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TLIC PAPER

Career Paths and Talent Management: A Study on Postgraduate Studies of Finnish Engineers

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ABSTRACT

Tight competition for jobs and skilled professionals has increased the need for talent development among both employees and employers. Employees must take care of their own skills to secure their position in the labor market and companies, in turn, must develop both the skills of their current employees and to attract new professionals. This paper focuses on the talent development of Finnish engineers, and it especially analyzes when and to what kind of master's programs they apply to during their careers. First, it explores the potential differences at the application ages of the undergraduates applying to master's programs offered by universities and polytechnics (UAS). Second, it investigates variations between the engineering management programs and discipline-specific programs of the UASs. Findings of the study indicate that the age distributions for the master's programs in universities and UASs differ significantly and the UASs programs seem to be an important form of education for engineers in employment. Results on different kinds of programs indicate that both engineering management and discipline-specific master's programs will be needed also in the future to fulfill the different kinds of career paths of the engineers.

KEYWORDS

engineering, career paths, talent management

1 INTRODUCTION

Changes in working life and global development trends pose significant challenges and reform needs for professionals in various fields. Skills and knowledge beyond the initial education play an independent and sizable role in employment and this highlights the importance of lifelong learning and career planning [1]. This also applies to engineers who need to follow the rapid technological developments in their field and to adapt to changes in organizational structures and new trends in management and leadership.

Lifelong learning can materialize as formal or non-formal education. Formal education involves organized learning within established institutions like

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universities, colleges, or professional training programs. It usually results in recognized credentials, such as degrees, diplomas, or certifications. Non-formal education instead refers to learning outside traditional educational settings, often emphasizing practical skill development. This includes workshops, seminars, online courses, self-paced learning modules, professional development programs, and on-the-job training.

Talent and skill development is no longer only a matter of employees, but it has great importance also among employers. As competition for the best talents has intensified, many organizations have adopted specialized talent management and development programs to improve not only the skills of their workforce, but also to attract new and retain their current employees. For these plans to achieve their objectives, they must be able to strike a balance between the individual career aspirations of the employees, the opportunities offered by the organization and the strategic goals of the company.

This paper focuses on the formal training of engineers during their careers, and in particular what kind of master's programs they apply to when they are already in employment. This study examines the issue from the perspectives of both the dual model of the Finnish higher education system and various degree programs. The degree program specific analysis is based on a division between engineering management (EM) and discipline-specific postgraduate education.

The structure of the paper is as follows. Sections 2 and 3 provide some background and focus on career planning and talent management as well as career paths and post-graduate programs for the engineers. The empirical part of the study is reported on Sections 4 and 5. First, Section 4 focuses on the age when engineers apply for various post-graduate programs. This data is used to identify the programs to which engineers decide to apply in the middle of their professional careers and whether there are significant differences in the timing of admission to the EM and discipline-specific programs. Section 5 delves deeper into the student experiences in the EM and sector-specific programs at three different phases of their studies: application, study, and graduation stages. Finally, the paper ends with summary and conclusions in Section 6.

2 CAREER PLANNING AND TALENT MANAGEMENT

For a long time, careers and career planning have been viewed primarily as individual responsibility [2]. On the other hand, organizations have realized that their success is deeply connected with the competency, skills, and knowledge of their workforce. Today companies pay more and more effort to develop and manage the competence of their personnel. Thus, enhancing human resources is significant for both parties, but the main challenge here is that achieving the desired outcomes requires time, patience, and the use of effective methods [3].

2.1 Career planning

Digitization, artificial intelligence as well as new communication methods and social practices have challenged the employees in all lines of business. Employees in all professions must now adopt an even more adaptable and proactive approach to their careers and actively manage their employability in the world of constant change [4] [5]. Thus, the career planning, which can be defined as *"an initiative where*

an individual exerts personal control over their career and engages in informed choices as to his occupation, organization, job assignment and self-development" [6] has become more and more important.

Scholars have created many theories of career planning and development and they typically emphasize the significance of being aware of one's personality and potential career opportunities [7]. For example, the lifespan, life-space theory of careers presents three views on a career choice and development, which are self-concept implementation, movement through stages and role arrangements [8].

Self-concept implementation means that professionals learn to understand their own skills, interests, values, opportunities, and obstacles [9]. They also seek new opportunities and jobs that match their career goals and interests. The goals and interests may change in different stages of their careers. New opportunities and available choices can exist either within their current organization or outside, and they can lead to different positions and roles. These professional roles can be seen here as ideals and expectations of what to be and how to behave in different positions [7].

2.2 Talent management and development

Although some scholars have recognized that many companies lack the organizational support for sustainable careers [10], talent management has undoubtedly become one of the most pressing challenges for companies globally. Talent management encompasses the systematic activities and processes aimed at attracting, identifying, developing, engaging, retaining, and deploying individuals who hold significant value to an organization, ultimately contributing to its strategic and sustainable success [11]. Investing in talent management has become increasingly vital for modern organizations as businesses strive to be more strategic and competitive. Additionally, the drive for talent management is fueled by evidence showing that aligning it with corporate strategy can result in higher profits [12].

Talent management contains many functions including talent planning, identification, attraction, acquisition, deployment, development, and retention [13]. This paper focuses on talent development which can be defined as *"the practice of developing skills and competencies of employees"* [14]. Traditionally, talent development has focused on high potential employees, but during the recent years inclusive talent development has received more interest among scholars and organizations [15].

3 CAREER PATHS AND POSTGRADUATE EDUCATION OF ENGINEERS

Changes in the workplace have reshaped the connection between formal education and the cultivation of expertise for professional engineering work [16]. Rapid technological and social developments have also increased engineering students' uncertainty about their prospects. Numerous engineering students harbor uncertainties regarding the nature of engineering and the roles engineers undertake [17]. Often this anxiety does not end with graduation but is also present in the later stages of their careers. Scholars have identified that both education and early career experiences have a strong effect on the career paths of the engineers. Professionals develop a deep connection with their profession based on both education and workplace experiences, allowing them to identify with the goals, values, norms, and interaction styles related to their profession [18].

3.1 Engineering careers

Although every engineer has an individual career path, engineering jobs are often divided into two main categories: technical and managerial posts. Based on this, the engineers can also be divided into two categories, i.e., experts and supervisors More detailed conceptualization can contain following professional roles: a technical, managerial, entrepreneurial, and project-based role [19]. Another frequently cited breakdown is based on career changes or promotions, where the entry level role is a junior engineer followed by a senior engineer, a staff engineer, and a manager's positions [20]. The first two require and emphasize expertise and technical competence in the profession. In contrast, leading and managing other people are essential parts of the job in the last two roles. Because these roles differ from each other, the skills and competencies required for the tasks vary accordingly [5].

Earlier studies indicate that a career path transition from a technical to management happens at some point during a typical engineering career [21]. However, this transition does not always mean a formal managerial position but just more responsibilities or temporary authority. Although some scholars suggest that this change takes place after the first five years of the career [22] length of time spent in early roles varies.

3.2 Engineering management and discipline-specific engineering programs

In today's economy, engineers are required to handle and solve a variety of complex tasks that involve a wide range of the sector or discipline-specific knowledge and general skills like communication, management, and leadership. These skills must often be used simultaneously as general skills empower graduates to apply discipline-specific knowledge flexibly and innovatively across various contexts [23].

In higher education, graduate competencies also fall into these two main categories: discipline-specific skills and general or soft skills [24]. Recently, there has been more discussion about general skills in higher education to enhance graduating students' capacities to adapt to the changing demands of the labor market. Nevertheless, researchers and policymakers have yet to agree on which general skills truly enhance employability and performance at work.

Today engineers can select a post-graduate degree program from a wide range of alternatives. They can continue their studies on their own technical domains and concentrate on the latest research and applications in their discipline. Some examples of the discipline-specific master studies include energy, construction, electrical, and information technology programs which are primarily intended for bachelor's graduates in those fields.

However, some undergraduates believe that such education might keep them stuck in technical routine jobs and therefore prefer more generic programs [25]. For them universities and colleges offer different kinds of engineering management programs (EM). EM is often described with a phrase bridging the gap between engineering and management [26], and it combines technical engineering expertise with leadership and business management concepts [27].

3.3 Dual model of engineer education in Finland

Even in the modern international labor markets, talent management both on organization and individual level is connected to the macro or country environment where companies develop their TM systems and individuals make career choices [11]. Therefore, in addition to international comparisons, it is also necessary to look at issues at the national level. National reviews like the one reported here also provide the basis for comparing and developing ideas from different education systems.

This paper focuses on engineering education in Finland. The Finnish higher education system consists of the universities and the universities of applied sciences (UASs) and both have plenty of different Bachelor and Master of Engineering degree programs. A master's degree in engineering from a science university is more theoretical and offers strong opportunities to advance to an expert and managerial position as well as to an academic career. Applicants for these programs are required to have a matriculation examination or equivalent. The studies begin at the bachelor's level and continue directly to the master's degree.

The education provided by the UASs is often considered somewhat less theoretical and it has a more practical orientation. This is also well reflected in the eligibility criteria for the master's programs at the universities of applied sciences, which require at least two years of work experience in the respective field after completing the bachelor's degree. So, the postgraduate programs of the UASs are aimed at professionals already in working life who want to develop their competence and advance their career in an applied and professional context [28].

4 APPLYING TO MASTER OF ENGINEERING STUDIES IN FINLAND

In this section, we will analyze how and when Finnish undergraduate engineers apply for their master's studies. The review pays first attention to possible differences between the programs organized by universities and UASs. Second, it examines possible differences of the application age between engineering management and discipline-specific programs. The analyzes are based on the public Educational Statistics Finland database which is derived from registers and data collected by Statistics Finland, the Ministry of Education and Culture and the Finnish National Agency for Education.

4.1 Application age distributions to universities and UASs

Master programs in engineering are organized by seven universities and 17 UASs In 2017–2022, there were totally 33,201 applicants to the master's programs of the universities and 10,617 candidates to the programs of the UASs. Students apply to all Finnish higher education institutions in a national joint application service. In this service, applicants fill out an electronic application form, select the degree programs and determine the priority order of the programs. Schools typically hold separate entrance exams, which vary depending on the degree program. Finally, applicants will be informed whether they have received a study place on this e-service.

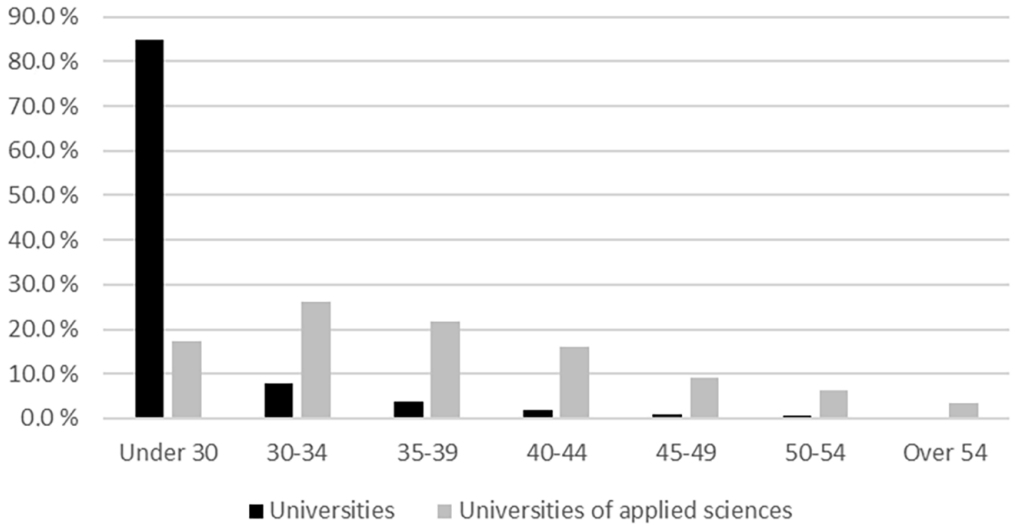

Fig. 1. The age distributions of the university and UAS applicants

Figure 1 shows the age distributions of all applicants during that six-year period. According to it, 84.7 % of the applicants for the university programs were under 30 years of age. The share of this age group was only 17.3 % among UAS applicants and most of the candidates were clearly older. Thus, it can be stated that the master's programs of the universities are typically studied before the beginning of an engineering career, while UAS degrees are done during different phases of the careers. Because the focus of the paper is on the formal education of the engineers during their careers, the rest of the study concentrates on the master programs of the UASs.

4.2 Application to management-oriented and discipline-specific UAS programs

Next, we look at the age distributions of the candidates for the EM and sector-specific programs organized by the UASs. According to Figure 2, the largest age group for both was 30–34 years old. In general, the distributions did not have significant differences although the share of younger applicants in discipline-specific programs was slightly higher, as 69.6 percent of them were under 40 years old, and the corresponding number in EM programs was 62.1 percent.

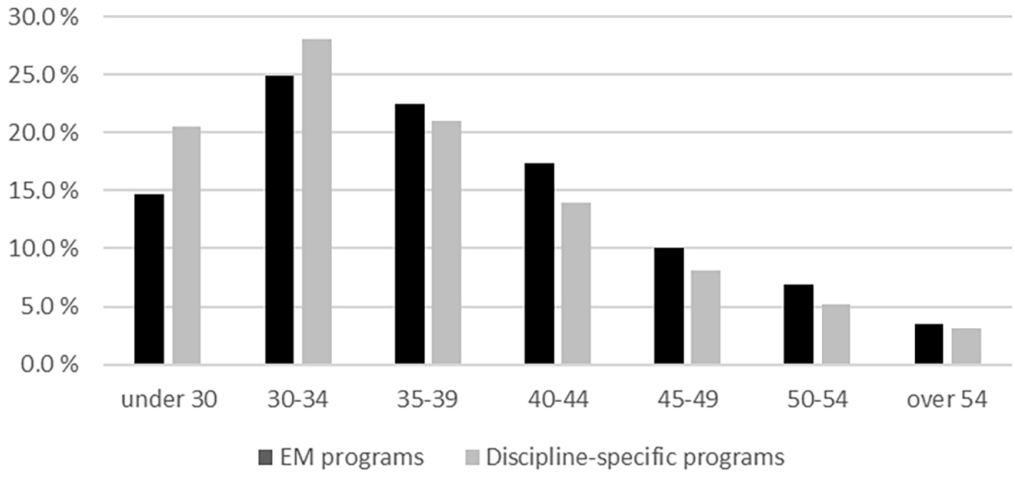

Fig. 2. The age distributions of the EM and discipline-specific programs

5 COMPARING ENGINEERING MANAGEMENT AND DISCIPLINE-SPECIFIC UAS PROGRAMS

As mentioned earlier, this study focuses on post-graduate engineering programs studied during working life. In addition, the programs are divided into two groups: engineering management (EM) and discipline-specific engineering programs. This section of the study concentrates on students' perceptions and focuses their opinions on EM and discipline-specific programs at seven Finnish universities of applied sciences. In the study, the views of the students are examined in three different stages of the study path, i.e. when applying to education, during studies and at the graduation stage. The sample of the study consists of 16 master of engineering programs (seven EM and nine discipline-specific programs). All participants in these programs are adult learners with significant professional backgrounds.

The study combines data from two different national data sources. First, the number of applicants and graduates are retrieved from the Educational Statistics Finland database used also in Section 4. Second, the satisfaction data is based on the national AVOP survey. The AVOP survey is organized by the Ministry of Culture and Education, and all students graduating at Finnish universities participate in it. It measures graduating students' satisfaction at different aspects of education, such as study content, teaching, learning environment, and support services.

5.1 Popularity at the application phase

The application phase analyses are based on all students who applied to the analyzed programs in 2017–2022. The total number of applicants was 6,280, of which 4,148 had chosen one of the studied programs as the preferred option.

Table 1. Number of applicants in 2017–2022

Year	Preferred Applicants		All Applicants	
	EM Programs	Discipline-Specific Programs	EM Programs	Discipline-Specific Programs
2017	42.0	43.5	69.6	60.0
2018	45.5	60.5	72.5	76.5
2019	38.0	36.6	64.5	43.1
2020	54.5	58.5	95.0	77.0
2021	49.5	38.1	96.5	51.0
2022	38.5	38.4	70.5	60.6
Average (SD)	44.7 (6.5)	45.9 (10.8)	78.1 (13.9)	61.4 (13.5)

Table 1 shows the average numbers of both all and preferred applicants to the EM and discipline-specific programs. During the six-year period, the number of the preferred applicants for 38 EM programs was on average 44.7 and for discipline-specific programs 45.9. These numbers clearly state that there is no statistically significant difference in the popularity of these different program types. It is also interesting to notice how the corona pandemic increased the number of applicants in both of them in 2020 and 2021. However, in 2022 the numbers returned to the pre-pandemic levels.

5.2 Student satisfaction

The data on student satisfaction was obtained from the Finnish national AVOP survey database, which is conducted by the Finnish Ministry of Culture and Education. Participation in the AVOP survey is mandatory for all students graduating from a Finnish university of applied sciences. To protect the privacy of respondents, individual student responses cannot be accessed from the AVOP database; instead, the results are aggregated and summarized for each year. Each annual summary of the degree program includes information on the number of respondents and the average for each question. If there are fewer than five respondents in some year, the results will not be presented. In the master's degree version of the survey students evaluate their satisfaction with the Likert scale (1–7) in twelve different dimensions.

Examination of student satisfaction is based on students who graduated in 2018–2023 and the total number of graduates was 1,642 and 807 of them were students of the EM and 835 studied in discipline-specific programs. They represented 38 EM and 50 specific starting groups. The averages of both EM and discipline-specific study groups are shown in Table 2. The results indicate that the satisfaction was higher in all dimensions among the EM program students, but only in three areas (learning environments, internationality and multiculturalism, and general satisfaction) the difference was statistically significant at .05 level.

Table 2. Student satisfaction of the EM and discipline-specific programs

Dimension	EM Groups (n = 38)	Discipline-Specific Groups (n = 50)
Study content	5.57 (0.33)	5.38 (0.44)
Planning studies, counselling	5.81 (0.37)	5.59 (0.49)
Teaching	6.04 (0.31)	5.86 (0.35)
Studying	6.28 (0.28)	6.17 (0.40)
Learning environments*	5.82 (0.29)	5.62 (0.39)
Support services	5.76 (0.27)	5.63 (0.49)
Feedback and assessment	5.74 (0.36)	5.66 (0.35)
Internationality and multiculturalism*	5.00 (0.55)	4.34 (0.73)
Connections with the working life	5.75 (0.37)	5.75 (0.35)
Career services	4.45 (0.50)	4.48 (0.42)
Thesis	5.92 (0.36)	5.74 (0.42)
General satisfaction*	6.01 (0.33)	5.83 (0.44)

Note: *$p < .05$.

5.3 Graduation rates

Unfortunately, the national databases cannot provide 100 percent accurate graduation rates. Although the number of graduating students for each year is available, there was no information when their studies began. In Finland, the students' study time may vary for many reasons. For example, granted discretionary additional study time, military service, or parental leave provide students more

time to finish their studies. As a result, Table 3 provides only indicative results at the graduation rates for students graduating in 2018–2023, and they should be interpreted in a more qualitative than quantitative way.

Although the used data has some limitations, the graduation rate for generic degree programs was clearly higher than for discipline-specific programs. The data used in this study reveals only the difference between graduation rates, but it does not provide any reasons for the difference. This topic clearly needs further investigation in the future.

Table 3. Graduation rates of the EM and discipline-specific programs

	EM Programs	Discipline-Specific Programs
Number of graduates	807	835
Graduation rate	71.4%	58.6%

6 SUMMARY

This paper examined formal education with a particular focus on the types of master's degree programs the engineers pursued while employed. The study approached this issue from two perspectives: the dual model of the Finnish higher education system and the range of available degree programs. The degree programs were divided into two categories: engineering management (EM) programs and discipline-specific postgraduate education. My analysis was based on data from the Educational Statistics Finland database and AVOP student satisfaction survey.

The findings of the study clearly highlight the difference between university and UAS postgraduate programs. At the universities, the large majority of the students complete a master's degree before starting their engineering careers. In contrast, candidates of very different ages apply to master's programs at the universities of applied sciences. Partly the difference can be explained with the eligibility criteria of the UASs, which require at least two years of work experience after completing the bachelor's degree. However, this is not the whole truth, as many of the students in these programs have even decades of work experience before applying. Indeed, the master's programs of the UASs seem to be more suitable for the life-long learning and development of professional skills during the careers of engineers.

When comparing the popularity of the EM and discipline-specific programs of Finnish UASs, there was no statistically significant difference between them. A plausible explanation for this is the variation in the career paths of the engineers. While some engineers aspire to remain in technical expert positions throughout their careers, others seek management roles. These distinct career paths demand different skill sets, leading engineers to select master's programs that align most effectively with their career aspirations.

In contrast, statistically significant differences were observed in some aspects of student satisfaction and graduation rates. Students enrolled in EM programs reported higher satisfaction in three key areas: learning environments, internationality and multiculturalism, and overall satisfaction and they also had higher graduation rates. However, the data utilized in this study did not permit an examination of the underlying reasons for this disparity. Previous research has explored factors contributing to dropout rates in both master's level studies and engineering education more broadly. These studies suggested that factors such as lack of motivation, negative outcome expectations, low self-efficacy, planning

difficulties, and curriculum-related issues may contribute to the discontinuation of studies. Nevertheless, further investigation is warranted to better understand this phenomenon.

Although the study was conducted only in one country, the findings of this study indicate the need for both discipline-specific and EM postgraduate engineering education globally. Different programs better cater to engineers with divergent career objectives. In addition, if higher education institutions all over the world want their master's programs to play a key role in the lifelong learning and skills development of working engineers, they will need to take better account of the needs of adult learners and not just target their programs at students starting their careers. In addition, companies should create better conditions for further education leading to a degree in their own talent development strategies. If properly implemented, these programs can improve the competitiveness of the businesses by attracting new and retaining their current employees.

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