Modelling Continuing Professional Development in an Innovative Context

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Being one step ahead of your competitors with incorporation of new knowledge in the products puts focus on the importance of human resources as a significant resource for industrial development. A major competitive parameter in knowledge society is engineering competence, especially in the industry subject to very fast innovation processes. Continuing professional development of engineering staff is therefore very important. A model for the continuing education process will be described. The elements of the model and their interaction will be discussed. Part of the modelling is based on interviews with development engineers from the very dynamic mobile communication industry. Some examples of CPD-programmes will be described.

Keywords: competence, CPD model, organisational strategies, lifelong learning

1. Introduction

Knowledge and competence have become two of the most competitive parameters in the information-technology (IT) consumer product industry in recent years. In order to maintain a competitive advantage, engineers must always be "one step ahead" in their incorporation of new knowledge into their products. For this reason, Continuing professional development (CPD) of engineers within this field has become increasingly vital. CPD includes the development of professional theoretical skills in addition to the practical work functions — i.e., a combination of continuing engineering education along with productive engineering. The extremely engineering-intensive field of mobile communications, which is subject to very rapid innovation processes in which the development of new products and services accounts for the majority of costs, provides an excellent example of an environment in which CPD of engineers is especially valuable. Thus, there is a new focus on the importance of human resources, as a significant recourse for the industrial development in Europe [1][2].

Planning of the educational activities within continuing professional development must be highly dynamic in order to accommodate the rapid innovation processes found in these organisational environments and therefore cannot be rigidly established well in advance to the date in which the course work will actually take place. Further, the framework for the professional development courses must include fast, periodic follow-ups on the needs identified by the organisation to ensure that the engineers are continuously obtaining the never-static knowledge and skills necessary to attain their goals. Exchange of information between the university and the organisation is thus critical in the establishment of an effective framework for professional development.

2. Background for the Model

Described below is a first schedule for a model for organising professional development cooperatively between the organisation and the university. The model is inspired by the Danish and Norwegian curriculum development models [3] [4] [5] [6], along with models of organisational theory [7], and is constructed in such a way as to capture cultural and societal differences in various countries and in a variety of organisation environments. The following basic principles serve as the foundation for the model:

— A number of elements that have influence on the specific development process are defined. Due to the complexity of each of the individual elements, each element is regarded as a subject for the research and development activities.

— The elements are not part of a linear process but are to be regarded in relation to each other. A dynamic process exists and each element influences the other elements of the process.

— The relationships between the elements create demands on an organisational level i.e., there is certain accordance between, for example, the continuing education strategies of the organisation and the participants' learning capacity on one side and lecturer's selection of contents and learning methods on the other.

How learning is interpreted within the organisation is greatly influenced by the cultural practices of the particular organisation and thus it is an important premise in the continuing education strategy that both the companies and universities are dynamic units in the development process.

3. The 8 Elements of the Model

The model proposed in Fig. 1 consists of eight elements, based on current research findings in the fields of didactics and organisational learning. All of the elements and their unique characters play a role in a flexible continuing education process.

Thus the organisational correlation between companies and universities, the companies' and the universities' different strategies for continuing education, and especially the professional development, goals and contents are of a more cultural and society-like character, than the other elements. However, it is the relation between all elements, that is decisively important for the concrete arrangements.

3.1. Professional Development, Goals, and Contents

The first element concerns the professional development process and its goals and content. Questions related to the specific types and levels of technical and knowledge-based needs must be answered cooperatively between the university and the participating organisation. Particular attention should also be given to the technological capacity of the society in which the organisation is based, as these needs may vary greatly across countries and the individual organisations. The findings related to this element in the model will significantly influence the selection of strategy for carrying out the needs analysis.

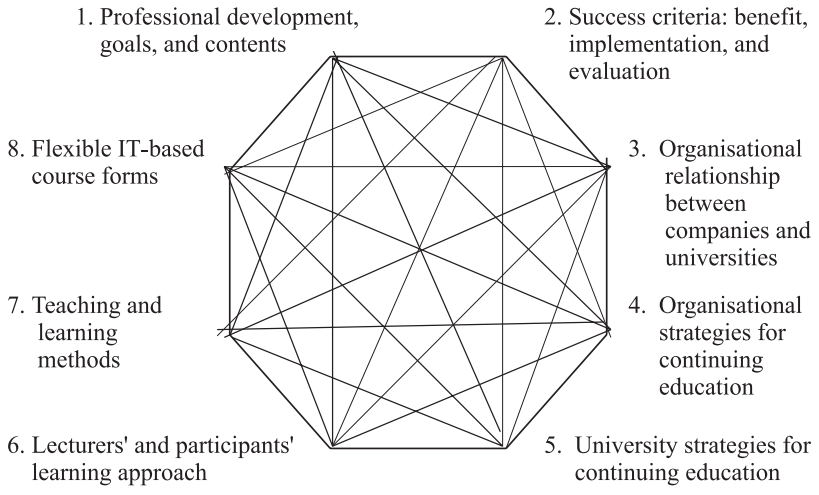

Fig. 1. Model for the context of continuing professional development.

3.2. Success Criteria: Benefit, Implementation, and Evaluation

Consideration must be given to the methods for applying the learned knowledge and skills in the organisation and thus integration of the newly learned professional skills should serve as an important criterion for success of the development process. Because the needs and values of organisations will most certainly vary in nature, it is imperative that the individual organisation explicitly describes the specific criteria that will be used to evaluate their own professional development process.

The goals should be presented as specifically as possible and be part of a mutual agreement between the university and the participating organisation. The organisation should take an active part in formulating the goals and success criteria. Experiences from numerous continuing education courses indicate that it is quite often the absence of such formulations of success criteria that results in ambiguous and ineffective evaluation of the completed courses.

3.3. Organisational Relationship between Companies and Universities

A joint frame of reference must be established between the universities and the companies in order to foster a cooperative relationship concerning the continuing education. The cultural practices of both parties must support interactive cooperation so that each is able to contribute its own unique qualities to the development of the developmental program.

The nature of the interactions between the university and the organisation will vary in character, depending on the national setting in which the two operate, due to local cultural conditions and the norms for both parties' with respect to research and education. The organisation must be aware of which resources are actually available from the university system — in other words, whether the university can effectively provide education on the theoretical knowledge and skills the organisation is seeking. It is critical that communication channels between the university and the organisation are established from the start. Creativity in terms of establishing open communication can be a distinct asset to the planning of the professional development framework. Networking based in university research groups, such as acoustic networks and signal-processing networks that are centred around and organised by the university, can be quite advantageous.

In terms of the educational methods, project-organised studies can be recommended as they optimise close cooperation between the university and the participating organisation. With project-organised learning, the students often begin the course by presenting an actual problem scenario from their own organisation. By utilising an actual problem scenario, opportunities for both better communication and cooperation between the organisation and the university are provided while, at the same time, better likelihood of successful application of the learning in the workplace is ensured. Consideration should be given to both immediate and future needs as the organisation formulates its goals. Conversely, the organisation should be aware that there might be elements of the coursework that may not be immediately relevant but will become useful in the future.

3.4. Companies' Strategies for Continuing Education

Internal organisation strategies for continuing education play a role in the planning of continuing education courses. Organisational strategies may vary greatly in the following manner:

— Total strategic planning for the company, where a basic education course plan is established for a number of employees.

— Individual employee strategies, where employees select their own continuing education courses, which may or may not be the same as the choices of their colleagues.

Often, an organisation's strategies for the professional development will fall somewhere between these two extremes and it is also quite possible that the organisation adopts a "laissez-faire" attitude by never fully formulating a strategy. In any case, the strategy that the organisation selects will greatly influence the formulation of the professional goals, success criteria, and the nature of cooperation and interaction between the university and the organisation during the developmental processes. Most important in

terms of selecting a particular strategy (or combination of strategies) is that the professional needs and goals of the organisation can be met and that the strategy best reflects the dynamic industrial environment in which the engineers function.

3.5. Universities' Strategy for Continuing Education

Traditionally, the primary tasks of the university have been centred on teaching and education. As a natural outgrowth of the teaching and education, universities soon became integrally involved in research activities as well. It appears that continuing education may soon become a third and equally important function of the university system.

Because the field of continuing education is still relatively new, programs may not yet be integrated into the university's educational and administrative practices. It is quite possible that the university wishing to integrate continuing education programs into their system will encounter perceptual barriers — e.g., that there is less prestige associated with shorter continuing education courses than with research-related activities and thus less interest. The dynamic nature of the continuing education may also present a barrier to adoption of these programs because the university's culture is usually based on rigid planning and clear administrative practices that are not applicable in this case. The university must be prepared to offer these courses on demand, rather than according to a rigid and predetermined schedule. Further, flexibility in terms of class size, content, and scheduling will necessitate the allocation of additional personnel resources in order to prevent overburdening of existing lecturers.

3.6. Target Group and Learning Approach

The target group and their approach to learning play a role in the planning of the continuing education courses. Further, a number of specific issues must be considered when planning the framework for the professional development program.

— Desired competency level at completion-continuing education of advanced level engineers vs. re-education courses

— Age of participants

— Homogeneity with respect to age, needs, education, experience, and job functions

— Educational background of participants

— Professional and working identification

— Organisational expectations concerning form and content of the education

— Investment of employee's time for learning-coursework to be offered during paid working hours vs. during the participants' spare time

— Investment of time and money

— Participant's family responsibilities and time management resources

— Necessity to maintain highest quality of educational practices

— Participants access to technology

3.7. Teaching and Learning Methods

The selection of methods for teaching and learning are clearly dependent on the other elements relevant to the professional development. Basically, there are two broad types of teaching and learning methods from which the organisation may select: *organisation-oriented or university-oriented methods*. Organisation-oriented methods may then vary according to structure, such as:

— The project form such as work-based learning, which may be characterised as a cooperative agreement between the university and the organisation (development departments) to participate in the development

— Just-in-time courses or courses-on-demand, in which the organisation defines its actual needs for knowledge development and the university quickly plans special courses to satisfy these needs.

To a great extent, the university-oriented methods can be thought of in terms of ready-made courses within given subjects, offered to both the individual organisation and group of organisations.

At a more specific level, the choice of the concrete teaching methods to be used is also important. Here again the relationship between the company and the qualification goals plays an important role, as more participation-oriented and interactive methods can be linked to the internal company work.

3.8. Flexible IT-Based Course Forms

The final element consists of various types of course forms and technologies, which may be used in both course development and course delivery. Typically, there are three basic course forms:

— Online-courses, in which the teaching form is a net-based (remote) education

— Mixed-courses, in which the teaching form combines face-to-face teaching with net-based education

— Face-to-face courses, in which traditional teaching forms are used.

Today, by far the majority of IT-based education is mixed-mode that allows the participants and the lecturers to establish social contact with each other and may facilitate subsequent communication between the parties during the continuing education process. The disadvantage with formal qualifying continuing education is that the motivation for active participation may be low. In an online-mode there is a risk of focusing too much attention on the presentation of the information, compared to dialog-based teaching and learning.

From a technological standpoint, there are quite a number of different options for assisting the teaching/learning process. For example, the Internet, web pages, IT-based conference systems, CD-ROM, audio and videotapes, etc. While the selection of the technological tools to be used is certainly not unimportant, the choice should be viewed in terms of the technical contents of the course, the learning methods being applied, and especially, the composition of the target group and their access to the various forms of technology. Additionally, it is important that the choice of technological tools to be used in the professional development is compatible with the selected form for teaching, which will be inevitably influenced by the applied technology.

4. Simplified Model

Based on experience from understanding and using the rather complex model described above, a revised model is given in Figure 2 [8].

Because the field of continuing education is still relatively new to universities, programs may not

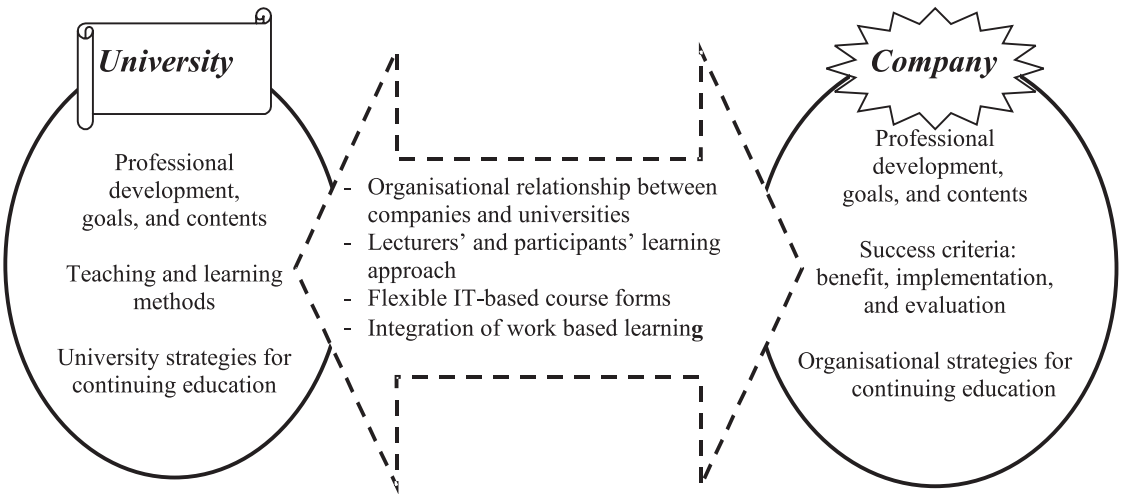

Fig. 2. Operational Model for CPD [8].

yet be integrated into the university's educational and administrative practices. It is important to consider **why** the university teachers should be involved in this activity, **what** will be the goals to achieve and **how** it must be implemented. Further, flexibility in terms of class size, content, and scheduling will make it necessary to allocate additional personnel resources in order to prevent overburdening existing lecturers.

5. Continuing Professional Development as a Company Task

The industrial organisation must realize the necessity of having access to the research-based knowledge present at the university and which goal they have to achieve. Consideration must be given to the methods for applying the learned knowledge and skills in the company and thus integration of the newly learned professional skills should serve as one important criterion for success of the development process. Because the needs and values of organisations will most certainly vary in nature, it is imperative that the individual organisation explicitly describes the specific criteria that will be used to evaluate their own professional development process.

To summarise from section three:

— The goals should be presented as specifically as possible and be part of a mutual agreement between the university and the participating company.

— The company should take an active part in formulating the goals and success criteria.

— Internal organisation strategies for continuing education play a role in the planning of continuing education courses and must, therefore, be defined and communicated to all staff members.

6. Continuing Professional Development as Cooperative Programmes

Until now, mostly private professional organisations offer courses for engineering professionals to update their skills, organised as in-plant courses, five days intensive courses in nice locations or major international cities etc. But this kind of upgrading, re-educations or just follow-up courses takes time. Most innovative companies are aware of the importance of improvement of professional competence. From research on trying to describe the context of CPD [8] it is known that, even though professional development is identified as vital for the future of the company, the individual engineering staff member often tells that he must find the time for such courses himself — they are not integrated in the time-plan for the project. Money for financing the course is normally no problem — but *time* is.

Another parameter that must be considered is the recognition of the course as being part of the personal curriculum — which means that some kind of standardised approvement is desirable. This means that we must develop a CPD-programme that is accepted by the managers as well as the engineers, a programme that integrates new academic knowledge into the productive daily process of the engineer or vice versa.

At Aalborg University we have done that in some specific "Master — programmes" implemented as research based PBL (problem based learning). These "Master-programmes" are 1–1.5 year programmes on half-time basis, which means that it takes 2–3 years to succeed. The programme consists of courses and project work. The project must involve at least 50% of the time and some of the courses must be applied in the project. The programme is organised in themes and for the engineer attending the programme it should be possible via the project to integrate his job tasks into his study — or to integrate the application of the courses into his job tasks. In this way the workload from following the study will nominally be reduced. Until now we have only urged the engineers to do this integration of study and work. We have, however, realised that this is not always easy. In the future we will consider new ways of more direct cooperation between university and company on management level to define the framework of the educational process.

In these master-programmes, IT-based distance education is very important [9][10]. In the courses as well as dialog between students, dialog between students and teachers, development

in the project work etc. distance education tools are being used. This means, for example, that even though an engineer for a period is posted to work from another country, he can still be an active student. Face-to-face seminars, though, are still important, if possible. We tend to schedule 7–8 two-day seminars a year at the university (or whereever optimal for the group or the content). Here the students and teachers can meet, hands-on laboratory exercises can be carried out, etc.

The mentioned concept for CPD-programmes has been implemented at AAU for several years. By now the acceptance of this concept is so outspoken that we have been requested to apply it to other programmes with less content.

7. Educational Degree Upgrading as Work-Based Learning

Teamwork often involves people with very different educational backgrounds. In many companies engineering teams often include staff with non-engineering background such as technicians. Such technicians with years of work-based experience can often be very difficult to tell from the group of engineers. Bright and experienced technicians can often come up with good experience-based solutions; they can solve the problem without understanding the theoretical background of what they are doing. On the other hand — if these people want to evolve with their tasks and be able to work with the inspiring engineering problems in the future, they must have some formal academic knowledge in addition to their work-based skills.

For people engaged in working life and having established a family and financial involvement etc. it is not attractive to leave their job and salary to study at the university. It might even be that they soon get bored and quit again. Therefore part-time programmes organised like the "Master-programmes" explained in section 6 might be a solution for an educational programme from technician to Bachelor of Engineering. A formal continuing education between these two levels will take several years and is therefore not attractive — to both the technician and his company.

Therefore, the curriculum for this programme must be organised in modules making it possible to identify professional fields and composing a personal educational programme from these modules, for two reasons:

— The individual technician can make the choice of studying a narrow field to reach a certain academic level (Bs.C.E.) within this field only

— The individual technician can go for a formal test within his strongest areas, without spending too much time attending lectures.

It is very important not to underestimate the skills obtained from years of experience. Universities must, therefore, develop ways to evaluate and compare work-based skills to academic skills within these fields [11]. Compared to the PBL concept, it is identified that there is a strong similarity between projects carried out by students in an ordinary PBL curriculum and projects carried out by students in a continuing education programme. One major difference is that full-time students in a university-based team are all on the same academic level whereas this is not the case with company-based teams. We consequently have to learn to evaluate projects and test students who are part of a very inhomogeneous team with respect to formal educational background, practical experience and goals to achieve.

8. Discussion

In PRO-ACTT [1], there is focus on establishing the framework for cooperation between the mobile communication companies and the universities in order to analyse the needs for continuing education and, subsequently, to develop and implement this continuing education via the Internet in a transnational way. Core elements have been pointed out in this article as important to establish the corporation between company and university.

Depending on the organisational culture, history, and management's insight in the mentioned problem presentation, the nature of the organisation's strategies for continuing education will vary considerably. The following examples represent a few possible organisational scenarios and how organisational characteristics will influence the professional development process.

1. The company is aware of the necessity of allocating additional resources to continuing education and these expenses become a part of the operating budget. Management trusts the individual engineer's ability to access his own needs pertaining to professional development and it is thus the engineer who determines whether he will participate in a continuing education program.
2. The management believes that graduate engineers, who have a research-based education by definition, do not need continuing education, as they should know how to acquire new knowledge. Time and financial resources would not be allocated for continuing education.
3. The organisation has an active management practice in which the product strategy is continuously revised, requiring continuous evaluation and re-evaluation of the engineer's technical professional skills. When necessary skills are found lacking, the engineers are either replaced or professional development programmes are implemented.
4. The company is organised into teams of engineers and the team managers are responsible for currently accessing the professional skills of the group as well as the planning of continuing professional development.

University organisation and strategy is similarly influenced by cultural, historic, political, and economic factors, in addition to the prevailing research traditions. Especially in older, historical universities, there are very "proud academic traditions", which can often mean that little to no basic educational and pedagogical changes have occurred. Research in these institutions is often "basic", or aimed solely at reaching higher levels of theoretical knowledge in narrow fields.

Other more innovative, technical universities have directed research towards a combination of application-controlled research and discipline-oriented research. Universities in which their is sustained interest in applied theoretical education may be much more open to the demands and changes which occur outside of the university environment (i.e., societal) and may thus be more open to undertaking new tasks [12].

However there are several "system issues" to be resolved before implementing a continuing education program:

— State-universities are economically controlled by very strict rules, which are seldom intended to work together with more commercially characterised activities (i.e., private industry).

— Professors and other researchers, who are normally accustomed to state-financed research and education, ordinarily do not give consideration to income. Correspondingly, there is no interference with how he or she conducts the job activities.

— Theoretically oriented university employees may have a certain fear of establishing contact with persons or organisations outside the university environment due to their lack of experience in this area.

In spite of the numerous obstacles that arise with the implementation of a continuing education programme, the intensive technological innovations occurring today create a significant need for methods of providing on-going and continuous professional development to industrial engineers. For a large number of these engineers — and especially those who are responsible for the application of new technology within their organisation, it is becoming increasingly difficult to obtain and maintain the high level of professional knowledge and skills demanded by the industry. By taking advantage of the research activities and educational experience existing in the university system, private organisations may well be able to satisfy their needs for continuous professional development of their engineers. It will be a challenging development for both companies and universities.

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In 2001 he received a major funding from the Ministry of Education to establish a Centre of Competence for Continuing Professional Development at Aalborg University. He is representing his university in more university consortia working on establishing CPD-programmes in cooperation and developing the Virtual University Campus.

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