

Engineering Education Process as a Logistics System.

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Abstract

The paper is an attempt of presentation of engineering education as a logistics system. The author presents engineering education as a logistics system, because he has found many elements and features in an engineering education process, which can be compared to some elements and features of the logistics system.

First of all, the author clarifies engineering education process conception and he divides the process in two parts learning and teaching. Then the author shows features and components of logistics and based on this division he points to the same elements in engineering education process.

Finally, he explains the reason why he has decided to present engineering education as logistics system. He tries to apply rules of logistics management to the management in technical universities.

1. Introduction

Education process is a very complex concept it includes two processes very closely connected each with other, they are learning process and teaching process. Learning process is a fundamental process of acquiring the information, skills and habits as well by the learning subject. Teaching process can be defined as a systematically, planned and direct managing of the learning process[1]. In engineering education process students fulfil the function of learning subject and the function of teaching accept adequately specialised teaching staff.

Another idea is a recognition the education process as a communication system. It consists in common meanings appearing as an effect of interaction between sender and receiver. Very important element appears in communication – a content of the message. In engineering education process the content consist of current industry and economy needs and technological problems. The academic teachers as message senders aim at generating the right reaction on the students' knowledge using various message presentation medium and technical tools. The knowledge is divided in suitable sequences according to the education contents because of it an engineer

graduating the study is equipped in theoretical preparation to the job.

In education process we have got also time and space transformation of students. In precise time periods, students change their education areas; it is connected with going through the courses. A few time sequences can be distinguished in Polish circumstances. They are as follows:

➤ Simple time sequences

➤ Connected time sequences

The simple time sequences are following:

✓ Bachelor's courses – 3 years

✓ Engineer's courses – 4 years

✓ Master's courses – 5 years

The connected time sequences contain:

✓ Bachelor and master's courses – 5 years

✓ Engineers and master's courses – 6 years

Creating every curriculum for engineers a few elements should be considered: technical university mission, basis phases (stages) of the didactical process and theirs elements, didactical methods and necessary human and material resources.

In purpose of right curriculum creation following operation should be done:

A. Sector definition for the future alumni work

B. Development routes definition for the future alumni careers

C. Development program proposal for the alumni competencies' improvement

Indispensable basis competencies (entrance competencies) - important for the present employment market will be always a base of curricula contents estimation, and so:

➤ Curriculum should contain up-to-date and complete knowledge;

➤ The knowledge should be divided on basic, complementary, specialistic ones;

➤ Education should allow for permanent acquiring of knowledge in large quantities;

➤ Used techniques should point on practical helpful of the knowledge;

➤ Teachers work methods should allow for taking an active part in education process.

Changing social, political, economical and technical surroundings causes fast knowledge out of date. It

connects not only such areas of knowledge as computing, or telecommunication but economics or marketing as well. It makes many difficulties for researchers who wants to explain new phenomena and processes and for the teachers who should show the new phenomena and processes with right reserve.

Fast changes in science and technique are going together with changes on an employment market. Educated people should be formed in the way allowing for adapting to new requirements with possible low waste of intellectual and professional potential, in case of profession change necessity. Because of it, it seems to be necessary to assure a balance in curricula between general education (wide and primary) and specialistic education. Choice possibilities of complementary knowledge should be developed. It is worth to point in this area that curricula contents should be decided by skill acquiring for today and future employment market.

In engineering education process following suggestion should be considered:

A Employment market demand

Engineering education process is operated by satisfaction of present industry requirements and creation of completely new courses connected with planned investments important for whole economy or implementing of new techniques in existing enterprises. Engineering education is depended on a few criteria arising from a level of received education:

- bachelors
- engineering staff
- master courses graduates (mostly managerial staff)

B Science staff that enable education

Excellent qualified science staff is necessary for new education courses or new specialisations creation. It conditions good education in those areas.

C Organisational structures

Education in particular areas require effectively working organisational structures (faculties, departments etc.) their operating areas are precisely specified in frames of structures.

2. Theoretical background of consideration

The starting point in presenting engineering education as a logistic system is a system theory where logistic system present itself as formal arrangement composed from ordered two elements of systems A and set R of their characteristics or relation between them [2].

$$S - (A, R)$$

where:

$$\begin{aligned} A &= \{a_1, a_2, \dots, a_n\} \\ R &= \{r_1, r_2, \dots, r_n\} \end{aligned}$$

If R^p means p – reasoned relation set between elements of set A, that ensure inclusion

$$R^p \subset A^p \cap R$$

where:

$A^p = A \times A \times \dots \times A$ means p times Cartesian product of set A by itself, so p – is Cartesian power.

The most interesting in logistic system S are R^1 and R^2 sets 1- reasoned relation (the characteristics of elements) and 2- reasoned relation, that is links of A set elements in two elements, so the characteristics of two elements.

For instance: in delivery's department, where a_1, a_2, \dots, a_n elements of logical system are parameters of delivery – R^2 set can mean set of prices of delivered materials. Owing to fact that logistic system S is functioning in the space Ω , and which it is a proper part of this space: $S \subset \Omega$, is indispensable accomplishment of generalisation of this problem.

In introduced record

$$S = (A, R, R^*)$$

sets A, R and R^* elements of logistic system of internal and external relation might be shown as sum (or sequence) of multitude elements relation. In this way it obtains deeply and more detailed entrance to structure of logistics system S.

Therefore, it could be

$$S = (A, R, R^*)$$

Where:

$$\begin{cases} A = A_1 \cup A_2 \cup \dots \cup A_s, \\ R = R_1 \cup R_2 \cup \dots \cup R_q, \\ R^* = R_1^* \cup R_2^* \cup \dots \cup R_k^* \end{cases}$$

or

$$\begin{cases} A = A_1, A_2, \dots, A_s, \\ R = R_1, R_2, \dots, R_q, \\ R^* = R_1^*, R_2^*, \dots, R_k^* \end{cases}$$

Logistic system (S) of enterprise creates set of elements, internal relation between elements of this system and external relation among elements of S system and elements of surrounding S'.

Basic generalised convergence:

$$S=(A,R,R^*)$$

is a base to initiate more detailed elements of logistic systems, which then is a sequence:

$$S=(M,B,L,Z,W,R)$$

Where:

R- set of relations,

M- inventories,

B- logistic material base,

L- workers doing logistic exercises,

Z- logistic exercises

W- realisation of exercises determining the existence and function purpose

3. Logistics systems' theory implication in engineering education

Making allowance for above theory and take methodological assumption presented by D.M. Lambert [3], engineering education can be presented as a logistics system starting from the input elements through the transformation to the output elements (fig.2). The most important input elements are employment market demand, material base, scientific staff and development prognosis. Transformation existing in education processes requires continuous referring to the tasks identified with logistics. A few logistics task are shows in engineering education (fig. 1).

Engineering education can be also presented as a logistics system, because there are many features in an engineering education process especially, which can be analogously compared to some features of the logistics system. They are as follows:

- informational and decisional processes; they are integral part of education beginning from university or course erecting decisions as an effect of information about requirement of education in particular course going through the informational and decisional processes inside university or faculty
- inventory optimisation; that is keeping optimal didactic and scientific staff in its' quantity and specialities to assure correct run of education process and its development. The inventory optimisation refer to material base necessary for education (optimal number of didactical rooms, laboratories)
- costs of the logistics processes; this element is especially important in market economy and situation of universities' strong competition on market in order to students acquiring but the element is also

important in case of universities centrally financed because of university cost optimisation

- physical object flow; the element is an implication of above-mentioned element. It is strongly visible in case of payable courses, they are evening and extra-mural courses in Poland
- logistics processes' infrastructure; is an consequence of pursue decreasing of incorrect employment demand prognosis, education time optimisation, costs reduction, improvement of information flow between process elements and elimination of wasting activities.

4. Conclusion

From above-mentioned consideration it is appeared that education cycle can be interpreted as a knowledge about logistics processes existing in engineering education and art of efficient processes' management.

Engineering education treatment as a logistics system with keeping all its elements, features and rules opens absolutely new possibilities for technical universities in efficient university management areas. The main feature of modern engineering education is clearly complex character and wide limits of education. Whole project is based on general assumption that studying is not the last stage ending education of engineers. Because after that next stages of education exist for example professional skills improvement or self-education.

In this situation education process must be directed not only for knowledge dissemination but also for formation of skill for self-knowledge acquiring and creative attitude for all problems appearing in work.

Because of it, components shaping professional side of engineer must be the consideration subject for university staff, industry management, businessmen and politicians. So continuous confrontation of educating institutions with real industry requirements should be run. It is a problem with basic importance because it answers for two question. Do graduates implement the model of engineer given them at technical universities? And is there a social need for such a model of engineer?

References

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Figure 1. Engineering education system elements.

