Becoming Fully Operational: Employability and the Need for Training of Computer Science Graduates

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***Abstract*— For graduates in computer science and informatics to get employment as IT professionals, there is a need for their education to provide the competence sought after by employers. To become fully operational in the organization, the candidates typically also need to develop their competence there. For a university offering master's degrees in computer science and informatics, it is important to know the employers' view of the relevance of the study programs and what is possibly considered to be lacking. Also, it is essential to know whether the missing part needed to become fully operational should be provided by the university. In this paper, we investigate these questions by asking employers of master students in IT. A combination of in-depth interviews and a survey is used. Analysis of the findings shows that employers overall find the candidates' competence to be adequate and that the time needed for in-house training is acceptable. We argue that collaboration between university and industry is essential to this success, pointing to a set of key steps in the process from entering a study program to becoming fully operational in work life.**

Keywords*— *Employability, Training, Higher Education, Computer Science, Graduates

I. INTRODUCTION

Being a new employee in an organization entails becoming a member of a community of practice [1], gradually developing expertise, and becoming more proficient in the organization's work practice. This is a learning process that can happen through formal and informal training. Workplace learning is always partially informal [2] and happens by working and learning from experience and collaboration with colleagues, but formal in-house training can also be provided. An employer recruiting new candidates from higher education (HE) expects to have candidates with an adequate starting point for this learning period, both the time to become "fully operational" and the continued and indeed life-long learning that follows.

Considering computer science and information technology graduates, the candidates usually get hired quickly after graduation, entering a currently favorable work market. At the same time, companies spend substantial resources on training the candidates to become fully operational. For the HE institutions, it is of great importance to know whether the candidates have the right competence upon graduating and whether the following months and years in work-life make them the IT professionals needed by employers and society. Interesting questions to explore include: What does it mean to become fully operational? What are graduates trained in, and how long does it take to become fully operational within a company? Does the graduate lack any competence which could have been taught in HE?

Employability could be understood as the skills, knowledge, and personal attributes needed to get a job [3]. In this article, we will look at employability from the meso level, from the industry and HE perspective [4]. Competence is in this article understood as "ability to use knowledge, skills and personal, social and/ or methodological abilities, in work or study situations and in professional and personal development" [5]. When we talk about students/graduates "getting a job," we refer to relevant, normally full-time employment in the industry or public sector, starting after completion of the university degree. Finally, for simplicity, we use the term "industry" to refer to employers in commercial businesses, public sector as well as NGOs.

In Norway, there is a relatively low unemployment rate in general (3,9% was unemployed in 2018) [6]. Within the IT-field, we have a high and increasing demand for software programmers and application developers, as well as system architects and analysts, while other IT graduates seem to have some challenges getting a job [7]. According to this report, there seems to be a mismatch between employer needs and the qualifications of the unemployed graduates. Accordingly, coordination between the employers and the HE sector is needed to make sure that the graduates get the qualifications sought after by employers [7]. A study of Norwegian bachelor students in a college in southern Norway found that 26% of the IT students get a relevant job without applying at all. Including students who sent between one and ten applications before they got a job, the employment rate is 78% of all IT graduates [8], which shows that IT graduates are in demand in the labor market.

In the hiring situation, online presence could be important for IT graduates, especially in online communities related to the field of the graduate, e.g., GitHub or StackOverflow [9]. Visible achievements in such communities can give employers an impression of the graduate's coding skills. Hobby activities, such as having own programming projects, and staying updated, are essential, providing an opportunity to demonstrate that the graduate can apply the knowledge gained in HE [10]. Also, extra-curricular activities like organizing events in relation to student societies or other organizations might increase the chances of getting a job and also contribute to learning new skills outside of the university [11].

Academic achievements are, of course, a key factor in the hiring process. In Norway, larger companies hiring IT professionals tend to focus on academic qualifications first, using grades as a convenient way of selecting the most promising subset of the candidates for interviews [12]. Personal qualities are considered next. Smaller IT companies, on the other hand, tend to start with personal attributes, to find out whether the person fit socially in the company, before looking at the academic achievements [12]. Academic achievements in the form of grades generally influence the chance of employment and the salary of the graduate [13].

978-1-7281-0930-5/20/$31.00 ©2020 IEEE 27–30 April, 2020, Porto, Portugal
2020 IEEE Global Engineering Education Conference (EDUCON)

Personal attributes are also an essential part of employability. A job-seeking graduate and a potential employer often have a different impression of the graduate's skills. Where employers often see leadership skills, emotional intelligence, and professionalism missing in the candidates considered for employment, the graduates believe they possess these skills [14]. Furthermore, the candidates' communication skills (primarily written) are reported by employers as frequently too weak [15]. In addition to the communication skills, newly hired graduates also seem to lack collaboration skills, technical skills, cognition, and orientation skills [16], and it is not the lack of "experience in programming, design or debugging" that are causing problems for newly hired graduates, but the social conditions at the new workplace [16]. Social skills are a "much stronger predictor of employment and wages for young adults age 25 to 33 in the mid-2000s compared to the 1980s and 1990s. In contrast, the importance of cognitive skills has declined modestly" [17]. When searching for employment, skills like project experience, and problem-solving often decide whether a graduate get a job or not [18].

Companies generally expect to take responsibility for teaching newly hired graduates' specific requirements for their job, because that it is almost impossible to define what requirements the professional areas have towards graduates in any generic sense, even only when focusing on one requirement like writing [19]. Even within one company, there is no agreement about what competence is most important [20].

Collaboration between the industry and the university makes them understand each other and could contribute to teaching graduates valuable skills through guest lectures and real-world insights to the students [21]. However, there is a need to strike a balance between addressing the industry's current needs, e.g., with regard to specific technologies and methodologies, and the need to provide students with core knowledge and skills that make them quick learners out in the workplace. Thus, universities should not facilitate employability too much, making the university inflexible because of too close tailoring to the industry [19]. One must remember that a university is a place for achieving theoretical understanding and are not vocational schools [22]. Some skills can also be hard to achieve through courses in a university setting (e.g., working with clients or work-life experiences) [18], and the educators should, therefore, consider telling the students what skills they do not learn in the university so that they could find other areas to learn these skills [23].

A significant body of research argues that we need to educate students to become employable, that they have the right competence needed in the labor market. Often this is measured through the number of graduates getting a job. In the field of computer science in the Nordic countries, we currently have a shortage of people, and there is a high demand for graduates with Computer Science degrees. Given this situation, it is interesting to investigate the time and effort needed in the organizations to make the graduates that are available fully operational, and we will in this paper attempt to provide answers on a number of questions in this regard;

- Do employers hire graduates who do lack knowledge needed in the company, and use more resources to train them to possess the needed competence, or are we educating students that fulfill the requirements from the industry?
- How long time do companies use for training graduates before they are fully operational, and how is the time used for training graduates to become fully operational perceived from the employer perspective?

To investigate this, we have looked at employability and the need for extra training for students from two specific study programs. In the next section, a description of this case is provided. We then present our research method before the results of the study are provided. An analysis is presented in the discussion section. The paper ends with a conclusion and an overview of related work.

II. Case

The master study programs looked at in this study include one in computer science (MCS, 5 years integrated master) and one in Informatics (a 3+2-year program).

In the MCS program, the first two years consists of fundamental courses in computer science, math, statistic and some courses in physic, philosophy and science theory. In the third and fourth years, the students specialize in four main areas (some of which are further divided into subfields):

1. Software: How to develop and use computer systems in organizations.
    a. Software Engineering
    b. Information Systems
    c. Interaction Design and Game Technology
2. Databases and Search: How to efficiently search databases and develop search engines
3. Artificial Intelligence: Methods and techniques for decision support and learning machines problem solving
4. Algorithms and Computers: Methods and techniques for developing high-performance systems.
    a. Algorithms and High-Performance Computing
    b. Visual Computing
    c. Computers and System Software

This structuring into specializations reflects the traditional way of organizing of the Computer Science field covering the CE, CS, SE, and IS area of ACM Curricula [24], while also meeting the continuously developing needs of industry and society. The popularity of the specializations among the students reflect current trends; for instance, the number of applicants for the artificial intelligence specialization currently exceeds the limit set by the department.

The Informatics master program offers students who already hold a Bachelor of similar possibilities (except CE) to specialize in their fourth year, with some mandatory and some elective courses within each of four specializations.

For MCS and Master of Informatics students alike, the fifth year includes the Master thesis, which is often undertaken in collaboration with an external client from industry or public sector. While the MCS is more structured than the Informatics program, the programs have significant overlap in practice and are generally considered by employers as equal with regard to the candidates' level of competence. The Master of Informatics and especially the MCS program have very high admission requirements, MCS is generally being regarded as the most attractive master program in computer science nationally. There are approximately 140 MCS students and 100 Master of Informatics students in each cohort. The university also offers other computing-related study programs (e.g., telematics, cybernetics), which altogether makes the

university the biggest national provider of master level IT education.

Collaboration with industry and public sector (for short in what follows: 'industry') happens in different ways, e.g., by having external stakeholders take client roles in student projects (e.g., in the context of research projects), be course examiners, take part in study program development, and visit as guest lecturers. These activities ensure that the study programs keep up to date with the industry's needs and simultaneously lets industry benefit from the competence and recruitment potential inherent to these activities. To support close collaboration with relevant partners, the faculty has organized a formal network of key industry partners that can be involved in an advisory role when there is a need to gauge the needs and concerns of industry, e.g., when study programs are evaluated and changed. The network also arranges events offering industry contact, especially for students.

Another key stakeholder in the university-industry collaboration is the student associations. The two associations for students in the master programs in our study collaborate with industry on events (presentations, fairs, excursions, courses) that typically have recruitment as the main objective, but also increasingly offer a technical content to attract interested students and inform them about current trends and possibilities in work life. These activities complement the industry collaboration of department and faculty staff.

An important part of the picture when considering employment and employability of the candidates from the two master programs addressed in this paper is that the work market is currently very favorable for the candidates. The students often get their first regular job early in their last year. In reality, the recruitment process often starts earlier, as the industry (e.g., consultancy companies) frequently employ students for summer jobs after their fourth year, using the internship as an occasion to evaluate the candidates before possibly offering regular employment. A survey-based study showed that 87% of the master students had secured a relevant summer job by the time they finish their 4th year, and 64% of the master students report that they had secured such a job already in their 3rd year [25].

The competition over good candidates over many years lead to a tendency to have students sign contracts for regular employment earlier and earlier. As recruitment processes create stress and potentially interference with students' focus on their studies in their fifth year, the student associations have made a deal with employers that the employers get access to the students through the channels provided by the student associations provided they do not start the recruitment process until October.

III. Method

The study presented in this paper used an exploratory research design [26] where findings from qualitative interviews were used as a basis for designing the survey questions.

The sampling approach included defining the sample universe and sample size, deciding on a sampling strategy, and recruiting the participants, which are the four main points in the guide to sampling in interview-based qualitative research proposed in [27]. Our sample universe and inclusion criteria for the interviews were that the informant should: (1) have hired students from master's programs mentioned above, (2) be located in the same country as the master's programs, (3) work closely with students from the master's programs, (4) be a part of the business network presented above. For the survey, the inclusion criteria were that the company should: (1) have hired students from master's programs mentioned above, (2) be answered by a leader for IT employees or someone else involved in hiring new IT employees.

The sampling strategy for the interviews was convenience sampling, where a sufficient number of respondents within the sample universe were interviewed. The survey also had convenience sampling to invite organizations/persons within the sample universe, combined with purposive (quota) sampling to cover two strata (private and public sector).

The interviews were held by two teaching assistants (TAs) using an interview guide designed by the main author. The questions targeted a) background and how familiar informants were with master's program, b) skills, knowledge and personal attributes a graduate have/should have/lack, and c) graduates' need for training and their expectations about work life.

A total of 16 e-mails were sent out to ask for an interview. We received 11 answers, and six respondents were willing to participate. Two of these respondents were from the same company but represented different roles and organization units, and they were both included in the sample as it was considered likely that they would provide different perspectives.

The survey was conducted in collaboration with the study program leader. He needed data for a formal evaluation of the study program and saw the study as an occasion to combine data collection for education research and study program evaluation. The overarching questions to be addressed in the evaluation were how employers see the competence of our candidates and whether there are aspects of our study programs that should be improved. The interview data were also used to inform the survey questionnaire, firstly to make sure the surveys covered and thus followed up on the questions explored through the interviews, second to go more explicitly into an interesting theme from early analysis of the interview data: the gap between graduates' competence after completing the study program and the competence needed to get fully operational in the organization. The survey questions covered a) background and the informant's familiarity with the master's programs in question, b) education (competence gained through the study program) and training (competence gained after being employed in the organization), and c) employability (which positions newly hired graduates get, what are their strengths, other possible candidates for the position). The survey was implemented in SelectSurvey and tested out with several faculty members and iteratively improved. The answers were anonymous. Information about the study and a checkbox to give informed consent was included on the first page of the survey.

The second author and the study program leader decided to send out the survey to all members of the business network. The survey was additionally sent to a number of companies that have previously been hiring from the study programs. In total, 50 invitations for the survey was sent out, leading to ten respondents. The recipients of the email were encouraged to answer the survey or forward it to someone in their organization who was the leader for new employees or who was a recruitment manager. One problem with this way of

sourcing respondents is that it made it hard to know who answered, and targeted reminders to individual respondents were not possible. Accordingly, no reminders were sent out.

We have done a thematic inductive analysis, where we followed Braun and Clarke's six phases of thematic analysis. The analysis was data-driven, where the research questions were developed from the codes [28].

IV. Results

We will here present the main results both from the interviews and the survey and will clarify the source under each point.

Most students from the master programs do seem to get the same type of initial position when they start working, according to the data in the interviews and survey. Programmer, system developer, or software developer is the central positions mentioned. Other positions graduates are recruited for is researcher, data scientist, or android/web developer. There seems to be a common understanding that they only work in these positions for some years, before entering another role. Informant 1 explains: "*They have been recruited as a software engineer. Everyone starts in this position. [...] and then, after some years, it could be 3-6 years, things start to happen. You get promoted to an architect or team leader, project leader, or something like that*".

To become employed, graduates need to have a set of skills, knowledge, and personal attributes. In some cases it seems that companies could hire a graduate that do not have the requested skills and knowledge, as long as they had appropriate personal attributes that make the graduate sought after, e.g., lifelong learning skills, problem-solving skills and so on, it is worth hiring the graduate and use more resources to train her/him to become fully operational.

A. Skills, knowledge and personal attributes

Several of the informants mentioned that they do not expect a graduate to have in-depth knowledge, but a broader knowledge base, which the graduates can build on during their training. According to the informants, this knowledge base should contain two or more programming languages, math, algorithms and data structures, knowledge of security issues, and how to deal with them, UX, database, cloud development and knowledge on how to manage version control. Some informants also point out that graduates should know different paradigms for software development and understand different frameworks (Informant 1, 3, 4).

Other skills considered necessary by the informants are problem-solving skills, teamwork skills, communication skills (in different languages, and the ability to describe a technical problem to a nontechnical person), understand that they are a part of a bigger system, and the ability to think holistically. Also, lifelong learning seems vital for all informants, based on the argument that graduates should be able to acquire new knowledge fast since technology changes rapidly. Due to this continuous development in technology, graduates should be able to adapt and adjust to changes quickly.

A graduate's interest in the field was mentioned as a very important factor for hiring. Graduates should "*convey their interest in the field, an interest in developing themselves in the field in which they have taken their education*" (Informant 1). Further, it seems that the easiest way of deciding whether a graduate has this interest or not is by looking at the projects or hobbies in which they have been engaging. Otherwise, the graduate has to convince employers during the interview that they have the interest and the motivation needed.

When asked about which skills and knowledge the graduates usually lack, most of the informant's answer "nothing specific." Two of the informants say they are happy with the knowledge and skills the graduates possess, but that they use some time to learn agile development properly. In the survey, the participants are asked: "*what additional knowledge, skills, and personal attributes are needed for the candidate to become fully operational in your organization?*". Teamwork (cross-disciplinary and/or global teams), communication (with non-technical persons or persons from other fields) and agile development is the topics that are mentioned most. There are no trends regarding the size of the companies and their answers.

B. Importance of grades

How much emphasis a company puts on grades seems to differ; Some are more focused on getting graduates with experience and argue that "*you could be a graduate with extremely bad grades which turns out to know a lot, but that the study situation is not entirely suitable for this person. Some of our best people have little or no education. [...] the reason [for this is] that we sought after graduates with extreme interests in programming and development, and we think that this [interest] is expressed through experiences*" (Informant 5). Others are mentioning motivation and internal drive for the field as important factors when hiring graduates (Informant 1, 2). Some are more focused on the grades, arguing that a graduate should have a high-grade average, but that they allow some bad grades - but that the graduate needs to be able to defend or explain why they have got them (Informants 1, 4).

Some of the informants argue that which courses a graduate have is important, and that they need high grades in the courses relevant for the company (Informants 4, 6). One of the informants does seem to disagree on the importance of personal attributes, arguing that there is an advantage having a hobby outside of the education, but that they "*do not hire people based on their personality*" (Informant 6).

C. What do they learn in their company training?

The companies report a variation of what graduates need training in to become operational in their company. Some inform that the graduates learn "a lot about the company, our strategy, visions. However, they also do some project work, which is closer to software development" (Informant 1). Others mention teamwork and use the time to define the new employees' role, responsibility, and contribution (Informants 2, 4) and tools to use for version control, testing and quality assurance (Informant 4). Also, the quality of the product (Informant 2), and how to deal with large, complex systems with a large user group, and significant risks (Informant 4) are a part of the training in one of the companies in the study. One company inform that they run a boot camp in embedded programming to make sure that all new employees are on the same level (Informant 6).

In the survey, we see that smaller companies do not have a training program, but that the training happens while the new employees work, and that they get close supervision by the nearest leader. The middle or bigger companies do seem to have an onboarding program taken by all new employees. Here graduates learn about the company - their rules, values, culture, and history. Some companies offer additional courses

TABLE 1: COMPANIES FROM THE SURVEY SORTED AFTER NUMBER OF EMPLOYEES (51-250, 251-1000 AND 1000<), TIME USED FOR THE GRADUATE TO BECOME FULLY OPERATIONAL, AND IF COMPANIES THINK THIS IS ACCEPTABLE TIME FOR TRAINING

Number of employees	Company	Private or public business	The time before fully operational	Acceptable time?
51-250	F	Private	2-4 Mos	As expected
	H	Private	1-3 Mos	?
	I	Private	6-9 Mos	As expected
251-1000	A	Private	?	As expected
	D	Private	3-6 Mos	As expected
	E	Private	12 Mos	As expected
1000<	B	Private	6-12 Mos	As expected
	C	Private	6-24 Mos	Too long
	G	Public	12 < Mos	Too long
	J	Private	6-18 Mos	As expected

for the graduate to attend depending on which competence they lack and where they will start working. Company G has answered that the graduates they hire usually do not need any additional competences to become fully operational, and that their training only includes "getting to know the company"-topics.

D. Time to become fully operational

There are different opinions on how long it takes to make a student fully operational. In the survey, the answers differ from "1-3 months" to "6-18 month", and two has answered "1 year" or "at least one year." We see that companies with fewer employees report a shorter training time for new employees. The informants also got a question regarding their view on the training time, where they could choose between three options: "Too long," "As expected," or "Surprisingly short." The companies report the time before graduates become fully operative as ranging from 6 months to two years (see table 1). Company C and G think the usage of time is too long. Company G reports that graduates mainly need to learn about the company during that time. If so, there would be understandable that company G thinks 12 months and above are too long time for the graduate to become operational. Most of the informants answered that the graduates used the expected amount of time on their training to become fully operational (see table 1).

Also, some of the interviews discuss the time it takes to get fully operational: "*... the new employees join a program that takes 3-4 years. Internal training, training, much traveling, you learn about the company, how we work. We are a big company, 100 000+ employees. It takes 30% of your working hours to get through the internal training over 3-4 years. Then, after finishing this, they work 100% on a project*" (Informant 1). Another informant argues that each employee needs a different amount of time to get fully operational.

In Figure 1, we provide a view of the process a person goes through, increasing their competence to becoming fully operational. When starting at HE, students have some competence from high school, which often are shown through their grades. The admission criteria at HE filter out the best ones and offer them a study place. Students' competence is increasing during their education, and by the time students graduate, they are Employable graduates. This state lasts until the graduate gets hired, which is often right before graduation, or directly after, depending on which study program they graduate from. After hiring, they have a short training program, which increases their competence enough to become fully operational employees.

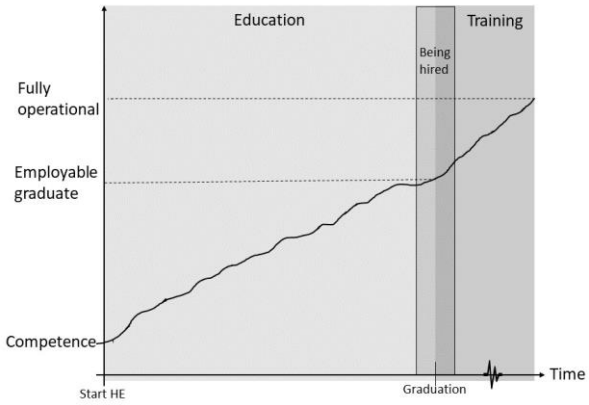

Figure 1: Illustration of a graduates increased competence from starting higher education until fully operational in a company

Although not shown in Figure 1, as described in the description of the case, one can look upon recruitment to start before graduation through summer jobs. Although the importance of summer jobs for recruitment is for students before the last year, there seems to be not only between 4th and 5th year summer jobs are provided. Informant 1 explains: "*We have had people from first-year computer science here. They have been here for 2 or 3 summers in a row. [...] I have tried to go in very early [to recruit students], between first and fourth year*". The informant state further that summer jobs is perceived as a long interview for a position at their company.

V. DISCUSSION

A. Lack of competence of graduates

Previous research shows that the IT industry considers several skills important when hiring new employees. This includes problem-solving skills [18], communication [15], [16], and teamwork skills. Our findings are consistent with these studies.

Considering what skills our newly employed graduates may be lacking, none of our informants brings up problem-solving skills. This is important because the lack of such skills may be preventing a graduate from getting a job [18]. It should be taken into account here that candidates who have not succeeded in getting employment in the informant organizations, might have been found less apt at problem-solving. However, the fact that some of our informants represent large organizations employing numerous candidates each year supports the impression that our graduates have the necessary problem-solving skills. The informants also talked about a knowledge base that they expected the graduates to have. This knowledgebase consisted only of technical

knowledge or specialized knowledge related to their field; soft skills were not mentioned at all.

Grades are, from the point of view of the HE institution, intended to reflect the candidate's level of skills as described in the learning outcomes of the courses and study programs. It is known from the general recruitment practices of large consultancies that grades serve as a key mechanism for filtering out candidates for personal interviews. The quote "*We do not hire people based on their personality*" (Informant 6). from one of our informants may be illustrative of this approach. The technical interviews and case assignments increasingly used by employers serve to assess the candidates in essential ways with no connection to (although possibly a correlation with) grades.

To some of our informants, grades seem to be of less importance than the candidates' motivation and work capacity, e.g., as programmers, computer scientists, and/or project managers. What was mentioned frequently by the informants, is the candidates' interest in the field. This is consistent with previous research (e.g., [10]). Projects related to volunteer and hobby activities demonstrate that the candidates have the skills as well as the drive and dedication sought after by many employers. However, in the case of having mediocre or bad exam results, a candidate needs to be able to explain the reason for these results.

Answering about knowledge and skills found to lack among the graduates, several respondents mentioned agile development. This is a topic currently covered in the study programs, but there seems to be a gap between graduates' knowledge and what the industry expects from them. Along the same vein, several informants mentioned that additional knowledge and skills in teamwork and the ability to work in cross-disciplinary and/or global teams are needed to be fully operational in their organization. Seeing these areas in connection, there is a potential for the university to address all of them through suitably designed student projects in agile development. Such projects can deliberately incorporate challenges and learning objectives related to cross-disciplinary [29] and/or global [30] teamwork, preferably with an external client to provide authenticity. On the other hand - all of this is already covered in existing project courses, which indicates that the university is already providing the right type of thing but might consider improving it and/or providing more of it. The fact that the informants in our study generally considered the time for in-house training acceptable can be seen as an argument to leave the "last finish" of training in agile development, teamwork, and cross-disciplinary work to the real-work context of the employer.

Two informants (company A and C) report communication skills missing in the graduates. They specifically refer to communication with non-technical persons and cross-disciplinary communication, which could indicate that communication with technical persons within the same field might be at an appropriate level. Since only two companies report communication skills as lacking, it could imply that all other companies are pleased with the level of communication skills graduates have. Alternatively, as Moore and Morton argue, skills in written communication are often so company-specific that the companies expect to train the graduates in it when hired [19].

In seeing different views on desirable skills in new candidates and the significance of grades in employing them, we should also take into account that different skills are needed for different roles in different types of organizations, e.g., technical experts, scientists, and customer-oriented consultants. These differences mean there may be different reasons to consider grades in general and grades in specific types of courses in particular. Also, in the current work market, there is strong competition over the best candidates, which means it can be harder for smaller companies with fewer resources for marketing and recruiting, e.g., startups, to compete for the best candidates. Having less visibility and perhaps less appeal to larger groups of students means there may be fewer candidates to select from, which makes getting the right person with the right motivation and practical/technical skills more important, e.g., as demonstrated through a technical interview.

It is a key finding in our study that most of the informants and participants answered "nothing specific" when asked about what skills are lacking in the graduates. This might indicate that the graduates that get hired do possess the skills needed for the companies. It might also indicate that the companies are aware of some shortage of specific skills but accept this and include it in their training period. The findings should, in any case, be considered in light of the current high demand for computer science graduates: there is a chance that employers would respond differently had the work market been different.

B. Time used for training and the perception of this time usage

The findings show that there was a difference between small and large companies when it comes to time used for training of newly hired graduates. The smaller companies explained that the new graduates do not go through a generic course or training program for all newly hired graduates, but that they start working from day one, closely supervised by a mentor. Since small companies usually consider personal attributes before looking into the technical side [12], it is a bit surprising that their newly hired graduates do not need training in specific technologies and/or methodologies, but start working on a project immediately. On the other hand, small companies might not have the resources to pay for a worker without him/her contributing to the workload.

Large companies, on the other hand, often provide a generic training program for all their newly hired graduates. Due to this training, the time a graduate needs to have before becoming fully operational is much longer compared to the smaller companies. Importantly, this in-house training takes place in parallel with the new employee's work in the organization; not being "fully operational" does not mean not being operational at all - this is a gradual process. On the other hand, this could show that the question is perceived differently than intended, that the graduate does indeed learn more than just about the company or that the graduate needs some practical experience to be able to use the competence he/she possesses.

The other companies in the survey answered that the time used to become fully operational was "as expected." This could indicate that the graduate has the right competence needed for the companies and that the companies do expect to train their newly hired graduates in job-specific knowledge and technologies before graduates become fully operational [19].

C. The process form education to becoming fully operational

As explained in the Case section, there is a significant collaboration between the university and industry to ensure the relevance of the study programs in question. We believe the close collaboration between industry and university, including the student associations, to be essential in explaining the overall satisfaction with students' skills seen among the employers in our study.

We see five key steps in the process of becoming fully operational: 1) Admission to the HE programs, 2) Introduction to the industry through HE, 3) Summer jobs, 4) The recruiting process, and 5) Training in the industry. In what follows, we will elaborate on these steps.

Based on the number of employed students, that the industry does think that the time used for training is as expected and that several of the companies think the graduates have the expected competencies needed to get a job, one could call the process from education to fully operational graduates in a job as successful. The process consists of five steps that are interconnected and related:

1) Admission requirements for the HE program

Due to the popularity of the study program, the admission requirements are high, making it hard to enter. This is affecting which students that enroll in the study program, and how dedicated they are for learning. Highly competent students, when they arrive at a study program, gives highly competent students when graduating from a study program [31]. The admission requirements do affect the competence of the graduates, making them more competent compared to study programs with lower admission requirements.

2) Introduction to the industry through HE (guest lecturers, arrangements)

Close collaboration with the industry leads to guest lectures and arrangements for students held by the industry like career days, presentations of the industry with additional dinner and drinks, courses held by the industry for the students, and speed interviews for summer jobs. The collaboration makes students get to know the companies before they apply for a job at them and get a closer understanding of which company that matches students' interests and values.

3) Summer jobs

Several of the companies have opportunities for the students to get a summer job, which makes the student get to know the companies well, and the companies have an opportunity to get to know the students well.

The summer jobs give the students experience in their field, as well as they will develop an understanding of how work life will be. A summer job could also provide students with additional skills not provided by HE [17]. On the other hand, students who did not get a summer job might be negatively affected: both in terms of not having the experience to put on their CV, but also their self-esteem might be affected.

4) The recruiting processes

The recruiting process starts already from the first time the industry meets the students. Through courses and guest lectures held for the students, companies might seek out talented students and make them apply for the job early. Several informants state that they see summer jobs as a long interview for a position in their company. This could make the student hopeful that he/she will get a job, and perhaps mentally "lock" themselves to one firm already from the first year. Recruiting students early or hiring students before graduation might affect their motivation in positive (I have got a job, I would not disappoint them) or negative (I got a job, now I can relax and do not worry about the grades) direction. This needs further research.

If the student has not been recruited through summer jobs, several of the companies report that they have interview rounds with case and technical tests.

5) Training in the industry

After getting a job, students get a period of training within the company. Some have intensive courses everyone must attend, while others have a more learning-through doing method as described further above.

D. Effect of collaboration

An example from our study illustrates some of the effects on the collaboration. One of the respondents in our study is a company that develops hardware and software close to the hardware, thus representing a particular niche in the market. The university understands the industry needs, and the master programs in IT offer a specialization that meets the needs of the company by teaching the students embedded programming. The company is pleased with this, but they need more people than there are graduates with this specialization, so they also hire other students. The industry has an understanding that the university could not teach everyone embedded programming and has therefore developed a course in this subject to be sure that all newly hired graduates have the same level of skills within embedded programming. If the supply of graduates with this specialization from the master program had matched the demand from the work market, the company would not have to offer their own training course.

VI. Conclusion and Future Work

The study presented in this paper shows that even though there is a high demand for IT graduates, companies do not hire students if they lack the right competencies. Employers report that they are pleased with the competencies graduates possess when hired, which could be a result of a recruitment process that is complex, long-term, and based on close collaboration between the university and industry. We have shown that the recruitment process is complex, starting from the students' first year at the university.

The careful selection of candidates may also have an impact on the duration of the training period, which is typically seen by employers as acceptable. Collaboration with the university gives the industry a better understanding of what training they need to provide to close the gap between the competence to be expected from a candidate at graduation and the one needed for being fully operational in work life. The collaboration between employers in the IT industry and the institutions educating IT candidates thus results in a clarification of expectations regarding employability.

Acknowledgement

Thanks to K. A. Strand, B. Deraas, and H. Løkensgard.

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