

Evaluation of the industrial internship for the Diploma IT programme at DTU

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ABSTRACT

In this paper we present the result of analyzing data based on more than 5 years' systematic collection of questionnaire survey data on the evaluation of the industrial internship for the Diploma IT programme at the Technical University of Denmark (DTU). Since 2005, we have been tutors for all students at Diploma IT. During this period we have systematically collected data from students and companies involved.

In total 785 questionnaires have been analyzed, which offers a good foundation for judging the success of the internship and a great opportunity for learning from the results.

The questionnaires comprise various questions measuring the general level of satisfaction with the internship. The results in general show high satisfaction, both from perspective of the companies involved and from the students' perspective.

In addition to the satisfaction surveys, we have also collected data on remuneration during the internship and data on the number of students who had a job at the time of graduation.

The last year of data collected, 2011, contains results from the new CDIO-based curriculum, which was launched in autumn 2008. This enables us to compare results for students enrolled in the old curriculum with students enrolled in the new CDIO-based curriculum.

In general the data collected forms an important source in understanding how the transfer from the educational system to industry is experienced from both sides.

KEYWORDS

Internship, Questionnaire survey, Internship remuneration, Job situation

INTRODUCTION

The Diploma IT programme consists of seven semesters, each with 30 ECTS points. All courses in the first four semesters are compulsory. The fifth semester contains elective courses, and the programme concludes with an industrial internship (sixth semester), followed by a final project thesis (seventh semester).

The sixth semester is reserved for a full time stay at a company in the IT industry. The purpose of the internship is that students get the opportunity to demonstrate and further develop their technical, personal and interpersonal skills. The student's working

tasks are defined in collaboration with the company. As a rule, we demand that the company pays a salary. (USD 2,500 per month, which corresponds to approx. 40% of a starting salary for a graduate)

An important point is that the students find their internship themselves by using their personal network. During the 5th semester, we introduce the students to the industrial internship.

The seventh semester includes the final project thesis of 20 ECTS points. In most cases this project is carried out in the same company that the students have their internship stay. During their internship, the students can take elective courses, which correspond to 10 ECTS points at the University.

Since autumn 2008, the curriculum has been based on the CDIO concept [1], [2], [3]. Hence, the first students enrolled in the new CDIO-based curriculum had their internship in spring 2011.

The overall curriculum structure is shown in table 1.

Table 1
Study plan for the Diploma-IT programme

	Semester period (13 weeks)					Lab period (3 weeks)
	5 ECTS	5 ECTS	5 ECTS	5 ECTS	5 ECTS	5 ECTS
1	01906 Math. 1	01917 Math. 2	31021 Electronics	02313 Dev. methods for IT systems	02312 Introductory programming	
2	01917 Discrete math. and databases	02311 Digital Systems	02325 Data communication	02326 Algorithms and data structures	02324 Advanced programming	
3	02323 Probability and statistics	02344 Object oriented analysis and design (OOAD) and databases		02332 Compiler construction	02321 Hardware / Software Programming	
4	02333 Parallel and real-time systems		02341 Model-based software engineering	02342 Distributed systems	02343 CDIO project	
5	Elective courses					
6	Industrial internship					
7	Elective courses			Final project		

Before 2008 the overall curriculum was structured in the same way, i.e. internship on sixth semester and final project on seventh semester. The difference is that the CDIO-based curriculum contains design-build projects involving more than one course on a semester. Also, a complete CDIO project is conducted in the fourth semester.

When the students complete their education, they will have been working closely with the internship company for one year. Hence, internship forms a good recruiting base and a great number of students are offered a permanent job at the internship company after completion of their final project.

THE SURVEY AND DATA COLLECTION PROCESS

The internship and final project part of the programme can be divided into three phases. These are the fifth, sixth and seventh semesters. Table 2 shows the activities in the three phases.

Table 2

Information briefing Job search	Internship found	Idea for exam project	Internship approved	Exam project completed successfully
Search for internship 5th semester		Internship 6th semester		Final project 7th semester
Statistics	D1 salary conditions	D2 and D3 Evaluation of internship		D4 Employment in company

Fifth semester

The student starts the process by finding an internship. Meetings are held at the university to brief the student about the process. It is the student's responsibility to find a relevant company.

The following requirements apply for the internship company:

- Relevant professional profile
- Level of education of the supervisor at the company
- The student must be remunerated during the internship.

The university provides help with courses in looking for a job as well as individual guidance on writing applications and a CV, and evaluation of these before they are sent to companies.

The aim is that this results in the student having found an internship and had this approved by the university at the end of the fifth semester.

Finding an internship is a widespread problem on the Danish labour market for more or less all educational areas, and this has applied for as long as anyone can remember. In order to alleviate this problem, it is possible for the company to choose not to remunerate the student. Instead the student will receive a student grant from the government. This amounts to about one half of the usual internship salary.

Since 2005 we have had sharp focus on increasing the number of students receiving a salary during the internship. In our experience this improves the quality of the internship. Also, finding a first 'job' so early, i.e. one year before the end of the study programme, benefits the student in terms of personal development and learning.

We register the salaries agreed with companies when approving the internships.

These statistics are under the point:

Salary in internship (data source: D1)

Sixth semester

The entire sixth semester is reserved for the internship. The student works on engineer-relevant tasks. These may be specific tasks or random tasks, but always engineer-relevant.

Irrespective of the task being worked on, initially there is a time-horizon of six months, i.e. the remunerated internship period agreed with the company. However, we aim to extend this period by an unsalaried period of six months.

This is achieved by finding a project in the company which the student can use as a final project. We urge students to find such a project as quickly as possible. If they are successful, contact with the company is extended by a further six months; in other words until the educational programme is completed. We reward student who have a draft project within three weeks of the start of an internship. We offer assistance in linking a DTU-supervisor from the university to the project. The job of finding a supervisor from the university is otherwise normally the responsibility of the student. The specialist supervisor now takes charge of contact with the company during the internship period and during the final project.

The internship is concluded with:

- The student completing a report describing the internship.
- The student evaluating the internship by completing questionnaire D2.

The result of the analysis is under the point:

Satisfaction survey - the companies answers (data source: D2)

- The company evaluating the internship by completing the questionnaire D3.

The result of the analysis is under the point:

Satisfaction survey - the students' answers (data source: D3)

Seventh semester

This semester comprises the final project, corresponding to 20 ECTS points and elective courses corresponding to 10 ECTS points. The courses are taken at DTU. The final project thesis is completed in collaboration with the company. Typically the student will be working on the project thesis at the company most of the time. The student is not 'employed' during this period and does not receive remuneration. The student is project manager during the period. The project is completed after six months with a thesis and oral presentation which completes the programme.

Usually it will now be time for the student to find his first job. However, many of our students already have an employment contract when they make their report and oral presentations; a contract with the company they have known and worked with during the internship and final project in the final year of the programme.

The result of the analysis is under the point:

Job situation after graduation (data source: D4)

DATA ANALYSIS

The data sources for analysing data are based on four documents that students and companies fill in. Table d1 shows the documents and the number collected per year.

Table 3
Documents for data analysis (D1-D4), and number collected per year (N)

id	Description	N (2005)	N (2006)	N (2009)	N (2010)	N (2011)
D1	Contains basic information on the student and the internship company Contains information on the internship stay and provides information on internship project and whether there is a salary or not. It also contains the abstract of the final thesis, which is usually done in the internship company	56	72	45	44	53

id	Description	N (2005)	N (2006)	N (2009)	N (2010)	N (2011)
D2	Satisfaction questionnaire – company 14 questions in total	45	64	40	29	47
D3	Satisfaction questionnaire – student 17 questions in total	44	66	42	31	46
D4	Status after graduation. Contains information on the grade obtained for the final thesis and the job situation	5	32	16	3	5

D1, D3 and D4 are filled in by the student, and D2 is filled in by the company.

D1 is filled in before the start of the internship period.

The questionnaires (D2, D3) contain general questions about internship and answers are rated on a numerical scale from 1 (worst) to 5 (best)

Examples of questions in the student questionnaire are:

- How relevant are your qualifications for the internship project?
- How do you experience your professional skills after the internship?
- What you think of collaboration with other staff?

Examples of questions in the company questionnaire are:

- Were the student's qualifications and previous experience adequate for the internship project?
- How do you experience the student's professional skills?
- How well has the student solved his tasks?

D2 and D3 are filled in after the internship period has ended and is mandatory in order to get credit points for the internship. As can be seen from table 3, a few documents are missing since there is a difference in N for D2 and D3. This can be explained by the fact that some companies have not completed the document and a few student documents have been lost.

Also the number of collected documents, D1, exceeds the number of collected documents, D2 and D3. This is explained by the fact that an increasing number of students receive credit transfer for the internship as a result of relevant work experience during their studies. In these cases D2 and D3 do not exist.

Upon completion of the final thesis the students are asked to fill in document D4. Table 3 shows that the number of these documents is quite low. This can only be explained as loss of documents in the data collection process.

Salary in internship (data source: D1)

During the internship, the student will work on equal terms with the other staff engineers in the company. The student will be responsible for relevant tasks such as problem solving, planning, sketching and design, and will be included in the daily routines at work. It is anticipated that the internship company pays a salary during the internship. Salaries are at a level corresponding to trainee pay. In data source D1, students are asked to indicate whether they get a salary or not in the internship.

Table d1 shows the distribution of the percentage of students who had a contract for paid internship before the start of their internship in 2005, 2006, 2009, 2010 and 2011.

Table d1
Percentage of students receiving salary by year

Receive salary?	2005	2006	2009	2010	2011
Yes	50	78	83	86	90
No	50	22	17	14	10

From this table it can be seen that the percentage of students receiving a salary has increased from 50% in 2005 to 90% in 2011.

Particularly noteworthy is that the percentage is increasing, even in periods of recession (2009 and 2010).

Satisfaction survey - the companies' answers (data source: D2)

The satisfaction survey for the companies is split into two parts. The first part contains student-related questions and the second part contains DTU supervisor-related questions

Average responses for companies by year are shown in tables d2.1 and d2.2. .

The bottom row shows the overall average of all responses by year.

Table d2.1
Company questionnaire, part 1
Company – student-related questions, answers mean and standard deviation

Question	2005	2006	2009	2010	2011
D2_1: Were the student's qualifications and previous experience adequate for the internship project?	3.69 (0.82)	3.88 (0.68)	3.78 (0.86)	3.62 (0.90)	4.15 (0.78)
D2_2 How do you experience the student's professional skills?	4.22 (0.64)	4.12 (0.60)	4.28 (0.60)	4.10 (0.67)	4.40 (0.61)
D2_3 How well has the student solved his tasks?	4.27 (0.58)	4.42 (0.59)	4.40 (0.67)	4.07 (0.65)	4.68 (0.63)
D2_4 What is your opinion of the student's ability to acquire and apply new knowledge?	4.49 (0.59)	4.48 (0.59)	4.58 (0.55)	4.28 (0.70)	4.62 (0.57)
D2_5 How well has the student been motivation?	4.38 (0.68)	4.41 (0.61)	4.68 (0.47)	4.14 (0.79)	4.62 (0.57)
D2_6 How creative has the student been?	4.00 (0.80)	4.19 (0.69)	4.20 (0.69)	3.89 (0.79)	4.36 (0.74)
D2_7 How well was the student able to cooperate with other staff?	4.36 (0.68)	4.34 (0.62)	4.35 (0.62)	4.21 (0.73)	4.66 (0.56)

Question	2005	2006	2009	2010	2011
D2_8 What was the student's social adaptability like?	4.22 (0.82)	4.23 (0.71)	4.43 (0.64)	4.17 (0.80)	4.70 (0.59)
D2_9 How punctual has the student been?	4.38 (0.83)	4.31 (0.89)	4.50 (0.72)	4.07 (0.84)	4.64 (0.67)
D2_10 If there was a relevant position available, would you hire the student?	4.51 (0.97)	4.55 (0.71)	4.58 (0.81)	4.38 (0.73)	4.66 (0.70)
Average	4.25 (0.77)	4.29 (0.71)	4.38 (0.71)	4.09 (0.78)	4.55 (0.66)

From table d2.1 it can be seen that all average scores for CDIO graduate students who had their internship in 2011 exceed the previous year's score based on the old curriculum structure.

The highest score is question D2_8: "What was the student's social adaptability like?" This could be explained in that the fact that the CDIO-based curriculum structure contains increased focus on training personal and interpersonal skills during the programme.

However, more data are necessary on future years' candidates to justify this observation.

Table d2.2
Company questionnaire, part 2
Company – DTU supervisor-related questions, answers mean and standard deviation

Question	2005	2006	2009	2010	2011
D2_a: Has the DTU supervisor been visible during the internship?	3.74 (1.48)	2.89 (1.69)	4.00 (1.18)	2.00 (1.00)	3.63 (1.54)
D2_b Has the DTU supervisor respected agreements for meetings etc?	4.48 (1.16)	4.24 (1.35)	4.73 (0.59)	3.00 (1.41)	4.19 (1.22)
D2_c Has the DTU supervisor had a relevant professional background?	4.05 (1.22)	4.33 (1.24)	4.27 (0.88)	2.50 (1.00)	4.00 (1.41)
D2_d What was cooperation with DTU supervisor like?	4.14 (1.04)	3.79 (1.32)	4.60 (0.63)	2.50 (1.00)	4.00 (1.41)
Average	4.11 (1.25)	3.78 (1.52)	4.41 (0.87)	2.50 (1.10)	3.95 (1.39)

From table d2.1 it can be seen that average scores for questions related to DTU supervisors in general are lower than for questions related to students. Also standard deviations are higher, indicating a greater disagreement among the respondents

We have tried to encourage DTU supervisors to be more visible and involved in the internship, and hopefully this effort will pay off in the future.

Satisfaction survey - the students' answers (data source: D3)

The satisfaction survey for the students is split into two parts. The first part contains personal-related questions and the second part contains company-related questions. Average responses for students by year are shown in tables d3.1 and d3.2. The bottom row shows the overall average of all responses by year.

Table d3.1
Student questionnaire, part 1
Student – personal-related questions, answers mean and standard deviation

Question	2005	2006	2009	2010	2011
D3_1: Do you think you were qualified for the internship project?	3.59 (0.84)	3.70 (0.80)	3.67 (0.85)	3.39 (0.76)	3.85 (0.82)
D3_2 What do you think of your professional skills after the internship?	4.09 (0.60)	4.15 (0.64)	4.02 (0.64)	3.97 (0.55)	4.39 (0.71)
D3_3 How well do you think you solved the tasks?	3.98 (0.51)	4.10 (0.56)	4.19 (0.55)	3.87 (0.62)	4.46 (0.59)
D3_4 How good have you been at acquiring and applying new knowledge?	4.32 (0.64)	4.30 (0.66)	4.21 (0.61)	4.26 (0.58)	4.57 (0.62)
D3_5 How well motivated have you been?	4.30 (0.67)	4.29 (0.72)	4.52 (0.59)	4.13 (0.85)	4.46 (0.75)
D3_6 How creative have you been?	3.93 (0.66)	3.97 (0.76)	4.05 (0.76)	3.90 (0.75)	4.20 (0.86)
D3_7 What do you think of your collaboration with other staff?	4.30 (0.70)	4.26 (0.79)	4.43 (0.80)	4.23 (0.72)	4.35 (0.85)
D3_8 How well do you think you have adapted socially?	4.11 (0.72)	4.18 (0.78)	4.12 (0.94)	4.03 (0.87)	4.42 (0.83)
D3_9 How punctual and reliable have you been?	4.27 (0.72)	4.30 (0.84)	4.38 (0.70)	4.10 (0.91)	4.67 (0.67)
D3_10 Have you been happy to go to "work" in the morning?	4.45 (0.70)	4.35 (0.72)	4.29 (0.77)	4.32 (0.87)	4.48 (0.86)
D3_11 If there was a relevant position available, would you like to be recruited?	4.16 (1.22)	4.32 (0.96)	4.33 (0.90)	4.13 (1.02)	4.35 (1.22)
Average	4.14 (0.77)	4.17 (0.77)	4.20 (0.77)	4.03 (0.81)	4.38 (0.83)

Like the results in Table D2.1, Table d3.1 shows that all average scores for CDIO programme students who did their internship in 2011 exceed the previous year's score based on the old curriculum structure.

The highest score is question D3_9: "How punctual and reliable have you been?" This could be explained by the fact that the CDIO-based curriculum structure includes increased focus on teamwork during the study period and thus there are more meetings and agreements within the team. The students learn that it is important to keep appointments.

As for the observation in table 2.1, more data are necessary on future years' candidates in order to justify this observation.

Table d3.2
Student questionnaire, part 2
Student – company-related questions, answers mean and standard deviation

Question	2005	2006	2009	2010	2011
D3_a: Have you received sufficient support from the company?	4.11 (0.75)	4.21 (0.81)	4.49 (0.68)	4.06 (1.06)	4.36 (1.03)
D3_b Have you received qualified support from the company?	4.32 (0.74)	4.27 (0.78)	4.61 (0.63)	4.35 (0.75)	4.56 (0.81)
D3_c How was the reception and integration into the company?	4.20 (0.90)	4.29 (0.76)	4.37 (0.73)	4.19 (0.87)	4.31 (0.79)
D3_d What do you think of the working environment?	4.27 (0.69)	4.24 (0.66)	4.44 (0.71)	4.10 (0.70)	4.27 (0.81)
D3_e Is the company a good internship?	4.32 (0.86)	4.40 (0.79)	4.54 (0.84)	4.16 (0.82)	4.47 (0.92)
D3_f Would you recommend an internship in the company?	4.34 (0.86)	4.45 (1.00)	4.56 (0.81)	4.00 (1.00)	4.60 (0.86)
Average	4.26 (0.80)	4.31 (0.80)	4.50 (0.73)	4.15 (0.87)	4.43 (0.88)

Scores for Student – company-related questions are shown in table 3.2.

Generally high levels of satisfaction are observed with regard to support from companies. Also in 2011 most students recommends their internship company, question D3_f. Moreover, satisfaction levels seem to be more constant over the period analysed, no score drops below 4.0.

Job situation after graduation (data source: D4)

Data source D4 is filled in by the students when they conclude their final thesis.

An important question is their job situation at that time. Table d4 shows the percentage of students having a job at the time of graduation and it shows the percentage of students continuing on a masters degree programme. In 2009, we experienced a drop in the percentage of students who have a job. This is probably due to the general

recession at that time. The percentage of students continuing on a masters programme increased to 20% in 2011.

Table d4
Percentage distribution of 'Job situation' after graduation by year

Job after graduation?	2005	2006	2009	2010	2011
Yes	60	84	19	67	60
No	40	10	62	33	20
Master's programme	0	6	19	0	20

Since the number of collected documents for D4 is very low, the significance of these figures is low.

CONCLUSION AND FINAL REMARKS

In the paper a statistical analysis of collected survey data has been carried out for the years: 2005, 2006, 2009, 2010 and 2011. Data for the intervening years are also available, but had not been processed at the time of writing.

Overall the results from the analysis show an average level of questionnaire responses above 4.0 for all years analysed, except results involving DTU supervisors, where the average levels drop below 4.0 for the years: 2006, 2010 and 2011. However, overall we consider these results very satisfactory.

Furthermore, there is an indication that the general satisfaction level has increased in 2011, where the first students enrolled in the new CDIO-based study programme graduated.

It will be interesting to follow the coming years' graduates in order to see if this trend continues.

However, it is important to stress that a more thorough statistical analysis is needed before the significance of this observation can be confirmed.

We would like to change the method of collection data. Currently the questionnaires are completed on paper, after which they are scanned and uploaded to a server by the students. Extracting data from this is a time-consuming process and not having the data online is a problem. We will work on having the data stored so that it is available online as soon as it has been collected.

For a long time now we have wanted a general evaluation of the internship process for all diploma programmes at DTU. It has recently been decided to work to make the questionnaires on students' evaluation of their internship (D2) and the companies' evaluation of the internship (D3) more widespread for all diploma programmes at DTU. The plan is to utilise existing questions as they are so that our statistics can be traced back to 2005. The questionnaires regarding D1 and D4 cannot be utilised directly for the whole university because the timing of the internship is very different for the different programmes.

Results in this paper also suggest that DTU supervisor's efforts and visibility should be given priority in future.

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Biographical Information

Mads Nyborg is an associate professor in software engineering at DTU Informatics. He has several years of experience in teaching in software engineering and has governed industrial projects both as a consultant and as a supervisor for student projects. He was the one of the primary movers in introducing the CDIO concept at the diploma programme at DTU Informatics.

Stig Høgh is an associate professor in software engineering at DTU Informatics. He has several years of experience in teaching software engineering and has governed industrial projects both as a consultant and as a supervisor for student projects. In the period 1985-2005 he produced software for quality control. He was one of the primary movers in introducing the CDIO concept at the diploma programme at DTU Informatics.

Pia Lauridsen is secretary for IT Diploma at DTU. Besides, she has extensive experience from the private sector where she has worked for several engineering companies as for example four years at Ramboll. Pia Lauridsen is currently completing her master's degree in communication and French.

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