ENGINEERING PROFESSIONAL CONTEXT AND CPD

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ABSTRACT

Engineers are professionals who have intense and continuous lifelong learning (LLL) activities regulated by professional organizations, by employers and by official agencies. This ongoing professional development is required due to the obsolescence of competences and the need to face new challenges. In most cases, however, the dialogue between LLL providers and users of the required continuing professional development (CPD) training is not structured. This article presents an analysis of a CPD survey among the engineering community of the federation of engineering professional organizations (FEANI) with respect to identifying methods and approaches of improving communication between LLL providers and engineers seeking CPD opportunities. Results are presented and discussed and conclusions are provided that propose content for a dialogue between LLL providers and users of CPD, such as engineers and employers.

CONTEXT DESCRIPTION

This article presents the needs of LLL for engineers based on a survey of professionals who possess the EUR ING (European Engineer) certificate issued by FEANI (FEANI, 2022). The EUR ING is a certificate delivered by FEANI as a guarantee of competence for professional engineers, and it can facilitate the movement of practicing engineers. FEANI, founded in 1951, is a federation of professional engineers that unites national engineering associations from 35 European countries and represents the interests of over 3.5 million professional engineers in Europe. The General Secretariat, who manages the activities of the federation, has been located in Brussels since late 1997. FEANI aims to facilitate the mutual recognition of engineering qualifications in Europe and to strengthen the position, role and responsibility of engineers in society.

The article aims to identify current practices of engineers and of employers in terms of depth of topics addressed, time spent in CPD activities, forms of CPD and the involvement of LLL providers. The role of university LLL providers, like those that are eucen members, was also one of the objectives of the survey done with this group of engineers. EUR ING certified engineers constitute a population of engineers with relevant professional experience and with involvement in improving this performance through education and training. This article also provides insights and opportunities for University lifelong learning (ULLL) providers to establish bridges with the professional engineering sector in order to provide the requisite training for such an important sector of society, particularly in the sustainable and digital

sectors. The authors are convinced there is a gap between the ULLL providers´ activities and the training needs of the engineering sector.

Firstly, the FEANI policy affirms that there is an ongoing need for CPD of engineers in Europe (FEANI, 2015). CPD is necessary for engineers in order to enhance their ability to adapt to emerging changes in technology and to remain permanently employable during his/her entire career. Does this also hold true, however, in practice? Does the individual engineer feel that CPD is needed for their career? Does the employer hold the same attitude? How much time is spent on CPD? What is required and who is paying for it? In order to evaluate these general formulated questions, FEANI organised a survey amongst their EUR ING's certificate owners.

CPD is considered to be the acquisition of knowledge, experience and skills and the development of professional and personal qualities. It embraces both the acquisition of new capabilities to broaden competence and the enhancement of existing capabilities to keep abreast of evolving technology and its application (UNESCO, 2021). CPD is essential for the maintenance of high professional standards and enhances the employability and mobility of individual engineers. It assists career progression and strengthens professional satisfaction. CPD benefits society and is of crucial importance in sustaining the competitiveness of European industry in the global market (Markkula, 1995).

CPD is the responsibility of the individual and requires the cooperation, encouragement and support of employers and professional and academic institutions as CPD providers. In some countries, professional engineering organisations require mandatory periodic CPD to maintain one's engineering status. Therefore, to be most effective, engineering CPD has to be planned and related to specific objectives. A personal development plan needs to be periodically updated with respect to competences. The CPD plan can include a variety of forms, including mentoring and the sharing of knowledge and expertise. This is one of the areas where LLL providers can cooperate with professional engineering organizations to provide guidelines for engineers.

These guidelines could potentially address inclusion of the promotion of CPD as an important element of the engineering mission and the establishment of a CPD policy that highlights the key role of qualified professional engineers for the development of the economy and society. Cooperation between the LLL providers and professional engineering organizations could address the encouragement of all stakeholders to invest in CPD for engineers, and define quality standards in CPD as well as innovative practices in learning (Fredriksson, 2021). Other topics include the support of individual engineers in their personal CPD definition, publicising good practices in CPD and supporting initiatives on competence recognition, mobility, employability and accreditation of education.

A second aspect of possible cooperation between engineering professional bodies and LLL providers might address the identification of training needs resulting from innovation developments among academic institutions in cooperation with engineering companies. Relevant innovations are a result of industry requests, and respective training to implement those developments could then be defined and planned jointly as a form of LLL provision. A third aspect could address the recording and accreditation by academic institutions of CPD achievements by engineers in terms of their professional personal development plans. To help assess the situation, FEANI has conducted an extensive survey of their members' CPD activities.

SURVEY OF CPD FOR ENGINEERS

Continuing Professional Development is an ongoing need for engineers in Europe. It is a requirement of life-long-learning of professional engineers at all levels to maintain proficiency. Prior to the pandemic, the European Monitoring Committee (EMC) of FEANI decided to organise a survey amongst engineers who received the EUR ING certificate during the last 10 years. From 1980 until just recently, over 32,000 European engineers have listed in the EUR ING register. A 10-year time frame was chosen for the survey to have a relevant period in which not only technology, but also the mindset of professionals all over the world, has changed significantly. Simply having a higher education degree is no longer enough to have and keep a satisfying job. Over the course of 10 years, LLL ought to have become part of one's professional life.

According to FEANI policy, CPD is the acquisition of knowledge, experience and skills as well as the development of personal qualities. It contains both the acquisition of new skills to broaden competence and the enhancement of existing competences to keep abreast of evolving engineering developments. CPD enables the employability and mobility of individual engineers. It enhances their career in the fast-moving world of technology and strengthens their professional satisfaction and well-being (Fredriksson, 2021).

Engineering competence is of interest to engineers' present and future employers. Therefore, one must keep an eye on what happens in one's field of technology to prepare in advance for change. Similarly, one must learn to live with a certain amount of uncertainty as it is very difficult to know which competences will be useful five years from now (WEF, 2018). In addition to technical competence, competence in the areas of knowledge, skills and attitudes are also important for working life. Updating competences and improving performance are minimum requirements for an engineer to maintain their position and employment. As such, engineers must invest in CPD for their careers to progress, whether through vertical or horizontal mobility.

There are many ways an engineer can continue to develop their professional competences. To name but a few: on the job learning and training, attending training courses, seminars or conferences, studying for another complementary degree, e-learning, writing articles in magazines and scientific periodicals or joining expert groups of technical organisations. Sharing experience and knowledge with colleagues is also an important way of learning. It is also often a requirement for many engineers since today's projects can be complicated and multi-faceted and next to impossible to manage alone (Dutta, 2012).

DESCRIPTION OF SURVEY

The approach to the survey was to design two different questionnaires: one for engineers and a second for employers of engineers. Both consisted of some general information to start with, followed by several questions specifically related to CPD. A number of questions were identical; however, the second part of the questionnaire was oriented more towards the target group.

The questionnaires were designed to gain a better understanding of what already exists in the workplace, to identify the barriers to training and development for engineers and to get an overview of what is happening in different countries across Europe. The responses were, of course, confidential and the results were aggregated for reporting and feedback purposes.

The survey was conducted online. The National Monitoring Committee of each member country was asked to mail an introduction letter to their EUR ING's and their employers with the link to the respective survey. The mailing took place in April and the survey was available

during the month of May. As usual, a delay in the administrative procedure was taken into account, so access to the survey was actually closed mid-June. Most of the responses were received between May and June with a peak response rate by the end of May.

Relevant responses

The responses were statistically valid. During recent years, around 500 new EUR ING's certificates have been awarded each year. Assuming around 5000 engineers received the EUR ING title over the last 10 years, more than 13%, or precisely 674 of individual engineers and 108 of their employers, took the time to answer. The responses per country varied due to their own contexts and engineering culture. Ten or more responses were received from engineers living or working in the following countries: UK (343), Ireland (66), Spain (53), Austria (18), Malta (17), USA (17), Canada (14), Germany (12), Romania (11), Croatia (10) and Slovakia (10). More than half of the respondents came from the UK and Ireland, but analysing the answers resulted in no significant difference compared with the others. For that reason, the data has been processed as a single group.

Each company size is represented, with a small majority of companies comprising more than 250 employees compared with those between 1-250 employees, as can be seen in *Table 1*. The function of an engineer can be quite variable. A large number of the EUR ING respondents have a lead role within the company, as presented in *Table 2*. Responses came from engineers working in several branches of the industry, as shown in *Figure 1*. More than 50% of the reactions, including those of individual engineers (in blue) and the employers (in orange), came from the same top four branches: professional services, energy and utilities, the construction sector and the manufacturing industry.

Company size	
1 – 10	175
11 – 50	67
51 – 250	80
251 – 2000	131
2000+	209
Blank	12
total	674

Table 1. Company size

Job title	
Director - managing director - CEO	93
Manager	90
Consultant	63
Head of …	22
Project manager	24
Lecturer / professor	15
Architect	5
Engineer	28
Retired	61
Other	12
674	

Table 2. Function EUR ING Respondents

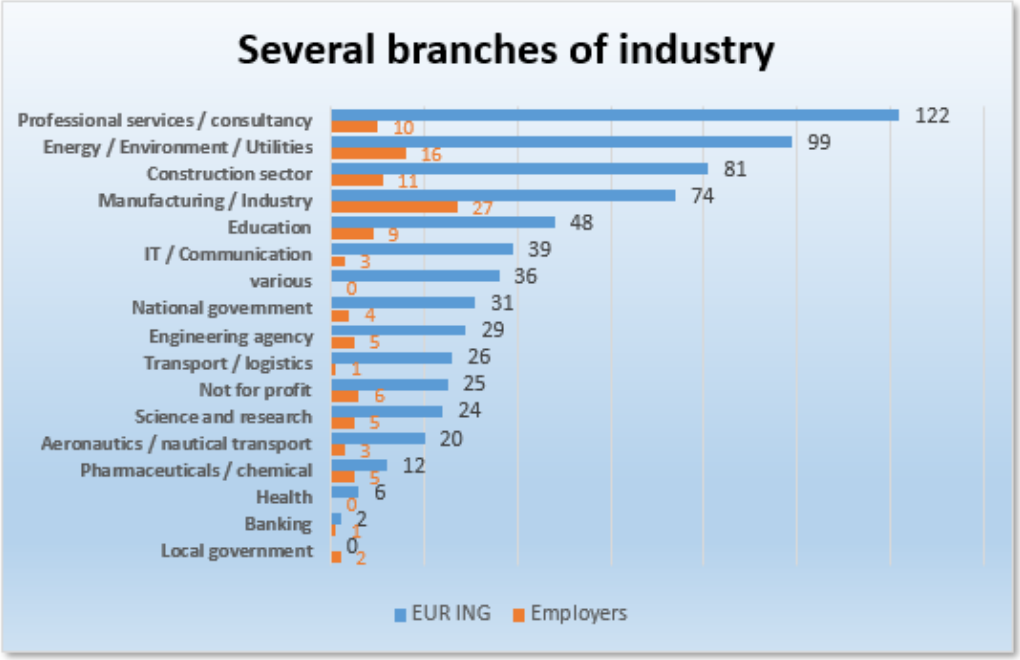

Figure 1. Respondents – individuals and employers - from several branches

Survey results for types and motivation

One of the most important questions asked was “what kind of CPD is most relevant for your future career as an engineer in your current company or elsewhere”. As can be observed in *Figure 2*, the subject with the highest score is “technical developments in the line of business”, followed closely by “regulations (CE, safety, environment,…) and “skills (leadership, coaching,…)”. Receiving an almost equivalent score are the topics “latest trends in technology and their applications”, “general management” and “project management”. The list closes with “business performance, finance, …” and “IT evolution in general”. The same question was posed in the survey for the individual engineer and for the employer. Of note is the fact that both employers and engineers have almost the same preferences, as shown in *Figure 2*.

Figure 2. Importance of CPD subjects for the employer

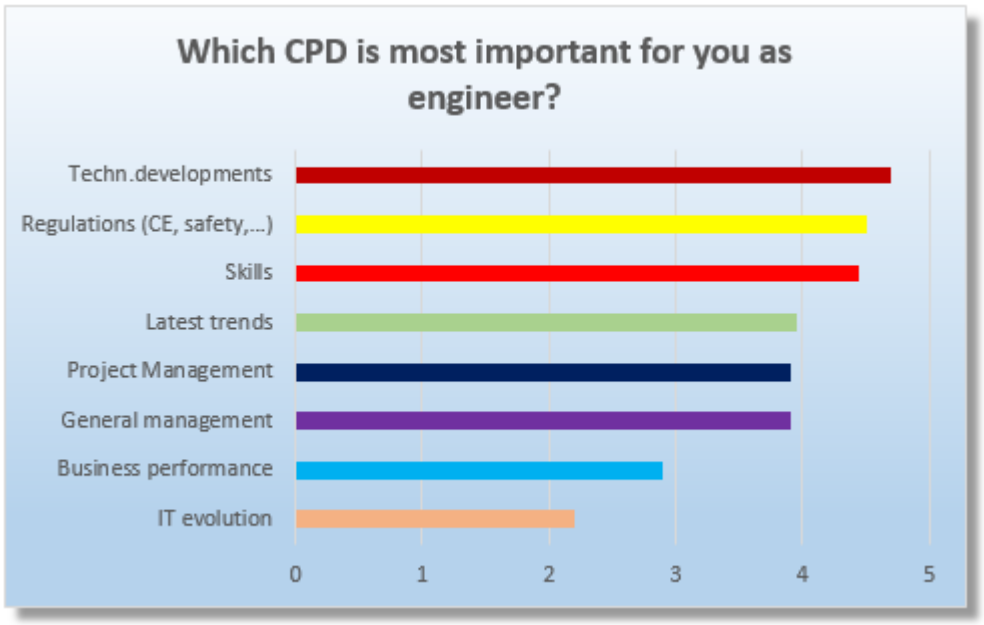

Figure 3. Importance of CPD subjects for engineers.

Another important question is what constitutes the types and modes of how CPD is applied. The list used in the questionnaire is based on a FEANI document called “credits for CPD” in which nine of the eleven items were listed as possible types of CPD to receive credit points. These credits are only an indicator of the commitment of the engineer to develop and to practice CPD for professional improvement. Credits are a numeric appreciation of the CPD activities and may contribute to the assurance of quality improvement of engineering practice. It is based on current practices by national engineers associations like Engineers Australia and Engineers Ireland.

An average of 40 credits per year is the minimum total of CPD for an engineer. In general, one credit is considered equivalent to one hour of participation in the CPD activity; however, there are maximum values for each type of CPD when calculating the yearly average, thus ensuring that CPD activity is diverse and has various types of activities.

The graph in *Figure 3* indicates how many times each mode and format of CPD was undertaken. As can be observed in this figure, “in company training” and “mentoring or tutoring other engineers” are the two most widely practiced forms of CPD. Although pursuing a “formal post graduate academic course” is not that highly valued by the employers, as shown in *Figure 4*, 82 engineers, or around 12% of total respondents, find it useful.

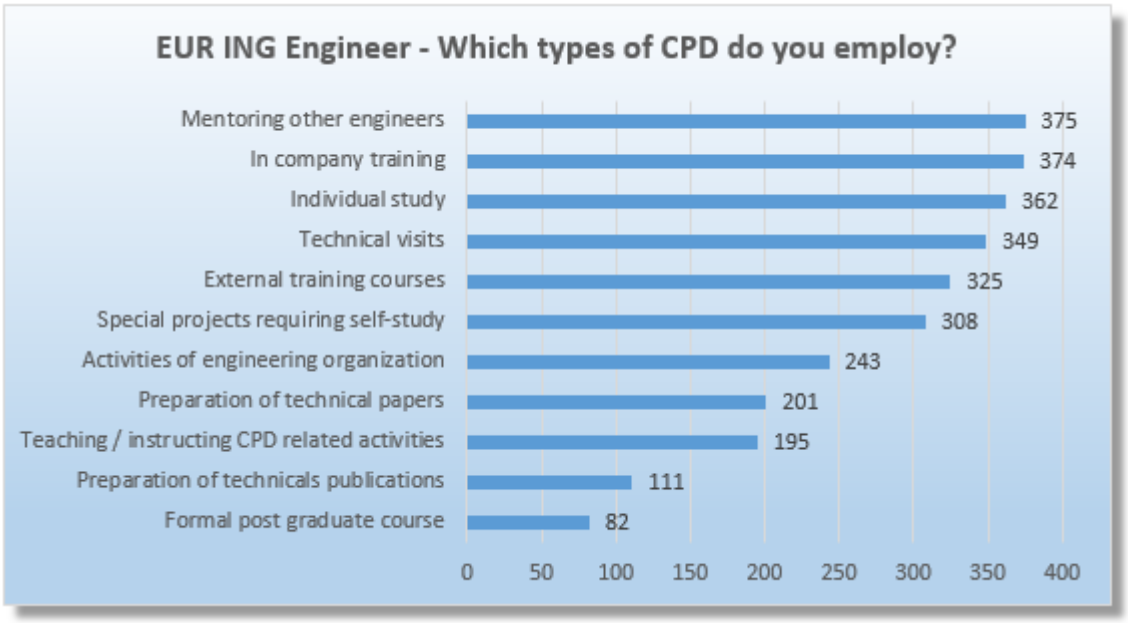

Figure 4. Types and format of CPD used by engineers.

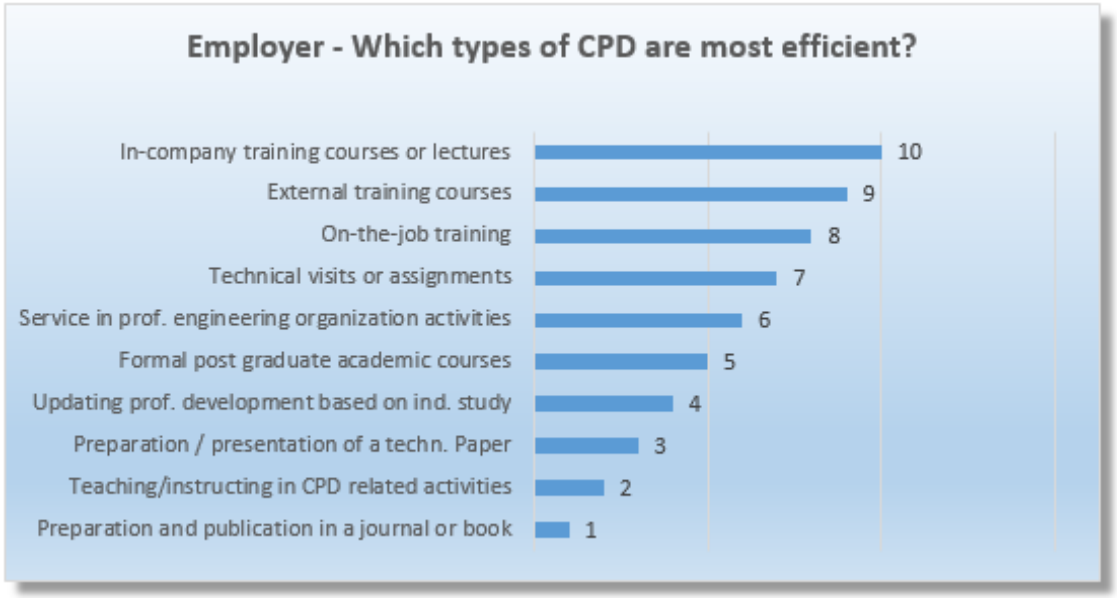

Figure 5. Most efficient types of CPD from employers' point of view

How do employers evaluate the different types of CPD? Employers were asked to rank the effectiveness of the different types of CPD in improving the professional knowledge, skills and attitudes of their engineers. The number 10 indicates the most likely to improve and 1 the least efficient form of CPD from the employers' point of view. Results are presented in *Figure 5*. Employers believe the company benefits most from internal and external courses and on-the-job training of their engineers. These are also the types of activities for which employers provide financial support. The other items are mostly individually oriented and undertaken on an engineer's own time.

When it comes to financing CPD, who is actually paying for the CPD activities? In both questionnaires there were three possibilities: "The company pays the complete amount when it is in line with the business", "The company pays a certain percentage and the employee the rest" or "The employee pays the amount depending on the subject". A closer investigation of the employer survey shows that 15% had not answered this question and

70% of the companies always pay the complete amount. Around 5% combine paying between the 3 options, 7% always choose option 2, that is paying a certain percentage, and in 3% of the cases the engineer pays depending on the subject. When compared with the results of the engineers, the values respectively are: 16.6% did not respond, 46.3% say the company pays the complete amount and 9% combine between the 3 options. Option two is referred by 9.2% and option three is indicated by 17%. The last 1.8% indicates the company combines options two and three.

Given the importance that companies ascribe to in-company and external training courses, it would seem logical that the employer would also want to evaluate the course results. However, this seems to be difficult to measure in most of the cases. This may indicate that there is no effective measurement process in place to verify if learning outcomes and competences were acquired.

In general, almost 60% of the participants responded that one or more evaluation techniques were in use. First of all, their own opinion was sufficient to judge the effectiveness of a CPD event. In half of those cases the company had a specific evaluation form to be completed and about 10% of them were asked for their opinion via an individual interview. Half of the group also noticed that they were subject to increased on-the-job observation following CPD completion.

Looking at these evaluation questions in more detail, participants were almost always or at least frequently asked about “participant satisfaction”, his or her “improvement in knowledge or skills” and “changes in views and attitudes” and if it was a “value for money” training course. Less important were questions pertaining to “changes in the participant behaviour” and if “organizational changes” were the result of a CPD activity.

Only 3% of the respondents affirmed that there is no evaluation at all and 12% did not answer.

Another question was intended to shed some insight on the main reasons a company wants their engineers to be involved in CPD. Four motives were presented and more than one could be selected:

- CPD of the staff is critical to the success of the organization;
- CPD is needed to keep motivated employees within the company;
- CPD is a necessity to maintain the quality of services and products;
- CPD is an investment in the future of the company.

This resulted in no significant difference between the options. They all scored almost the same value. Thirty percent of the employers even checked all four of them.

Survey results related with time invested in CPD

CPD requires time for engineers and for employers. An important aspect of the survey was about time and periods spent on CPD by engineers. It is relevant to know how much time engineers are willing to spend on CPD, how much time the engineers are allowed to invest in CPD and where employers stand in terms of sending engineers for CPD. These values may be sometimes difficult to calculate due to the nature of some CPD activities. There was a clear attempt to obtain as much reliable information as possible. Some of the answers were not direct and occasionally only estimates were provided in the questionnaire by engineers and employers.

For employers, questions were defined to provide the number of days for CPD courses per year an engineer needs to remain up-to-date in his or her job. Courses could be long

duration course or several short-duration courses or a combination of both. The choices for employers were between one to five days per year with possibility of having more days in one year.

Another question was related to the fact of having periodic mandatory CPD to maintain one's professional engineering status. From the part of the companies a bit less than 50% of the companies stated that it was mandatory in their country. These countries are the United Kingdom, Slovenia, Ireland, Malta and Belgium.

About the same rate of companies, 48%, stated that the company policy requires that each employee has a minimum number of credits or days of CPD per year. So, about half of companies responding were either legally forced or bound through internal policy to have mandatory periodic CPD for their engineers. The frequent interval of number of days per year of CPD for engineers was between three and five days per year.

Evaluating the answers of the individual engineers was complex. Engineers were asked to enter a number of days spent on the eleven different types of CPD during the previous year. Some responses were listed in hours since training sometimes did not have durations of entire days and were presented in hours. To get comparable results with those of the employers, only the "in-company" and the "external courses" were considered as these were all entered in days; that was directly in line with the question posed to the employers.

It is notable that 127 engineers, or about 19%, did not have the opportunity to participate in any course during a whole year. This does not mean they did not attend any other type of CPD. Analysing the data of these 127 engineers shows that they attended other types of CPD such as "service in professional engineering organization activities" and "updating professional development based on individual study".

On the other hand, about the same percentage stated they were able to participate in courses for 10 days or more per year. Taking the average of the 532 engineers who answered this question yields a result of around 4 days per year of CPD. This is about the same as the values obtained from the employer data that indicated 3 to 5 days a year of CPD as typical practice among employers.

CONCLUSIONS AND RECOMMENDATIONS

This CPD survey of FEANI addressing engineers with EUR ING certificates and respective employers from across Europe was informative and presents a snapshot of needs and practices of the engineering community. It is relevant to note that CPD practices are, in a large part, independent of the LLL providers' organizations. It is clear that dialogue between LLL providers, engineering companies and engineering professional organizations, like FEANI, could and should be developed and implemented.

Another important conclusion is that engineers as well as their employers are putting their "technical knowledge" at the top of the list of CPD topics attended during training. This is followed by topics like existing regulations in areas of CE, safety, environment, sustainability, digital tools, etc. Competences (knowledge, skills and attitudes) like leadership, coaching, mentoring related with the engineering community follow the other two groups.

The choice of the engineering community to develop these competences is to attend in-company or external courses and on-the-job training. Engineers also like to study on their own or through a formal postgraduate academic course. It appears that more can be done to design effective templates for evaluating the CPD needs of engineers. This area should be studied further by all stakeholders, especially the LLL providers.

From the study of the survey it seems that the annual average of 40 hours as the total minimum of CPD for an active and updated engineer is commonly achieved. Those hours may consist of 3 to 5 days of courses a year supplemented with CPD activities done by each engineers during private time. The collaboration of LLL providers with stakeholders to develop personal and company development plans may clearly benefit the organization and the implementation of a robust and effective system of providing adequate CPD for the engineering community. Considering initial questions by FEANI, the practice of CDP is constant, the majority of engineers want to have CPD as a necessity to progress in the career, the majority of employers support CPD of engineers, time spent yearly in CPD is more than forty hours and payment of CPD is shared by engineers, employers and official agencies.

Another important recommendation emerges from a FEANI proposal "E4E – Engineers for Europe" that has been proposed for funding by the European Commission (E4E, 2022). In fact, the proposal aims to build a structured and durable alliance between education and the engineering profession (professional bodies and industry) to foster innovation and resilience of European engineers through the acquisition of new skills and competences, including knowledge, attitudes and leadership, with specific focus on digital, green, resilient and entrepreneurial competences. One of the objectives is to prepare the engineering profession to tackle EU societal challenges and priorities (green and digital transformation, decarbonisation, etc.).

The conclusions listed above indicate that some recommendations can be made to foster cooperation between the engineering professional sector and ULLL providers. One possibility is the joint participation in projects and proposals funded by the European Commission related to innovation, technology development and qualification. Another possibility is the nomination of joint observatories and/or committees to define training programs and cooperating platforms. A third action might involve periodic surveys, like the one described in this paper, to define what is needed by engineers and what ULLL providers can contribute. A better mutual understanding and knowledge among ULLL providers and engineering professional associations could be promoted with benefits for all, but especially for the qualified engineering population.

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