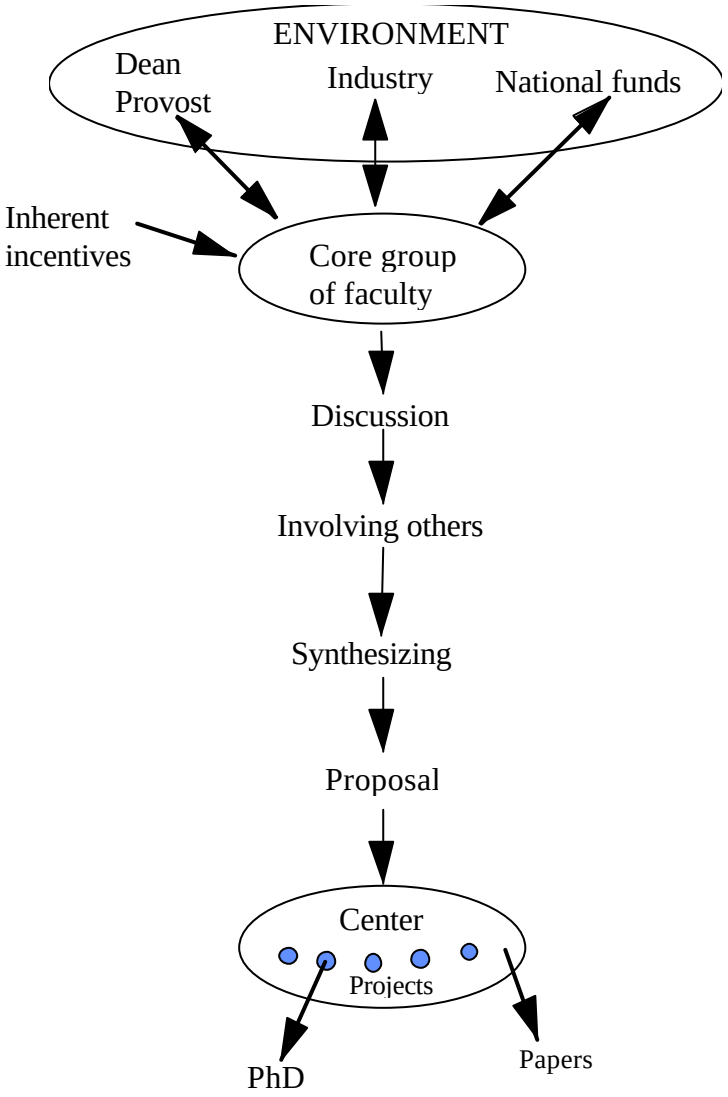
At Rensselaer, we were told that the most convincing argument in favor of cooperation was that one’s own career was influenced, as cooperation is regarded as a credential when an individual is

being considered for tenure. This is in contrast to statements at MIT such as, “Junior researchers don’t usually want to make the extra effort required to work in centers”.

Distinguishing characteristics for a successful center were said to be:

- Some strong leaders (motivation and vision)
- A clearly stated central goal with good financing conditions
- Interdependence between members

In our opinion, “central goal” means that the definition of the center’s activity is narrowed down, as in “sustainable energy” instead of just “energy” or “lean aerospace” instead of just “aerospace”.



2.2.2. Analysis

At Chalmers (in Sweden) the terminology is somewhat different, or else we are more modest when classifying research cooperation. We do not often use the terms “centers”, “laboratories”, “institutes”, etc; rather we tend to use the terms “project” or “research program”. However, it must be admitted that the formal status that comes with the name, along with the authorization from the university, is a strength in the discussion with financiers and other interested parties. Indeed, one main purpose of the established centers at the universities we visited was to make it easier to attract external research funds.

At present, there are several centers at Chalmers, with varying degrees of activity, some of which might be described as “associations based on common interest” rather than as active research centers. The former are not unimportant as forums for meetings and discussion; rather, the reverse is the case. However, the issue of whether or not centers should be awarded formal status associated with active research cooperation must be discussed. They do not need this authorization in order to serve their purpose, but it is important not to weaken their role as meeting places.

In most cases, researchers at centers work in different places. Centers create a matrix organization in which some focused research is carried out by the centers, while other research, education and intradisciplinary “intellectual discussions” are carried out within the line organization. At the universities we visited, basic education is consistently provided by the line organization. This deserves close attention due to the risk of teaching becoming impoverished and coordination diminishing if centers are the primary force determining where people are located. Furthermore, there are relatively fewer top positions in Sweden, which is an obstacle for co-location of centers, since professors probably participate in more than one cooperative project in many cases.

In Sweden, the same tendency exists as in the US; i.e. a focus on the necessity of interdisciplinary cooperation. The US appears, however, to be a few years ahead. The same priorities are stated, but the manifest rewards for cooperation (or absence of rewards in the reverse cases) are perhaps less explicit. Are cooperative initiatives and attitudes rewarded, for instance, when discussing promotion?

Different kinds of meeting places as generators of discussion and understanding, which may ultimately lead to cooperation, were often brought up in our conversations. There was no systematic approach to this at the universities, but it was regarded as an important issue. Our impression is that the faculty plays a more formal role at the universities we visited than is the case at Chalmers today. The administration is responsible for gathering support, by means of dialogue, for its decisions. Faculty discussions and decision-making must not disappear from the arena, but must be replaced with a decision-making procedure based on participation which is more effective than our previous procedure.

When the center concept is transferred to Chalmers, we must remember that ours is a relatively small institution. Thus, we must focus not only on cooperation, albeit cross-departmental, within Chalmers, but must examine the potential for cooperation with other universities and colleges with special competence that we lack.

2.2.3 Recommendations

1. That work be started on the creation of terminology and procedures related to the establishment of centers and laboratories at Chalmers
2. That an explicit policy be defined at Chalmers, linking willingness to cooperate with incentives
3. That funds for seed money be created at the school (department) level, to be used primarily for cross-disciplinary collaboration

2.3 Attitudes and influencing attitudes

During the preparatory work for our trip, attitude issues emerged as central to the ability, or lack of ability, to change. On the one hand, there are catchwords such as "openness", "mutual respect", "interest in others' work", "academic debate"; on the other there is "guarding of territory", "excessive egocentricity" and "my share of the pie". We obviously wished to study these counterpoints at the universities we were to visit.

2.3.1 Impressions

Conditions for individuals with university educations in the US differ from those in Sweden in one important respect. Salary and promotion have much greater impact since the salary range is wide. This means that specified goals that influence salary have great impact. At many institutions there is a system in which an individual's colleagues vote on his/her salary, resulting in a strong local culture. On the other hand, this means that an individual who is interested, for instance, in teaching at an institution that does not appreciate teaching, will be in trouble.

Another general reflection is that the sense of academic community is more widespread in the United States. We were repeatedly told about "intensive support-generating processes at all levels", "faculty involvement in the recruitment of new staff", "regular meetings on science, seminars and workshops" and "social events".

A third observation is the large degree to which entrepreneurship was expected of faculty members. Since this word has been overused, I will use "curiosity" and "initiative" instead. This was especially explicit for junior staff, who were given considerable freedom (MIT and Georgia Tech). Cooperation skills are also expected, and this was emphasized during the recruiting process.

We found enormous differences in the ways in which administrations influenced attitudes, possibly due to the universities' positions. Georgia Tech was pervaded by the "we want up" idea (defined strategic plan) and took pride in having risen on the ranking list of the US' best universities. Georgia Tech and especially UMass Lowell perceived themselves as expressly regional universities; Lowell with a strong base in local industry. Motorola University can be compared to a company, the management of which has an explicit policy. Each employee had a little plastic card with the university's commandments, which he/she was expected to know by heart. The first phrase is "total customer satisfaction". Rensselaer turned out to have a very well-formulated policy on IT/interactive

learning/globalization, which was the object of extensive support at all levels of the university. At the extreme end of the passive scale is MIT, completely satisfied in the knowledge that it is the best, content to observe developments in order to protect that position, and live by the motto "Let people develop in an atmosphere of freedom-that works out best". At MIT, junior researchers enjoyed great freedom. Work space was distributed fairly to junior researcher and Nobel prize winner alike.

At several universities the focus was on teaching and the introduction of IT. This was especially obvious at Rensselaer, but UMass Lowell, Northwestern University and Motorola University also were oriented in this direction. Work proceeded in a coordinated fashion, spread out over the major parts of the university and involving large investments in infrastructure: computers, computer networks and support staff (200 employees assigned to provide Northwestern's teachers with IT service!)

At Northwestern, Research Support Offices had been set up as a service to the faculty, their sole function being to make it easier for faculty members to do their job and focus on research/teaching. An Office of Strategic Initiatives had also been opened in order to aid the university in strategic thinking and in responding quickly to cooperation initiatives from industry, government and other universities. At UMass there was a central database covering the faculty research profile, used by the administration in order to identify researchers and encourage them to apply jointly for funds when the opportunity arose.

2.3.2 Analysis

Due to the difference between the American and Swedish cultures, certain instruments in use in the US are out of the question here. Labor market legislation is one such area. In other areas, however, the Americans not only work on the same issues but their methods can also be transferred to Chalmers. Some universities are threatened by very palpable factors, which are barely discernible here at Chalmers, such as weak interest in basic education, and are effecting major structural changes in order to survive. (One example of this is UMass, at which the changes, terminating programs and redistributing resources, were made at the last possible moment). This seems to make people accept rough treatment from the administration; hopefully, we do not have much to learn about this type of change. Other universities resemble Chalmers more, i.e. want to make changes before the threats become urgent. It is more interesting to study the process in these cases.

Major resources are being invested in these main areas:

- Reputation (ranking)
- Relations with alumni
- IT infrastructure (computers, networks)
- IT support staff
- IT in both basic and graduate education
- Interdisciplinary research centers in the broad sense of the word

Successful research is based on the assumption that participating researchers know each other and wanted to collaborate. Thus, we must increase the interface among the faculty at Chalmers.

The social context, and especially freedom for junior researchers, appears to be important. Formal hierarchies counteract this freedom, and we would like to emphasize that the Chalmers structure contains an etiquette system that especially counteracts such freedom. For example, we have the terms "subject area representative" (="I´m the professor in charge")[2], "examiner" (why are both an examiner and a main advisor necessary?) and the plethora of research education subjects (each professor is entitled to his/her subject).

2.3.3 Recommendations

2.3.3.2 Short-term

1. Increase IT venture, coordinate
2. Scrutinize the "subject area representative"/examiner/main supervisor complex. Can a preliminary examination of theses replace the examiner? Can an internal examination committee replace the examiner? The advantage of an internal committee is that the flow of information across department borders increases.
3. Can the number of research education subjects be reduced? For example, at the ED Department, electrical engineering and computer engineering should be enough. And at the Chalmers level, a PhD in Engineering or in Architecture.

2.3.3.3 Long term

1. Plan for and introduce methods aiming at increasing faculty participation, on a wide basis and at all levels, in Chalmers' future, and current operations. The faculty must carry on a vital debate on research and teaching issues of common interest, a debate that must not be isolated in committees and administrative groups.

2.4 Research education

2.4.1 Impressions

Research education at the universities we visited is decentralized. In some cases there are a few rules at the department level, but it seemed to be up to the individual advisor to make many decisions. In some places there were a few compulsory courses and in others none at all.
Doctoral candidates are enrolled once or twice a year, depending on the department. All universities we visited, except MIT, recruit actively by letter, telephone and invitations to visit the department. Doctoral candidates are often recruited externally (UMass, Lowell, is an exception), and only a handful remain at the same university after finshing their PhDs. Most accepted doctoral candidates are hired at a salary and their tuition is paid with money procured by their advisors.

[2] This "subject area representative" (ämnesföreträdare) does no longer exist at Chalmers, but the concept still remains in the mind of several professors at Chalmers.

At enrolment, the doctoral candidate has no advisor; he/she chooses one after a while. The grapevine warns the candidate away from poor advisors. In addition to the advisor, the doctoral candidate has an advisory committee (3-4 individuals including the advisor), that monitors his/her progress, decides when he/she is ready for examination and also carry out the examination itself.

After 1-2 years, the candidates take a general examination testing their knowledge level. The exam has an oral and a written part and aims at covering both the candidate's area of research and broader subject knowledge. If you fail the exam, you may not proceed to your PhD, but may choose to write a Master's thesis and obtain a Master's degree instead. A candidate may also be allowed to study some more and repeat the general exam, if the advisory committee finds this appropriate. After the general exam, the doctoral candidate does not take any more courses and devotes him/herself entirely to research. When the advisory committee decides that the candidate is ready, he/she writes his/her thesis and defends it before the committee. Theses are mainly written in the form of monographs. The average period from Bachelor's to Doctor's degree is approximately 5 years.

There is no education for advisors and the concept appeared to surprise everyone we questioned about it, nor is there any follow-up of the advisor's performance. The advisor's only incentive is the reputation enhancement associated with producing as many and as good PhDs as possible in the shortest possible time. No one seems to feel a need to change or renew research education.

2.4.2 Analysis

The group's impression is that the research education provided at Chalmers is better than the American one. The system entailing the same group functioning as advisors and examiners threatens quality, as does the absence of education and evaluation of the advisors. We might possibly learn form the minimal number of centralized rules for research education, for example concerning compulsory courses, in the American system.

2.4.3 Recommendations

Appoint a committee to review Chalmers' rules regarding research education and to decide if they all are necessary.

3 External and internal relations

3.1 Alumni, fund-raising, marketing and lobbying

Impressions

It was mainly Georgia Tech, UMass Lowell and MIT that presented their efforts in these areas. These three institutions have more or less extensive resources both at the central and at lower levels, such as a School Dean. Although the names may vary, the following units exist at these universities:

- Advancement (or Development) Office for fund-raising (industry and sometimes alumni)
- Marketing Office
- Corporate relations
- Alumni

Typically 30-50 people work at the central Development Offices. Several departments also have their own Development Offices (Georgia Tech), but local activities are coordinated with the central unit. The Development Office's most important job is private fund-raising from both industry and alumni, as well as corporate relations. The alumni work has become considerably more intensive and contacts can even be made on a local basis with Development Office staff. Another more or less common factor is that work takes place in close cooperation with the faculty, the Dean of the college in question and the researcher(s) concerned. The office staff defines itself as a support group for the faculty. One fund-raiser with a background in charity work in the USA and Latin America also pointed out that fund-raising is ultimately about discussing the future, the development of society and how the university can act as a positive developing force. Thus, the Development Office was not seen merely as a unit aiming at bringing in money, but also given the role of communicating the university's role in society.[3]

Georgia Tech is a state university and receives a relatively large proportion, some 30% of the total budget, of its support from the state, but expanding at the rate Georgia Tech has done creates a demand for increased financing from other sources. At present, the "Campaign for the Georgia Instititute of Technology" is in progress. The goal is $200 million during 1995-2000. So far, the campaign has been very successful and the goal has already been exceeded by $67 million.

[3] At one of the universities visited we were provided with the following **requirement profile of a fund-raiser**:
- Converted academic
- No used-car salesmen
- Must understand the operations of the core institution
- Must be able to close a deal
- Must understand that the Deans are to be deeply involved
- Good listener
- Competent personality analyst
- Relationship generator

In addition, lots of volunteers (classmates, etc) are used in fund-raising.

The Georgia Research Alliances, created by the state of Georgia, are one special feature. This is an organization which is to promote growth in areas expected to be important in the future, with a focus on Bioengineering, Telecommunications and Environmental Engineering. GRA is financed by industry and the state, and the idea is that it should provide seed money for projects in new areas with potential to attract companies.

MIT has a very large Corporate Relations department that handles a number of functions such as contracts, fund-raising, the Industrial Liaison Program, development of new business contacts, etc. The Corporate Development Group in charge of fund-raising is a support group for the faculty, primarily the President, Provost and Deans, in their endeavors to find new companies with which to develop long-term relationships. It has also started to sell services, primarily leadership and administrative functions, to research centers at MIT, and has noted increasing interest on the part of the researchers.

The Industrial Liaison Program is very prominent, a membership program with some 200 member companies. The annual fee, $40 000-50 000, entitles the company to admittance to MIT, via its liaison officer. It is, of course, possible for a company to attempt to contact MIT researchers directly, but contact is not always made, even if one knows whom to approach. In addition to a designated liaison officer, membership involves a number of other privileges, such as meetings on campus, customer-designed workshops on technology and management, member-only reports, Web access to internal MIT information, publications and links to the MIT library. Recruitment of new employees is an important feature of American companies' contacts with the universities. As an ILP member, a company may receive aid in designing an individual program, making contact with researchers from relevant groups and starting internship programs for students at the company.

ILP is primarily directed at larger companies. There is, however, a mini-alternative at $15 000 per year for companies that cannot afford the full program. The fact that MIT has difficulty cooperating with and adapting to SME was admitted openly. Activities consist mainly of consulting done by individual faculty members. The Chairman of MIT made a statement contrasting this when questioned about the universities' future, stating that MIT must begin cooperating closely with local high-tech companies, which are often smaller.

One new feature of MIT's cooperation with companies is "strategic partnerships", entailing a long (>5 years) and extensive ($3-5 million/year) commitment. So far, 3 agreements had been made and negotiations about more were in progress.

The visit to UMass was exciting since it differed markedly from the other universities. First, the institution defines itself explicitly as a regional university. This affects its external relationships, for example, as seen in its extensive involvement in the surrounding community and contacts with smaller companies. Second, the university has only worked on external relations in a structured and conscious way for three years. This work was presented very openly and many of the reflections and approaches seemed to be very relevant for Chalmers.

The reason for starting this energetic external activity three years ago was the distinct decline in the number of new students. There was a 20% decrease in the age groups but UMass was losing 50% in annual enrolment (Colleges of Engineering). Since tuition and other fees constitute about 1/3 of the

university's income, a major effort was necessary in order to turn things around. One example of this was the establishment of active and powerful units aimed at increasing external support (the Office of Advancement and the Research Foundation) and marketing the university (the Office of Communication).

The Office of Advancement is mainly in charge of fund-raising from alumni and industry. Having started almost from scratch a few years ago, today there are 19 full-time employees and an unspecified number of part-time employees. There is a clear link to university operations, as every School has its contact at the office. Also, fund-raising is an important task for the Dean.

The difficult economic situation during recent years has also resulted in a marked increase in contacts with industry and especially industry-supported research. In contrast to MIT, for instance, there is great interest at UMass in working with smaller companies, as might be expected at a regional university. Helping junior faculty members build an industrial contact network is regarded as a key task. One way of achieving this is to provide them with a mentor, usually an older colleague who has previously cooperated successfully with industry. Contacts with industry are handled through a central organization, the Research Foundation, which also hires staff for project work and is in charge of administration.

At UMass Lowell, work with alumni was quite recent. Three years ago, there was no clear picture of where the more than 40 000 Umass' alumni were. Now, those gaps had been filled. It turned out that many alumni had done well, confirming the university's reputation as a "poor man's MIT", and there were many alumni who had the means to support their alma mater. According to the Dean of the College of Engineering, alumni should give something back, especially something of a more emotional nature. In addition to the alumni Newsletter which provided information on events at UMass, different ways of focusing on individuals had evolved: the Francis Award, the Francis Academy of engineering, the Lifetime Achievement in Teaching Award, the Service to the College Award, the Service to the Community Award, etc. The alumni are asked to nominate candidates and the awards are presented at a banquet. "Presenting plaques can yield major returns." It has taken several years of work, but now the university receives support from many sources and is increasing its fund-raising work as the potential grows. The College of Engineering has 200 "key prospects" who are visited personally by the Dean and a representative from the Office of Advancement.

In addition to generating more external funds, the Office aims at increasing interaction between the university and industry/society. An interesting example of the latter is one department inviting alumni to a roundtable on education each month. 200 invitations were sent out, and 10-15 people usually showed up. Their discussion with 10-15 faculty members is the starting point for an INTERNAL discussion, which was emphasized as the most important effect.

Georgia Tech has a relatively new Communications Division, with a staff of 10. Although the unit is central, each college has a group in charge of work at that college (an individual can participate in more that one group). One important goal is to present a uniform picture of Georgia Tech in all outward-oriented activities. The unit also works on market research, letting the results influence its actions. An example of this, taken from the recruitment of new students, was given. In a recent market report, it was discovered that one important incentive for potential candidates to apply to a specific line of education was the prospect of a high salary after graduation. Georgia Tech

immediately changed its information material, which is sent all over the country, so that it clearly stated which salaries are realistic after graduation.

The Office of Communication at UMass Lowell is somewhat smaller. Its job is to handle the media, information to the public, all publications and relations with the state. This is also a relatively new function, and it is difficult to find the time to do everything that needs to be done (such as manage all the web pages). These 1998 goals give an idea of the tasks at hand:

1. Increase the UMass Lowell presence in the media.
2. Increase assistance to fund-raising efforts
3. Increase assistance to recruitment efforts
4. Enhance internal communication
5. Increase UMass Lowell's visibility among elected officials
6. Explore and establish new communication efforts

A lot of effort is put into local press releases. Internal information is also given a lot of attention as many people do not participate in internal debate.

Relations with the state and, perhaps even more so, with the city, are very well-developed, in accordance with Umass' identity as a regional university. During recent years, UMass has cooperated with the federal government in order to restore a part of the old canal area in Lowell. It is also involved in several construction projects: an ice hockey rink, a baseball stadium and a student center. Another project is endeavoring to improve high-school education in the region, for instance through off-site courses, offered to 15 schools, special "college prep" programs, competitions for high-school students, summer science camp, etc. As large Hispanic and Cambodian groups have migrated to the area, the university has helped develop education programs in three languages. Cooperation with the city and the region includes other areas such as environmental issues, continuing education and job training, information, culture, public health and safety, etc (see "Connections-For a Stronger Region").

Georgia Tech has a full-time lobbyist, whose main job is to build confidence among elected officials, primarily at the state, but also at the federal, level. An essential part of this task was providing information on what Georgia Tech means to the region.

Analysis

Although conditions and approaches concerning external relations differ widely among the universities, there are also some similarities. They all invest considerable resources both in fund-raising among alumni and industry and in marketing. Efforts have increased during recent years, the main reason being the difficult economic situation, specifically triggered by huge cutbacks in federal research funds, especially for defense. Another important reason is the decline in the number of technology and science students (evident at UMass, Northwestern and Rensselaer), which cannot be compensated for by raising tuition, as fees are already quite high. Due to its reputation, MIT has not noticed a corresponding decrease in interest so far, but people there are worried, as at the other universities, about what the future will bring in the area of education, and various recruitment efforts are ongoing.

However, a comparison between Georgia Tech, UMass and MIT discloses distinct differences. Of the three, it is clear that Georgia Tech is the most aggressive in terms of external work with a clear strategy. This applies both to fund-raising and to the university's profile in relation to the state of Georgia. As can be concluded from studying Georgia Tech's rapid ascent on the ranking lists, this has been successful. The Engineering School is now among the 3 or 4 best in the United States, which was among the stated goals.

UMass was forced to act a few years ago. In accordance with its stated vision of being a regional university, the effort put into external relations has more of a local and small-scale character, at the same time as a lot of energy is being invested in establishing direct cooperation with local authorities. The attitude is more open and humble here.

MIT's reputation as one of the world's foremost universities of technology makes its situation somewhat easier. Since it has been private for many years, people are more accustomed to working on external relations. MIT has the most developed system by far, with the ILP and the strategic partnerships as prominent features. Probably no more than a handful of other universities could operate similar programs. Regardless of the more favorable starting point, MIT seems to invest the most resources in developing external contacts.

Based on their respective fundamental conditions, all three universities have succeeded in expanding their external relations. It is clear that strong central units have been a major factor at all three institutions. A response to our direct question was "It takes resources to create resources.".

Although Chalmers' efforts in corresponding areas are much more modest, much of what we are discussing or starting up here is in full swing at the universities we visited. One noticeable difference is the emphasis on involving faculty in fund-raising from industry right from the beginning. Even if a company donates money, people want to feel they are receiving something in return, and this requires faculty participation.

The importance of receiving something in return is emphasized even more when discussing fund-raising among alumni, an effort that requires several years of cultivation before it begins yielding support to the university.

Changes in society, above all via globalization and expanding IT-technology, have even led to a discussion of the universities' chances of survival. Although there were some doubters, the majority believed that there will be room for universities in the future as well. They will, however, have to change, not least in the area of external relations. As the Chairman of MIT put it, the universities' *raison de etre* will be:

- Research, requiring facilities and proximity in order for cooperation to work
- Interactions between students on campus
- Cooperation with local small high-tech companies

Recommendations

It is important to note that there are two reasons for extensive fund-raising and alumni activities. The obvious reason is of course to create more resources, but even more important may be to increase external contacts, receiving feedback and support for development of the university's operations. As the complexity of our world increases, especially in Sweden with many influences on the universities' conditions, it is important for Chalmers to export its message and influence decision-makers who in turn influence our development. The following recommendations can be made:

1. Chalmers should continue to invest in central resources both for fund-raising and alumni activities, which should increase.
2. Fund-raising and alumni activities should occur in closer contact with the university's operations.
3. Contacts with alumni should be expanded in order to create a stronger relationship between alumni and Chalmers. Contacts should include social activities in order to provide the alumni with the opportunity to give their feedback on the university's activities.
4. Chalmers should consider allocating lobbying resources. At the local level, the creation of the Western Götaland region means greater possiblities for Chalmers.

3.2 Recruitment and development of staff

Impressions

Since I only asked questions about specific principles for the recruitment of teachers at MIT, I will begin my report there and add my general impressions from other areas, gathered from conversations both at MIT and at the other five universities. It is primarily based on a discussion with Lotte Bailyn, professor of organization psychology at the Sloan School and Chairwoman of the Faculty Committee:

"Recruitment of teachers" is my Swedish term. In the United States, the term used was the same as we used at Chalmers prior to 1994, i.e. "appointment". The word "recruitment" implies a hiring procedure dictated by the requirements of the situation. At MIT, on the other hand, people are appointed when they have reached a certain competence and experience level. "Appointments move up the system" is a direct quote from L. Bailyn. Even if the Dean suggests a candidate via the committees, the process starts with a discussion at the department level, then proceeds to the faculty committee, is brought by the dean to the School Council and then to the Academic Council. The latter consists of President, Vice-President, Provost, Deans and the Faculty Chair. Positions at the level of Assistant Professor and higher are handled this way.

1. *Assistant Professor*: appointment on a temporary basis, to be extended or else individual moves on in the system. Extension possible if further testing of individual is necessary.
2. *Associate Professor*: one-year position; individual expected to move out of the system during period. "Up and out"
3. *Non-tenured Associate Professor*: this individual is on the tenure track and has 8 years

(3 previous and 5 future) to qualify for tenure. One year before period is over, individual is advised as to whether he/she may proceed or should apply elsewhere.

The assessment process consists of interviews, trial lectures (several) at which the interaction between lecturer and students is observed closely. CV plus letters/statements from inside and outside the university are required for the tenure track. "Blind letters" are not permitted, which I assumed to mean that the experts' statements should be signed. Various kinds of evaluations, with varying degrees of structure, from the relevant Deans also seemed to be a basis for evaluation.

In order to obtain the title of *Full Professor*, 3-4 more years are required in order to procure new letters. Assessments of influence in the world of research, international reputation, etc, are an additional requirement. In addition, a professor can have or lack a chair, corresponding to the Swedish "Subject Area Representative". About half the professors at MIT lack chairs.

We learned at Georgia Tech that *Endowed Chairs* were professorates for which the funding had been donated. As in Sweden, there were also *adjunct professors*, working maximum half-time. There were also *Professors of the Practice*, mainly at the School of Architecture (cf Artistic Professor), a position lasting a maximum of 10 years. *Lecturer* and *Senior Lecturer* are two alternative careers, limited to teaching. *Research Scientist* and *Senior Research Scientist* are also temporary positions; reviewed after one year, may be transferred to teaching. The staff of centers is chosen and appointed by the Vice-President of Research, as are positions that cross departmental boundaries, such as program leaders.

At MIT, creating a broad recruitment base for top-level positions is a very important policy issue; thus there is a great deal of internal recruitment.
Pedagogical skills are regarded more highly than previously, but there is no question that research is valued even more . It is not just the number of publications that counts. 10-12 external and 4-6 internal letters of recommendation are required at MIT. When teaching qualifications are assessed, student evaluations are often used. At tenure reviews, the committee members are required to attend lectures and observe the individual being evaluated.

When a position is free it is advertised. Special quota rules for minorities and women must be observed. A free position at MIT's School of Engineering is handled by the Dean as if it were at the disposition of the entire School of Engineering, creating slots in new areas to replace the former postions. This, however, is uncommon at the other universities. When recruiting for a position, a special committee can be formed, as at the Sloan School or the School of Engineering, for instance, which specifies requirements and proposes candidates, after which the matter proceeds to the School Council and on to the Academic Council.

Positions under the Assistant Professor level are reported to the Academic Council. All appointments are thus observed from the top level, and are regarded as very important. "We educate the best and have the best teachers."

Recruitment of leaders is carried out according to the above policy. Leaders are rarely recruited externally. They are not generally hired on a temporary basis, and it is attractive to be a leader. Leadership is a full-time job, and comes with power, a budget and a salary raise. One of a Dean's

most important tasks is to handle hiring at lower levels and to encourage researchers and teachers to reach the highest levels.

Selection methods vary, but ranking lists, compiled by the Dean or at a higher level when a Dean is to be appointed, are mainly used. More than one name is usually presented.
The search committees are made up of members from the Schools's faculty and sometimes there is a MIT faculty member from another School as well. The decision is up to the nearest superior, beginning at the Dean level. Appointments are followed up at 9 and 12 months.

At the School of Engineering, the Department Head compiles ranking lists of all faculty members, which are presented to the Dean and are the basis for salary adjustment and promotion. The evaluation is made on a 6-step scale, along which the faculty at each department should be normally distributed. The Dean supervises the distribution of the faculty along the normal curve. In contrast, each Department Head tries to achieve an uneven distribution, using only the upper grades on the scale, but this is not accepted. Ranking is done according to the variables research, teaching and service. It is not just an individual's place on the scale that is noticed, but also the trend, or derivative as it would be called at Chalmers. Ranking is based on an self-evaluation. The Research group head and the Dean give their feedback to the faculty member at a kind of evaluation and planning session, but he/she is not informed of his/her ranking on the scale.

One problem is that the faculty is getting crowded due to all the tenured professors who have been involved in operations too long and cannot be persuaded to retire. At MIT, this was handled with an early retirement plan, which resulted in 80 professors aged 63 and up retiring or choosing to work part-time, primarily with teaching. They kept their titles and did not become emeriti.

Selecting the right candidates for tenure has become increasingly important and the procedure is much more advanced than 30 years ago. It is, however, almost impossible to debate limiting tenure in the United States. The possibility of doing something about a tenured faculty member who is no longer productive is very small, but at least the problem is visible nowadays.

One major problem is that women have fewer chances in the system "if they want families" (Of course, this applies to men as well, if they want to participate in family life. This was my own addendum). Producing 30 papers over a seven-year period in order to obtain tenure, at the same time as one handles family responsibilities, is a difficult life. Many young people-both men and women- do not want a life like that today. There are not many female role models in top-level research positions. At the School of Engineering, women believed that they were appreciated less and ranked lower than they deserved. There have never been any women on the Engineering Council. The university teacher/researcher job has become a stressful one. The teaching load has increased due to the lack of resources resulting from federal research grant cutbacks.

The faculty at MIT consists of 10% women. There are hardly any African-Americans or other minorities. No Department Head is a woman.

It may be added that at Rensselaer, colleagues' opinions of an individual´s teaching skills carried a lot of weight. Deans were said to often be externally recruited at UMass. Dean Krishna Vedula at

UMass recommended to his colleagues that each lecture be evaluated. He often attends lectures himself.

This is a list of advantages, compiled by the IT boss at MIT, which in his opinion were incentive for top-level IT-staff to remain in their positions:

- People who are devoted to MIT should be chosen
- More flexibility than in the industrial world. "You get all the "toys" you want."
- Staff is given as much exposure as possible to the surrounding world.
- Within reason, they are permitted to undertake consulting in addition to their jobs.

In Provost Moses' opinion, a Nobel Prize for teaching should be created, so that teaching might gain prestige. "Salaries are good and the quality of life is bad", was his statement apropos of the academic career with its enormous amount of stress and the diminishing freedom of choice in research.

Finally, some comments concerning the role of staff organizations, such as human resources. According to the Vice-President of Administration at Georgia Tech, a staff's job is to add value to the university, and to be able to document and measure that its activities do actually add value, thus justifying its expense to the line managers. This in turn means that the staff must not become a "jack-of-all-trades", but rather must work in a focused manner, as its goals contribute to the fulfillment of the university's goals. This also means regular communication between line and staff.

At UMass Lowell, library staff were educated in providing IT-support. Thus, librarians could search for and access documents on the screen of the "electronic library", instead of subscribing to expensive publications etc. Is this the situation at Chalmers as well?

Analysis

Despite the differences in retirement and promotion "culture", we can learn some things from the six universities we visited. We appear to have come farther when it comes to recruiting academic staff based on pedagogical qualifications. When it comes to evaluation of publications, expert evaluations, and letters of evaluation, I believe that the recommended procedure at Chalmers is better and results in a more three-dimensional picture than current practice at MIT.

However, in my opinion, the custom of ranking and assessing an individual's qualities in relation to a position is a more widespread feature of professional culture in the United States. Peer reviews and the ranking of staff performed by the Dean of Engineering at MIT are examples of this. The selection process for leaders also reflects the fact that leadership of operations is regarded as necessary and desirable; thus leaders are actively sought and rewarded. At MIT, deans were internally recruited, while this was an external procedure at UMass Lowell. Trial lectures and more extensive exposure of applicants than is common here was the norm; we heard, for instance, that applicants were asked to undergo a two-day evaluation, something that might be an improvement on our hiring procedure.

Dean Krishna Vedula at UMass Lowell has had an interesting career. A distinguished researcher (from Cornell, I believe) who was more interested in teaching than "in the Nobel Prize" and, having

acquired the necessary prestige, could look for challenging tasks in this area. He was attracted to UMass Lowell by the university's strategy and is currently devoting his energy to leadership work: pedagogical renewal, marketing, developing contacts and fund-raising.

We need to define our leader profile better, especially for Deans. We should recruit both externally and internally and spotlight, develop and reward individuals' leadership.

Salaries were not on public record at the institutions where I asked about them (not all). This makes salary differentiation easier
Ranking of faculty members is perhaps taking things a bit too far, but the attractive part of this process, and the part that we should adopt, is the long-term follow-up of all employees. The derivative is development over time and long term career planning.

Development conferences and self-evaluation can also be of use. The following questions are given to the employee in a Motorola-style development conference:

- Do I have a challenging, meaningful job that contributes to my personal development?
- Do I receive the necessary training?
- Do I have an achievable, realistic career plan?
- Am I given feedback every month?
- Does my work at Motorola add value to Motorola?

I will be adding this list to my library of recommendations for evaluation and planning sessions that is available to every Chalmers leader on request (with accompanying verbal advice where desired). Motorola also practices 360-degree evaluation of leaders, evaluation by superiors, subordinates and customers. Today, Chalmers' lecturers are being evaluated by our students (customers), but this broader evaluation could be an idea to consider at the university as well

Recommendations

1. Input from more categories of staff/students in evaluation of applicant
2. More exposure of applicants when they are interviewed
3. Recommendations and references from other sources than experts
4. Attend applicants' lectures
5. Regard every vacancy as a matter of concern for the department and Chalmers
6. Correct procedure for selecting leaders, based on leadership criteria
7. External recruitment of Deans
8. Recruitment and development of faculty members is one of the Dean's most essential tasks
9. Long term career planning and self evaluation as an input for planning sessions

3.3 Entrepreneurship

In this section, two types of entrepreneurship are described: academic entrepreneurship on the one hand, and the connection between the establishment of new technology-based companies and the university's research and teaching on the other hand. During our visit, the word "entrepreneurship" came up very often in various discussions. In many cases, the person using the term wished to emphasize the importance of individual faculty members taking initiatives, sometimes with seed

money. This academic entrepreneurship resulted in the establishment of centers or programs or in the evolvement of a new subject area through providing certain people with unlimited authority to recruit. The other type of entrepreneurship applies to the connections between research and the establishment of new technology-based companies at many universities. Sometimes these connections were reinforced by entrepreneurship education and by co-localization of departments and incubator.

Entrepreneurial faculty

At MIT, the independent role of each individual as an important source of renewal was emphasized. Employees are expected to be entrepreneurs, not primarily in the financial sense of the word, but rather intellectual entrepreneurs. "When you come here, you won't be anybody's assistant; you'll be expected to hoe your own row." The opinion was also expressed that when two colleagues from different departments get the idea of cooperating, it always turns out well, as both are world-class since they work at MIT. The other side of the picture is the enormous pressure, and resulting stress, put mainly on junior faculty members. They are highly overworked and declining interest in the academic career is starting to be noticed.

Academic entrepreneurship via the establishment of centers and programs

Perhaps our group has had more discussions with our hosts about EXTERNAL than about INTERNAL relations, but we have also observed examples of the connection between the two. In many cases, it is probably the desire to fulfill an external need that leads to internal collaboration. At all the universities we visited, a number of centers have been established "to pursue an opportunity", as it was put at Georgia Tech. One example is the Interactive Media Technology Center at Georgia Tech, created so that Atlanta could include virtual reality presentations in its application to host the Olympic Games. There are some 60 centers at Georgia Tech and 31 at UMass Lowell.

We have heard nothing but positives about centers/labs/programs wherever we went. Two quotes from Georgia Tech: "A very flexible organization. By and large, it works very well". "The barriers to interdisciplinary research are very low." Initiatives in which the administration has faith are often supported with seed money. At Northwestern University, we heard that centers evolve naturally, "from the bottom up". The responsibility of the university's administration is to evaluate the initiatives and determine which ones are to be provided with the wherewithal to develop further. Quality and competence were the most prominent criteria.

Chuck Vest, the President of MIT, underlined the importance of cooperation with industry for renewal, "Shaping programs jointly with industry is the only way to really make progress." However, he also emphasized the significance of internal cooperation, citing the example of the collaboration between the School of Engineering and the Sloan School of Management.

The International Center for Research on the Management of Technology at MIT, the director of which, Bill Lucas, we met, is a somewhat different type of center. It resembles a collection of projects on a theme. Bill Lucas' job is to get the best researchers to work at the center. His stratagem was to invite Assistant Professors to lunch, two at a time, in order to interest them in participating, and to make it easy to start a project: short application, no bureaucracy. He also

organized meetings of a social nature regularly, including all participants during recent years, inviting prominent senior Professors such as Tom Allen and Jim Utterback. This is another example of how external relations co-develop.
We hear everywhere that it is not complicated to start a center, and it happens often, but the fact that centers are rarely discontinued was also admitted.

Entrepreneurship, education and incubators

Georgia Tech, MIT and Rensselaer appeared to be the universities that had invested the most effort in the education-entrepreneurship theme. There is a clear ambition at Georgia Tech (and work has already begun) to achieve physical co-localization of departments and incubators, resulting in an important dimension in new construction. This was about all we found out about entrepreneurship education here. Most activity related to establishment of new companies and entrepreneurship seemed to take place outside teaching. For instance, GLATT (Georgia Center for Advanced Telecom), a state-financed operation on campus, has begun to yield excellent results in terms of companies that were introduced on the stock exchange, etc. Investing in the establishment of new businesses was a strong trend.

MIT's entrepreneurship education was located at the Center for Entrepreneurship, where Matt Utterback explained how they had managed to maintain a relatively large combined teaching and innovations operation (some 300 engineering students per year in some courses), despite a small teaching staff. The center had strong relations both to small technology-based companies in the region and to venture capitalists. A company offering projects to the center is expected to pay $1000 when the course is over. Teachers are allowed and encouraged to invest their own money in companies evolving from the education program. It is said that there is a great general lack of teachers in entrepreneurship in the world. The center's managing director, Ken Morse, is an entrepreneur himself, as is Ed Roberts, another teacher. MIT students think it is "cool" to get involved in new ventures, despite the fact that McKinsey and other companies are offering fairy-tale deals with paid training and salary starting at $150 000.

Rensselaer presented an image of a university with a strong focus on technology-based entrepreneurship; there is a long tradition of students' starting their own businesses and of entrepreneurship education. Furthermore, there are fine connections between engineering and management, which was most noticeable in Susan Sanderson's excellent plan for our visit. The Lally School of Management also engages in entrepreneurship when it offers authorized distance learning Masters' programs in China, Denmark, etc. There is a growing tendency to choose distance learning programs because:

1. it is easier to combine with work.
2. it is offered by the employer as incentive for an employee to remain at a job.
3. it is possible to finish an education even if the student moves or changes jobs.

Analysis

New resource combinations yield new opportunities. The creation of a new center or similar unit means that a new resource node is included in the network through synergy between existing nodes.

We have seen how seed money is used to make this possible, and have also been clearly informed that the initiative must come from the bottom up, via interactions in the network.

At all the universities we visited, the establishment of cross-disciplinary centers, laboratories or programs was said to be the primary instrument of renewal. Perhaps we have not utilized these opportunities optimally at Chalmers. It would be interesting to take a closer look at different types of centers, at how they work, what they achieve and what has sparked their establishment.

As might be expected, the infrastructure related to entrepreneurship and the establishment of new companies is much more developed in the USA than in Sweden. For instance, there is the opportunity to offer, mainly via the network, entrepreneurship education of the size offered at MIT. Georgia Tech seems to be several years ahead of us when it comes to the tendency to link educations, institutions and companies (via incubators), although Chalmers is well on its way in this respect. More entrepreneurial (= problem- /reality-based) education programs such as D++ (a new teaching initiative at the Department of Computer Engineering) and the entrepreneurship school at Chalmers seem to be quite developed, even compared to American universities. Traditional educational methods, such as lectures and prepared exercises seem to have a secure foothold on the other side of the Atlantic as well (with Rensselaer as the exception). Education programs have traditionally been described in terms of the process; i.e. certain courses in a certain order. To some extent, this also applies to research education in Sweden; a certain number of course credits, a certain number of papers. Perhaps this attitude is even reinforced in the "research schools" being established everywhere. The more flexible research education we observed, for example, at MIT, is possibly the result of focussing on the goal instead of the process.

Recommendations

1. Describe the education program as a network of resources to be orchestrated in order to bring the student closer to the stipulated goals, rather than as a process. An outlook like this requires:
   - Explicit requirements made on the student who has enrolled in the program
   - Specific goals for the program
   - A functioning resource network and a description of
     - why it can be used and
     - what contributes to its continuous development

A resource should develop by being used. This network approach should be applied both to basic and research education. The opportunity to utilize the competence network in a flexible way opens new interesting opportunities for the research student, among others. One advantage of the network approach is its inherent openness. The network must be open both to reality and to other organizations.
In other words, Rensselaer Studios should be pushed one more step toward "Reality Studio" where technology students and doctoral candidates are linked to spin-off companies and research projects early in their education. Perhaps expensive labs can also be located in associated companies, which can yield income for the spin-off company as well as save space for Chalmers' departments.

2. Another relatively radical suggestion is to start three different education tracks for engineers: one science-oriented track (for instance E, K, etc), one entrepreneurial track and one track with a more humanistic orientation. These tracks can overlap quite a bit, but higher demands can, for instance, be placed on students on the entrepreneurial track when it comes to organizing projects (for themselves and others), participate in arranging courses, etc, since this provides training in necessary skills

3.4 The student-teacher relationship

Impressions and analysis

If I allow myself for once to simply write down my impressions from our trip in a non-structured way, just as they come to my mind, I would say that the teaching studio at Rensselaer Polytechnic Institute made the most powerful impression on me. The studio was quite spectacular in itself, but it was also a result of a comprehensive philosophy in which active learning was central (strategy for student-centered programs). The studio was an example of a new way to equip a lab, as well as demonstrating a new way to approach learning problems. In contrast to the lecture hall where one is passively exposed to knowledge, the studio[4] is a space in which one is expected to take some sort of action. The studio is equipped like a modern lecture hall for 40 students, in which the teacher can give a lecture with full multi-media support, with the students facing her/him. At the same time, it is a computer-supported lab with a fully equipped laboratory experiment space behind the students.

Using modern technology and spotlights, the lecturer could direct the students' attention either to him/herself or make them focus on the lab desk. In contrast to traditional teaching, in which the students attend lectures, calculation exercises, and laboratory exercises at three separate times, these three elements are fused together in the studio. A traditional laboratory exercise, at Chalmers often consisting of a four hour-long assignment, can be divided into four studio exercises here.

A typical lesson consisted of:

- Review of homework /looking back(10 minutes)
- Discovery example (15 minutes)
- Construction example (20 minutes)
- Mini-lecture (15 minutes)
- Computer simulation (15 minutes)
- Hands-on exercise (35 minutes)
- Next subject/looking ahead (10 minutes)

How brilliantly simple! Why haven't we thought of this? The thought has possibly been brought up at Chalmers before, but I am not aware of any discussions of the laboratories' design, maybe because they have never been allowed to cost anything and the laboratory desks that were acquired during the sixties are still there. As a laboratory instructor, I often feel the lack of equipment that makes it easier for the instructor to gather the students for discussion of their measurement results. However, it must also be remembered that most of the equipment in the Rensselaer studio was donated by HP

[4] According to the dictionary, a studio is an artist's workroom or an establishment where art is studied

and other companies, while we usually have to buy our laboratory equipment in Sweden. Recently, 2 million dollars worth of equipment was put into the second year electrical measurement laboratory within the framework of the E-96 program.

The next powerful impression is made by Provost Joel Moses[5], whom we met our second day at MIT. He was refreshingly free of marketing jargon and marvelously academic. He was unafraid to describe university conditions as they really are, nor was he ashamed of the fact that his university really is a university and not some type of organized company. His description of MIT as a dinosaur[6], with a big body, whose tail wags and toes wiggle without any signals passing the brain, evoked many associations from Chalmers[7].

I often thought, "How like Chalmers!" during his talk. Some comments I wrote down are,

- "Most things that happen come from the bottom up."
- "Department Heads are marvelous at creating barriers.There are a lot of barriers in education."
- "The faculty's quality of life isn´t good; they feel very overworked."
- "Yes, we are doing a number of things to promote teaching. You just can´t get away with poor teaching any longer."
- "I don´t know how to kill any thing or any department."
- "The real power is with the budget (because money talks)."

Here, we find material for a strategy discussion. How can we define a strategy that begins with the university's flat, unrestrained network organization and makes it into a force for the future instead of letting ourselves be bureaucratized and introducing ASEA's obsolete hierarchical structure (belonging to the 20th rather than the 21st century)?[8]

Even if universities are bottom-up organizations in many respects, we were exposed to an interesting top-down support organization at MIT, which apparently supplemented the bottom-up organization in an excellent manner. I am referring to their IT and Multimedia organization with many world-renowned members. That afternoon, we met Steve Lerman, CECI (Center for Educational Computing Initiatives), Jim Bruce, Information systems, and Richard Larson, AES (Center for Advanced Educational Services). Lerman is known primarily from the Athena Project which successfully developed a coherent database environment for network-connected work stations. This project is currently being developed further toward multi-media support (we were given a bundle of references). Jim Bruce is in charge of hardware and infrastructure availability. It should be possible to go around MIT with your PC and hook up anywhere, using spare time to read e-mail, etc. Here, we saw the embryo of the next stage of development of IT society, i.e. carrying your PC (not just your cellular phone) around. You arrive at the lecture hall, plug in your PC and your Power-Pointed lecture (do a screen-dump and hope the students are prepared to download). The next step is cordless computer networks, WLAN. In this field there is certainly room for new strategic thinking at Chalmers!

[5] "I am the Pope; he (the President) is the emperor!"
[6] The fact that dinosaurs are extinct is perhaps somewhat annoying in this context.
[7] There goes my promotion!
[8] The reference is here made to the old Swedish MNC ASEA's structure, which was changed in the late 1980's and further modified when ASEA became part of the ABB group.

A few weeks later, I was on the train to Lund and read the material we had received at the visit to MIT. The MIT Educational Council Report especially got my attention. On first sight, it looked interesting, but soon turned out to be rather tedious and repetitive. The report did not give any real perception of a well defined IT-vision at MIT (just like Chalmers). The main idea is that MIT's activities must be unique and the best in the world (with the same type of impact that MIT has had on the way in which engineering is being taught today). The "me too syndrome" must be avoided, which will be expensive (costing at least $150 million). But what should one really do to be the best in the world? I think this is an interesting leadership problem: on the one hand, university leaders are aware that "now is the time for experimenting", which is actually being carried out by the teachers, but not well known by the administration; on the other hand, the administration needs a strategy for action.[9] The difficulties inherent in defining a strategy at this stage of the process are obvious in the report. The report does, however, contain some interesting ideas, such as the proposal for a young Peoples' MIT Science club, in which elementary school or high school students establish relationships with MIT via the Internet. The proposal for MIT Early Admission is also interesting, in which about 35 % of the students are accepted to MIT at Christmas the precious year. Thus, the whole last term at high school, the student knows that he/she is going to MIT and can take special introduction courses in engineering subjects via the Internet on weekends and during free periods. Another area for strategic thinking at Chalmers! I have already suggested to the Math Department that they convert the Introduction to Math course into an Internet course that students can start on while they are still in high school (where they have plenty of free periods and many of them are understimulated). This gives students a reason to contact Chalmers at an early stage, they can work with college-level introductory math while they are still in high school. This way, we won´t have to stuff them with 5 hours of math lectures during their first weeks at Chalmers.

Since the purpose of our group's trip was to study external and internal relations, it was most interesting to hear Jim Bruce's clear perception of how to hold on to the world's best computer staff, despite their being offered three times the salary by industry! IT is often a question of small, simple things relating to personal freedom (such as being permitted to buy a somewhat more elaborate laptop than you are really entitled to at your level in the hierarchy or being able to take a long leave of absence in order to lecture in Paris). Perhaps Chalmers' administration shouldn´t be obsessed with the fact that its staff travels for SEK 50 million per year. Number one, you have to travel to keep up with your field, and number two, it might lead to Chalmers' keeping staff whose salary would cost at least as much on the world labor market (50 individuals @ SEK 50 000/month = SEK 30 million). The limited opportunities for travelling, according to the individual's own decisions, in industry are without a doubt an important competitive factor to Chalmers' advantage. There is **definitely** room for a strategy at Chalmers in this area.

Finally, MIT's multi-media venture did not make much of an impression on me. Maybe I did not get the whole picture, but are multi-media personalities shooting monkeys with canons in the fragmentary style of the Children's Science Show on TV really what we need to attract more students to engineering? And does this appeal to young women whom we wish to recruit to engineering. (PS I

[9] Compare to Andy Grove´s book about leadership problems at Intel. When the management finally decided to discontinue memory production and only work with microchips of the 386, 486, Pentium types, this change had essentially already been made in a bottom-up process in the organization.

am very fond of the Children's Science Show and often watch it with my kids. But is it really appropriate for a university?)

One lasting memory from the first day at MIT is Dean John Vander Sands' very personal presentation to us total strangers from Sweden. In a very personal way he gave us an excellent insight into staff matters (hiring, development, promotion, salary determination, etc) at the School of Engineering (see section 3.2). During that first afternoon at MIT, we also met Matt Utterback from the Center for Entrepreneurship, Bill Lucas from the international Center for Research on the Management of Technology, Carmon Cunningham of Sloan Alumni at the Sloan School of Management, as well as the administration of MIT's Corporate Relations (which employs 50 people!). To a researcher who lives in an environment in which the MOS transistor's internal well-being is the main theme of the day, the company talk and the begging for money sounds like a strange argot. It´s all so politically correct and is all about money, money, and how to get more money. What is a university, anyway? Are we really just another service provider, like a cable-TV channel or a telephone company? What a contrast to hear, that very afternoon, invited lecturer Anita Roddick, founder of the "banana shampoo store chain" The Body Shop, speak to the MIT School of Entrepreneurship! How refreshing to hear her "radical 1968" language after all that political correctness! A university should also have Anita Roddick's humanitarian outlook, have a holistic view and educate good students from poor environments in addition to its business perspective. There are other things than money that count. Regarding a university as a profit-hungry "service provider" feels very wrong to me.

A few more weeks have passed since our visit, and my impression of MIT as a university that is very aware of its role in society (notwithstanding my criticism above) is becoming stronger. Perhaps it comes with the self-confidence accompanying the number one position on the university ranking list. MIT is very aware of its role in designing modern engineering education (together with Stanford University). Maybe there is some hesitation about IT and the future. "MIT is the only university which has not declared that it is *the* virtual university in the US.".

Another thing I liked about MIT was the decision to let faculty be fully financed by university funds instead of forcing them to run after every little research penny (maybe in areas in which they are not really interested). I think a great deal of energy might be liberated within the system if we didn´t have to discuss which percentage teaching funds, which percentage research funds and which percentage external funds that will finance each individual every year. Furthermore, we could require faculty members to devote one day a week to faculty work.
Today, the individual has difficulty making ends meet when we aim to achieve so much without anyone being willing to finance anything, especially not completely. There appears to be some kind of academic insight behind MIT's decision. Is there a corresponding insight at Chalmers and if so, has it been explicitly stated in our policy documents?

What can be said about UMass Lowell? At Lowell, we did not meet the university's academic roots, but rather the new addition devoted to external relations that was forced into existence when the student body diminished radically. The decision was made to invest resources in order to obtain resources. Of all the people we met, two especially stand out in my memory, the new Dean Vedula and Christine McKenna, Executive Director of University Relations, who talked about spinning and Lowell's new media profile. Dean Vedula spoke enthusiastically about Lowell's new three-point

program consisting of 1) the student-centered approach, 2) the industrial approach and 3) the resources approach. Vedula, who had been recruited externally for the Deanship, had many interesting ideas about all facets of teaching, alumni relations,etc. He was, however, relatively new on the job, even after two and a half years. The impression of the good intentions not quite having made it out to operations was reinforced by Jannicke Åhlgren, the President of our student union, who saw UMass as a university for the teachers rather than for the students.

Finally, an interesting idea from a project at Rensselaer where I met, outside our official visit, a Norwegian guest researcher working in my own field, on a year's sabbatical in Troy. By www-connecting dirigible measuring instruments, Rensselaer can provide its students with lab access 24 hours a day, which is worth thinking about for the Chalmers IT venture.

A final note: like the others, I have, to a certain extent, seen what I wanted to see. This, however, is what is called signal identification in systems technology[10].

Recommendations

1. Begin a cooperation project with Rensselaer on studio teaching and the Internet. There are many reasons for this: Rensselaer seems quite interested and it is also in accordance with Chalmers' focus on alternative teaching methods. There is considerable interest at Chalmers, not least at the Department of Technical Language.

2. Start an IT initiative aiming at establishing relations with elementary and high-school students. Put introductory math out on the Internet and make it something to work with before students actually begin at Chalmers.

3. Investigate the possibilities and consequences of letting all faculty be 100% financed on university funds. Let doctoral candidates, non-academic staff, etc be financed by project funds instead.

[10] Correct me if I´m wrong, Holger

4 IT for education and learning

4.1 General impression

4.1.1 Our focus

We have studied three main aspects of IT in education:

- Learning
- Continuing education for industry
- Infrastructure

Our observations and opinions are based on the goals for Chalmers IT venture:

- *Engineers, architects and researchers who graduate from Chalmers are to be the best in the country and among the foremost in Europe when it comes to the ability to use IT in their professions.*
- *Chalmers should also be known for effectively utilizing IT in its activities, i.e. education, research, administration, management, library activities and the so-called third task.*

These goals are related to our description of the conditions we observed at the American universities.

4.1.2 Changing conditions for university education

One general and clear picture evolving from our discussion with our American colleagues is that of universities and colleges being confronted with a radical change in working conditions. There may be several reasons for this change, but it is obvious that the development of educational technology, especially IT, is the dominant driving force, which has subsequently opened the door to a powerful increase in internationalization, if not globalization, of education and research with an accompanying increase in competition. At the same time, the increase in businesses internal education and in education provided by private companies makes national competition harsher. One important issue to be considered is if these conditions also apply to Swedish universities and colleges. Yes, it is obvious that we are faced with increasing international competition, and the driving forces behind this process are comparable to those acting on the American universities.

4.1.2.1 Education market in transition (opportunities and threats)

Thus, there is a widespread understanding that the role and status of the university will undergo radical change in the next few years due to IT and market forces. There are already enormous off-site university programs such as offered by Open University in the UK and the University of Phoenix in the USA. The opportunities available to each student who can choose freely among the world's university programs, while staying at home for reasons of cost, content or quality, motivate many universities to become a part of the developments. The threat consists of losing students to off-site education's multitude of attractions, thus losing income. In a longer-term perspective, the opportunities offered by IT to attract better students, support and retain more knowledgeable faculty and achieve more effective learning are under discussion. Another long-term possibility inherent in IT is that its use can bring down the high costs of education that lead to high tuition fees.

4.1.2.2 Wanting to remain the best or wanting to become the best

There is a distinct difference between Georgia Tech and MIT, but also a definite similarity. MIT is a very well established university that has topped the ranking lists for many years, while Georgia Tech has made a conscious effort to improve. The universities were founded based on quite different philosophies: in MIT's case that engineering education should be based on science and in Georgia Tech's case to raise the status of applied knowledge. They both endeavor to be the best. Georgia Tech, which is state-owned, has had to fight for its privileges and receives considerable support via the present governor's education-friendly policy. The pioneer spirit is palpable. MIT, private and privileged, has been an object of high-tech industry endeavors. All six universities rank high for research and education. It is apparent that the universities, which are accustomed to being the best, for instance MIT, have invested and are continuing to invest resources in IT, as a measure toward maintaining their positions. You have to excel at everything. Other universities, for instance Georgia Tech, express a desire to ascend the ranking lists of the best universities. If you wish to attract the best students and teachers, you must be able to offer the best facilities.

4.1.2.3 To focus on teachers or to focus on teaching

At the University of Massachusetts at Lowell (UMass), it was obvious that consideration for the faculty's needs was a prominent feature of pedagogical development in general and of pedagogical-IT development in particular. Here, teachers have the space and support necessary to implement their ideas, and are shown appreciation for their achievements. The driving force consists of making the best of your resources. The administration at UMass is proud of the fact that three teachers have been promoted to professors on the basis of their teaching achievements. Georgia Tech also endeavors to support professors by providing them with the opportunity to investigate the students mode of thinking as well as their learning.
This was the (conscious or unconscious) focus for teaching with IT. "Anchored collaboration" has, for instance, been used in various ways in various courses (see 4.3.1). At MIT, on the other hand, a lot of effort is invested in the individual teacher's influence through IT, relying solely on the teachers experience.

At two universities, Rensselaer Polytechnic Institute and Northwestern University (Northwestern), learning was the express focal point. Both universities support the "learning by doing" principle but they interpret it differently. Rensselaer wants to train engineers who are self-reliant but who also can cooperate in groups, communicate effectively and learn under different conditions. At Rensselaer, classroom design and the structure of teaching have become a means to achieve better learning. At Northwestern an excellent Center for Learning Science has been founded based on AI and cognitive science.

4.1.2.4 On/Off/Near-Campus

On-campus, off-campus and near-campus are three different ways of using IT with a great deal in common. We saw an on-campus attempt to integrate the computer's modeling and simulating capacity in a reformed electrotechnical education program in which qualitative understanding is given initial priority (Georgia Tech). The computers will be used in the classroom as well as in the

dormitory in this case. All distance teaching consists mainly of the off-campus use of computers, where the distance between teacher and student can vary from miles to an entire continent. By "near-campus", we mean the attempts we have encountered to encourage better communication, with a focus on teaching, outside the classroom, such as Mark Gudzial's work at Georgia Tech (see GVCU in section 4.1.3.1).

One principle behind the design of both on-campus, near-campus and off-campus courses became apparent several times, mainly at Motorola University, i. e. the importance of optimal utilization of IT and personal contact. In order to make the most effective use of the occasions in which face-to-face communication takes place, IT solutions are created to support the participant both in preparing before this lecture and processing it afterward

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4.1.3 Examples of pedagogical approaches

A major pedagogical change can be based on *pedagogical philosophy, pedagogical methodology* or *pedagogical conviction*. A pedagogical philosophy or, rather, theory, provides the changes with a scholarly base, yielding the possibility of results that may be the basis of interpretation and generalization. A conviction, on the other hand, can result in a narrow view of what is possible, as can a methodology, which offers limited opportunities to interpret the effects of the change outside the methodological framework. To lack a philosophy is to lose the opportunity to define goals and investigate effects in a scholarly acceptable way. With a philosophy as the foundation, one can decide which experiments to try, which pedagogical approaches that may work and how successes and failures should be regarded.

4.1.3.1 Georgia Tech

At Georgia Tech, the concept is to remain in the front line of technology, in order to attract, retain and educate the best possible students with the best possible teachers. Here, pedagogical development is an attempt to "assume leadership in the application of educational technology to instruction…" in a multi-faceted venture. The EIT (Educational and Informational Technology) venture is very interesting. The administration has focused on certain areas, such as IT for educational use, an advanced infrastructure, and an extended campus (all student dormitory rooms are connected to the network). In 1990, the Graphics, Visualization and Usability Center (GVUC) was started, at which a number of researchers develop, implement and evaluate innovations in EIT, particularly within Georgia Tech's education areas. The development of learning tools and research on what they accomplish is outstanding. Software is being developed to simulate otherwise inaccessible phenomena and processes, within a pedagogical framework. The Internet is used in innovative ways to support cooperation in projects and problem solving, using so called "anchored collaboration" (http://guzdial.cc.gatech.edu/papers/aera97/mbl/html). Plans have been made to support "collaborative spaces", i.e. develop web-based systems which focus on a single aspect of knowledge - such as modeling in MatLab which may be used regardless of which course you are taking, aiming at achieving an integration of the students work and knowledge.

Teachers have made use of GVUC's activities, for example by trying to link courses across subject and age boundaries. Web-based tools make cooperation possible between a sophomore course in numerical methods and a course in control engineering for senior-year chemistry students. The

teacher has observed increased interest on the part of the students and better insight into the gray zones between the subjects.

"Classroom 2000" (http://c2000.gatech.edu/) (see 4.1.5.2), which has been developed at Georgia Tech, is an "electronic" lecture hall. The teacher prepared notes (Power Point pictures) can be shown on an electronic whiteboard as well as on the student's laptops or palm-held computers. Everything that is written on the whiteboard or projected onto the video screen, everything that is said and the teacher are videotaped in order to be accessible on the web. This can play the role of multi-dimensional notes for the students, or a more meaningful one as a basis for development and discussion; this is currently being evaluated. Georgia Tech defines its mission rather than its philosophy, a mission that is necessary for a successful venture but not necessarily for successful development of the university and its store of knowledge.

4.1.3.2 MIT

IT for students and teachers got off to an amazing start at MIT when the Athena project was started 15 years ago, resulting in a network consisting of 2000 linked terminals, which is still the foundation of the infrastructure. An experimental approach has been chosen at MIT, an example of which is a respected and entertaining professor of physics who records typical questions put to him about mechanics on "video answer". His pedagogical style consists of relating mechanics to everyday phenomena, leaving the student with a new question. The student will be able to replay these sequences in his/her dormitory room, searching out the difficult questions.

4.1.3.3 University of Massachusetts Lowell (UMass)

UMass is a state university with the additional assignment of promoting development in the local community, the Merrimack River Valley, as well as supporting its teachers and students. Promoting development in the local community has developed into long-distance support, with globalization as the key word. UMass reaches out to the surrounding world, which in turn comes to UMass by means of an extensive video- and computer-based distance education program. There is an explicit bottom-up strategy here, in which the administration makes a conscious effort to encourage teacher initiative. Councils, consisting of a group of committed teachers, are involved in a number of ventures such as the Council for Learning and Teaching. The driving force for renewal lies with the teachers themselves, with symbolic support of minor grants and awards, as well as major support of knowledgeable staff and access to the most modern equipment.

4.1.3.4 Rensselaer

Rensselaer is a private and renowned university of technology. Rensselaer's perception of pedagogical development is that successful learning takes place through interaction and collaboration, involving both students and teachers. In accordance with this line of thinking, the administration has encouraged solutions, both in the areas of IT and architecture that promote and facilitate interaction and collaboration. This is a conviction rather than a philosophy, but a very well-founded one. Classrooms and labs have been rebuilt in order to encourage a freer style of work, in which the key ideas are integration of the different components of teaching (labs, exercises, lectures, seminars, etc) and free movement of teachers and students with frequent change of work mode and pace as well as

instrumental music in the background. “Studios” (http://hibp7.ecse.rpi.edu/~connor/studios.html) have been given different designs for different purposes and subjects (for instance, physics: http://www.educom.edu/program/nlii/articles/wilson/html). Teachers have been encouraged to work in teams consisting of professor, doctoral candidate and senior student in order to meet the students learning needs. The teacher is expected to “orchestrate” the different elements according to the needs that arise. Meaningful cooperation is an important goal. Computers are a natural part of all teaching, both inside and outside the classroom. The unique role of IT is to support communication before, during and after the classroom meeting, both with text and audio-visual aids as needed.

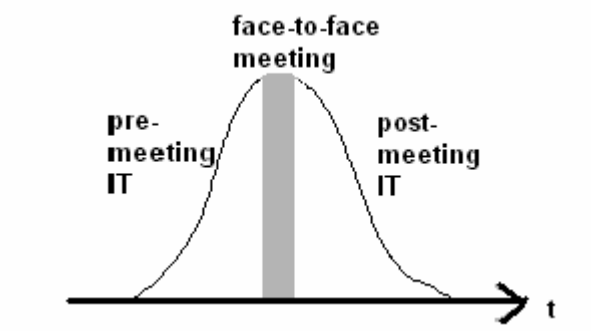
It has been said that this type of teaching is as cost-effective as any other teaching. The total contact time between teacher and student has decreased since higher demands are placed on students outside the classroom. The classroom contact is of higher quality than previously. Each studio has “open house” in the afternoons where the students can meet each other and their teachers in order to finish assignments and elucidate questions. Rensselaer’s main pedagogical principle is constructivistic in nature, i.e. that students learn best by working “hands on” with communication and interaction, both alone and in groups, as well as student-student and student-teacher (http://www.ciue.rpi.edu/studioteaching.html).

4.1.3.5 Northwestern

The same phrase, “learning by doing”, is used at Northwestern as at Rensselaer. While Rensselaer emphasizes the integration of various aspects of the material that is to be learned, aided by the computer and IT, the Center for Learning Sciences (CLS) at Northwestern puts its efforts into creating computer-based packages consisting of a combination of knowledge to be learned and a challenge to be presented to the user. This means that the individual sits in front of the computer and navigates a labyrinth of knowledge “bites” in a computer-game-like environment; makes decisions, draws conclusions and, where appropriate, asks for help and feedback. It should be pointed out that there is a more diversified, albeit apparently technique-oriented support program at Northwestern called Academic Technologies (http://www.at.NWU.edu/default.ssi).

4.1.3.6 Motorola University

The mission of Motorola University is to maintain the competence of the 150 000-member, worldwide concern staff. This takes place both on campus and as distance education, the latter to a great extent by means of advanced IT techniques. We were made aware of one principle for designing courses-both on-, near, and off-campus, i.e. the importance of utilizing IT and personal contact optimally. In order to make the most effective use of the face-to-face teaching opportunities, IT solutions are created in order to provide the participant with support both during the preparatory phase and the processing phase after the course.



At Motorola University, advanced AI techniques are currently being created in order to aid the individual employee in his/her competence development, by profiling and matching relevant courses. Thus, Motorola University endeavors to achieve its goal of continuously educating its staff within the framework of its key goals: being the best in its class in terms of people, marketing, technology, products, manufacturing and service.

4.1.4 Continuing education for industry

4.1.4.1 On a commercial basis

In the US, businesses often finance Master degrees as well as other types of continuing education for the employees. Thus, companies play the role of customer and make demands, as does the individual participant. This contributes to a continuous process, a natural component of which is a dialogue between universities and companies regarding content and form of continuing education programs. This process is often run on a commercial basis, which means that the universities are trained to both understand and adjust to the needs of industry to the greatest possible extent.

4.1.4.2 Increasing IT support in the area of continuing education

Several of the universities have extensive experience of providing continuing education with the aid of distance-overcoming technology. (One example is the Rensselaer Program for Industry, RPI) Until now, this type of continuing education has been provided as TV/video-based lectures. In many cases this has taken place in real-time (synchronous), making immediate interactivity possible as dialogues between teachers and participants or groups of participants. Today lectures and educational tools are increasingly computer based. We saw examples of everything, from ordinary lecture support that the individual participant can utilize before and after a traditional lecture, to fully developed multimedia educational materials. Experience from the experiments conducted for undergraduate students can be useful in this connection as well (see 4.1.3).

4.1.4.3 From real-time teaching to asynchronous solutions

It is reasonable to assume that industry will be demanding more asynchronous solutions. Teaching that is not limited in time is perceived as being more cost-effective. The student can choose where and when he/she wishes to study. As digital technology is being developed, both on the production (university/other course producers) and the recipient (the company) side, several universities, with MIT among them, predict that the selection in this area will grow at an explosive rate in the US. It is, however, important to point out that the combination of asynchronous courses with some type of

teacher support in real-time, is regarded as significant both by the university and industry. This can take place in many different ways, from traditional meetings between participants and teachers to web-based discussions within the virtual classroom framework..

4.1.4.4 From a regional/national customer base to a global market

The existing market for universities of technology in the area of competence development for professionals is changing from being relatively limited, with a regional/national base, to being global. Rensselaer was the university we visited where the goal of becoming a leading player on the global continuing education market was most clearly expressed. John William of MIT's Sloan School, who has computerized "his" Master's program, "System Design and Management", predicts that there will be powerful competition in the area of computer-based programs for industry within a few years. In William's opinion, the education market will become the largest single service market in the future. Ann Drazen, also of MIT's Sloan School, stated that it is in the area of continuing education that volume will increase the most rapidly during the next three years, after which a corresponding increase in the area of basic education will follow. In Drazen's opinion, it was essential to expand infrastructure and begin production now in order to possess sufficient knowledge and experience when "the market takes off in three years time".

4.1.4.5 From courses to individually based "continuing education packages"

The products also develop from traditional courses adapted to groups into individual-adapted items. Thus, it is not only the type of increase in competence that will undergo transformation in order to reach larger markets; new customer groups will also evolve. Today we focus on traditional courses each designed to suit different groups of engineers, such as "high school engineers" or engineers with a Bachelor or Master degree. Digital technology makes it quite simple to put together education packages in order to suit the individual engineer/group of engineers' needs, based on educational level and assignments. Motorola University presented an elucidating example of this: a database in the making in which course modules are stored (see 4.1.5.3). Each employee can then, based on his/her specific needs, put together his/her own competence development program. The continuing education offered to industry by universities in the future must be constructed of smaller modules (each module corresponds to approximately one working day), which can then be packaged and delivered according to the wishes of different individuals or groups.

4.1.4.6 New demands on universities in the area of continuing education

Progress thus makes new demands on universities as providers of continuing education. They must master a new production technology. We did not observe any examples of universities outsourcing course production to separate production companies. This indicates that the universities wish, at least in the initial stage, to create their own production capacity (section 4.1.4.4 Ann Drazen; MIT´s Sloan School). Furthermore, the new technology makes it necessary to teach teachers to use new media and to deliver education modules that can be tailor-made to the individual and work asynchronously. All universities we visited had ongoing experimental programs both in the areas of production and of education for teachers. In several cases, these activities were based on the "enthusiast principle", i.e. it was up to the individual teacher to start/participate in an IT-based continuing education program. At Rensselaer a continuing education unit, established many years ago in combination with a clear

vision of becoming the world leader in the area of IT in education, was the foundation of Rensselaer's endeavors to develop multimedia solutions to industry's need for continuing education.

4.1.4.7 Alliances and partnerships

As a consequence of the extensive selection of education alternatives that will be available to individuals and businesses, a demand for "intermediaries/education brokers" will arise. The universities may develop a similar need for aid in making potential customers aware of what they offer. Different types of alliances and partnerships are one way to share marketing and sales resources.

4.1.5 Infrastructure

4.1.5.1 Computer networks

When we regard Educational Technology from an IT perspective, there is no doubt that a functioning infrastructure is essential. This includes computer networks with servers and workstations, standards for distribution, production and demonstration of multimedia as well as classrooms equipped for IT-supported teaching. Internet dominance means that the local university networks support the physical standard and the protocol (rules or standards controlling the way in which computers communicate) used in that environment, i.e. TCP/IP. We are under the impression that different UNIX dialects are the dominant operating system for the network servers. UNIX workstations are very common as are Apple computers of which there is a long-standing tradition in the American university system. The increasingly powerful Wintel platform is, however, gaining ground both from the UNIX and Apple platforms; the system usually chosen is Windows NT.

In the USA it is relatively common for universities to have their own dormitories on or in the immediate vicinity of the campus. This geographical proximity makes it possible to equip dormitories with computer networks to a much greater extent than that to which we are accustomed.

An interesting observation at MIT is that Athena, the system established 15 years ago in order to provide the university with the necessary IT resources for education and, at the same time, continue to develop the technology, is still the framework of computer networks, servers and workstations.

4.1.5.2 Classrooms

The very short visits we were able to make to the classrooms showed that computers have not been integrated into them to any great extent. There were, however, several interesting attempts to construct classrooms with more qualified IT support, such as Classroom2000 at Georgia Tech, the Studio at Rensselaer Institute of Technology and The Design Studio of the Future at MIT. These classrooms represented standard technology, however, what struck us was the successful integration of traditional teaching methods and IT. Classroom2000 consists of a large back projection screen connected to a computer also with Internet connection. Information is stored in a web server, using the usual protocols and formats for systems of this kind. The screen can be drawn on, using an IR pen. Software had been created, with the help of which writing or drawing was copied into the picture or text being shown. Html or Power Point documents were primarily used and they were

shown using a browser which served as an interface for the system. The equipment was developed for use during lectures. With the help of a video camera, lectures could be taped and the digital video sequences stored on a web server.

Students can visit the web site before lectures in order to prepare or after lectures in order to repeat or work on things they do not understand. They can also participate in the lecture via the computer network, but then it is impossible to communicate with the lecturer in real-time.
Because of its simple, html-based construction, Classroom2000 provides the lecturer, via the Web interface, with Internet information in its entirety directly in the classroom. It also means that he/she has access to a cheap and simple platform for the lecture material he/she wishes to produce on his/her own. The system is created to serve as a tool for lectures, but we believe that the simplicity of the structure, so attractive in our view, can be used in many more areas, of which the possibility of asynchronous studies is very interesting.

At Rensselaer, Studios had been constructed, i.e. integrated environments in which both computer support and traditional educational materials were used. The premises were designed so that the students faced away from the computers when listening to the lecturer. There was also space to set up traditional measuring instruments, for instance, which could be used parallel to computer-based measuring systems in measurement technique courses.
The computer equipment could handle all types of multimedia data. We were attracted by this concept, which had resulted in the development of a previously individual-oriented pedagogy into an alternative characterized by “collaborative learning”.

The Design Studio of the Future is a project started by Professor William J Mitchell after he was recruited as Dean of the School of Architecture at MIT. As in the above-mentioned cases, the concept is not technically advanced; it is the fact that computers have been placed in the School’s design studios rather than in a separate computer lab that is a novelty. Different systems-UNIX, Mac, PC- and software are used, depending on the assignments at hand, e g construction estimates, sun studies, modeling, drawing production, visualization. It is also important to point out that traditional media such as paper, pens, cardboard and clay have not been discarded. This in turn provides the student with opportunities to go farther in his/her work since he/she becomes familiar with a broader selection of design media.

4.1.5.3 Systems

The World Wide Web has established itself as the dominant systems solution for communication of information over the Internet and Intranet. WWW also plays this role in the systems we have studied. There simply was no other solution that could compete when it came to the problem of distributing information over computer networks and the formats used for storing data.

We have, however, observed that the systems used, as it were, behind the web technology, tend to vary. We found a very interesting such system at Motorola University. A solution has been developed in which the educational material is stored in an object-oriented database. Each such object or section of the course corresponds to about 2 days of studying. As the system currently work the student is guided by an assistant in putting a suitable course together. A selection is made from the assortment offered by the database, according to the new tasks with which the individual is

confronted in his/her profession as well as his/her current level of knowledge. In the future, this process will be automated by storing previous selections in the database, to be used when analyzing the individual needs and resources for continuing studies.
When this process has been completed the student can begin his/her studies, using the browser to interface the individually adapted, distributed course which can be provided asynchronously and thus be coordinated with work at the company.

4.1.5.4 New media

At several of the universities we visited, work was being done with digital video on computer networks in various teaching situations. The most advanced experiments are being conducted at MIT where a video streamer has been installed, from which digital video is distributed over networks where IP is run over ATM. In other environments, such as Georgia Tech (Classroom2000), digital video distributed from a Web server was used. Other areas of use for video over computer networks include video conferences, but the examples we observed mainly involved analogue video over traditional video networks. It is also obvious that the computer types and protocols used must be adapted to the different situations that arise if communication is limited to the university computer network. This also applies if there is a need to make communication by telephone possible with places not directly connected to the campus computer network, which can be relevant when students need to access information from their dormitories as well as in connection with distance education programs provided to companies.

4.1.5.5 Operations and maintenance

We had a very interesting conversation with the Vice President for IT Resources at MIT. He has served in this capacity since Athena was established and is currently responsible for all IT, i.e. computer networks, servers, administrative systems, telephone switchboards, etc. Operations staff consists of some 150 individuals, and a “core group”, consisting of a few people, runs computer network operations. Retaining this staff whose level of competence is very high is, of course, a problem; each one is a prominent expert in a different area of computer communications. The Vice President has a pragmatic attitude regarding this and encourages his staff to participate in conferences at which they may contribute their competence in order to benefit both the individuals themselves and MIT.

Today, the network at MIT is a double FDDI ring connecting all buildings. There are plans to expand the system so that each building is served by an FDDI ring and work is in progress to make every outlet able to handle 100 mbps. There are approximately 18 000 network outlets. MIT continues its tradition of being involved in development projects in cooperation with industry, which makes one of the best technical levels in the world for the necessary computer communication possible, as well as contributing to the development of basic technology.
At present, MIT has initiated a comprehensive renewal of the administrative systems. $57 million have been earmarked for purchase and implementation of the SAP system. This is expected to reduce paper handling to a minimum. There is a clearly expressed goal of being able to justify this investment by the resulting liberation of research and teaching resources.

4.2 Future perspective for Chalmers

4.2.1 Strategic support for implementation

During the last years, the need to invest in IT for basic education, research and research education has become apparent at Chalmers. This will require major investments for several years, greatly affecting Chalmers ability to live up to its goals and thus its future as an independent university. These goals must also be accompanied by a strategy clearly indicating which priorities must be made in order for the investments to yield the desired results. The payback comes in the form of more efficient administration in which time is used appropriately and investments in the area of education are profitable because they yield improved learning methods as well as the potential for better teaching and examination methods. Graduates of Chalmers must have extra IT know-how which, together with the necessary development and renewal of our basic subject areas, relevant to the individual, society and industry, lead to the future we wish to create.

During our visit, we could see that there is space, albeit limited, for Chalmers to develop its own profile. When it came to our areas of interest, it was obvious that some universities were very goal-oriented and convincing in their efforts while others projected a much vaguer profile. Developing an integrated learning environment, in which traditional methods - the meeting between teacher and student - cooperate with future-oriented information technology, should be a goal for Chalmers. In order to achieve these goals, Chalmers should work with students and teachers in focus, developing projects which put teaching first, supporting student initiative and involving engineering students and doctoral students in the development of teaching in order to benefit from their experience.

It is becoming increasingly obvious that IT reinforces the need for identity. Aided by IT, information flows all the more rapidly and we communicate to a greater extent with our neighbor in the hall or a colleague or friend on the other side of the planet. This results in a desired or undesired state of openness from which we cannot opt out, regardless of our opinion of it. An identity with communicable visions and goals is thus important in order to be able to define and focus among the plethora of available information, so that results and quality are achieved.

We propose a strategy which makes Chalmers reinforce and develop systems that can support initiatives from students and teachers. We will actively seek out initiatives, e g the teachers attempts to improve learning, develop his/her own IT-based teaching materials, produce his/her own IT-related courses, explore the inherent possibilities and effects of IT in teaching/ learning and evaluate projects. Existing centers and other units such as the center for Pedagogical Development and Medialab should be used to promote this development. One essential component of the strategy is the development of courses for industry. This need is based on the fact that applied technical knowledge is increasingly becoming a perishable item. People who work with technology in society and industry will have a growing need for continuing education as part of a life-long learning process. This education must be provided with qualified IT support in order to be competitive.

4.2.2 Pedagogy for IT

In order to play a leading role in the development of pedagogical IT within the university world, thus making the educational programs offered at Chalmers among the foremost in the world, we must

adopt a fundamental pedagogical philosophy with roots both in our subject areas and in pedagogical research. For the last ten years, Chalmers has had an established phenomenographic approach to pedagogy based on empirical research, a philosophical concept framework for pedagogical projects and a focus on the knowledge development. By the term *"knowledge development"*, we mean the core of a university's main activity. It involves the creation of the new subject knowledge that the students deal with in their own learning (new to them), and with which the teachers/researchers are involved in their research (new to the research community). At this point we would like to define another task for Chalmers, concerning the relationship between the teacher, the student and knowledge. If our pedagogy is to be worthy of the name, and develop satisfactorily, we must ensure that a genuine knowledge development takes place within the area of "Chalmers pedagogy" as well: the teachers learn-study, investigate, explore-about their students learning. This is our pedagogical philosophy and theory and it can promote the knowledge development in the introduction of pedagogical IT. The "Studios" way of thinking at RENSSELAER can be profitable when it comes to the planned rebuilding of classrooms, as well as in minor redecorating projects, in order to encourage teachers to work together with their students more. UMass Lowells's focus on teachers and their projects is similar to Chalmers current RePU (Chalmers Reference Group for Pedagogic Development) venture and can also be used as an excellent instrument for making a philosophy and mutual policy pervade our pedagogical IT endeavor.

4.2.3 Continuing education for industry

The increasing investments in multimedia based courses for continuing education at American universities present Chalmers with a major challenge. If we are to follow their example, we must not only develop our important but limited regional/national continuing education market, but also simultaneously make our university an interesting player on the global market for continuing education. We must also manage to make it more possible to adapt continuing education packages to suit individuals and/or groups of engineers. The only way to accomplish this is probably to rewrite a major part of our course selection utilizing IT and individual solutions. Our ability to accomplish this may be of great importance for the marketing of our competence on the international arena, and thus for the position we can attain in an international ranking of universities of technology.

4.2.4 Infrastructure for cooperation and interaction

It is almost taken for granted that universities today have computer networks integrated with the Internet. The general nature of the computer networks means that they are used for multiple purposes: education, research and administration. One prerequisite for working with qualified IT support in teaching is that the infrastructure should be able to handle all types of data, e g text, sound, pictures and video (multimedia) and accessible to teachers and students in their daily work. We also regard resources for the development and production of IT-based educational materials and appropriately equipped premises as part of the infrastructure.
The technology must offer sufficient bandwidth for the computer network and it must be able to handle real-time data (video and sound). At present, Chalmers has a FDDI backbone with a bandwidth of 100 mbps, from which the network is distributed to each sub-domain with a bandwidth of 34 mbps. The connection points for each individual computer usually have a bandwidth of 10 mbps, although there are some that have 100 mbps. The network is basically constructed to handle non-multimedia although the increasing bandwidth makes it easier to distribute sound, for instance, as

well. The computer network is not, however, suitable for video in its present form. This means that we must prepare for new technology allowing speeds at the gigabyte level.

When it comes to protocols and formats for distributing different types of data used to develop IT-based educational materials, data types related to Web technology are entirely dominant. In our opinion, it is not necessary to explore the issue of appropriate formats any further; instead, Chalmers should focus on formats such as http, html, xml, pdf, jpeg, gif, etc. After this we should create support resources and competence in order to spread knowledge about how these protocols and formats are used to produce educational material which can be distributed, internally and externally, by Web servers. The third component linked to infrastructure is the "digital classroom" in its different forms. We have emphasized that it must be digital in order to serve our future needs. Of course, we can and should make use of the pedagogical experience gained when analogue technology, such as traditional video conference systems, has been used, but the flexibility and diversity inherent in digital technology must be placed in focus.

The digital classrooms we design must combine an environment for meetings between students and teachers as well as between teachers and researchers in different disciplines with the teaching and research IT of tomorrow. Combining space with IT in this way will challenge our usual conceptions of advanced university environments. The size and location of seminar rooms and labs, furnishing, light and sound environment, equipment such as computers, projectors and screens, security issues and accessibility are examples of issues that acquire new meaning.

Management and administration of education is essential for an efficient organization in which it is becoming increasingly important to invest time appropriately. Appropriate IT support relieves pressures and makes things easier for students and staff; thus, new administrative systems for managing students performance as well as finances and staff must be created in order to meet the organizational needs at the department and School level.

A smoothly running library also belongs to the infrastructure. Knowledge breeds the need for more knowledge and, considering developments in the area of IT, it is important that the library resources are made easily available and accessible over the network. The Chalmers Library has been implementing such a strategy for some time and is now prominent in this area. However, we recognize a growing need for different kinds of information which means that library access should be made easier. An infrastructure of networks and servers should be created for greater accessibility.

If students are to graduate from Chalmers with satisfactory ability to use IT professionally, there must also be different tools available on which they can practice, making access to software and hardware necessary, according to the organizations needs. This already exists to some extent at Chalmers Medialab, but there is a major need for workstations with appropriate IT equipment targeted for the students.

4.3 Proposals

After our visit, and based on the strategy discussed above, we should like to see the following elements in Chalmers organization.

4.3.1 Pedagogical development

Pedagogical project
During the spring of 1998, the Center for Pedagogical Development (CPU) and Chalmers Medialab have presented a proposal for a project that might constitute a framework for Chalmers development in the area of learning and IT. The project includes education for teachers and support for their own projects. It consists of two inter-related parts: course activity and project implementation.

Course activity
One part of the course activity is IT-based, according to the model described in section 4.1.3.6. In the beginning, the teachers participate in a Web-based course in which principles and basics are taught and discussion takes the form of the previously described "anchored discussions". Learning is the central concepts in the different IT-related teaching forms. Then a workshop is held at which the teachers can obtain hands-on experience. During these two phases, the teachers design projects for their own situations, in which various aspects of pedagogy and IT are elucidated.

Project implementation
The second part consists of intensive work on participants' own projects, which evolve from the teachers themselves or as a result of department endeavors. These projects will serve as a basis for research in the areas of IT in learning and education at Chalmers, in order to offer more qualified support in the future. Chalmers Medialab and CPU are given the task of supporting the teachers in the implementation of their projects.

The project proposal is created along the same lines as some of the situations and programs we have observed at several of the universities we visited, and promotes a direction of development we feel is important to Chalmers.

4.3.2 Infrastructure for cooperation and interaction

There are already projects in progress at Chalmers that will greatly influence the development of the infrastructure. For example, CHIPS which aims at creating a system enabling students and teachers to use a single set of log-in information regardless of where at Chalmers they need access to computers and other resources. This also includes the professional pool of modems which has been available for a year and the database project which entails the creation at Chalmers of a modern database environment for research, education and administration. A number of student homes in Göteborg will be connected to the Internet within a couple of months.

Video over Chalmers computer network
As part of a development project for Chalmers computer networks, the manner in which the network can be developed so that it may be used for digital video distribution is studied. One suggestion is for a trial installation to take place in which the video streamer at Chalmers Medialab is used for technical and learning experiments, as well as one or more of the IT classrooms we suggest be constructed as soon as possible. A project of this nature is very technology-intensive and should be possible to run in cooperation with companies active in this area.

External teaching environment
Chalmers teaching environment will change radically (see below) and, as part of that change, students and teacher will work at home to a much greater extent than previously. In order to benefit from the resources affiliated to our infrastructure for cooperation and interaction, e.g. information, course material, library, etc, when working off-campus as well, we must expand the present pool of modems, a development which can hopefully occur in collaboration with telecommunications companies.

Distribution protocols and formats for multimedia data
Chalmers should identify appropriate protocols and formats for distribution and production of multimedia for teaching. As part of this process, development in the area of Web-based technology should be closely monitored. The process should be continuous and the results reported on a regular basis to interested groups at Chalmers, in the form of applications demonstrating technology in areas relevant to Chalmers.

4.3.3 Chalmers teaching environment

IT classrooms
In order to use IT simply and effectively in education, it is important that lecture halls be equipped with proper tools such as computers, data/video projectors and network access. An inventory should disclose the present situation in this respect and proposals for solutions (technical, financial and administrative) should be presented. The project should result in a basis for a proposed course of action and different groups which share an interest in this area should participate. The inventory part of the project is already in progress, and will lead to a report with implementation proposals.

Classroom 2003-5
One project is devoted to constructing and evaluating classrooms for future teaching. This project is based on the inquiry into IT classrooms also proposed by us. Concepts such as Classroom2000 are examples but adoption to Chalmers must be made.

Multimedia studio for students
As education and examinations change, higher demands are made on oral and written presentations. A Chalmers graduate should master the use of modern tools for cooperation and communication over networks. Thus, we must also provide the students with these tools and construct a studio for them containing the necessary hardware and software to create multimedia-based presentations of projects, diploma theses, etc. Modern systems for communication by audio, video and collaborative working over networks should also be easily accessible.

4.3.4 Develop learning materials

Lab for developing multimedia for teaching
Chalmers should start a lab which develops multimedia for learning and is a part of the Medialab. It should provide teachers with continuous support in the areas of technology, media and pedagogy. A project with this purpose should be started immediately (a pilot study was carried out this spring).

Virtual Reality applications for teaching in technology and design

Chalmers invests in advanced technology for Virtual Reality at the Medialab. There is great potential in VR in the area of creating material for advanced teaching in technology and design, both when it comes to visualizing and to simulating technological processes and artifacts. VR's greatest advantage is in offering contents not available, perhaps for economic reasons, today, making it unnecessary to replace the teaching materials we have. We should start projects that initiate developments of this kind, in cooperation with pedagogical experts.

4.3.5 Development funds and additional staff

We suggest that a teacher should have the right to the time, money and resources necessary to develop and adapt his/her teaching materials to teaching with qualified IT support. We believe this can be facilitated by access to seed money at the department level. This resource can, for instance, be used to replace teachers temporarily so that they may spend a sabbatical period developing their teaching materials.

4.3.6 System for managing student performance

The IT council has strongly recommended, and many people have requested, that a project be started to investigate the need for a system devoted to administrating student records at Chalmers. The project is to present a report on the current situation, describe the actual need and explore future needs, as well as make recommendations for future activities. The result is to be used, among other things, to determine if a supplementary system should be created for internal use and to make requests to the "Ladok consortium" as well as make demands on the next Ladok generation (Chalmers new administrative system).

4.3.7 Studio

In order to make it possible for a new type of qualified education with powerful connections between education, research and development to emerge, Chalmers needs to establish three Studios in various areas, located in different departments. These attempts are part of a strategic development at Chalmers in the area of design as.

4.3.8 Organization for the creation of multimedia-based courses for industry

Within the framework of its "strategy project", the School of Electrical and Computer Engineering has started a pilot organization assigned to establish a program devoted to multimedia-based courses for industry. The pilot project ran from June, 1997 to June 1998 and resulted in two four-credit multimedia-based courses, one in *signal processing* and one in *control engineering*. Interest in this endeavor is considerable on the part of industry, and pilot courses have been held and evaluated in cooperation with Volvo Truck Corporation and Ericsson Microwave Systems.

This program should be extended, expanded and eventually made permanent. It is essential to create an organization that can handle all aspects of market-adapted course production for industry, including competence in programming, multimedia solutions, graphic design, marketing/sales, realization/delivery of courses and the ability to create international partnerships/alliances for marketing and sales purposes.

Addendum 1

Groups for US study tour - March 25 - April 5 1998 980317

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Professor Anders Sjoberg, President
Professor Hans Bjur, Dean of the School of Architecture
Professor Olof Engstrom, Dean of the School of Electrical and Computer Engineering
Associate Professor Per-Eric Thornstrom, Head of Adm., School of Chemical Engineering
Professor Hans Bjornsson, Dean of the School of Technology Management and Economics

Group 2 - Focusing and collaboration in research and research education

Professor Ann-Sofie Sandberg, Vice dean, doctoral educ., School of Chemical Engineering

Gunnar Jonnergard, Human Resources and Leadership Development
Associate Professor Knut Stromberg, Vice dean, doctoral education, School of Architecture
Professor Holger Broman, Vice dean, doctoral educ., School of Electrical and Computer Engineering
Associate Professor Mats Johansson, Transportation and Logistics, School of Technology Management and Economics
Asa Enarsson, Chairman of the PhD students' union, PhD student at Dept. of Nuclear Chemistry

Group 3 - External and internal relations

Professor Thomas Hjertberg, Dean of the School of Chemical Engineering

Kristina Kvarnevi, Director of Personnel
Professor Kjell Jeppson, Vice dean, undergraduate educ., Electrical Engineering, School of Electrical and Computer Engineering
Professor Bertil Svensson, Vice dean, undergraduate educ., Computer Science and Engineering, School of Electrical and Computer Engineering
Assistant Professor, Mats Lundqvist, Innovation Engineering and Management, Head of Entrepreneurship School, School of Technology Management and Economics

Group 4 - IT in undergraduate and continued education

Professor Susan Jagner, Vice President, Undergraduate Education

Dr. Shirley Booth, Pedagogic Development
Associate Professor Hans Lindgren, Head of information technology, School of Architecture
Birthe Carlsson, Continued education, School of Electrical and Computer Engineering
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US study tour March 25 - April 5 1998

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Addendum 2

January 10, 1998

Chalmers University of Technology Study Tour to the US in 1998

Background

Chalmers University of Technology located in Göteborg, Sweden, is divided into the schools of; architecture, chemical engineering, civil engineering, electrical and computer engineering, environmental sciences, mathematical and computing sciences, mechanical and vehicular engineering, physics and engineering physics, and technology management and economics. There are 2.500 employees (staff and doctoral students) and 6.500 students in master's programs. In addition the university offers continued education for industry, research and Ph.D. programs within all schools.

Purpose

Chalmers recently became a private (owned by a foundation) university and as part of developing a new strategy, a study tour to the US has been planned for March 25 to
April 5, 1998. The purpose of the study tour is to learn from excellent US organizations in order to adapt and introduce good ideas and practices at Chalmers.

This study tour includes visits to leading US universities and research organizations and is headed by the president of Chalmers, Professor Anders Sjöberg. In addition, the group includes representatives from the presidents staff and representatives, including the deans, from four of the schools; architecture, chemistry, electrical and computer engineering, and technology management and economics.

The participants of the study tour have been divided into four study groups with responsibilities for different areas: strategy development and leadership, cooperation and focusing of research and Ph.D. education, external and internal relations, and IT in Education. A list of participants from Chalmers, divided into the four study groups, is attached.

The aim of the study visits is that each study group will have the opportunity to discuss their area of responsibility with peers and others concerned (e.g. students or staff) at the universities visited. The main questions for each group are presented below. In addition, in order to clarify each study groups interest, a list of more detailed questions has been attached for each area.

Main questions of study groups:

1. Strategy Development and Leadership

- How are strategies developed and implemented at your university?
- How are leaders elected and how are they developed?
- Is your university a learning organization - are there processes in place for learning and sharing of good practices?

2. Cooperation and Focusing of Research and Ph.D. Education,

- What is your approach to the development of research areas with a high potential? (including focusing and closure of existing research areas)
- How do you foster, within your university, a climate of academic cooperation rather than academic competition?

3. External and Internal Relations

- What is the role of external stakeholders in the development and life of the university? How does your university communicate, market and cooperate with external stakeholders?
- What is the present, or near future role, of inter-disciplinary/-departmental/-school cooperation and how do you manage and develop this kind of cooperation?

4. Information Technology in Education

- How is IT used and what are your experiences from the use of IT in undergraduate and continued education

Specific questions for each study group:

1. Strategy Development and Leadership

The role of the university in society

- What do you want to accomplish as a university?
- What have you accomplished and how do you measure the accomplishment?
- What are the most important trends influencing the role of the university?

What processes exist for the development and implementation of development strategies for the university?

- What approach have you used for strategy development?
- How do you create new directions and abandon old areas of research/education?
- How is the strategy anchored and implemented within the university?

Leadership

- How are leaders elected or selected?
- How are leaders developed?
- What kind of motivational system exists?

Organization and management

- How is your university organized and managed?
- How are decisions made?
- What kind of evaluation/measurement system exist for follow-up of activities and processes?

Cross-functional processes

- Are there processes that cut across the university and how are these managed? (e.g. educational or research-processes)
- If these cross-functional processes are managed, what are your experiences of this form of management and what results has it provided?

Is the university a learning organization?

- Is there room for reflection and learning in daily work? What is done to accomplish learning on different levels of organization? (e.g. individual, groups, departments, schools, university)
- Are there processes in place for sharing of good and bad experiences, and of good practices?

Change of direction?

- To what extent and how has the strategic direction of the university changed over the last 5 years?
- What factors account for the shift of strategies and direction?
- What trends do you see that could influence your university's direction in the future?

2. Cooperation and Focusing of Research and Ph.D. Education,

How to prioritize?

- How are research areas prioritized - i.e. what are the processes and criteria for selection of research areas to develop? How are decisions made, and by whom?
- How are new research areas initiated? Who initiates?
- How is the issue of closing of research areas dealt with?
- What are the most important factors influencing the choice of what to go for and what to close?
    - Competent individuals (present or potential to recruit)
    - The ability of research groups to obtain external funding
    - The needs of industry/society at large, or the internal priorities of the university

How is research cooperation initiated?

- How and by whom is research cooperation initiated?
- According to your experience, is it possible to organize for cooperation? (through economic incentives, creation of meeting places, etc.)
- To what extent is it possible to influence attitudes - and through what means? (e.g. to break down barriers between individuals, disciplines, departments, schools, etc.)

Ph.D. education

- What are the goals of your Ph.D. education and how do you measure the fulfillment of your goals?
- How is your Ph.D. education organized?
- Have you developed or introduced any new innovative ways for your Ph.D. education?
- What is the relative importance of the Ph.D. education? (in relation to undergraduate and Master's programs, research, etc.)

Leadership

The questions regarding focusing of research are closely related to questions concerning leadership.

- How do you encourage leaders on various levels in your university to bring about a creative academic atmosphere where competitiveness is kept constructive?

3. External and Internal Relations

External relations

What is to role of external stakeholders in the development and life of the university?

- What is the role of external stakeholders such as: industry, society (local community and state government), suppliers, parents, funding agencies, etc. ?
- What is the role of the Alumni in the development and funding of the university? How are the Alumni relations organized and managed?

How does your university market its offerings and communicate with external stakeholders?

- How are information and marketing activities organized?
- Are professional marketing/information agencies/consultants used? If so, how are they used?
- Are professors/teachers being trained in marketing of the university and if so, how?
- What is the role of Alumni in marketing?
- Does your university conduct market analyses? If so, how and what categories are surveyed? (students, industry, etc.)
- To what extent are market analyses influencing the profile of the university being communicated?
- How and by whom is this "marketing profile" of the university developed?

Cooperation with industry

- Do you use different approaches in the cooperation with large companies as compared to small and medium sized firms?
- To what extent is your university involved in offering continued education and specifically designed programs for industry? How is this being organized?

Internal relations

What is the present, or near future role, of inter-disciplinary/-departmental/-school cooperation?

- In what fields does this kind of cooperation occur: research, education, etc.?
- How do you manage and develop this kind of cooperation?
- How are issues concerning shared resources, decision-making and ownership handled in such cross-cooperations?

What is the role of the student?

- Is the student seen as raw material, product, customer or partner in the educational process?

4. Information Technology in Education

- What are/were the driving forces to implement IT in education at your organization?

Undergraduate education

- How is IT used in undergraduate education?
- What were your expectations and what have your experiences been? (good and bad!)
- What would you say IT has added to the value of your educational programs?
- What, if any, effects have the opportunities offered by IT had on the curriculum?
- Has IT lead to greater collaboration between the schools of the university in the form of new or changed programs?

Continuing education

- In what ways, if any, is IT used in continuing education?
- What have your experiences been? (good and bad)
- What would you say IT has added to the value of your continuing education?
- What are the main differences, if any, as compared to the use in undergraduate education?
- What is your experience in establishing good contact with the students when IT has been used as the primary teaching media?
- What context has been created to ensure collaboration between the students, their workplaces and the campus?

Research into IT and education

- What, if any, research is carried out here on the use of IT in education?
- What are the topics of the research?
- How is such research organized within the research structure of the university?

Implementation and evaluation of IT

- In what ways, if any, have the staff been educated in the use of IT?
- Have the pupils been given any special education for using IT?
- What would you say the major investments have been? (hardware, software, infra-structure, staff, etc.)
- Have any special investments been made for your students (computers, intra-net, etc.)
- What evaluations on the effect of IT in education have been undertaken? With what results?
- Have you started new centers especially for multimedia, instructional technologies or learning centers?

IT organization and infrastructure

- In what way is your organization structured and what are your experiences with this form of organization?
- What are the profiles of the people in management?
- Do you participate in exchanges or collaborations with other universities (or other organizations) to alleviate the costs of producing media-based educational material? With what experiences?

Visions for the Future

- In what way are you predicting change in IT and the use of IT in education?
- In what ways are you preparing for such change?