ENGINEERING STUDENTS EXPERIENCES OF THE TRANSITION FROM STUDY TO WORK

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Abstract

A key concept in this study is employability. Several studies indicate a gap between different stakeholders´ definition of the concept. A common measure is the degree of establishment on the job market, with a minimum wage, at a specific time after graduation. In this paper we present data from a longitudinal study of four cohorts of engineering students´ experiences of the transition process and compare these data with national and international studies. Our data show that students courses that were applicable and useful were considered important for their employability, and that the final master thesis was a ticket into the job market. The CDIO project courses, implemented in the curriculum from 2000, were considered the must useful, and the 2000 and 2002 cohorts felt more prepared for working life than the 1998 and 1999 cohorts did. They also to a higher degree did their thesis abroad and got a job through their thesis project. The skills of problem solving, critical thinking, managing heavy work loads and working in projects, were considered most transferable to job situations. National data show that on an average, Engineering students in Linkoping to a high degree are employable, especially students in Electrical engineering. One year after graduation about 80% are established, and of those about 75% have a job that require a Master degree.

Keywords: Transition, employability, graduate job market, student experiences

Introduction

Within European Higher Education one main goal in the Bologna process is to enhance the students' employability. With the massification of higher education graduate employment is becoming a political as well as pedagogical issue. The issues of education and employability are now addressed at top political level conferences and are no longer an internal issue for academics. At the recently set up Swedish council of globalization one of the invited key note speakers concluded that the weaknesses of the Swedish job market, compared to other countries, are that too many jobs are directed to the public sector, few people are self-employed, a segregated job market and a focus on job security instead of employability [1]. These discussions highlight the issue of the mission of higher education in a "knowledge society" where the job market is characterized by changing working conditions with an increase in temporary and insecure employment conditions requiring generic and transferable competencies as well as key competencies within a specific field of knowledge.

Employability is a key concept in research on student trajectories and experiences of the transition from a study context to the world of work. The concept is full of nuances but indicates that an employable person holds knowledge, skills and characteristics that makes that person useful and valuable in a specific context. The definition of employability as *"a set of achievements – skills, understandings and personal attributes- that makes graduates more likely to gain employment and be successful in their chosen occupations, which benefits*

themselves, the workforce, the community and the economy" [2] catches the complexity and diversity of the concept. There are several studies indicating a gap between different stakeholders definition of what knowledge, skills and characteristics a graduate person could be expected to hold [3, 4, 5, 6, 7, 8, 9, 10, 11]. These studies focus on the role of tertiary education from a social, economic, labor market perspective with an aim of finding a way of predicting a balance between supply and demand of knowledge and competence on a globalized, competitive knowledge market. In this paper we will present longitudinal comparative survey and interview data focusing on *the students experiences* of being the targets of this process of transition, from studies to work.

One main goal of the Linkoping CDIO project has been to focus on the students´ employability through the integration of generic skills and competencies into a broad, theoretical graduate engineering program in Applied Physics and Electrical Engineering and in the construction of an open and supporting study environment. The implementation of the CDIO syllabus has been monitored in a longitudinal study in Linkoping, where four cohorts of students have been monitored through their whole study period of 4.5 years with a follow up one year after graduation [12]. The first cohort (1998) studied within a traditional curriculum, the second (1999) had a CDIO project course in their third year, the third (2000) had a CDIO project course in their third and fourth year and the fourth (2002) had a project course in their first, third and fourth year, a full CDIO curriculum.

After a short background of the educational context and the longitudinal study of which this study is a part, we will present survey and interview data concerning the engineering students way out of the life of education into the life of work. Many studies show that it is during the first year many students drop out, for various reasons [27]. As a consequence the longitudinal designs suffers from a methodological flaw as there is a selection of the participating students. In this paper we will focus on questionnaires 5-7 and on those students we have interviewed more than four times. The results are valid only for those students who managed to graduate within stipulated time. The survey data gives an overview of the trajectories of the students and the interview data gives meaning to the experiences and choices of the students, during their way out of the educational system.

From the end of 1990ies the overall job market in Europe has shown an increasing difficulty for young adults to get into the regular job market and this is also true for the graduate job market. During the same time enrolment rates in Swedish higher education have declined, especially in science and engineering. In discussing our data we will refer to other, mainly European, research on the impact of curricula and graduates' skills on the students´ job search process and their establishment on a job market.

Background
The context of this paper is a 4.5 year Masters' program in Applied Physics and Electrical Engineering (henceforth the Y-program). The program is marketed as prestigious and at the international front of technical development with the aim to "educate Masters of Science in Engineering who are capable of working at the international forefront of technical development and secure and enhance the competence of industry and society" [13]. The combination of Applied physics and Electrical engineering is quite unique [ibid.].

The overall design of the program encompasses a compulsory curriculum the first two years, designed to lay a basic foundation of the forthcoming studies. After completing their basic studies, the students can choose among different profiles of engineering. During their final

year a concluding Masters' thesis is written. The thesis is accomplished in a business- or academic context, nationally or internationally. The work is organized with a large proportion of scheduled lectures, laboratory work and lessons. The content is organized in a large number of both sequential and parallel courses. The lessons and laboratory work are managed by course assistants, often a PhD student or senior student. Lectures and lessons are scheduled but not mandatory, so the students have a freedom to organize and manage their personal schedules in a way that suits their learning style and personal circumstances.

In 1999 the planning of implementing a CDIO curriculum started and was gradually implemented from 2000 {14}. The cohort of 2002 was the first cohort who studied in a full CDIO curriculum, with project courses in the first, third and fourth year. In this paper we make a distinction between those students who studied in *the traditional curriculum* (1998 and 1999) and those studying in a *CDIO curriculum* (2000 and 2002).
Across all cohorts, independently of curriculum, the students have reported highly demanding courses and heavy workloads [12, 15, 16] with the third year being a threshold.

In 1998 the study board of the Y-program initiated this study with the purpose of understanding why so many students dropped out and why lecturers and students found the study climate tough, harsh and grumpy. In 1999 the study board initiated the CDIO collaboration as *one* way of reforming the program and therefore it was decided that the study should be enlarged to encompass four cohorts of students, enrolled in 1998, 1999, 2000 and 2002. The overall purpose was to compare the expectations and experiences of the students and, if possible, evaluate the impact of the CDIO curriculum [12]. The registered students in all four cohorts have been surveyed annually during their study period, with a follow up approximately one year after stipulated graduation. Ten students in each cohort have been interviewed annually, with a follow up interview one year after stipulated graduation [12]. In this paper, the focus is on the students´ transition from the world of education into the world of work, i.e. the last questionnaires (Q5-7) and interviews. Choosing their profiles in their third year and starting to find a subject for their final thesis are the first steps on this road.

Disposition of the paper
After a brief introduction to concepts and theoretical frameworks underpinning research on graduate employment in Europe, the paper is framed around five themes emanating from our empirical data:
- The most instructive courses and the writing of a Master thesis
- The job search process
- Employment and job situation
- Evaluation of transferability of knowledge, skills and competencies
- Looking back – satisfaction with career choices
The results are discussed within the framework of European research on graduate students transition from the world of education to the world of work.

Research about graduate employability and employment
Studies about graduate employability and employment are focusing on three main questions. What will the job market look like in the future? What knowledge, skills and competencies will be demanded? How should the educational systems develop to meet these demands? [10, 8, 5, 2, 25, 26].

The future job market

In the above mentioned studies different scenarios are presented but they share some common assumptions:

- Traditional ways of thinking about markets, finance, class, education and career trajectories do not capture the potentialities and risks of an emerging new kind of job market.
- The general educational level in the population is rising very fast, with increasing competition for the best students as well as for the best jobs.
- Mobility and flexibility, of markets, organizations, jobs and people challenges the concept of job security and highlights the concept of employability.
- Increasing competition challenges the basic assumptions underlying the idea of a knowledge society, i.e. the good of a further, formal education; the priority of abstract, analytical knowledge and competence and the depreciation of practical, communicative and relational knowledge and competencies.

These assumptions are mainly based on social and political aspects of the relevance of further education. From a student perspective it is relevant to mention the research by Leccardi [17] who argues that biographical insecurity makes it difficult for young people to picture themselves in a future and to how their choices and non-choices today can be related to that future. Rapid technical development and a feeling that time moves on too quickly, contributes to a perception of not having, and not being able to have, control over their own lives. In a longitudinal, comparative study of the relationship between life goals and fields of study among young European graduates (CHERI-project) it is concluded that there are some similar patterns among students in seven European countries, despite cultural and labor market differences. Significant similarities regarding gender, educational and social background and life goals, were strongly related to specific fields of study [18]. Engineering graduates i.e. are predominantly males with high marks in secondary education and a vocational educational background. They are not interested in life goals such as social prestige, personal development, varied social life, home/family life. They are more interested in professional development through academic inquiry and in making money. In a study context they want to develop their own ideas, in challenging and well-ordered tasks and in working in teams.

What knowledge, skills and competencies will be demanded?

Within a longitudinal study of job satisfaction among young European higher education graduates, Mora et.al [19] found that the total effects of educational determinants on job satisfaction were quite homogeneous across Europe. A significant positive link was found between job satisfaction and a well-designed program, content of courses and practical learning. The positions held by the students, four years after graduation, did not fulfil their expectations regarding earnings and possibilities for life-long learning. Most interesting is the result that a perceived surplus of qualifications and competences was one of the most relevant causes of job dissatisfaction. A high level of disappointment was found when graduates could not use their knowledge and competence at work. On the other hand, being under-educated or having lower competencies than required, increased job-satisfaction! Young graduates with permanent job contracts and full time jobs were most satisfied, especially those working for the public sector and in small firms.

The relation between educational systems and employment

In discussing Higher education policy in relation to changing conditions and challenges in the world of work, Teichler [5] argues that higher education has to accommodate to a situation where students are more diverse in their motivations and capabilities as well as in the jobs and positions the will hold, after graduation. Apart from knowledge in a subject area, higher

education is also expected to help students to improve their social and communicative skills, to inform them about the labor market for graduate jobs, to address the tensions between academic and professional approaches to problems and prepare them for an insecure and flexible job market. If, as many studies indicate, "social competences" are generic, transferable skills demanded by employers, and learning is taking place in specific social contexts where these skills are learned, the challenge for higher education is to design high quality courses and programs that are well managed and flexible. High quality content and research is required, but it is not enough to attract young students. As the boundaries between work and private life are blurring, so are the goals and values attributed to work and life. Career choices are not regarded as something separate from life choices and life styles. Choosing a field of study and/work is choosing a social identity and a life style as well.

Method and data

Questionnaires: Seven questionnaires have been distributed, with questions focusing on issues relevant for the actual period of study as well as some recurrent questions about self-rated study results, study satisfaction, study related health, identification with the program and feelings connected with their studies. In table one the response rates are reported. Response rate is calculated as the relation between filled in questionnaires and registered students the actual term (in brackets). Focus in this paper are Q5-7.

Table 1: Number of filled in questionnaires. The number of registered students and the response rates are within parenthesis.

	Q 1	Q 2	Q 5	Q 6	Q 7
Cohort 1998	185	137	76 (117, 64%)	62 (120, 52%)	66 (110, 58 %)
Cohort 1999	170	155	65 (139, 47%)	43 (131, 33%)	52 (90, 58 %)
Cohort 2000	173	159	47 (117, 40%)	39 (114, 34%)	50 (89, 55 %)
Cohort 2002	174	145	42 (104, 40%)	30 (78, 38 %)	
Total	702	596	230 (479, 48%)	144 (365, 40%)	

Q1 was filled in by almost 100% of the students within the first two weeks of the first semester. Q2 was filled in within the first two weeks of the second semester. Drop out rates are most frequent during the first semester. The responses must be interpreted with caution because of methodological issues like drop outs and "stop outs" (students taking study leaves) which distorts the results. The results are valid only for the students who manage and fulfill the requirements in stipulated time and who respond to the questionnaire. In Q6 the response rate is on an average 21% of the *original* cohort and in Q7 about the same. If we look at the registered students we estimate that on an average (across all cohorts) 32% dropped out after the first year, and in the fifth year 48% had dropped or stopped out.

Interviews: In sampling students to be interviewed we used lists of all students who were registered for their first semester. The students were listed by class, name, birth registration number and address. From this list we made a strategic sampling in order to have students from all classes and a variation in age and gender. The study board requested that 50% of the interviewed should be females, in spite of the fact that they were only between 13-20% of the

entire cohort. Only the researchers know who the interviewed students are. The selected students were contacted and informed of the design of the study and asked if they would accept to be interviewed. They were also informed that the interviewing would be on a regular basis once a year through out their entire time as students with a follow up about one year after graduation. Very few students refused to participate and for those who did we had reserves. In table 2 we have listed students in each cohort that have been interviewed 4-7 times in total. All of them have been interviewed during their job search and transition period. Listed are students interviewed 5-7 times in cohorts 1998 and 1999 and students interviewed 4-6 times in cohorts 2000 and 2002.

Table 2. Interviewed students.

Cohort 1998	Cohort 1999	Cohort 2000	Cohort 2002
Male born 1967	Male born 1977	Male born 1980	Male born 1981
Male born 1978	Male born 1979	Male born 1981	Male born 1981
Male born 1978	Female born 1972	Male born 1982	Male born 1982
Female born 1978	Female born 1980	Female born 1978	Male born 1983
Female born 1978	Female born 1980	Female born 1980	Male born 1983
Female born 1979		Female born 1980	Female born 1982
			Female born 1982

Data from previous interviews were used as triggers and points of departures for the following interviews The interviews were taped and transcribed and analyzed as texts. The students have not read the transcripts but have had access to project reports and conference papers.

The survey data is presented as descriptive data and interview data analyzed by a step-by-step approach of IPA (Interpretative phenomenological analysis) [20]. These steps involve a systematic search for themes and how these are related to each other. Verbatim extracts are presented as instances of how these themes are articulated by the students. The purpose is to understand the variation and complexity of "meaning making" within a specific cultural and temporal context.

Most instructive courses and Master thesis
After the first two basic years the students can choose classes out of interest. The class of origin is dissolved, due to drop- and stop outs as well as more individual study strategies [12]. Lizzio and Wilson [21] argue that the perceived relevance to future work is the strongest predictor for student interest in courses and a prime determinant of the effort they are prepared to invest in those courses. In the interviews the students articulated their considerations during this phase in their studies. Should they choose out of pure interest, or from the reputation of the course and teacher or should they make strategic choices, courses that might make it easier for them to get an interesting master thesis project and maybe a job offer?

Most instructive courses
In Q 5-6 the students were asked to name the courses they had found *most* as well as *least* instructive, and to motivate their choices. The responses are categorized into three categories: (i) Useful, (ii) Applicable, and (ii) Interesting courses [24].

Instructive courses: Computer hardware and architecture and CDIO-project courses were identified in this category.

"Interested in the subject"; "of general interest"; "fun"; "stimulates one's own thoughts and creativity"; "you learned a lot and it was great fun"; and "interesting contents".

The meaning of "instructive" courses, with reference to the above mentioned, indicate that relevance is not enough, interest and joy were emotional aspects related to more cognitive aspects. The project course in Electronics, which is a CDIO-course the third year, was by far considered the most instructive course by the cohorts 2000 and 2002 (the course was not in the traditional curriculum).

Useful courses: Calculus, Complex analysis, Circuit theories, and an Automatic control project course were identified in this category.

"…is useful everywhere"; "essential for many courses to come"; "without it you couldn't pass any other course"; and "could use much knowledge from many other courses".

The students found theses courses instructive because they were the foundations for later courses in the program or because they were considered to be general knowledge. During the first year most students struggled with these courses and had difficulties in finding the relevance and usefulness for future jobs [12].

Applicable courses: Complex analysis, Automatic control, CDIO-project courses, Digital signal processing, and Computer hardware and architecture were identified in this category.

"the course contains many things that are applicable in reality"; "relevant assignments"; "the course the closest to reality"; "you could apply the knowledge practically"; "closely connected to how you work in companies today"; and "clear relevance for the future".

These courses were considered instructive because the students anticipated that applicable elements in the courses would be comparable to real work life situations.

Master thesis

During their final year the students have to write a Master thesis, an examination paper. They have to find a project within the academy, at a teaching/researching department or research group, or at a private or public sector department. By tradition this has been the gateway to the first graduate job for many students, or at least generated net-works and contacts for the future job search. In the interviews many students commented that it was during this master thesis process they became conscious of their overall employability skills as well as the lack of these! During this process it also became evident for them that work-life conditions were quite different from study-conditions, when it comes to autonomy, possibilities to influence their personal work-conditions and time-management as well as the composition of work teams.

If the students take study leaves and/or have many re-sits their work with their final thesis will be delayed. As we can see from table 3 the proportion of students who have started their thesis work at the beginning of their fourth year (as stipulated) has increased between 1998 and 2000.

Table 3. Percentage of students who have initiated their thesis work at the beginning of their fourth year.

Cohort	Initiated	Not initiated
Y98	44	56
Y99	70	30
Y00	61	39

In order to increase the students´ employability, they have been encouraged to inquire for projects for their master thesis in firms to a higher degree as a tradition have been that many have relied on projects at the University or in the public sector. The results in table 4 indicate that this message has had an impact on the students search strategies.

Table 4. Percentage of students doing their thesis project in different contexts.

Cohort	Firms	Public sector
Y98	59	41
Y99	63	38
Y00	69	27

One goal in the Bologna reform process, is to increase mobility among staff and students and to increase the internationalization of higher education. The Y-students have been encouraged to look for thesis projects abroad and table 5 show that there has been an increase. One reason for this is that in 1999 the Yi, the international class, started. These students have spent one semester abroad during their study time and this might have enabled their international contacts.

Table 5. Percentage of students doing their thesis project in Sweden and abroad.

Cohort	Sweden	Abroad
Y98	96	4
Y99	96	4
Y00	88	12

The students themselves have the responsibility to make the arrangements for their thesis projects and in all cohorts about 50% found this difficult. In the interviews the students meanings were that in firms as well as in the public sector, emergent reorganizations and cost-cutting put a lot of strain on the employees, and having to supervise a student just put an other burden on their shoulders.

The definition of employability we use in this paper *"a set of achievements – skills, understandings and personal attributes- that makes graduates more likely to gain employment and be successful in their chosen occupations, which benefits themselves, the workforce, the community and the economy"* [2] highlights the question of what parts of the curriculum that contributes the most to employability, and if these skills are best learned within the educational context or withinin the context of work life, or work-based learning situations. In the interviews many students have argued that generic skills and cultural values are best learned in extra curricular activities and in work contexts, and that doing a thesis project in a firm was the best learning experience during the whole study period. As we can see from table 6 there was an increase in students, between 1998 and 2000 who, at the start of their final year, felt prepared for working life.

Table 6. Percentage of students feeling prepared for working life at the beginning of their final year.

Cohort	Prepared	Not prepared
Y98	53	47
Y99	66	34
Y00	71	29

The job search process

From the interviews we can learn that for many students the job search process start during the thesis writing process, although the motivation to go from the study context into working life, varies among the students, within as well as between cohorts. One important reason for the variation *between* cohorts is the situation on the job market as a whole. From survey data (Q7), about 90% of the students in the 1998 and 1999 cohorts responded that they had been motivated to start working after graduation, but almost 70% had found it very difficult to get a job. In the 2000 cohort the students were just as motivated to start working as the previous cohorts, but in this cohort about 60% had had no problems in finding a job after graduation! As mentioned before, the job search process changed, most probable due to a general change in recruitment and employment strategies by the end of the 1990ies. Net-working, career-centers, career-counselling and hiring of staff on short time-contracts became more common, in contrast to the "Swedish model" of high employment security and public job centers. In table 7 the survey results from Q7 show how the students got their first jobs and how long it took for them to get them.

Table 7. How the students´ got their first jobs after graduation and how long it took for them to get them.

%	Through thesis project	Through personal contact	Through job. ad	Other	Time (months)
1998	24	27	41	8	3.2
1999	29	31	27	14	2.3
2000	37	20	35	8	1.6

The free text responses in the surveys show that it was quite common that the students in the 2000 cohort were offered a job before they graduated, usually where they had completed their thesis project.

The free text responses in the surveys, as well as the interviews, indicate that the students considered the most valuable skills and competencies in the *job search process* to be having done a good thesis project; to have a diploma from the Y-program proving that they have been able to manage a tough study program and to manage a heavy work load; self confidence in knowing that they could solve complex problems and that they possessed broad knowledge base.

Employment and job situation

The Swedish Council for Higher Education (HSV) annually presents a report regarding the graduate employment rates. The study is based on data from Statistics Sweden (SCB). The definition of the degree of establishment on a job market is that one year after graduation the student should have a job with a minimum income of 160.000 Swedish crowns/year (about

16.000 Euros). On an average the degree of establishment varies between different subject areas, i.e. 90% (medicine and health care), 80% (engineering), 50% (arts and sciences), but also between universities within the same subject area. In Linkoping the above mentioned data have been elaborated further [22] and these data show that graduates from Linkoping establish themselves quicker and get jobs corresponding to their qualifications, to a higher degree than students from other universities.

Students with a degree from the Y-program have better job prospects, compared to graduate students from Computer Science and Engineering and Mechanical Engineering. For those graduating 2001/2002 and established in 2003 and those graduating 2002/2003 and established in 2004, the employment and job situation is shown in table 8

Table 8. The degree of establishment of graduate engineers in 2003 and 2004.

	Mechanical Engineering 2003	Mechanical Engineering 2004	Electrical Engineering 2003	Electrical Engineering 2004
Linkoping	75%	86%	85%	81%
Chalmers	83%	79%	52%	73%
KTH	77%	84%	69%	76%
Average for all Universities	77%	84%	70%	76%

These figures show that the students have a job and a minimum wage, a year after graduation, but they do not show if these jobs are related to the students´ qualifications. Do their efforts pay off, and to they get jobs requiring a Master degree, or are they working in lower qualified jobs. The HSV report, elaborated by Kindgren [22] regarding the students who graduated 2002/2003 have looked at this, and the results are shown in table 9.

Table 9. The degree of students having jobs that require a Master degree

	Mechanical Engineering	Industrial Engineering and Management	Electrical Engineering	Computer Science and Engineering
Linkoping	55%	55%	72%	75%
Chalmers	46%			69%
KTH	758%	58%		62%
Average for all Universities	50%	50%	73%	73%

These comparative data show that even before 1999, when the planning of the implementation of a CDIO curriculum started at Linkoping, the students from the Y-program were highly competitive on the job market and this also contributed to the image held by both students and faculty, that the Y-program was tough and challenging, but offered good career prospects for the graduates. In table 10 we show how the students responding to *our surveys* reported on their job activities and job positions after graduation. As a first job, after

graduation, 56% of the 1998 cohort held a position as a graduate engineer, compared to 80% in the 2000 cohort. In both cohorts 18% started an academic career as a doctoral candidate. This is well in line with Kindgren´s [22] results if we add jobs as graduate engineer and doctoral candidates (74% having a position requiring a Master degree)

Table 10. Activities and positions after graduation

%	Graduate Engineer	Other job.	Unemployed	Parental leave	Studying	Self-employed		Doctoral candidate
1998	56	9	9	2	3	2	2	18
1999	73	8	4	2	2	0	0	12
2000	80	2	0	0	0	0	0	18

Several studies show that a general tendency is that casual jobs, projects and time limited on probation jobs are being more frequent on the Swedish job market [23], although as we can see from table 11, this does not seem to be the case with the engineering students from the Y-program. 71% in the cohort of 2000 held permanent positions, compared to 58% in the 1998 cohort. Casual jobs and project jobs were less frequent for the students in the 2000 cohort although jobs on probation had increased.

Table 11. Different forms of first job employment after graduation

%	Permanent	On probation	Casual	By the hour	Project	Doctoral candidate
1998	58	2	11	0	3	17
1999	63	4	6	2	6	12
2000	71	6	4	0	0	18

The free text responses in the surveys as well as the interviews indicate that the most valuable skills and competencies *in relation to the present job situation* were above all problem solving, mathematics and subject specific knowing and learning, ability to manage time, to learn new things and to manage stress and heavy work loads.

On the job – what knowledge and skills acquired during their studies do the students find most valuable and transferable?

In the last questionnaire (Q7) the students were asked to rate to what degree they believed their acquired knowledge and skills in specific areas, problem solving, co-operation, working in projects, managing projects, managing a heavy work load, critical thinking and information management were useful and transferable to their present job.

Problem solving is rated as most valuable by more than 90% of the students in all cohorts and critical thinking is rated very important by 78% in the 1998 cohort. In the cohort of 1999 critical thinking is less valued (table 12).

Table 12.The value of critical thinking skills on the job

%	Not at all	A little	To some extent	Quite a lot	To a high degree
1998	3	3	15	39	39
1999	4	6	31	35	23
2000	2	6	22	45	25

These responses are not unambiguous. Do they indicate that after 1998 the students have not learned the skill of critical thinking or do they indicate that critical thinking is not a valued skill in the world of work?

Another competence they gave a high rating was competencies in information management, meaning the competence to search for, to monitor and acquire knowledge, to interpret information and to communicate what they know. Information management, in this sense, was valued to a higher degree by the 1998 and 1999 cohort. The reason for that could be that the 2000 cohort was the first cohort who had project courses in their 3rd and 4th year and these students learned how to share information and to collaborate with other people in project teams. The 1998 cohort had no project courses while the 1999 cohort had a project course in their third year. Table 12 show that about 60% of the students in the 2000 cohort believe that their co-operative skills and competencies are quite a lot or to a high degree useful in their present job, compared to about 30% in the 1998 and 1999 cohorts.

Table 12. The value of collaborative skills on the job

%	None	A little/to some extent	Quite a lot/to a high degree
1998	5	66	29
1999	17	52	31
2000	2	39	57

One question is if these skills mainly are related to the project courses and if so, in what aspects. 45% of the students in 2000 find the capacity to work in projects useful, compared to about 30% in 1998 and 1999. What we cannot say anything about is if this difference is due to the fact that they do not need the capacity in their present job or if it is because they do not hold the capacity. The same question arises when it come to how they value their capacity to manage projects.

Table 13. The value of a capacity to work in and manage projects in their present jobs

%	Work in projects			Manage projects		
	Not at all	A little/to some extent	Quite a lot/to a high degree	Not at all	A little/to some extent	Quite a lot/to a high degree
1998	11	63	26	33	56	9
1999	17	58	25	25	66	8
2000	4	40	46	35	54	10

The capacity to work in projects is highly valued by the 2000 cohort but not the capacity to manage projects. These results open up the question of over- and under qualifications In a study of the relation between qualification and job satisfaction among graduates in Europe, Mora et.al [19] found that a perceived surplus of qualifications and competences was one of the most relevant causes of job dissatisfaction. A high level of disappointment was found when graduates could not use their knowledge and competence at work. On the other hand, being under-educated or having lower competencies than required, increased job-satisfaction! The 2000 cohort had project courses in their curriculum, but from the results above it looks as if that kind of competence is not so important in the kind of first-jobs they get after graduation.

The Y-program has a reputation of being tough and demanding, and in all cohorts the students have commented on heavy workload and symptoms of study related stress. On the other hand, this has also been mentioned as being the core value of the program, that makes the Y-program stand out from other programs. The students claim that faculty put heavier demands on Y-students, than on students from other programs. The acquired capacity to manage a heavy workload is mentioned as a valuable skill in their present job situations.

Table 14. The value of a capacity to manage a heavy work load in their present jobs

%	Not at all	A little/to some extent	Quite a lot/ to a high degree
1998	3	13	84
1999	4	14	81
2000	0	20	80

Conclusions

- National data show that engineering students are quite successful in getting a job after graduation, compared to students within other subject areas, and in particular Linkoping students in Electrical Engineering. This is valid for students who graduated before 2003, i.e. before the students in our longitudinal study graduated. About 80% of the students have a job with a minimum wage one year after graduation and of those about 75% have a job that requires a Masters degree.
- There are differences between the attitudes to studying and to the study experiences of the 1998 and 1999 cohorts, who studied in a traditional curriculum, and the cohorts of 2000 and 2002, who studied within a CDIO curriculum. The students in the latter cohorts are more focused on monitoring how they can find their individual trajectories within the curricular frames, while the first cohorts were more focused on adapting to the curricular frames.
- Perceived relevance for a future job is perceived to be a strong determinator of students´ motivation and efforts. The students identified a number of courses they found instructive, useful and applicable, and among these the CDIO- project courses were identified in all three categories.
- The Master thesis project is considered a springboard into the job market.
- Students in the latter cohorts feel more prepared for the job market than students in the first cohorts.

- Students in the latter cohort found it easier to get a job than students in the first cohorts
- About 75% of the students in our study held a position, requiring a Master degree, after graduation. About 18% of these held a position as a doctorate candidate. These data are well in line with national data from Statistics Sweden
- Most valuable transferable skills, for their present positions, were problem solving, critical thinking, information management, managing heavy work loads, collaboration and working in projects.
- Our data indicate that the implementation of the CDIO curriculum have contributed to enhancing the students own activities to become employable, to actively and strategically choose courses and thesis projects they find instructive, useful and applicable.
- The interpretation of our results must be done within the context of the overall job market and for the graduate job market in particular.
- A key issue for further study is the career development, wage development and job satisfaction within a longer period of time and from a gender perspective. What happens if the students cannot apply their knowledge and skills at work and if they feel that they are being used for lower qualified jobs?

Discussion

Our results show that the graduating students from the Y-program were quite successful in getting into the job market before 2000, when the CDIO curriculum was implemented, but that the CDIO curriculum seem to have changed the students strategies and activities in their job search process. It is not possible to say to what extent this depends on the overall job market, and/or the overall change in attitudes to their studies that we have noted between the traditional (1998 and 1999) and CDIO (2000 and 2002) cohorts. Questions to be asked are:

Job prospects are good for these students, but in spite of that, enrolment rates continue to drop and the drop out rate is quite high. How should this mismatch be dealt with?

The capacity to work in projects is highly valued in the job situation, but not managing projects. Is that because the students do not hold these skills or because they are not able to practice it on the job?

From an educational perspective, one must deal with the issues of declining enrolment rates as well as high drop out rates from different perspectives. Is it the image of Engineering programs that must be changed in order to attract young people of today, where work is very much part of a lifestyle, or is it enough to change the curriculum and pedagogy, or must these aspects be aligned in the design of the whole study context? This question is well in line with the theme of this conference, "Changing contexts for Engineering education". In the CDIO curriculum, transferable skills are emphasized in the project courses in the first, third and fourth year, but how are these courses aligned with the rest of the curriculum? Our study show that there has been a change in attitudes between the cohorts, that the latter cohorts put more emphasis on what the "program" can offer them and what options they have, while the first cohorts put more emphasis on their own efforts and capacity to meet the requirements of the "program". From our results we must also ask the question if it is the mission of an engineering program to *make* the students employable or is that the responsibility of the students to *become* employable?

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