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STATISTICS FROM THE WORK EXPERIENCE PROGRAM IN COMPUTER SCIENCE AND ENGINEERING

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Abstract

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In this report I describe a typical Finnish work experience program in computer science and engineering. The program is compulsory for all students. It is cheap, moderately controlled, and unstructured.

I present feedback from students and employers. Also, I have estimated the costs of the program. The feedback from the program is compared to the feedback from a highly structured and competition-based co-operative education program in the USA, which can be seen as a kind of opposite to the Finnish program. One might expect the feedback from a cheap and unstructured program not to be very good. However, the feedback from both programs was positive.

Keywords: higher education, computer science and engineering, work experience program

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1 Introduction

In this report I describe a typical Finnish work experience program in computer science and engineering. The program is compulsory to all students. It is cheap, moderately controlled and unstructured. The feedback from the program is compared to the feedback from a highly structured and competition-based co-operative education program in USA, which is a kind of opposite to the Finnish program. One could except that feedback from a cheap and unstructured program is not very good. However, the feedback from both programs was positive.

In this section, some concepts are defined and I describe the work experience program of the degree program in computer science and engineering (CSE) at Helsinki University of Technology (HUT). Also, I classify the program. In the second section, I present the results from two questionnaires and data relating to employer satisfaction, and I estimate the costs of the program. In the third section, I compare the feedback from the HUT program to a highly structured and competition-based co-operative education program in the USA. Finally, I reach some conclusions.

1.1 Definitions

On-the-job training programs can be classified into three major classes. The following definitions of work experience and internship programs are directly from (ERIC Thesaurus 2001) and the definition of a co-operative education program is based on the following (*ibid.*):

- **Work experience programs** provide on-the-job experience designated to increase the employability of participants. They include are a variety of federal job training, vocational, career education, and correctional programs. Work experience programs are often less structured than co-operative education programs.
- **An internship program** is a program offering supervised practical experience for advanced students or recent graduates in professional fields.
- **A co-operative education program** is conducted between the university and the employer. Co-operative education means work and university experiences under the direction of a teacher co-ordinator, arranged between the university and the employer in such a way as to complement each other in progressing towards an occupational goal. These programs are often more formally structured and supervised than other work experience programs.

1.2 Description of HUT program

The degree regulations of HUT (1995, §17) state: ”The degree shall include from 2 to 10 credits for practical training, as specified more precisely in the curriculum regulations of the degree program[1]. A three-week training period is equivalent to one credit. Practical training may consist of periods of working environment experience and professional training.” In the degree program of CSE, the minimum extent of training is four credits and the maximum extent is eight or nine credits (Antikainen 2001). The maximum number of working hours in the program is about 1000.

The program supports the search for training opportunities. For example, the training advisor provides students with information about open positions, obtained from employers (Antikainen 2001). However, the students themselves are responsible for finding their positions (Yliheljo 2001a, p. 76). Practically all students receive salary for their work.

[1] All MSc programs in HUT require 160 credits in total and the Master’s thesis.

The degree program has about 1600 students and each year between 250 and 350 new students are admitted. In 2001, 216 students submitted an application for training credits (Yliheljo 2001b). A student submits his or her application[2] to the practical training advisor. A testimonial from the employer has to be attached to the application as an appendix. The Department of CSE has no model for the testimonials, but there are some minimum requirements. As a minimum, a testimonial must contain information about the student's duties and the duration of the training. A typical testimonial is written on a single page and contains from two to four paragraphs of text.

The applications are processed as follows. The practical training advisor evaluates the applications, and makes a proposal to the planning officer of the degree program as to which applications should be approved and which not. The planning officer makes the final decision (Antikainen 2001). Thus, the grading is completely taken care of by the administrative staff. The people involved have no degree in CSE or nearby fields, but they have experience in evaluating applications. Training is graded only pass/fail; that is, no numerical grades are given.

1.3 Classification of HUT program

The HUT program cannot be classified as an internship program because it is not targeted only on advanced students. There are no preconditions and younger students can participate, too. The level of co-operation with the companies is low, and therefore the program cannot be classified as a co-operative education program. The name 'work experience program' describes the program best.

[2] The English version of the application form can be found at (Surakka 2001).

2 Results

2.1 Questionnaire prepared by the Finnish Association of Graduate Engineers (TEK)

Every year, the Finnish Association of Graduate Engineers, TEK, organises a training survey. The survey is targeted on all Finnish MSc students of engineering.

In the summer of 2001, the survey was conducted via the World Wide Web. Participation was voluntary and the answers were given anonymously. No letter or e-mail was sent to students, but the survey was advertised in several ways, for example in the monthly TEK bulletin. The questionnaire had 22 questions; the English version can be found at (Surakka 2001). The results are reported in (Muhonen 2001), unfortunately only in Finnish.

For this study, the data from the survey of the summer of 2001 was given to me. 312 students from the degree program of CSE at HUT responded to the questionnaire. At the time of the survey, this was about 20% of the total number of students enrolled in the degree program. I removed from the data 71 students who did not take part in training in the summer of 2001.

The results from the questions are presented in the following tables or short paragraphs. The order is the same as the order of the questions.

Question 1 was ”Sex”. 90.0% were men and 10.0% women (n = 241).

The results from Questions 2 and 3 are not presented here because they were not interesting from the point of view of this study.

Table 1. Question 4: Year of studies in the autumn of 2001.

Year	Proportion (%)
0	0.0
1	3.0
2	11.0
3	19.9
4	17.8
5	18.6
6	11.4
7	7.2
8	3.4
9	2.1
10	1.3
11 >	4.2
Sum	**99.9**

In Question 5, the number of credits on May 31st, 2001 was asked for. The average was 96.1 and the standard deviation 44.1 credits (n = 231). Question 6 asked how many credits the student completed during the summer of 2001. The average was 1.3 and the standard deviation 3.2 credits (n = 229).

Table 2. Question 7: Work during the spring term 2001 (n = 240).

Option	Proportion (%)
I worked more than 400 hours (ongoing part-time or full-time job)	45.8
I worked less than 40 hours (less than one week or not at all)	30.8
I worked 40-400 hours	23.3
Sum	**99.9**

Table 3. Question 8: During the summer of 2001... (n = 241)

Option	Proportion (%)
my work was associated with my advanced or professional studies	68.5
my work was associated with my studies in some other way	22.0
my work was not associated with my studies	9.5
I prepared my Master's thesis	0.0
I studied full-time	0.0
I was doing my military service, I was on maternity leave, etc.	0.0
I did not work or study	0.0
my situation was other than descriped above	0.0
Sum	**100.0**

Table 4. Question 9: I worked in the summer 2001 (you can answer multiple items)... (n = 240)

Option	Proportion (%)
in Finland	97.1
abroad	2.9
for the same employer that I worked for during the spring term	47.5
for more than one employer	3.3

In Question 9, the length of the working period was asked about. The average was 12.7 weeks (n = 82). If a student worked for more than one employer, the number of employers was asked for. In these cases, the average number of employers was 2.2 (n = 9).

Table 5. Question 10: My employer was (if you had more than one employer, base your answer on the longest working period)... (n = 234)

Option	Proportion (%)
an industrial company	37.6
a company in the field of commerce or services	17.1
an engineering, architect's, or consulting office	14.5
a university	7.7
the government or a commercial enterprice of the government	5.1
my own enterprise or company	3.8
a rural district or commercial enterprice of the rural district	2.6
an organization, a foundation, or suchlike	1.7
another option than the previous ones	9.8
Sum	99.9

Table 6. Question 11: The field my employer was in was... (n = 235).

Option	Proportion (%)
IT	56.6
Networking	11.5
Education	4.3
Commerce	3.8
Other services to the business sector	3.0
Information processing services	2.6
Public administration	2.1
The forestry industry	2.1
Building	1.7
The electrical indusry	1.7
The metal industry	1.7
Investment and banking	1.3
Some other field of industry	0.9
Energy	0.4
The chemical industry	0.0
Other than these	6.4
Sum	**100.1**

Table 7. Question 12: The number of employees was... (n = 231)

Option	Proportion (%)
from 10 to 49	30.3
over 500	29.4
from 50 to 249	22.5
less than 10	10.0
from 250 to 499	7.8
Sum	**100.0**

Table 8. Question 13: I got the working position... (n = 235)

Option	Proportion (%)
by contacting the employer directly	28.5
with the help of my other connections	23.4
through the Internet	20.0
when the employer offered the position to me	14.5
through a recruiting service or other employment service	4.3
by answering an ad in the newspaper (or an ad in the "Work Book for the Engineering Students")	3.0
by other means	6.4
Sum	**100.1**

Table 9. Question 14: Getting the working position was influenced most by... (n = 230)

Option	Proportion (%)
my special skills	29.1
my own activity in searching for the position	17.0
my personal connections	14.8
my previous working relationship with the same employer	13.9
my previous working experience	11.7
my achievements in my studies	7.4
my activity in my leisure time interests	2.6
my language skills	0.4
another reason	3.0
Sum	**99.9**

Table 10. Question 15: My main duties were... (n = 238)

Option	Proportion %)
product development and research	36.1
automatic data processing tasks	22.3
planning tasks	15.5
operational and maintenance tasks (also ”boiler suit tasks”)	5.9
education and training tasks	4.6
supervising tasks	4.2
commercial and marketing tasks	2.5
office and administrative tasks	1.7
quality tasks	1.7
other than the previous options	5.5
Sum	**100.0**

Question 16 was about pay and other benefits:

- The average monthly gross pay, without extra payments such as overtime compensation, was 12,447 Finnish marks (1,838 USD[3]) and the standard deviation was 692 USD (n = 152).
- The average gross pay per hour was 11.4 USD and the standard deviation was 5.0 USD (n = 64).
- The average tax value of fringe benefits was 78 USD per month, and the standard deviation was 166 USD (n = 81).
- The average monthly income before tax, with extra payments and fringe benefits, was 2,037 USD; the standard deviation was 811 USD (n = 72).
- The average gross pay per hour, with extra payments and fringe benefits, was 11.5 USD; the standard deviation was 3.7 USD (n = 20).

[3] Hereafter monetary values are presented as USD.

Table 11. Question 17: How well did the salary reflect the duties? (n = 230)

Option	Proportion (%)
Well	50.0
Fairly good	43.5
Poorly	6.5
Sum	**100.0**

Questions 18 and 19 were left out because they were not interesting from the point of view of this study.

Question 20 was ”With respect to the demands imposed on you by your duties, did you get enough guidance?” 81.4% answered that they got enough guidance and 18.6% got too little (n = 226).

Question 21 was left out because it was not interesting from the point of view of this study.

Table 12. Question 22: This summer, was it easier or more difficult to get a training position than last summer? (n = 216)

Option	Proportion (%)
No difference when compared to the previous year	56.5
Easier	33.0
More difficult	10.2
Sum	**100.0**

2.2 Questionnaire that was planned for this study

To get more information, I conducted an additional survey with questions different from those in the TEK questionnaire. The questionnaire had 13 questions. For example, students were asked about their level of satisfaction, and to evaluate the guidance they had received, and also about the effect on their motivation to study. The English version of the questionnaire can be found at (Surakka 2001) and as a paper version from the appendix B.

I e-mailed the questionnaire to 89 students whose training applications were accepted on October 24, 2001. Response was voluntary, and the students had two weeks' time in which to answer. 46 students (52%) responded. I e-mailed no reminder to students who did not answer.

2.2.1 Analysis of non-response

In this subsection, I compare the background information, *i.e*. gender, age, the year of studies, the number of credits and the weighed average of course grades, between the initial 89 students and the 46 students who answered. I estimated the probabilities using hyper-geometric distribution for sex and normal distribution for the other issues.

Sex

First, I calculated the statistical significance of sex, using the following equation (Mitra 1993, page 99):

$$p(x) = \frac{\binom{D}{x}\binom{N-D}{n-x}}{\binom{N}{n}}.$$

In the equation,

- D is the number of nonconforming items in the population (in this case, the number of women)
- N is the size of the population (in this case, the size of the basic group)
- n is the size of the sample (in this case, the number of respondents)
- x is the number of nonconforming items in the sample (in this case, the number of women).

There were five women in the basic group, so $D = 5$. Three of them answered the questionnaire, thus $x = 3$, $N = 89$, and $n = 46$.

The proportion of women who answered the questionnaire is higher than the proportion of women in the basic group. The expected value for the number of women in the group of respondents is $5.6/100 \cdot 46 = 2.576 \approx 3$. So, it is necessary to know what the probability is that the number of respondents was three or more:

$$P(x \geq 3) = P(x = 3) + P(x = 4) + P(x = 5)$$

Let us start from the probability $P(x = 3)$, because it is probably the greatest. In the following, I have substituted the parameters of the equation (Mitra 1993, page 99) with the values:

$$P(x=3) = \frac{\binom{D}{x}\binom{N-D}{n-x}}{\binom{N}{n}} = \frac{\binom{5}{3}\binom{89-5}{46-3}}{\binom{89}{46}} = 0.330241.$$

$P(x = 3)$ is greater than 0.05, and therefore it is not necessary to calculate the values of the probabilities $P(x = 4)$ and $P(x = 5)$. There is no statistically significant difference between the two groups.

Other issues compared

The averages, standard deviations, group sizes, and t-test probabilities of the other issues compared are shown in Table 13 on the next page. Before the table, as an example, the t-test for age is calculated.

I have used the following equation (Milton and Arnold 1995, page 351) to calculate the value t_0 for the t-test:

$$t_0 = \frac{\bar{x}_1 - \bar{x}_2 - \Delta\mu_0}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}.$$

In the equation,

- n_1 is the size of the first sample
- $\bar{x}_1$ is the average of the first sample
- s_1 is the standard deviation of the first sample
- n_2 is the size of the second sample
- $\bar{x}_2$ is the average of the second sample
- s_2 is the standard deviation of the second sample
- $\Delta\mu$ is the difference between the population means μ_1 and μ_2.

The first sample is the basic group and the second sample is the respondents. Therefore, n_1 = 89, $\bar{x}_1$ = 22.820, s_1 = 2.124, n_2 = 46, $\bar{x}_2$ = 22.978, and s_2 = 2.499. I have used the Smith-Satterthwaite procedure (Milton and Arnold 1995, page 351) because the variances are unknown. According to this procedure, ν, the number of degrees of freedom is needed. Let us calculate the value of ν (Milton and Arnold 1995, page 351):

$$\nu = \frac{\left[s_1^2/n_1 + s_2^2/n_2\right]^2}{\frac{\left[s_1^2/n_1\right]^2}{n_1 - 1} + \frac{\left[s_2^2/n_2\right]^2}{n_2 - 1}} = \frac{\left[2.124^2/89 + 2.499^2/46\right]^2}{\frac{\left[2.124^2/89\right]^2}{89 - 1} + \frac{\left[2{,}499^2/46\right]^2}{46 - 1}} \approx 79.2290$$

The value of ν is 79 because it has to be rounded down to the nearest integer.

In this case, the test is two-tailed and the hypothesis is: $H_0: \mu_1 = \mu_2$, and therefore $\Delta\mu = \mu_1 - \mu_2 = 0$. Let us substitute the parameters with the values in the equation (Milton and Arnold 1995, page 351):

$$t_0 = \frac{\bar{x}_1 - \bar{x}_2 - \Delta\mu_0}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} = \frac{22.820 - 22.978 - 0}{\sqrt{\frac{2.124^2}{89} + \frac{2.499^2}{46}}} \approx -0.3659 .$$

The probability for a two-tailed test is $P(|T| \geq |t_0|)$. Let us calculate P at the point $|t_0|$ = 0.3659, using the function TDIST of Microsoft Excel and the value 79 for v:

$$P(|T| \geq |t_0|) = 2 \cdot P(T \geq 0.3659) = 0.7154 .$$

There is no statistically significant difference between the two groups, because the probability is greater than 0.05.

Table 13. Statistical information from the basic group and the group of respondents.

Subject	Basic group:			Respondents:			P (t-test)
	Average	Standard deviation	n	Average	Standard deviation	n	
Age	22.820	2.124	89	22.978	2.499	46	0.7154
Year of studies	4.573	1.976	89	4.739	2.408	46	0.6883
Grades	3.215	0.722	89	3.113	0.713	46	0.4348
Credits	86.006	38.092	89	85.902	38.054	46	0.9880

All probabilities are greater than 0.05 and there are no statistically significant differences between the two groups. Therefore, I believe that the sample of respondents is representative.

2.2.2 Actual results

The results are presented in the following tables or short paragraphs. The order is the same as the order of the questions. The results from Questions 1 and 2 are not shown because they dealt with identification information (name and student number). Question 3 was ”Do you give your permission to use your testimonial for research purposes?”. 93.5% gave their permission and 6.5% did not (n = 46).

Question 4 was ”Which training position are your answers based on?”. The student should write the name of the employer and the working period. Most of the working periods were recent; only two periods (4.3%) were before the year 2001 and one student (2.2%) did not give the working period in his or her answer. On the grounds of the employers’ names, I classified the employers into those in the private and public sectors. 87% worked for the private and 13% for the public sector.

Also, I tried to find out the number of employees from the Web pages of the employers. The results are shown in the following table. ”Not found” means that I did not find the number of employees within a reasonable time.

Table 14. Question 4: Which training position are your answers based on? (n = 46) The numbers of employees were found on the Web pages of the employers.

Number of employees	Proportion (%)
Less than 10	4.3
10-49	6.5
50-249	13.0
250-499	6.5
More than 499	50.0
Not found	19.6
Sum	**99.9**

Table 15. Question 5: Give a general grade for your training position as a whole. (n = 46)

Option	Proportion (%)
Poor	0.0
Satisfactory	4.3
Good	13.0
Very good	52.2
Excellent	28.3
I do not know.	2.2
Sum	**100.0**

Table 16. Question 6: Was the difficulty of the job reasonable? (n = 46)

Option	Proportion (%)
The job was all too difficult.	0.0
The job was somewhat too difficult.	6.5
Yes.	76.1
The job was somewhat too easy.	15.2
The job was all too easy.	2.2
I do not know.	0.0
Sum	**100.0**

Table 17. Question 7: Was the amount of work reasonable? (n = 46)

Option	Proportion (%)
The amount of work was excessive. I felt I was obliged to work much more overtime than I would like to work.	2.2
There was somewhat too much work, but not excessively.	17.4
Yes.	58.7
There was somewhat too little work available. I could have worked more.	17.4
There was all too little work available. I would have liked to work much more.	4.3
I do not know.	0.0
Sum	**100.0**

Table 18. Question 8: How independent your work was? (n = 46)

Option	Proportion (%)
Very independent. In the start, I was told what to do. In the end, I reported the results of my work.	26.1
Sometimes, there were 2-3 weeks periods of independent work.	28.3
On average, the supervisor guided my work once a week.	37.0
The supervisor guided my work daily.	6.5
Every day, the supervisor guided my work several times.	0.0
I do not know.	2.2
Sum	**100.1**

Table 19. Question 9: Did you get reasonable amount of guidance? (n = 46)

Option	Proportion (%)
My work was guided or supervised all too much.	0.0
My work was guided or supervised somewhat too much.	0.0
Yes.	58.7
My work was guided or supervised somewhat too little.	34.8
My work was guided or supervised all too little.	4.3
I do not know.	2.2
Sum	**100.0**

Table 20. Question 10: Give a general grade for the guidance as a whole. (n = 46)

Option	Proportion (%)
Poor	4.3
Satisfactory	15.2
Good	43.5
Very good	17.4
Excellent	17.4
I do not know.	2.2
Sum	**100.0**

Table 21. Question 11: Has training had any effect on your motivation to study? (n = 46)

Option	Proportion (%)
Training has improved my motivation to study greatly.	10.9
Training has improved my motivation to study somewhat.	52.2
No effect at all.	23.9
Training has made my motivation to study somewhat lower.	8.7
Training has made my motivation to study much lower.	0.0
I do not know.	4.3
Sum	**100.0**

Questions 12 and 13 were open, *i.e.* the student could write his or her answer. Question 12 was ”Did training have any effect on how you chose your option, major, minor, or courses? Or did training have any other effect on how you planned your studies?”. 39 students answered this question. The results are presented in the following table. I classified some of the answers into two categories, and therefore the sum of answers is greater than 39. I calculated the proportions by dividing the number of answers by 39. For example, I calculated the proportion of the classification ”The training had no effect” as 24/39 = 61.5%.

Table 22. Question 12: Has training had any effect on how you had chosen your option, major, minor or courses? Or has training had any other effect on how you plan your studies? (n = 39)

Classification	**Answers**	**Proportion (%)**
The training had no effect.	24	61.5
The training had an effect on how I have chosen my courses.	6	15.4
The training had an effect on how I have chosen my option, major or minor	5	12.8
I have slacken my study pace because I work more than earlier.	4	10.3
I try to graduate faster.	1	2.6
On the autumn term, I planned my studies less than before.	1	2.6

The guiding text before Question 13 was: ”According to some studies about training, training during the 1st, 2nd, and 3rd years of study might be especially problematic because students do not get training positions relevant to their own field of study.” Question 13 was ”Describe below if you have had any experiences relevant to this point of view”. 30 students answered this question. I classified the answers and the results are presented in the following table. I classified some of the answers into two categories, and therefore the sum of answers is greater than 30. However, the classification was more difficult than with Question 12 and I could not classify all the answers. I calculated the proportions by dividing the number of answers by 30. For example, I calculated the proportion of the classification ”The student had no problems at all” as 11/30 = 36.7%.

Table 23. Question 13. Training experiences during 1st, 2nd and 3rd year of study. Did the student have any difficulties to get the training position? (n = 30)

Classification	**Answers**	**Proportion (%)**
The student had no problems at all.	11	36.7
The student got the first training place from his or her own field on the summer between 2nd and 3rd year of study.	8	26.7
The student had some or severe problems to get the training place on the summer between 2nd and 3rd year of study, too.	4	13.3
The student mentioned that his or her frends had some problems.	2	6.7
I could not classify the answer.	6	20.0

2.3 Employer satisfaction

I also evaluated the satisfaction of employers on the basis of the testimonials that were submitted with the training applications. Under Finnish law and other work-related regulations, an employee has the right to demand a new testimonial without an evaluation if he or she is not satisfied with the evaluation provided. In practice, a testimonial cannot contain a negative evaluation but it can contain a positive or a neutral evaluation.

From the 89 applications that were submitted on October 2001, the training advisor picked 38 testimonials at random for this study. The training advisor removed some identification information from the copies that he gave to me because this information was confidential under Finnish law. However, the copies I received did contain the evaluations. From these 38 testimonials, I was able to make the following classification:

- 27 (71%) had a positive evaluation
- 7 (18%) had no evaluation but the work still continued
- 3 (8%) had no evaluation and the work ended
- 1 (3%) had a neutral evaluation and the work ended.

Most working relationships were for limited periods of time. If the supervisor had been dissatisfied with the trainee, he or she could have ended the working relationship. Therefore, in the seven cases where the testimonial included no evaluation but the work still continued, the supervisor was probably satisfied with the trainee.

2.4 Credits

2.4.1 Recent graduates

During 2001, 74 students graduated as a MSc(Tech) from the CSE degree program at HUT. I present the statistics about their training credits here. From the data concerning these 74 students, I removed four students because training credits were substituted for them on the grounds of earlier studies. These four students had a BSc degree of a degree from a polytechnic.

The average extent of training credits was 7.8 credits per student. The following table shows how the extent of training was distributed. Most students had eight or nine credits when they graduated.

Table 24. Recent graduates: How many training credits? (n = 70)

Credits	Number of students	Proportion (%)
8-9	58	82.9
6-7	5	7.1
4-5	7	10.0
Sum	**70**	**100.0**

At HUT, training courses are divided into two main categories: working environment training and professional training. Also, there are corresponding course names for international training. Working environment training is such work as does not demand professional studies. Professional training is more demanding, based on advanced studies, and normally supervised by a BSc(Eng) or MSc(Tech). The following table shows how the credits were distributed among different courses.

Table 25. Recent graduates: How were credits distributed? (n = 70)

Course name	Credits	Proportion (%)
Working Environment training	131	23.9
Professional Training	382.5	69.9
Training Report	1	0.2
International Working Environment training	8	1.5
International Professional Training	25	4.6
International Training Report	0	0.0
Sum	**547.5**	**100.1**

2.4.2 During 2001

In 2001, the work experience program produced 1182 credits. In the following table, how the credits were distributed among different types of courses is presented. I have calculated the numbers from (Yliheljo 2001b).

Table 26. Distribution of training credits among different courses in 2001.

Course name	Credits	Proportion (%)
Working Environment Training	230	19.5
Professional Training	908	76.8
Training Report	0	0.0
International Working Environment Training	4	0.3
International Professional Training	39	3.3
International Training Report	1	0.1
Sum	**1182**	**100.0**

2.5 Costs

I estimated the costs of the program using a simplified activity-based costing (ABC) method. ABC is a technique that attempts to increase the accuracy of preparing product or service cost information for management. The approach is focused on overhead costs and the need to develop means to accurately charge these overheads to products or services (Glautier and Underdown 1994, p. 456). My goal was to estimate the cost per credit. I calculated first all major costs during 2001, regardless of whether they were paid for by the Department of CSE or the central administration of HUT. Next, I calculated how many credits the program produced in 2001, and finally I divided the costs by the number of credits.

The costs of the program are presented in Table 27 on the next page. In the following four paragraphs, the largest costs are explained. The costs are divided into three groups:

- The costs that the Department of CSE paid.
- The costs that the Careers Service paid. The Careers Service is part of the HUT central administration.
- The costs that were paid directly to the trainees. The Careers Service also paid these costs.

The training advisor worked part-time and his yearly salary was 5,385 USD[4]. The additional expenses, such as pension fees, were 30 percent. He worked for three degree programs. The Department of CSE paid half of his salary and the Department of Automation and Systems Technology paid the other half. The training advisor shared an office with one other part-time employee and he had a computer for his personal use. Others did not use the computer. (Antikainen 2001) I asked the laboratory engineer about the computer costs. He estimated that one computer costs about 738 USD per year; this sum also includes some maintenance and software costs. (Mård 2001) I have assumed that the Department of CSE paid half and the Department of Automation and Systems Technology paid the other half of the rent and the computer costs.

I got the Careers Service's cost information from Kangaskorte (2001). On purpose, the salaries of individual employees are not shown but all the salaries are added together. I calculated the proportion of the CSE degree program by using the proportion of CSE students to that of all the HUT Master's students. In 2001, HUT had about 11,200 Master's students and about 1,600 of these were from the degree program of CSE. So, the proportion of CSE students was 14%. For example, the salaries of two full-time and one part-time employees of the Careers Service together were 60,543 USD. 14% of this is 8,476 USD.

HUT pays stipends for travel expenses to students who travel abroad for training. Also, HUT pays the salaries of the HUT trainees who complete their training in CERN or Finpro's Trade Centers abroad. This is part of HUT's international co-operation education program. CERN is the European Organization for Nuclear Research, the world's largest particle physics centre (CERN in 2 minutes, 2001). Finpro is an association owned by Finnish companies. Finpro supports Finnish companies by helping them find effective operational models and solutions for internationalisation. (About Finpro, 2001) In addition to its Helsinki office, Finpro has 48 Finland Trade Centers in 38 countries. Finpro employs 370 persons, some, approximately 140, of whom are based in Helsinki and 230 at the Trade Centers. (Finpro's Organization, 2001)

In the table, "Other salaries of trainees" means that HUT paid the salary but the trainee worked outside HUT. These salaries were paid to the CSE students and I got the information from Kangaskorte (2001). Of course, there were also several CSE students that worked at HUT, for

[4] On purpose, the monthly salary and the number of working hours are not presented.

example as part-time assistants, and HUT paid them normally. However, I have not classified these costs as training costs but as part of education or research processes.

Table 27. Costs of the work experience program in 2001.

Subject	**Costs (USD)**	**Comments**
Department of CSE:		
Trainee advisor's salary	3,500	5,385 USD/year + additional expenses 30%. Department of CSE paid half.
Rent of the trainee advisor's office	390	13 m2, 12 months, 10 USD/m2/month, 25%
Trainee advisor's personal computer	369	One computer, 738 USD/year, 50%
Other salaries	143	
Trainee advisor's telephone bills	9	37 USD, 25%
Careers Service:		
Salaries	8,476	14% from 60,543 USD
Office rent	589	14% from 4,207 USD
Computers	413	Four computers, 738 USD/year, 14%
Telephone bills	151	Estimated 1,079 USD/year, 14%
Staff training days	103	14% from 738 USD
Salaries and stipends for the trainees:		
Salaries for trainees in CERN and Finpro	20,424	
Other salaries for trainees	4,429	
Stipends for travelling expenses	3,912	
Sum	**42,908**	

The central administration invested in international training on purpose because the goal of HUT is to increase the proportion of students who work or study abroad for part of their degree. According to HUT's strategy to become more international (2001), "By the year 2005, at least 75% of M.Sc. students will have studied or trained abroad". The following costs arose from international training:

- About 60% of the salaries of employees, rents, and computer and telephone costs of the Careers Service were from international training. I have calculated the proportion from the more detailed information presented in (Kangaskorte 2001). This proportion was 5,509 USD.
- salaries for trainees in CERN and Finpro
- stipends for travel expenses.

Together these costs were about 29,845 USD, which was about 70% of the total costs of the program. However, in 2001, only 44 credits (3.7%) resulted from international training (Yliheljo 2001).

In 2001, the program produced 1,182 credits (Yliheljo 2001). Thus, the average cost per credit was 36 USD (42,906 USD/1,182 credits). The cost per credit was as high as 678 USD for international training (29,845 USD/44 credits) and only 11 USD for training in Finland (13,063 USD/1,138 credits). Thus, international training was quite an expensive form of education and much more expensive than domestic training.

My purpose was to compare the cost information from different kinds of work experience programs in computer science and engineering, but unfortunately I could not find enough information concerning other programs to complete this task. I could, however, compare the cost of training to the cost of ordinary courses at HUT. For example, the cost for a normal basic course in programming is, roughly, from 60 to 100 USD per credit. Compared to this, domestic training is cheap.

3 Comparison to highly-structured program

Ziegler (1987) described the program of the State University of Binghamton. This structured program featured mandatory seminar sessions and students had to prepare up-to-date resumes, keep a daily journal, and submit a paper from eight to ten pages in length. In addition, the academic supervisor visited the student at their work site (Ziegler 1987, p. 58-59). The HUT program has none of these properties. In the HUT program, a student may submit a comprehensive training report and get an extra 0.5-1 credits for it. The degree can contain only one such report, and the credit for the training report is included in the maximum number of training credits (Yliheljo 2001a, p. 75). In 2001, only one training report was submitted (Yliheljo 2001b).

Ziegler presented the results from his survey of student participants and industrial supervisors. For brevity's sake, only the results from two items are presented in the following table.

Table 28. Feedback from the State University of Binghamton program (Ziegler 1987, p. 61).

Item	Not beneficial (%)	Beneficial (%)	Very beneficial (%)
Overall benefit of the program (students' answers)	0	24	76
Overall benefit of the program (supervisors' answers)	0	36	64

In order to compare these results to the results in Table 15, I have classified the answers 'Satisfactory' and 'Good' as beneficial and 'Very good' and 'Excellent' as very beneficial. Thus, it can be assumed that 17.3% of the students of the HUT program felt that the training was beneficial and 80.3% considered it very beneficial.

On the basis of the results in the Subsection 2.3 'Satisfaction of Employers', it can be assumed that at least 71% of the employers felt that the student's work was beneficial or very beneficial to the company. However, here it is not possible to differentiate between the results in the 'beneficial' and 'very beneficial' levels of satisfaction.

4 Conclusions

The testimonials were not the best possible data source for evaluating the satisfaction of employers, because they could not include negative evaluations. The lack of an evaluation does not automatically imply that the supervisor was dissatisfied with the employee. It might be company policy that testimonials are normally or always written without evaluations. On purpose, I did not send an additional survey to the employers, because I was not very interested in their satisfaction. The main purpose of training is students' learning, not the satisfaction of employers.

It is possible that those students who were not satisfied with their training positions did not answer the questionnaire. To verify the results of this study, the HUT program should make submission of a feedback questionnaire a compulsory part of training.

As we have seen, a moderately controlled and unstructured program can be good or at least satisfactory. If the training positions were genuine poor from the viewpoint of learning, this would obviously have a negative effect on students' satisfaction and motivation to study.

Finally, it is worth noting that my purpose is not to claim that the HUT program is better than highly structured programs. Quite the contrary, I believe that such programs are better from most points of view. I am searching for a combination of the beneficial properties of the program presented by Ziegler (1987) and the compulsory program at HUT. A more structured program would probably be a little more expensive than the current HUT program. However, the extra costs would not be significant, because the major part of the total costs, in any case, result from the various supporting tasks and, particularly, from international training.

Acknowledgements

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References

About Finpro, 2001. Finpro. URL: http://hny.net/page.asp?Section=814. The page was red on December 25, 2001.

Antikainen, Tuukka, 2001a. Practical Training Advisor, Department of Computer Science and Engineering, Helsinki University of Technology. Interviews on November 19 and 20.

CERN in 2 minutes, 2001. European Organization for Nuclear Research. URL: http://public.web.cern.ch/Public/whatiscern.html. The page was red on December 25, 2001.

Degree regulations, 2001. Helsinki University of Technology. Approved on June 12, 1995, updated on June 18, 2001. URL: http://www.hut.fi/Study/degree.html.

ERIC Thesaurus, 2001. URL: http://www.ericfacility.net/extra/pub/thessearch.cfm. The page was red on November 10, 2001.

Finpro's Organization, 2001. Finpro. URL: http://hny.net/page.asp?Section=819. The page was red on December 25, 2001.

Glautier, M. W. E. and Underdown, B., 1994. Accounting theory and practice. 5th edition. Pitman Publishing. 784 pages.

HUT's strategy to become more international, 2001. Helsinki University of Technology. URL: http://www.hut.fi/Yksikot/Kehittamisyksikko/strat05.html. The page was red on December 25, 2001. (In Finnish)

Kangaskorte, Tarja, 2001. Planning Officer, Careers Service, Helsinki University of Technology. E-mails to Sami Surakka on November 23 and 30. (In Finnish)

Milton, J. S. and Arnold, Jesse C., 1995. Introduction to probability and statistics. Principles and applications for engineering and computer sciences. Third edition. McGraw-Hill, USA. 811 pages.

Mitra, Amitava, 1993. Fundamentals of quality control and improvement. Macmillan Publishing Company, New York. 664 pages.

Muhonen, Teuvo, 2001. Training survey to engineering students. Tekniikan Akateemiset 21, 9 (December 2001), 48-49. (In Finnish)

Mård, Pekka, 2001. Laboratory Engineer. Helsinki University of Technology, Laboratory of Information Processing Science. Discussion on November 2001.

Surakka, Sami, 2001. Questionnaires about training. URL: http://www.cs.hut.fi/u/ssurakka/papers/training/questionnaires.html. November 21.

Yliheljo, Sanna (editor), 2001a. Study guide 2001-2002. Degree Program of Computer Science and Engineering. Helsinki University of Technology, Department of Computer Science and Engineering. (In Finnish)

Yliheljo, Sanna, 2001b. Result lists from training in year 2001. Department of Computer Science and Engineering, Helsinki University of Technology. Tuukka Antikainen e-mailed these as Excel files to Sami Surakka on November 20 and December 20. (In Finnish)

Ziegler, W. L., 1987. Highly structured internship and cooperative program in computer science. SIGCSE Bulletin 19, 3 (September 1987), pages 56-64.

Appendices

Appendix A Year 2001 Questionnaire prepared by the Finnish Association of Graduate Engineers (TEK)

Every year, the Finnish Association of Graduate Engineers, TEK, collects information concerning the training, types of duties, and salaries of engineering students. The results of the survey are used, for example, to promote the supply of training positions and make out recommendations for training salaries. The answers are always kept totally confidential.

Instructions for answering: Choose the option that describes your situation best or write your answer in the space that is reserved for answering. Choose only one option unless stated otherwise. Those students who have just started their studies, are preparing their Master's thesis, or are working full-time, can answer those questions that are appropriate for them.

1. Sex
- Female
- Male

2. University
- Helsinki University of Technology
- Tampere University of Technology
- Lappeenranta University of Technology
- University of Oulu
- Åbo Akademi University
- University of Helsinki
- University of Joensuu
- University of Jyväskylä
- University of Kuopio
- University of Tampere
- University of Turku
- University of Vaasa
- Other university

3. Degree program or major
- Architecture
- Automation and systems technology
- Automation technology
- Electronics and electrical engineering
- Energy technology
- Chemical engineering
- Real estate economics and law
- Mechanical engineering
- Geomatics
- Landscape architecture
- Education in mathematics and science
- Mathematics
- Materials and rock engineering
- Materials engineering
- Process engineering
- Forest products technology
- Civil (and environmental) engineering
- Engineering physics

(The list continues on the next page.)

- Textile and clothing technology
- Computer science
- Information and knowledge management
- Electronics for communications
- Networking
- Computer science and engineering
- Industrial engineering and management
- Communications and industrial electronics
- Community engineering
- Environmental protection
- Environmental engineering
- Other degree program or major

4. Year of studies in the autumn of 2001: _____
(Real year of studies also for the so-called Nth year students[5].)

5. Number of credits on May 31st, 2001: _____

6. I completed _____ credits during the summer of 2001.

7. Work during the spring term 2001
- I worked less than 40 hours (less than one week or not at all)
- I worked 40-400 hours
- I worked more than 400 hours (ongoing part-time or full-time job)

8. During the summer of 2001,
- my work was associated with my advanced or professional studies
- my work was associated with my studies in some other way
- my work was not associated with my studies
- I prepared my Master's thesis
- I studied full-time (move to the question "Comments and proposals" at the end of the questionnaire)
- I performed my military service, I was on maternity leave, I had leave to take care of my children at home, etc. (move to the question "Comments and proposals" at the end of the questionnaire)
- I did not work or study (move to Question 21)
- my situation was other than described above (move to the question "Comments and proposals" at the end of the questionnaire)

9. I worked in the summer of 2001 (you can answer more than one item)
- in Finland
- abroad. The name of the country was: _____
- for _____ weeks altogether
- for the same employer that I worked for during the spring term
- for more than one employer. The number of employers was: _____

10. My employer was (if you had more than one employer, base your answer on the longest working period)
- an industrial company
- a company in the field of commerce or services
- an engineering, architect's, or consulting office
- a university
- the government or a commercial enterprise of the government
- a rural district or commercial enterprise of the rural district
- an organisation, a foundation, or suchlike
- my own enterprise or company
- another option than the previous ones

The name of the employer: _____

[5] "Nth year student" is part of the university slang in Finnish engineering programs. It means an MSc student who has studied for longer than four years.

11. The field my employer was in was
- the forestry industry
- the chemical industry
- the metal industry
- the electrical industry
- an industry but one other than in the previous options
- energy
- building
- IT
- networking
- information processing services
- commerce
- investment and banking
- other services to the business sector
- public administration
- education
- other than these. What? _____

12. The number of employees was
- less than 10
- from 10 to 49
- from 50 to 249
- from 250 to 499
- over 500

13. I got the training position
- by answering an ad in the newspaper (or an ad in the ”Work Book for Engineering Students*”)
- through the Internet
- through a recruiting service or other employment service
- by contacting the employer directly
- when the employer offered the position to me
- with the help of my other connections
- by other means. How? _____

*) ‘Teekkarin työkirja’ in Finnish. The book is available only in Finnish.

14. Getting the training position was influenced most by
- my achievements in my studies
- my special skills
- my language skills
- my activity in my leisure time interests
- my personal connections
- my previous working experience
- my previous working relationship with the same employer
- my own activity in searching for the position
- another reason. What? _____

15. My main duties were
- operational and maintenance tasks (also "boiler suit tasks")
- product development and research
- planning tasks
- automatic data processing tasks
- quality tasks
- supervising tasks
- office and administrative tasks
- commercial and marketing tasks
- education and training tasks
- other than the previous options. What? _____

16. My gross pay without overtime compensation, shiftwork compensation
and such extra payments was
_____ Finnish marks/month or
_____ Finnish marks/hour

The tax value of the fringe benefits was _____ Finnish marks/month

My gross pay with extra payments and fringe benefits was
_____ Finnish marks/month or
_____ Finnish marks/hour

17. How well did the salary reflect the duties?
- Well
- Fairly good
- Poorly

18. Was the TEK recommendation for training pay discussed when the working agreement was made?
- Yes, and the recommendation had an effect on my pay.
- Yes, but the recommendation had no effect on my pay.
- No, it was not discussed.

19. Was the collective agreement of the field applied to your working relationship?
- Yes
- No
- I do not know

20. With respect to the demands imposed on you by your duties, did you get enough guidance?
- Enough
- Too little

21. Did you use the ”Work Book for the Engineering Students”* or other TEK guide books as a resource when searching for the training position?
- Yes
- No
- I do not know what these publications are

*) ‘Teekkarin työkirja’ in Finnish. The book is available only in Finnish.

22. This summer, was it easier or more difficult to get a training position than last summer?
- Easier
- More difficult
- No difference when compared to the previous year

Comments and proposals: _____

_____

_____

Thank you for your answers!

Appendix B Questionnaire that was planned for this study

Questions about training

You have to answer Questions 1-5 to be able to send the answers. Background information on the study can be found at this page.

Identification information

1. Student number: _____

2. Password: _____ (The password has been e-mailed to you.)

Permission to use your testimonial for research purposes

You have returned a testimonial as an appendix to your training application. The testimonials are confidential and I have no permission to read them. I have to ask permission from each student to read their testimonial.

My purpose is to publish a research article or report on training. These will not contain information about individual students, supervisors, or companies. The report or article will probably have tables of percentages concerning different issues. The permission in question is only for Sami Surakka's study during the autumn of 2001 and for testimonials that are submitted as an appendix for the training applications during the autumn of 2001.

3. Do you give your permission for your testimonial to be used for research purposes?
- Yes, I give my permission.
- No, I do not give my permission.

Actual questions

Answer the questions on the basis of the training position which you applied credits in the autumn of 2001. If your application was accompanied by several testimonials from different positions, answer the questions as they relate to only one position. In any case, write below which training position your answers are based on.

4. Which training position are your answers based on?

Write the name of the employer and the time of training (for example: "Company X, summer 2001)
_____

5. Give a general grade for you training position as a whole.

In this question, your level of satisfaction is especially asked for. The options are:
- Poor
- Satisfactory
- Good
- Very good
- Excellent
- I do not know

It is not mandatory to send the answers to the rest of the questions.

Some trainees like challenging and demanding duties, but some might be frustrated if their duties are too difficult. In this question, ‘demanding’ means how difficult tasks are, not how much work is required. The amount of work is asked later, in Question 7.

6. Was the difficulty of the job reasonable?
- The job was all too difficult
- The job was somewhat too difficult
- Yes
- The job was somewhat too easy
- The job was all too easy
- I do not know

Some trainees like to work overtime, but some do not.

7. Was the amount of work reasonable?
- The amount of work was excessive. I felt I was obliged to work much more overtime than I would have liked to work.
- There was somewhat too much work, but not excessively so.
- Yes.
- There was somewhat too little work available. I could have worked more.
- There was far too little work available. I would have liked to work much more.
- I do not know.

8. How independent was your work?
- Very independent. At the start, I was told what to do. At the end, I reported the results of my work.
- Sometimes there were 2-3-week periods of independent work.
- On average, the supervisor guided my work once a week.
- The supervisor guided my work daily.
- The supervisor guided my work several times per day.
- I do not know.

Question 9 is about the amount of guidance and Question 10 is about the quality of guidance. Some trainees like the work to be independent and not to be guided "too much". However, some trainees are guided a lot but still would like to have more guidance.

9. Did you get a reasonable amount of guidance?
- My work was guided or supervised far too much.
- My work was guided or supervised somewhat too much.
- Yes.
- My work was guided or supervised somewhat too little
- My work was guided or supervised far too little.
- I do not know.

10. Give a general grade for the guidance as a whole.

For example, you were able to understand the advice given by the supervisor, the supervisor treated you in the proper manner, and the supervisor knew enough about the tasks to be able to guide your work well enough. The options are:
- Poor
- Satisfactory
- Good
- Very good
- Excellent
- I do not know

The rest of the questions do not concern only your last training position but are more general:

11. Has training had any effect on your motivation to study?
- Training has improved my motivation to study greatly
- Training has improved my motivation to study somewhat
- No effect at all
- Training has made my motivation to study somewhat lower
- Training has made my motivation to study much lower
- I do not know

For some students, training has no effect on how they plan their studies. However, for some students, training might have an effect on how they plan their studies, for example in the following ways:
- A student liked his or her training position during the summer between the 2nd and 3rd years of study. This influenced how the student selected his or her option and major.
- Training had no direct effect on the selection of the option and major but the student has chosen elective courses of the major that are good for his or her work. In this case, the working relationship of the student is already quite permanent.
- A student has changed his or her option, major, or minor on the basis of his or her training experience.

12. Has training had any effect on how you chose your option, major, minor, or courses? Or has training had any other effect on how you plan your studies?

According to some studies about training, training during the 1st, 2nd, and 3rd years of study might be particularly problematic because students do not get training positions relevant to their own field of study.

13. Describe below if you have had any experiences relevant to this point of view:

Send answers **Clear the form**

URL: http://www.cs.hut.fi/u/ssurakka/papers/training/questionnaireCSE.html
The page was last updated on November 26, 2001.
Sami Surakka, e-mail sami.surakka@hut.fi, updates the page.