The changing needs of engineers for professional development

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ABSTRACT

As the change in technology and working environments accelerates, the professional development needs of engineers expand. Simultaneously, less resource is available from employers and thus the responsibility for development lies on the shoulders of individual engineers themselves.

Here we focus on the views of individual engineers, based on extended surveys made and experiences collected by The Association for Academic Engineers and Architects in Finland. What kind of services, support, materials and resources do engineers require to be able to carry the responsibility for their professional development? What will enable engineers to make best use of the offerings of education providers? How do offerings and needs match?

If 70:20:10 is accepted as the ratio for different learning opportunities, the challenge is how to tutor and mentor the 20% (active learning on the job) and what kind of offering (format, discipline, cost) is needed for the 10% (courses, seminars, MOOCs etc)?

Keywords
Career development, engineers, continuing education CE, non-formal learning, work-based learning, competence, skill, accreditation
1. INTRODUCTION

Academic Engineers and Architects in Finland - TEK - is a professional and labour market organisation. TEK is involved in professional and educational matters related to work, employment and the careers of its members. The graduate members of TEK need to hold at least a MSc degree, mostly in Engineering. Seven out of ten Finnish engineers (MSc) are members of TEK. TEK promotes the quality of engineering education, including continuing education and professional development, and offers career services.

In order to support its aims, and as part of its mission, TEK undertakes research into the present and future needs and competences of engineers. This focus covers also the methods by which these competences might be developed. The target group covers the whole profession in Finland, independent of the employer, customer relationship to providers, age, field of engineering, career status, etc. Thus the results of these researches are used to influence the national policies and financing principles of engineering education, including continuing engineering education.

In this presentation we introduce first the overall competences needed from engineers, then the results of the latest survey about the needs of competence development, coming finally to some ideas for ways to develop and finance continuing engineering education.

2 COMPETENCES AND SKILLS REQUIREMENTS FOR ENGINEERS

A national collaboration group coordinated by TEK has defined an engineer’s competence requirements (Figure 1). In addition to a technical core competence, an engineer needs to master cross-disciplinary competencies and general skills. These form the basis for continuing education and development. Every engineer does not have to master all of these skills and competencies, since sharing knowledge and networking are ways to both deepen and widen personal knowledge into a competent team or network.

The map of competences and skills provides a solid framework for building up competences although the specific competences of the technology area in question should be considered separately. The map of competences and skills has been used as the framework for the knowledge, skills and competencies referred to in the Survey on Continuing Professional Development.
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It is a big challenge to prove and credit the competence development needed in “team working” or to prove other non-accountable competences. The evidence needs to be based on the actual jobs and work executed in real life. Documented experience on success stories and lessons learned might be one way of collecting evidence. Another way is to keep a learning diary about the everyday work. In addition books and articles read, information collected from networks and findings from social media should be documented in the diary. Self-assessment before and after a period of work could also be used as evidence for the non-formal learning of soft skills.
3 THE NEED FOR CONTINUING ENGINEERING EDUCATION

The accelerating pace of technological changes and the needs of the global economy set new demands for knowledge, skills and competence of engineers. TEK executed the most recent survey in the beginning of this year [2]. In that survey of continuing professional development, the respondents were asked to evaluate the importance of the set of knowledge, skills and competencies which were described in the framework of Competences and skills of an engineer. One target of the survey was to find out how much the opinions are varied according to the age of the respondents.

Figure 2. Importance of knowledge, skills and competencies

Figure 2 shows that respondents evaluated the importance of knowledge, skills and competencies in a similar manner. This listing of competencies according to their importance in working life seems to be very similar across all the other age groups presented in the
survey of continuing professional development and this paper. It could be argued that it resembles the competence values of a typical engineer. The competencies are fairly similarly rated by the young, middle aged and senior engineers. The generation born in 1981 emphasise skills from the category of interaction, internationalisation and organisational skills. Where for this group 6 out of the 10 most important skills are linked to the category of interaction/communication for the group born in 1955 five out 10 most important skills are from the category of key technical competence.

Key technical competencies
In the category of key technical competencies the discipline specific skills seems to be quite well managed. On the other hand form the basis of engineering competence the problem solving and information retrieval skills are most important for the respondents.

Values and attitudes
Across the age groups self-confidence is perceived as the most important of the competencies from the category of values and attitudes.

Interaction, internationalization and organizational skills
In the category of interaction, internationalisation and organisational skills there are differences between the age groups in what is considered as the most important skill. This might be explained by the fact that different generations may have great differences in what they comprehend as essential in interaction and communication.

Interdisciplinary competencies
In the category of interdisciplinary competencies all age groups considered knowledge of the basics of business operations significantly more important than entrepreneurial skills. However none of the groups considered skills from this category to the top 10 most important in working-life.

The respondents of Survey of Continuing Professional Development were asked to evaluate whether they felt that some extensive competence remained lacking in their engineering degrees [2]. The respondents feel that they would need more competence in business management, finance and accounting as well as in general management and leadership. Other competencies mentioned that remained lacking were communication and interaction skills in general, foreign languages and internationalisation skills, project management skills, ICT, coding, programming and entrepreneurship. Key technical competencies were seldom mentioned in responses. These results also link and correlate with the Graduate Feedback Survey made by TEK earlier this year. According to the Graduate Feedback Survey, the key technical competencies are developed well in studies, but the there are major gaps in for
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instance entrepreneurial skills [3].

Figure 3. The suitability and use of different forms of professional development

The use and suitability of different forms of continuing professional development are presented in figure 3. The respondents to the Survey on Continuing Professional Development were asked to evaluate how suitable they found the listed forms for professional development and how much they have used these forms in the past. As with previous surveys of continuing professional development, the latest results show that the most popular and suitable forms for continuing professional development are the forms where self-learning plays a major role. However, there is a significant gap in suitability and use of extensive training programs. The respondents perceive extensive training programs relatively suitable to meet their needs for continuing professional development, but type of programs have not been used to a large extend.

4 SOLUTIONS

Interesting career opportunities and satisfying tasks are more often available to those engineers, who update their professional competence continuously. However, the hectic pace of working life sets limits to the possibilities to participate in continuing education.
Fortunately according to the 70:20:10-thinking 70% of the competence development happens thought the challenging job tasks and opportunities at work. Then we need to encourage the 20% that applies to self-study and reading professional materials and the 10% that would be collected from formal courses.

The part of CPD which is formal education needs to find both providers and financing. Several employees are offering such courses for their employers, especially when the competences are essential for the success of the job - but in other cases engineers need to find the opportunities and financing for themselves.

Massive open online courses (MOOC’s) could be one option for such need - but in Finland that option is still fairly weakly supported and known.

Universities also offer fee-charging continuing professional education and Open University instruction, which do not lead to degrees. Open University studies are considerably less expensive that CE as it is funded by the government and the prices are regulated by a decree.

Additionally there is a big market for fully charged courses offered by commercial companies or professional organisations - but those are in most cases so expensive that engineers would shrink from funding attendance themselves.

Currently higher education in Finland offers practically unlimited possibilities of tuition free education, and unfortunately this causes some misuse of system and resources. Somebody, who needs to upgrade his/her knowledge or needs retraining, in other words has a profile of a continuing education (CE) student, but wants to study without paying, can take the university entrance exam and if admitted, can start to study free of charge, without even any intention of graduating. This opportunity is sometimes seen as a fraud by commercial CE providers.

Challenging for engineers is the situation when a totally new set of competences are needed. This might mean a need to study an amount which is equivalent to half or one year of full time studies. According to the TEK studies Finnish engineers find it necessary for such situations that higher educational institutes should develop individually designed continuing education programs, which utilize work-based learning and recognise prior learning [4].

For this need and in close collaboration with stakeholders the Ministry of Education and Culture in Finland has started the process to develop a new type of professional development. The Ministry appointed a working group to propose a model for post-experience specialisation education in higher education. The proposed professional specialist education for higher education graduates is aimed to promote professional development and specialisation. According to proposed model, the studies should be for a minimum of 30 ECTS and the length is going to be regulated by a decree.

This would offer an option additionally to those occasions in the careers of individuals when the need for a formal recognition of competence becomes necessary. In those occasions a professional diploma (PD) degree awarded by a Wide Multidisciplinary Competence
IACEE World Conference on Continuing Engineering Education (WCCEE 2014 STANFORD).

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Development (WMCD) program is proving its strength [5].

A Professional Diploma degree (illustrated in figure 4) should fill the requirements of working life. It should also fit the financial and work situation of an individual engineer. The participant in a PD programme should be required to have either a Master’s degree or a Bachelor’s degree. In this case, the PD degree deepens or widens the competence of the participant. PD studies can be accredited to a Master’s degree later on. The PD degree may also consist of research oriented and/or third cycle studies, if the participant already has at least a Master’s degree and wants to deepen his/her knowledge. In this case PD studies can be accredited to a PhD degree later on. The university, or its centre for continuing education, should evaluate and accredit the prior learning of the participant. [4]

![Figure 4. The structure of a Professional Diploma. [3]](image)

**New ways of financing individually chosen education; Vouchers or other similar demand-oriented instruments**

As described earlier in this paper the funding of continuing professional education has been two-fold. On the one hand there have been a plenty of opportunities to study free of charge within the degree programmes, but also many possibilities for fully charged continuing professional development programmes. With public funding, which is available for adult education in general and continuing graduate education more specifically, becoming more scarce, there has been a public discussion in Finland regarding possible introduction of tuition-fees and limiting access to higher education degree programs for graduated experts.
Ministry of Education and Culture in Finland launched a project in 2012 to introduce a new funding model for adult education. These so called “education accounts” or vouchers would be for continuing professional education. This, according to many, would change the system from our current more supplier-oriented, to an individual-friendly demand-oriented system. It would give the individual the power to choose what kind of education he/she would use with the financing. With this kind of a system in place, the providers have to ensure that there would be sustainable, high quality education available.

5. CONCLUSIONS & RECOMMENDATIONS

Hopefully, universities in Finland will become truly lifelong learning universities, where we see that the need for education is far wider than our current degree model. The universities should deliver to the engineers working in industry the newest knowledge coming out from the research executed in there. Additionally the CE providers in universities could organise tutoring and mentoring to MOOC’s delivered from universities around the world.

Digitalisation and new technologies bring new challenges to continuing educations offerings. Where open online resources provide latest knowledge available around the globe, how can the continuing education providers stand out in the competition for learner’s attention? The possibilities may lie in proving a platform for collaborative learning and bringing about the skills and competencies development of each individual learner [6].

REFERENCES