FACULTY PROFESSIONAL COMPETENCE DEVELOPMENT PROGRAMS – COMPARING APPROACHES FROM THREE UNIVERSITIES

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Abstract
This paper describes faculty professional competence development programs at Chalmers University of Technology, the Technical University of Denmark, and Linköping University. Examples of professional competences include project management, communication, teamwork and organizational change management. The description of the programs is complemented by interviews with faculty aiming at clarifying the needs for and experiences from faculty professional competences development programs.

Keywords: Faculty professional competence development, CDIO Standard # 9

Introduction

Engineering faculty are typically hired and promoted on the basis of their disciplinary knowledge and achievements in terms of impact and quantity of scientific publications and generated research income. Long-term sustained focus on a narrowly delimited research problem is a prerequisite for being successful with respect to these criteria.

However, there are many situations where faculty members are also required to exercise professional skills similar to those of an engineer in the field. Examples include:

- Teaching situations such as project-based courses, where the faculty needs to be able to teach students how to plan, conduct and evaluate a project. Also faculty often needs to coach and guide students on aspect of professional personal behavior concerning team working, collaboration and communication.
- Leading large, multidisciplinary research projects, which require professional project management skills for coordination. In addition, funding agencies are increasing demands on accounting. This requires that faculty can plan and execute large projects, as well as act as participants in multidisciplinary, international teams.
- Acquiring funding for and setting up research projects in collaboration with industry, which requires that faculty understand the industrial context of their work, and that they are able to communicate effectively with industrialists.

- Participating in and driving university change efforts. Historically, universities have been very stable institutions. Today's universities, however, need to be able to perform efficient change processes driven by external factors such as the Bologna process or requirements on more business-like management processes. This requires skills in organizational change management.
- Contributing to university strategic goals such as "create a sustainable society" or to be "the entrepreneurial university". Faculty members are in their research and teaching expected to contribute to this kind of goals. This requires the ability to link one's own research and teaching to long-term societal goals.
- Managing day-to-day business in a university department, division or group. This requires operational management skills, including budgeting, communication, and conflict resolution etc skills.

In conclusion, current faculty members need professional skills such as project management, teamwork, (intercultural) communication, as well as an understanding of the industrial and societal context of their work. In agreement with this conclusion, CDIO standard #9 [1] suggests that actions that enhance faculty competence in person and interpersonal skills, and product, process and system building skills are essential for implementing a CDIO-based education.

Traditionally, faculty members have needed to develop these skills by themselves by on-the-job learning. At best, this is a time-consuming task for the individual. Meanwhile, the university, its students and the faculty members themselves suffer. Available data suggests that few schools rate high with respect to faculty professional skills. For example, the average self-evaluation rating across Chalmers 12 MScEng (Swedish: "Civilingenjör") programs in the national evaluation of engineering degree programs with respect to standard #9 was 2.0 out of 4, implying a prototype state of implementation with respect to this standard [2]. In a 2005 comparison of CDIO schools, the average was 2.2 out of 4 [3]. However, increasingly universities are recognizing the value of directed faculty development programs addressing the needs for these skills.

In this paper, we describe and compare efforts of this kind at three universities: Chalmers University of Technology, Sweden, the Technical University of Denmark (DTU), Denmark, and Linköping University (LiU), Sweden. The efforts are analyzed with respect to stated motives and goals, how they address the situations mentioned above, and how they have been experienced by the participants. Analysis of documentation of the programs is complemented by interviews with participating faculty. The result of this paper is a survey of existing practices and the identification of experienced needs and motives for development of faculty professional skills. The emphasis is placed on the data from the faculty interviews, the program descriptions provide a context for interpreting their responses.

The remainder of this paper is structured as follows: we first account for research methodology applied in this study. In the findings section, we describe in some detail the faculty professional competence development programs at Chalmers, DTU, and Linköping University, make comparisons, and account for the participants' view of the utility of the programs, in particular in view of the above identified critical situations. Finally, we list conclusions and recommendations for future work.

Research Approach
This research can be categorized as a pre-study. We are first aiming to describe competence development programs at a few selected universities, including both the pedagogical and management components. Brief accounts are given and compared. We are further aiming to analyze faculty members' perceptions of needs for professional competences, their own skills and needs for future education. The data for the latter analysis was mainly collected through interviews. Ten interviews took place. Eight interviews were with faculty members, mostly young faculty members, hypothesizing that these would be "lead users", who could articulate their needs. Each interview lasted about one hour. A standardized interview guide was used for the interviews with the faculty members, outlined in Figure 1. Three of the faculty interviewees were from Chalmers, two from DTU, and three from LiU. Two interviews were carried out with staff responsible for professional competences development programs, targeted at academics and industrialists. Both of these interviewees were from Chalmers.

Interview guide for mapping of faculty members experienced needs for professional skills

Background questions
      Age and sex of interviewee
      Discipline
      Career path including current position

Questions requesting freely worded responses on professional skills
      What needs for professional competence do you have in your work?
      Can you identify any particular situation where you have felt constrained by your lack of a certain professional competence?
      How would you assess your level of skills as regards professional competences in comparison with faculty and industrialists of the same age?
      What organized professional competence education have you participated in? What were your motives for undertaking this education?
      How did you experience the organized education? Can you identify any particular improvement of your skills that was an identifiable outcome from the education?
      Which professional competences do you feel that you need to develop further? How can the university support this?
      Will professional competences become more or less important for future faculty member? Why?
      Will any particular professional competence stand out as more important?

Questions related to the critical situations and associated skills
      How important is the skill for you personally?
            <10-level scale from not important at all – very important>
      What is your self-assessment of your ability with respect to the skill in question?
            <10-level scale from no ability at all – very strong ability>
      What organized education addressing the skill have you participated in?
      What improvement of your abilities did the organized education result in?
            <10-level scale from no improvement at all – very strong improvement>

Figure 1. Structure of interview guide.

Findings
In this section, we will outline the findings of the study. We will first give an account of the faculty competence development programs at Chalmers, DTU, and LiU, providing a view of what is available to faculty who wish to develop their professional competences. We then discuss the findings from the interviews.

Faculty Professional Competence Development at Chalmers University of Technology
Faculty competence development programs at Chalmers are run by the Centre for Communication and Knowledge Building in Higher Education (CKK) and by the Human Resource division (part of the administration). CKK [4] is responsible for pedagogy courses, although some of its courses include professional competence elements such as communication and ethics. The HR division offers management courses. In addition, various departments may organize specific training course, for example in group dynamics. Table 1 provides an overview of the course programs at Chalmers, DTU and LiU.

The pedagogy courses offered by CKK are open to the entire academic staff, including doctoral students. However, the typical course participant is a young faculty member, an assistant professor who needs to complete a "Diploma of Higher Education" in order to meet the qualifications as "docent", a requirement for gaining tenure. Each course corresponds to a workload of 120 or 240 hours. In order to gain this diploma they need to complete about 400 hours of pedagogy courses, selected from the list in Table 1. Two of the courses are "recommended", while the others allow some specialization according to individual interest.

The management courses offered by the HR division aim to develop skills in project management, operational management skills and coaching, see Table 1. The *Project Management for Academics* course provides an introduction to basic project concepts, and discusses management issues, group dynamics, intellectual properties and so on. *The Difficult Conversation* course is aimed at academic manager with personnel responsibility, preparing for situations where the manager needs to have a sensitive conversation with a staff member, perhaps concerning a threatening termination of employment. The *Young Research Leaders' Program* is a management training program aimed at selected young faculty members. The program aims to develop coaching skills, train skills in leading teams and networks, and to gain familiarity with the central management processes in a academic environment. The program has evolved during the last decade, gradually putting more emphasis on coaching, network-building and organizational change management, recognizing that these are the skills that the participants have valued highest in earlier courses. These courses are somewhat smaller than the pedagogy courses, ranging from 80 to 160 hours workload.

In addition, training in professional competences may be arranged by department or education programs. For example, the Mechanical engineering program has run a 20-hour course in group dynamics for faculty who teach project-based courses in the program.

Faculty Professional Competences Development at the Technical University of Denmark (DTU)
Similar to Chalmers the structure of the program for developing and maintaining professional competences of faculty members at DTU is divided into two parts. All pedagogical issues are

covered by Learning Lab DTU [5], which is an independent department that reports directly to the Dean of Studies. Managerial, personal development and leadership issues are covered by the human resource division, which is part of the university administration. Table 1 provides an overview of the course program at DTU.

Learning Lab DTU is responsible for a range of courses aimed at different levels of competence. Two courses are compulsory for all young educators. *Learning and Teaching* is a course that is also open for Ph.D. students and deals with development, planning and dissemination of teaching sessions with the focus on student learning. *Didactics and Methodics* constitutes the core of the pedagogical training of young faculty members at DTU. After taking the course participants are able to i) identify central elements of a course and put this into learning objectives, ii) assess student preparatory knowledge and student benefit of the teaching, iii) plan course sequences and evaluation, which supports the learning objectives and finally iv) use feedback techniques as a tool in teaching and learning. This course is divided into 3-4 modules, which young faculty members must complete during the first three years of employment. The workload of *Learning and Teaching* and *Didactics and Methodics* are 50 and 200 hours, respectively.

For more senior faculty members Learning Lab DTU offers a course aimed at improving the standards for advising Ph.D. students. This course deals with aspects of structuring advising, creating a positive and constructive environment, handling of personal and human aspects of advising – including motivation, constructive feedback and crisis management. All new faculty members are appointed a supervisor when they start their employment. This is an experienced faculty member, who knows "all the corners". Learning Lab DTU also offers a course to enhance and improve the quality of the guidance from these supervisors.

Apart from a short introductory course none of the management courses offered by the HR division are compulsory. The workload of the courses are typically in the range of 7-14 hours. The courses are for all – both employees and leaders/managers at DTU. Personal competence development is a declared focus area at DTU. Next to this a secondary aim of this program is to facilitate networking between participants across campus. A large part of the program is devoted to topics related to management and financing of research projects, which is of central interest to DTU. All employees have an annual "employee development assessment meeting", where employee and head of department or section discuss individual needs and requests for participation in the HR program.

Faculty Professional Competence Development at Linköping University
The faculty professional competence development at Linköping University is in mainly managed by the unit CUL (Center for Teaching and Learning) [6]. This unit serves all parts of the university, which means the Faculty of Arts and Sciences, the Faculty of Health Sciences, and the Faculty of Science and Engineering. The unit offers a variety of courses covering various aspects of teaching and learning. The purpose of the courses is to gradually develop the skills of the faculty members as more and more experience from teaching and learning is obtained, and the backbone of the course program is a sequence of courses offered for teachers at different levels of experience. In addition to the competence development offered by CUL the university organizes competence development and training for faculty members in their roles as e.g. head of department.

The first course, *Step 1: Teaching, learning and knowledge*, in the sequence is meant for teachers who are about to start teaching or have rather limited teaching experience. A substantial part of the participants are PhD students, who, as a part of their PhD students, are expected to take part in teaching. The course involves topics such as planning, execution and evaluation of various types of learning situations, and the activities in the course are closely connected to the current teaching activities of the participants.

The second course, *Step 2: Design, Assessment* and *Organization,* in the sequence addresses the situation when a faculty member becomes examiner for a course and treats various aspects of this. Important topics in this course are e.g. formulation of expected learning outcomes, course planning, assessment, etc. It also covers theoretical aspects of knowledge and learning.

In the third step of the sequence two courses with different background and aims are offered, and the course denoted *Step 3a: Supervision of Research*, is designed for faculty members that in the process of becoming supervisors for PhD students. The course *Step 3b: Pedagogical Leadership* is meant for faculty members that have management roles concerning the pedagogical leadership, e.g. as director of studies at a department. The course contents involve topics like e.g. management of change processes, support and guidance for faculty members. One part of the examination of the course is that the participants are expected to write a short essay where the person's own situation in the pedagogical leadership is analyzed and discussed.

In addition to these more general courses around teaching and learning at university level CUL offers courses that are related to particular pedagogical ideas and methods. One example of this is courses in Problem Based Learning (PBL) which is used throughout all education at the Faculty of Health Sciences, but also within the engineering program Information Technology within the Faculty of Science and Engineering. Another example is a course in the project model LIPS, which has been introduced in a number of courses as a result of the participation in the CDIO Initiative. This course treats several aspects of the use of projects as learning activity. Examples of aspects are the definition of a project, how to form projects a group with well defined roles, group contracts, the phases of a projects, the importance of milestones, e t c. As an integrated part of the course the participants are expected to, based on a thought project in his/her own course, formulate examples of the first documents that are required in a project, which means the project directive, requirement specification and project plan. A third example a more general course offered by CUL is courses in tools and methods for distance learning. The workload of the courses ranges from 40 to 160 hours.

Comparison
From the data summarized in Table 1, it is apparent that there are strong similarities in how pedagogy courses are run at the analyzed universities. Pedagogy courses are taught by dedicated units who offer a variety of courses. They are offered to all faculty members and are part of the requirements for promotion.

Management courses, on the other hand, are typically run by the Human Resources departments. DTU offers a comprehensive package, whilst Chalmers and LiU lack a structured offering of connected courses.

Table 1: Comparison between faculty course offerings at Chalmers, DTU, and LiU.

	Chalmers	**DTU**	**LiU**
Pedagogy courses	Teaching, learning and evaluation Pedagogical project Philosophies of learning Supervision of research Learning in digital media Theory and practice of science Popular science communication Ethics, science and society	Learning and teaching Didactics and methodics Supervison of Ph.D. students Supervision of assistant professors Rules and standards for courses and exams Team work in teaching – why, what and how	Step 1: Teaching, learning and knowledge Step 2: Design, assessment and organization Step 3a: Supervision of research Step 3b: Pedagogical leadership Introduction to PBL Supervision in PBL Project management using the LIPS model Thesis supervision on bachelor and master level
Management courses	Project management for academics The difficult conversation Young research leaders' program Group dynamics	*Leadership related courses:* From researcher to manager LEAN inside research based organizations The many roles of leadership Conflict resolution and negotiation Coaching Pre-manager program – desire to lead *Human resource tools:* Prevention of stress Prepared for changes Job announcement Job interview – the moment of truth *Project management and financing:* Project management program The optimal research council application *Personal development:* Effective communication Self management Personality test Voice training	Management

These schools do not yet see pedagogical and professional competence development as a whole. The competences are addressed by different organizational units, there is no unified view, and there are overlaps. It should be pointed out that the differences between DTU and Chalmers/LiU are exaggerated in the table. The management courses at DTU are subdived into smaller modules (7-14 hours) whereas some of the Chalmers management courses are 80 hour programs. Given that the management courses at Chalmers and LiU are somewhat scattered, it is difficult to assess their coverage of the critical situations discussed in the introduction and in Table 2. We also observe that some professional skills are addressed in pedagogy courses, eg generic communication skills and ethics. However, it appears that especially leading large projects, acquiring funding and communicating with industry are poorly addressed at Chalmers and LiU.

A notable aspect of LiU:s Step courses is that they are clearly linked to particular roles: examiner, director of studies, PhD student supervisor etc. This setup acknowledges the differences in these roles and provides an opportunity to insert training in role-specific skills in the proper context and towards a coherent target group of participants. For example,

organizational change management in the context of program-level pedagogical development is addressed in the Step 3b course.

The interviewed staff who lead professional competence development programs emphasized the need to tailor management and leadership training to the academic context. The setup of professional competence development programs targeted at industrialists may therefore not be suitable for academic leadership programs. Their experiences are that the differences between academic and industrial leaders and leadership are too large: The target group for industrial programs is managers who already know how to run a large organization, and the focus of the course is typically to reflect on the experiences with peers from other companies. Faculty members generally lack the practical advance-level management experience needed to contribute to the discussion in such a group. In contrast, the target group for university programs are leaders who are about to lead or have recently been appointed to a management position. For them, practical training in certain new tasks, eg coaching or conflict resolution is essential. Thus, adaptation to the academic context is essential. The need for adaptation of leadership training to the academic context is clearly visible in the evolution of Chalmers Young Research Leaders' Program. Over time the course has put less emphasis of strategic planning tools ("Academics don't need to be taught tools like SWOT analysis, they can easily learn it by themselves"), but more emphasis on coaching and change processes in the academic environment. However, there is an opportunity for universities to explore the competence in management education that they already possess within their organization, given the proper adaptation.

The management courses at Chalmers and LiU are generally offered to a select groups: division/department heads, "future research leaders" etc. This seems to imply a somewhat hierarchic view of academic leadership, similar to that in industry but with the addition of the notion of "excellent individuals". However, this does not take into account that many academics have a working situation similar to that of a small-business owner: they generate their own research income, hire their own PhD students, have their own industrial "customers", and can act very independently. Few academics can avoid a working situation where they act as salespeople, managers, researchers, teachers more or less continually, and even fewer can expect some other faculty member to find funding for their research. This is different from the industrial situation, where specialization is more evident. The point we wish to make is that there are many more "managers" in academia than is seen in the organizational charts. Selective professional competence development programs in academia such as those at Chalmers and LiU therefore run the risk of not reaching out to all faculty members that would benefit from the training. By contrast, DTU has a more broad-based approach which aims to develop the professional competence of all faculty members.

Faculty views on needs, importance, and abilities regarding professional competences
Let us now turn our attention to the views of faculty members on needs, importance and abilities regarding professional competences. The results from the quasi-quantitative questions related to the critical situations and associated skills are summarized in Table 2. The table lists the critical situations and associated skills, the faculty members' assessment of the importance of the particular situation and their ability in it, along with a note on how many have taken part in some organized education addressing the skill.

In this explorative study with a limited number of interviewees, the primary ambition of quantifying the data is not to support statistically valid inferences, but rather to identify major trends and differences in opinions, and to support the visualization of essentially qualitative data.

We observe in Table 2 that all situations are given a high average importance rating. Teaching project-based courses and understanding the industrial context of their work are identified as the most important skills. Planning and leading multidisciplinary projects and linking their research to societal goals are identified as the least important. This difference may partially be explained by that all interviewees were junior faculty (35-42 years), who have not yet reached senior academic leadership positions.

We also notice that the interviewed faculty members are relatively confident with their ability in these skills, the average being 6.9 on a ten-level scale. The interviewees rank their abilities as good as or better than their academic peers. Planning and leading large projects is the skill for which the interviewees rate their abilities as poorest.

Areas where the interviewees estimate that practitioners have superior skills include planning and execution of large projects, and communication in the sense of selling a message. Several interviewees stress the importance of being able to sell your ideas to industry. However, few have had any training in "sales" communication, although some state that they have had industrial experience that helped them. Pedagogical courses which train communication are identified as helpful but do not provide the entire answer, it also has to do with being able to connect your research to the industry needs, language and pre-requisites.

Many interviewees mention the tutoring/conflict resolution situation as one where they have felt constrained by lacking professional skills. This is reflected in the evolution of Chalmers Young research leaders' program, which initially emphasized tools for strategic planning, but has gradually become more oriented towards mentoring and coaching.

The organized education undergone by the interviewees is generally well appreciated. This observation applies to both pedagogy and management courses. For the pedagogy courses, the interviewees can pinpoint particular capabilities gained (eg "write good learning outcomes and map them to the teaching in the course"). The outcomes of management courses are described as of less specific character; the interviewees state that they have provided a better understanding of the function of the university, a cross-departmental network of peers, a more holistic view etc. However, several interviewees mention the use of management course to provide concrete training in difficult and sensitive manager tasks.

Some interviewees point to the importance of informal education in several of the skills, notably leading large projects and communicating with industry. Mentorship and activity in the interviewees' home department has in these cases provided on-the-job-training. These interviewees point out that successful departments have a good leadership culture, they are good at acquiring funding and obtaining results.

Table 2. Faculties views on importance of and their ability to cope with the critical situations.

Situation		Skill	Importance		Ability		Organized education (%)
			Avg	Dev	Avg	Dev	
1	Teaching project-based courses	To teach students how to plan, conduct and evaluate a project	8.8	0.9	7.6	0.6	50
2	Leading large, multidisciplinary research projects	To plan and execute large projects, as well as act as participants in multidisciplinary, international teams.	6.8	2.3	5.6	1.9	12.5
3	Acquiring funding for and setting up research projects in collaboration with industry	To understand the industrial context of their work, and communicate effectively with industrialists	8.9	1.1	7.6	1.4	25
4	Participating in and driving university change efforts.	To organize change processes in large organizations	7.4	1.2	6.8	1.4	62.5
5	Contributing to university strategic goals such as "create a sustainable society" or be "the entrepreneurial university"	To link one's own research and teaching to long-term societal goals.	6.7	2.3	6.4	1.8	50
6	Managing day-to-day business in a university department, division or group.	To master operational management skills, including budgeting, communication, conflict resolution etc skills.	8.4	1.3	7.7	1.2	50
	Average		7.8	1.5	6.9	1.4	

All interviewees think that professional skills will be more important for future faculty. Almost all interviewees emphasize the role of communication skills: An important motive is that they need to communicate effectively with industry in order to secure research funding, but the interviewees also state that today's students to a higher degree demand that their teachers can relate the subject matter to practical applications, and demonstrate awareness of industrial working practices. Some also point out that effective administrative skills are essential if current faculty shall be able to free up enough time for their own research. Some interviewees argued that it is difficult to single out one particular skill as more important, future faculty need to be good at all situations listed in Table 2.

Discussion
This investigation has analyzed a small number of schools, and with a limited number of interviewees. The general validity of the findings is thus difficult to assess. There may be technical universities with more comprehensive faculty professional competence development programs in place. However, we have had informal contacts with an additional number of universities in Europe and in North America without being able to identify any outstanding leader in this respect. Given this observation, we would argue that the situation as regards professional competence development at studied universities are quite representative for technical universities. Again, this points to that this research should be viewed as a pre-study. In

the next phase, a more comprehensive search for information on professional competence development programs should be performed.

Conclusions and future work

The faculty members interviewed in this study assess that proficiency in professional skills is of high importance in their working situation. In particular, skills in teaching project-based courses and to be able to relate one's research to the industrial context are identified as very important.

Out of the three studied schools, only DTU offers a comprehensive package of courses that teach these skills. The other schools have more fragmented offerings, in particular when comparing with the pedagogy development programs that have been established during the last decade.

Pedagogy and management skills are addressed by different organizational units at all schools. However, there are areas where pedagogical and professional competences overlap and a unified approach could offer advantages in terms of coordination and a more holistic view of academics non-disciplinary competence.

Professional competence development programs for academics should be practical in nature and offered to the entire faculty, recognizing that almost all faculty members have a need for a wide range of professional skills. The programs also need to be carefully adapted to the academic context.

The study is of explorative character and was conducted with a limited empirical material based on analysis of the situation at three Scandinavian technical universities. The selection of these universities as objects of study is argued to be representative. However, larger-scale studies are needed to confirm the findings and to identify best practices within the area.

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