

ENGINEERING PROFESSIONAL CONTEXT AND CPD

Alfredo SOEIRO, AECEF, Portugal, aecef@fe.up.pt
Karel de WEVER, FEANI, Belgium, de.wever@mes.be
Dirk BOCHAR, FEANI, Belgium, dirk.bochar@feani.org

ABSTRACT

Engineers are the professionals that have intense and continuous lifelong learning (LLL) activities regulated by professional organizations, by employers and by official agencies. That is due to the obsolescence of competences and the need face new challenges. The dialogue between with LLL providers and users of the required continuing professional development (CPD) training is not structured in most of the cases. An analysis of a CPD survey among the engineering community of the federation of engineering professional organizations (FEANI) is made in terms of foreseeing methods and approaches to improve the communications between the LLL providers and engineering CPD consumers. Results are presented and discussed with conclusions providing content for a proposal of dialogue between LLL providers and users of CPD like engineers and employers.

Keywords: *CPD, LLL, Providers, Cooperation, Engineering*

1. CONTEXT DESCRIPTION

In the first place, the FEANI policy affirms that there is an on-going need for CPD of engineers in Europe (FEANI, 2015). CPD is considered 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 individual's responsibility and requires the cooperation, encouragement and support of employers and professional and academic institutions as CPD providers. Some countries professional engineering organizations require mandatory periodic CPD to keep the status as engineers. Therefore, engineering CPD, to be most effective, has to be planned and related to specific objectives. A personal development plan in terms of competences needs to be periodically updated. 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 address inclusion of promotion of CPD as an important element of the engineering mission and establishment of a CPD policy highlighting the key role of qualified professional engineers for the development of the economy and society. The cooperation between the LLL providers and professional engineering organizations could address encouraging all stakeholders to invest in CPD for engineers, define quality standards in CPD as well as innovative practises in learning (Fredriksson, 2021). Other topics are the support of individual engineers in their personal CPD definition, publicizing good practices in CPD and include initiatives on competence recognition, mobility, employability and accreditation of education.

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

2. SURVEY OF CPD FOR ENGINEERS

Continuing Professional Development is an on-going need for engineers in Europe. It is a requirement of life-long-learning of professional engineers at all levels to maintain proficiency of their art. Recently, the European Monitoring Committee (EMC) of FEANI decided to organize a survey amongst the engineers who received the EUR ING certificate during the last 10 years. 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. Currently over 32.000 European Engineers are listed in the EUR ING register.

In 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 your present and future employers. Therefore, one must keep an eye on what happens in your field of technology to prepare in advance for change. Learn to live with a certain amount of uncertainty because it is very difficult to know what kind of competence will be useful five years from now (WEF, 2018). Do not forget that, in addition to the technical competence, also other competences (knowledge, skills and attitudes) are important in the working life. Updating competences and improving performance are minimum requirements when an engineer wants to hold its position and stay employed. If an engineer wants its career to progress, through vertical or horizontal mobility, an engineer needs to invest in CPD.

There are many ways an engineer can continuously develop their professional competences. To name a few: on the job learning and training, attend training courses, seminars, conferences, study for another complementary degree, e-learning, write articles in magazines and scientific periodicals or join 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 these are impossible for just one engineer to manage alone (Dutta, 2012).

3. 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 more oriented to the target group. The questionnaires were designed to get a better understanding of what already exists in the workplace, to identify the barriers to training and development for engineers and to get a view of what is happening in the different countries across Europe. The responses were of course confidential and the results were be 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 with the link to the 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 taking into account, so the access to the survey was closed half June. Most of the reactions have been received between May and June with a peak by the end of May.

3.1. Relevant responses

The responses were statistically valid. Assuming around 5000 engineers got the EUR ING title during the last 10 years, more than 13%, 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 analyzing the answers resulted in no significant difference compared with all the others. For that reason the data has been processed as just one group.

Each company size is represented with a little majority of companies with more than 250 employees compared with those between 1-250 employees as can be seen in table 1. A lot of the respondents have a leading function in the company as presented in table 2. Answers came from engineers working in several branches of industry as shown in table 3.

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
total	674

Table 2: Respondents function.

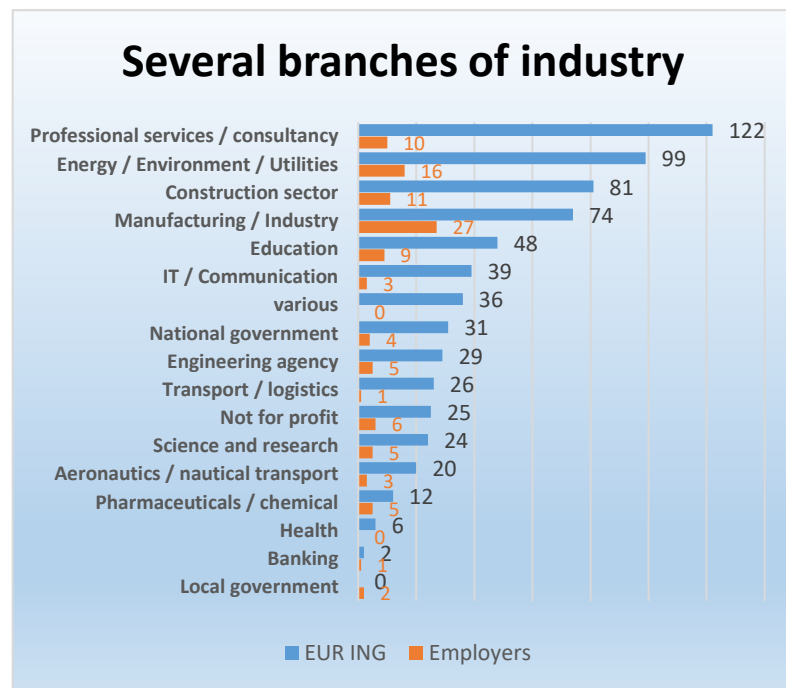


Table 3: Respondents from several branches.

3.2. 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 it can be observed in figure 2 the subject with best score is “Technical developments in the line of business”, very close followed by “Regulations (CE, safety, environment,...)” and “Skills (leadership, coaching,...)”. An almost equal score have the topics “Latest trends in technology and their applications”, “General Management” and “Project Management”. The list is closed 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. It is noticeable that the employers have almost the same preferences as the engineers as shown figure 1.

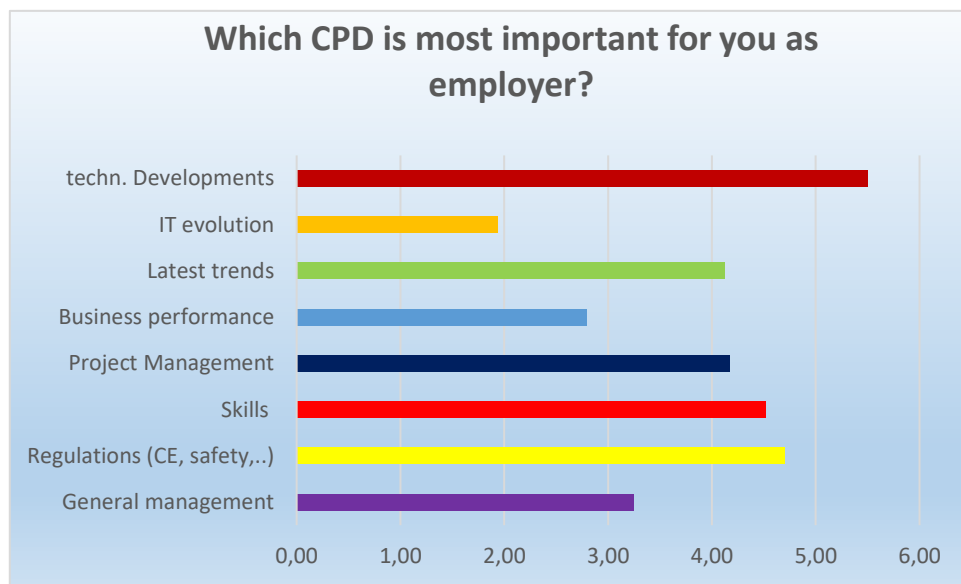


Figure 1 - Importance of CPD subjects for the employer.

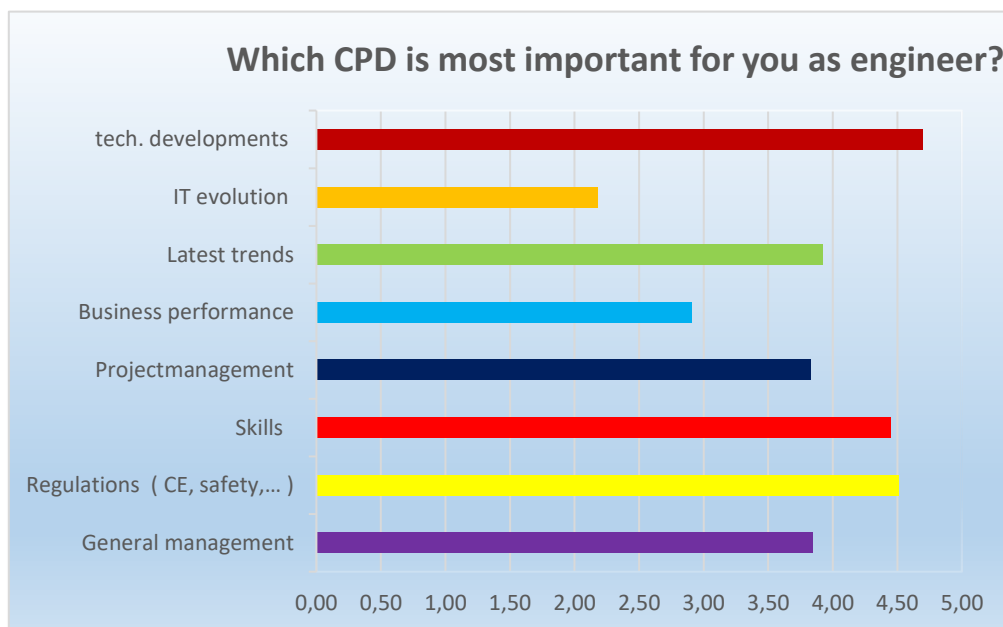


Figure 2 - Importance of CPD subjects for engineers.

Another important question is what constitutes the types and modes on how CPD is applied. This list used in the questionnaire is based on a FEANI document “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. One credit is considered, in general, equivalent to one hour of participation in the CPD activity but there are maximum values for each type of CPD when calculating the yearly average thus ensuring that CPD activity is varied and not for a few ones.

In the graph of figure 3 it is indicated 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 following a “Formal post graduate academic course” is not that highly valued by the employers, as shown in figure 4, there were 82 engineers, which is around 12% of total, find it useful.

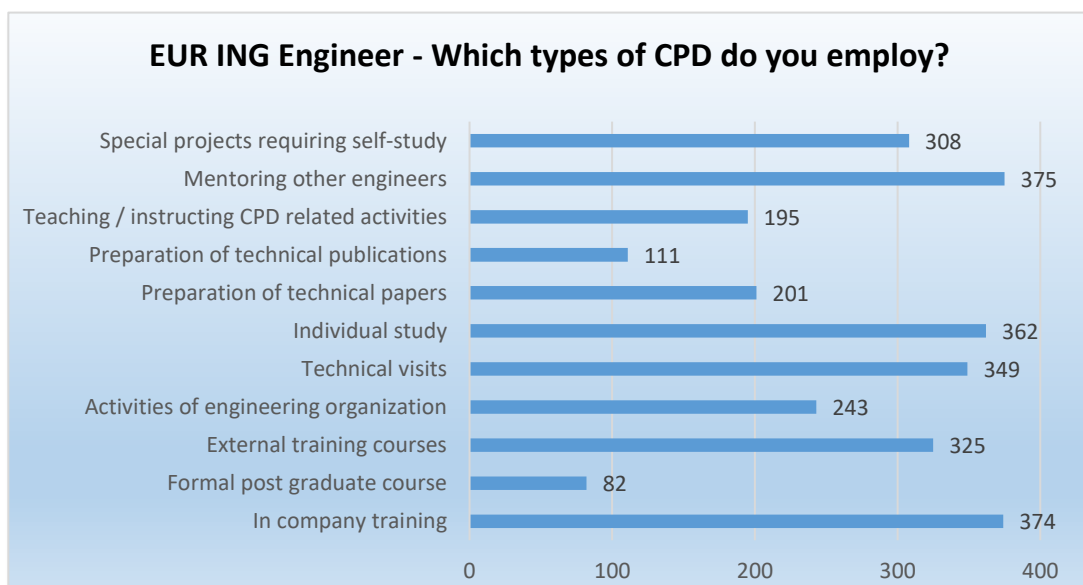


Figure 3 - Types and format of CPD used by engineers.

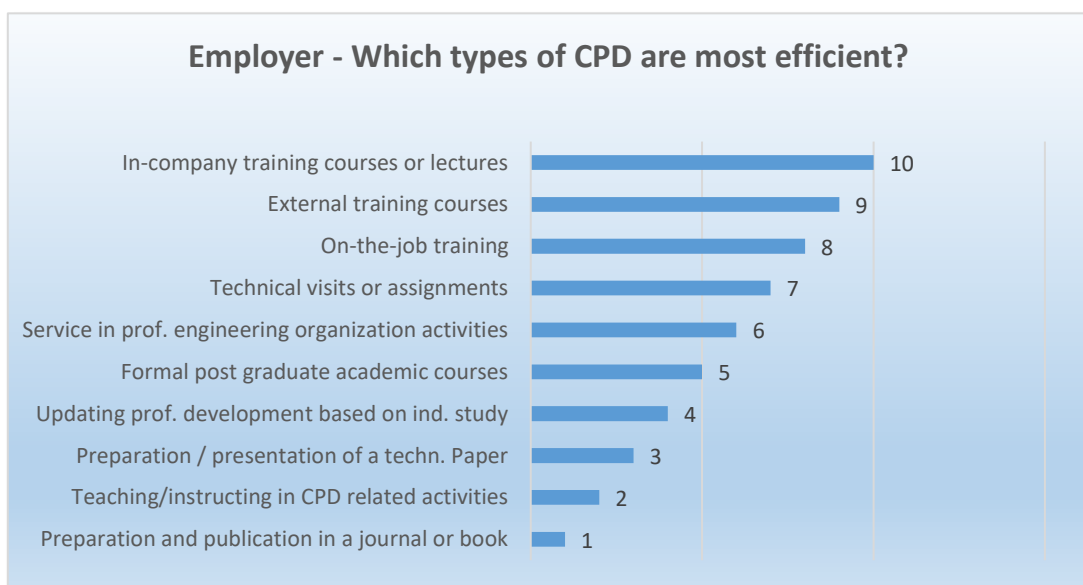


Figure 4 - Efficiency of CPD from the viewpoint of the employer.

Mentioning the employers, how do they 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 means the most likely to improve and 1 the least efficient form of CPD from the employers' point of view. Results are presented in figure 4. Employers believe the company benefits the most from internal and external courses and on-the-job training of their engineers. These are also the types for which employers provide financial support. The other items are mostly individually oriented and consume time of the engineer during his private life.

When it comes to financing CPD, who's 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". Investigating the employers survey shows that 15% has 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 for option 2, that is paying a certain percentage and in 3% of the cases the engineer pays depending on the subject. Compared with the results of the engineers the values respectively are 16,6% did not respond, 46,3% says the company pays the complete amount and 9% combines between the 3 options. Option 2 is referred by 9,2% and option 3 is indicated by 17%. The last 1,8% indicates the company combines options 2 and 3.

Given the importance of companies assigning to In-company and to external training courses, it would be logical one wants also to evaluate the course results. However, this seems to be difficult to measure in most of the cases as expressed in Table 4. This may indicate that there is no effective measurement process in place to verify if learning outcomes and competences were acquired.

the opinion of the participant himself	●	●	●	●	●	●	●	●									
via our own evaluation form	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
via an individual interview afterwards	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
by observing the job performance of the trainee	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
there is no evaluation																	
%	2	1	8	8	7	5	15	12	1	1	3	5	3	5	9	3	

Table 4: Evaluation of the person after a CPD event.

Again 12% of participants did not answer. In general, the opinion of 58% of participants considers that one or more techniques are sufficient to verify effectiveness of CPD. Only 3% says of respondents affirm that there is no evaluation at all. Connected to this survey question there was the following one: "When an engineer has participated in a CPD event, how often have the effects of CPD in the listed aspects been evaluated?" The results can be seen in Table 5.

	Always	Usually	Sometimes	Rarely
Participant satisfaction	45	30	9	4
Changes in participant views/attitudes	14	39	25	10
Improvement in participant knowledge/skills	28	37	19	4
Changes in participant behaviour	10	29	40	9
Organisational changes	4	29	31	24
Value for money	19	26	29	14
Does evaluation influence future CPD activities?	23	32	24	9

Table 5: Evaluation of CPD – all values in %

Another question was intended to have some insight in the main reasons a company wants his engineers to be involved in CPD. These motives were presented as options and no other

options were provided to employer as possible choices. Table 6 illustrates the results obtained.

CPD of staff is critical to the success of our organization	●	●	●	●	●	●	●									
to keep motivated employees within the company	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
it's a necessity to maintain the quality of services and products	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
it's an investment in the future of our company	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	%	27	4	2	6	8	2	2	5	4	11	4	7	4	2	

Table 6: Importance of CPD for the company

3.3. 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 in CPD, how much time the engineers are allowed to invest in CPD and what is the employers attitude in terms of dispensing engineers to have CPD. These are values that may be sometime difficult to calculate due to the nature of some CPD activities. There was a clear attempt to obtain as much reliable information as possible. The answers were sometimes not direct and only estimates were provided in the questionnaire by engineers and by employers.

For employers questions were defined to provide the number of days for CPD courses per year an engineer needs to keep up-to-date in his job. Courses could be long duration course or several short-duration courses or a combination as well. The choices for employers were between one to five days per year with possibility of having more days in one year. The results are shown in Table 7.

Another question was related with the fact of having periodic CPD as mandatory to maintain the engineering professional status. From the part of the companies a bit less than 50% of the companies stated that it was mandatory in their country. Those countries are 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 either were forced legally or due to 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 taken into account as these were all entered in days and that was directly in line with the question posted to the employers.

Table 7 presents the results. It is noticeable that 127 engineers or about 19% did not have the opportunity to participate to any course during a whole year. This does not mean they did not attend other type of CPD. Analyzing the data of these 127 engineers shows 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 courses for 10 days or more. Taking the average of the 532 engineers who have answered this question brings a result of around 4 days per year of CPD. This is about the same as the values obtained from the employers data that indicated 3 to 5 days a year of CPD as typical practice among employers.

course duration (c)	number of engineers (e)	Total days (d)=c*e	AVG sum(d)/sum(p)
0	127	0	0,00
1	21	21	0,14
2	41	82	0,54
2,5	2	5	0,57
3	43	129	1,01
4	39	156	1,44
4,5	1	4,5	1,45
5	55	275	2,04
6	24	144	2,31
7	24	168	2,61
8	15	120	2,82
9	10	90	2,97
10	34	340	3,52
11	10	110	3,69
12	14	168	3,94
12,5	1	12,5	3,96
13	11	143	4,17
14	5	70	4,27
15	25	375	4,81
14	5	70	4,90
15	25	375	5,37

Table 7. Average days of CPD per year.

4. Conclusions

This CPD survey of FEANI addressing engineers with EUR ING certificate and respective employers from across Europe was informative and presents a portrayal of needs and practices of the Engineering community. It is relevant to notice that practices of CPD are in a great 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” on top of the list of CPD topics attended during training. These are 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 those competences is by attending in-company or external courses and on-the-job training. Engineer also likes to study on his own or to subscribe a formal post graduate academic course. It appears that more can be done to design effective templates for evaluating the needs of CPD 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. Collaboration of LLL providers to develop with stakeholders personal and

company development plans may clearly benefit the organization and implementation of a robust and effective system of providing adequate CPD for the engineering community.

5. References

Dutta, D., Patil, L. and Porter, J.B. Jr. (2012) Lifelong Learning Imperative in Engineering. Sustaining American Competitiveness in the 21st Century. National Academy of Engineering. Washington, DC: National Academic Press. Available at: <https://www.nap.edu/read/13503/chapter/1> (Accessed: 26 November 2021)

FEANI (2015). Available at <https://www.feani.org/feani/cpd/policy-guidelines> (Accessed: 26 November 2021).

Fredriksson, C. (2021) 'Lifelong Learning And Continuing Professional Development In Stem – Innovation, Sustainability, Inclusion', 17th World Conference on Continuing Engineering Education Proceedings, NTNU, Trondheim, paper 37.

Markkula, M. (1995) 'The role of professional organizations in developing systems for lifelong learning'. Industry and Higher Education, Vol. 9, No. 4, pp. 227–235.

UNESCO (2021) Engineering for sustainable development: delivering on the Sustainable Development Goals. International Centre for Engineering Education. Paris: UNESCO.

WEF and BCG. (2018). Towards a reskilling revolution: A future of jobs for all. World Economic Forum and Boston Consulting Group. Available at: www3.weforum.org/docs/WEF_FOW_Reskilling_Revolution.pdf (Accessed 26 November 2021).