ROLE OF VOCATIONAL ASSOCIATIONS IN LIFE LONG LEARNING SHOWN ON EXAMPLE OF CROATIAN MAINTENANCE SOCIETY AND OF EUROPEAN FEDERATION OF NATIONAL MAINTENANCE SOCIETY

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Abstract:
Strong development of technologies and the process of globalization are causing constant changes in maintenance activities. In order to keep track of changes and fulfil user expectations, it is necessary to go through continuous education – "life long learning". The need to always acquire knowledge brings us to continuously discover its missing pieces and makes us search for knowledge sources. A significant role in this process is played by national maintenance associations and EFNMS (European Federation of National Maintenance Societies) – supreme European maintenance association.

Keywords: maintenance, life long learning, EFNMS, competences.

1. Introduction

In a modern society marked by natural sciences, technology and world trade, maintenance is very significant. Individual equipment and entire systems are increasingly replacing the work of humans, not only in areas of mechanical work, but also in the sophisticated leadership and management activities. Complexity as well as users' dependence on systems is growing; in everyday life there are more and more systems present. Without them the user's life would be lower in quality, plus if systems are unavailable this causes immense difficulties and material costs. All this puts the maintenance role right on top of the list of priorities.

With due regard for the other mandatory maintenance elements (spare parts, tools, diagnostic equipment, documentation…), human resources are of special importance. Motivation, sense of belonging to the company, leadership, team work etc. are important values for human resources; but a special place belongs to *competences.* This article describes how to determine required competences and knowledge therein, how to acquire and permanently enhance them and how associations of maintenance personnel can help out.

2. User expectation from maintenance

In a company which is dedicated to the product, maintenance is an important element of the production process so there are high user expectations imposed on maintenance. According to the definition [4] *maintenance* is a combination of all technical, administrative and managing procedures during the life cycle of an element with the goal to keep or return the element into a condition where it will perform its required function. There are many maintenance key performance indicators [1], some of which need to be:

- *minimized* (down time, time to repair, consequences of failure, maintenance cost, life cycle costs),
- others need to be *maximized* (revenue, profit, time between failure, availability and OEE - Overall equipment efficiency),
- while yet in others there is a desire for *achieving required level* of quality, safety and environmental protection.

Another important thing – maintenance personnel need to avoid all additional activities which do not influence some of the above noted key performance indicators.

3. Maintenance organization

A question arises on how to organize maintenance so that it satisfies the described user expectations? The basic division in a maintenance organization is to „Maintenance Management" and „Maintenance Resources". There are many factors essential for successful implementation of such a complex maintenance organization; especially important are *human resources*.

This paper focuses on the field of competences in human resources so it does not deal with the other relevant maintenance elements for example spare parts, tools, IT support, connections with other parts of the company, relations to external companies etc.

4. Maintenance human resources management

Human resources consist of several elements such as competences, motivation, sense of belonging to the company, team work etc. First, terms such as knowledge, skills and behaviour will be defined. In line with standards [3] and [2] *competences* are a group of:

- *knowledge,* which is a collection of acquired and connected information (knowledge can refer to *theoretical and factual)*
- *skills* which encompass the application of knowledge and use of the prescribed methods of work in performing tasks and solving problems. Skills can be *cognitive* (logical, intuitive and creative thinking), *psychomotoric* (physical aptitude and usage of methods, instruments, tools and materials) and/or *social*
- *behaviours* which indicate a reached application of concrete knowledge and skills, according to the

given standards (eg. independence, responsibility etc.)

Defining the difference between education and training it can be said that by education a person acquires knowledge, and by training - competences.

Basic terms mentioned in above text are summarized in figure 1.

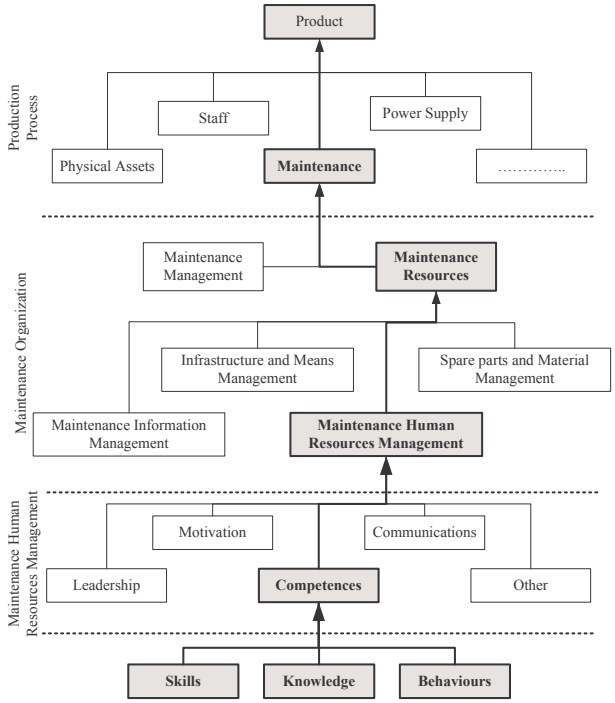

Figure 1.: Role of maintenance competences in production process

4.1. Job description

The basis of each organization is working place, for which there has to be a job description. Job description as a rule contains two basic groups of information:

- *general information* – this is the title of the working place, organizational unit, main role and responsibilities, this also requires professional qualification, required work experience in the identical/similar activities etc.
- *specific information* – detailed description of activities/tasks and required specific knowledge and skills.

Indispensable competences which are necessary for performing tasks emerge from the job description of a particular working place, and these can be divided into two groups:

- *overall* required competences for the working place
- *specific* required competences for the working place.

4.2. Determining required knowledge - EFNMS document „Qualification of maintenance personnel“

At working places which are on higher hierarchical levels, what prevails is theoretical (general) knowledge while on lower levels there is more of a specialist (factual) knowledge and skills. Establishing knowledge, especially general knowledge, is not simple – here, with their first document, EFNMS did a huge favour to its members. Technical committee TC 319 has in 1990s started creating a document „*Qualification of Maintenance personnel*“ which specifies the required knowledge. In this document Maintenance personnel is divided into three levels as follows:

- *The European Maintenance Manager* – a person with approved engineering background and sufficient theoretical knowledge to perform and co-ordinate maintenance.
- *The European Maintenance Supervisor* - a person with at least two years of practical experience in maintenance and sufficient theoretical knowledge to independently perform and coordinate maintenance projects (responsible for medium term decisions)
- *The European Maintenance Technician* – a craft person with at least two years of practical experience in maintenance and sufficient theoretical knowledge to independently perform and coordinate maintenance activities (responsible for short term decisions and communication).

And levels of knowledge are here divided into:

- *1 – very good knowledge* – to be able to lead change and handle special tasks
- *2 – good knowledge* – to be able to understand the implications of change and making the correct decisions
- *3 – understandings* – to be able to participate in decision making within the team and carry out the tasks

In each syllabus the overall approach is to ensure that maintenance tasks are:

- carried out safely and in a safe manner
- carried out in a correct manner first time
- carried out on time and cost effectively

Required competences are divided into two major groups and a range of sub-groups:

- *General Competences*
  - Corporate / Company Environment
  - Work Planning
  - Team Working and Communications
  - English Language
  - Information Technology
  - Training and Instructions
  - Quality Assurance
  - Environment
  - Automation
  - Occupational Health and Safety
- *Responsibilities and Competences*
  - Maintenance Objectives, Policies and Strategies
  - Maintenance Concepts and Methodologies
  - Restoration Techniques
  - Maintenance Terminology
  - Partnering and Contracting
  - Laws and Regulations
  - Conditions Based Maintenance
  - Fault Finding Techniques
  - Improvement Concepts and Techniques
  - Documentations Management
  - Spare Parts Management

- Materials Technology

For a better illustration on the example of "2.7. Condition Based Maintenance" detailed representation is presented. CBM contains the following sub-groups:
2.7.1. Significance of CBM in maintenance
2.7.2. CBM procedures and techniques
2.7.3. Measuring Techniques
  - Calibration of measuring tools and instruments
  - Disturbance, interference and noise

For this example "*Maintenance Manager*" has to be at level 1 of "Level of Required Knowledge" or in other words he "Knows, and can apply economically, different types of condition monitoring systems, measurements techniques and other suitable inspection systems. Knows how to implement them."
"*Maintenance Supervisor*" also has to be at level 1 of "Level of Required Knowledge" for the said example, but the description is somewhat different "Knows the most common condition monitoring methods and devices and is familiar with their use in practice."
For "*Maintenance Technician*" it is enough to be at level 2 of "Level of Required Knowledge", and the description is the following "Knows the most common condition monitoring methods and devices and is familiar with their use in practice."

4.3. Project "EuroMaint"

Besides the cited document („Qualification of Maintenance personnel") one has to mention "Euromaint" project, initiated to define the formal shape of regular education (eg. at universities). Actuality of providing high quality training in the field of maintenance is also evident from the fact that there are several international projects financed by European Commission going on.

"Euromaint" is a 2-year project supported by the EU performed within the European programme Leonardo da Vinci. Leonardo da Vinci measure is aiming at quality and innovation of vocational training. Project "Euromaint" is focused on suggesting instruments, qualification structures and procedures to support development of professional skills for Maintenance Managers all over Europe. Twelve partners from nine European countries take an active part in the project. Activities are divided in seven work packages:

- Determination of competences on national level.
- Determination of competences on European level
- Educational products
- Personal Competence Development Plan
- Assessment and Qualification
- Valorisation: dissemination and commercialisation
- Valorisation: evaluation and monitoring of the effect

The first task of the project was to set a list of the needed and demanded competencies of both engineers and managers working in maintenance. Following task of the project was development of instruments, qualification structures and procedures to support human resources development. Other ongoing tasks are gathering educational materials to help the development of appropriate competences, as well as taking part in preparation of a certification system.

Partners are aiming in fulfilling the following goals:

- Listing the required professional and general competences of engineers and managers involved in the maintenance process
- International consensus on this list.
- A definition and procedure for a Personal Development Plan for developing the required competences.
- Gathering educational materials to learn the required competences.
- Integration in the European Qualification-system.

It is impossible to determine specific competences without detailed knowledge of job description which corresponds to the working place.

4.4. Knowledge test – „ValidMaint"

After defining the required competences in accordance with job descriptions these must be compared with the competences already possessed (acquired) by the job applicant. Knowing the level of knowledge and identifying the training needs are crucial for the development of employees. Besides for the evaluation of competences when employing a person or when creating a working place, evaluation is also done while the employee is carrying out daily tasks, sometimes even without him noticing it. The employee himself usually recognizes any shortages, or this is recognized by members of the team he cooperates with, his manager or it is seen from comments of inspections and audits.

In this area, EFNMS provided significant contribution. Maintenance Society from Sweden together with „Gavle University" and maintenance societies from Belgium, Denmark, Ireland, Slovak Republic and Slovenia have under the wing of EFNMS created a programme „ValidMaint" – online examination tool with over 1200 questions in all maintenance areas to:

- evaluate the knowledge of maintenance personnel
- test the knowledge of job applicants in maintenance
- certify maintenance technicians to conform the EFNMS requirement and the CEN qualifications standards
- evaluate the maintenance technicians of subcontractors
- identify the training needs of maintenance technicians and measure the results of a vocational training

Testing is done in two areas (according to EFNMS document „Qualification of Maintenance personnel") and it covers nineteen areas (from mechanics and hydraulics, through electronics and all the way to programming). The programme has been translated (and is available) in the languages of the six EFNMS members, and it will soon be prepared for other members as well. Testing in the field of theoretic knowledge is done (after login with password) through Internet, and the results from practical tests are entered in the same way; practical tests are done at the location of the person who is taking the test (Figure 2.).

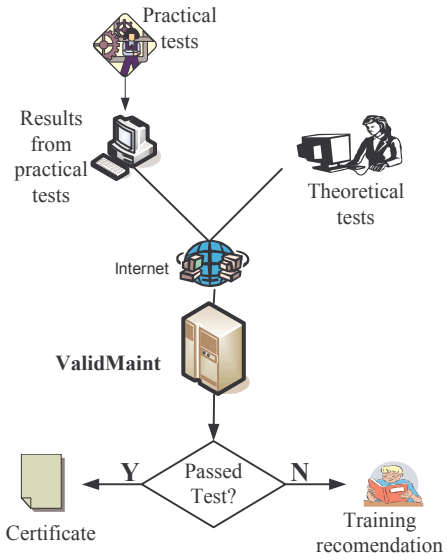

Figure 2.: Programme "ValidMaint"

Following is an example of question (question No. 766) from „Condition based maintenance". The question is:

- A vibration measurement in the frequency interval 2-5000 Hz gives the result: Acceleration = 10 m/s^2, Velocity = 1.6 mm/s, Displacement = 0.25 µm. What can be said about the frequency content of the signal?

and the given answers are:

A) Nothing can be said about the frequency content without making a frequency analysis
B) The signal is dominated by low frequency components (< 10 Hz).
C) The signal is dominated by medium frequency components (~ 100 Hz).
D) The signal is dominated by high frequency components (>> 100 Hz).

One of the options of „ValidMaint" is a recommendation of activities to do in order to improve testing results.

4.5. Additional education

This article has already drawn attention to the constant changes because of new technologies, globalization etc. and all this refers to acquisition of knowledge as well. Once acquired, knowledge becomes outdated soon, so besides for evaluation at employment start, a special attention has to be given to additional education, mostly in order to:

- renew the already acquired knowledge if this is rarely used in everyday work so there is a danger of losing the satisfactory knowledge level;
- acquire general knowledge in the areas of work which do not relate directly to the specific working place;
- because of changes, acquire knowledge which refers to the working place such as in process technology, equipment, legal regulations or other procedures (most often quality assurance).

Continuous changes mentioned several times already also cause the existing competences to age fast. Today, an employee who possesses all required competences also has a line of unnecessary (earlier acquired) ones, not used at present. To remain on the same level of competences an employee will have to already during the following year acquire some additional competences, since some of his current ones will become superfluous. In three or four years about a half of today's competences will become useless, and in that time he will have to master the same number of new ones (in order to remain on the same level of competences, without taking into account creation of additional values). In seven or eight years, very few of today's competences will be used at work; completely new ones will have to be acquired. Soon after that, the competences to be acquired next year will become unusable. And this goes on and on, faster and faster. Only the ones who will be able to adapt to the requests of the tremendously changing surroundings will survive at work; adapting means constant adoption and use of new, mostly more complex competences. This does not only refer to knowledge and skills, but also to behaviour. Large workforce fluctuations, Internet and growing individualization influence this part of competences too, and here adapting is particularly important.

4.6. Acquisition of new knowledge – knowledge sources

After establishing the missing knowledge, it is necessary to determine the optimal way to acquire it. There are many possibilities like for eg. *traditional (workshops) courses and workshops on or off site, on - the job - coaching and counselling, apprenticeships, internal instructors, consultant and/or vendor instructors, working along an experienced person, distance learning, application SW (CD-ROM), self-training, books, magazines, Webinar, e-learning...* There are many solutions – sometimes it is enough to acquire missing knowledge by working alongside an experienced person, and sometimes it is necessary to select another education method.

After the education method has been selected, next in line is analysis of potential suppliers on the market. Different „external training providers" are popular, but professional institutions of education (schools, universities) are rare. The reason can be found in the fact that schools and universities are more focused towards general or basic knowledge, and during life long learning what is mostly required is specific and specialist knowledge. Besides, and this is very important, they are much slower in changing the adopted programmes and keeping track of changes.

Today, the largest and the best knowledge sources are *vocational associations.* Their members and the connections created which associations at home and abroad is an accumulation of the largest possible practical knowledge. And this knowledge is checked during daily regular business activities. Simultaneously, this is the commitment of associations in order to justify their existence and be useful to its own members and to the wide community. Associations need to constantly monitor the requirements of their members and adjust education programmes accordingly. Furthermore, an association needs to possess a knowledge base of its members (for the purpose of hiring lecturers).

4.7. Acquisition of knowledge and EFNMS

Even though an association has vast knowledge accumulated among its members this is often not enough to cover such a wide area (which is permanently changing too). This is why within EFNMS a "Working group number five" was founded (WG 5) – „*European maintenance training framework - EMTF* ". Working group consists of experts representing different national maintenance societies. Goal of the group is development of European framework for training in maintenance. WG members are active in different European projects concerned with training in maintenance.

Figure 3. describes a partial summary of this paper up to this point. Stemming from "Job description" there are general and special competences (the role of EFNMS is stressed in establishing general competences with document "Qualification of maintenance personnel"). The employee has some acquired knowledge (partially due to "EuroMaint" project as well). A comparison of the needed and existent competences is done by "ValidMaint" programme resulting in confirmation of existing competences or in defining additional education where the role of National Maintenance Society and EFNMS is again important. This is not a loop done once; because of continuous changes it is frequently repeated.

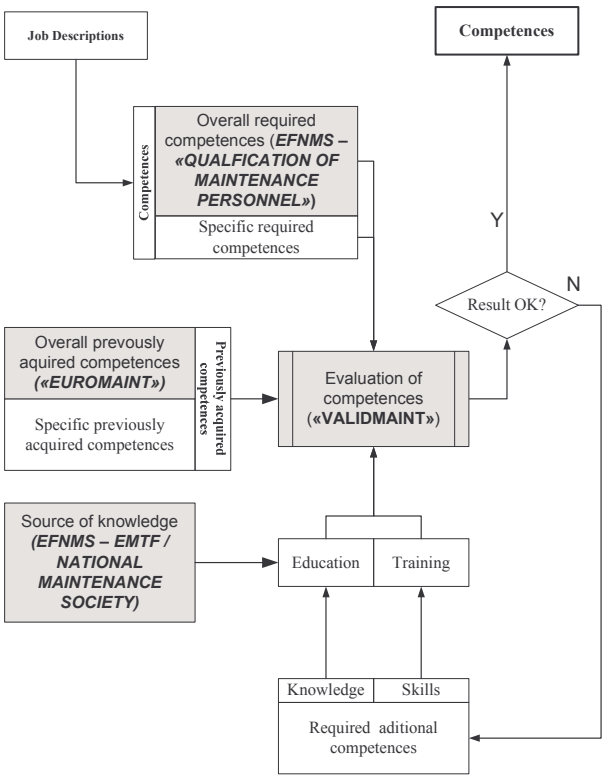

Figure 3.: Evaluation and acquisition of competences

4.8. Acquisition of knowledge – e-learning efficiency

The paper so far presented the existing structure for acquiring competences, described the need for competences and the help that EFNMS provides for its members in the whole process. However, now EFNMS, and particularly „WG 5" (European maintenance training framework - EMTF) stands before a huge challenge. EFNMS bodies have partially done their homework – required knowledge is defined, evaluation system is prepared, so the next step is - help with acquisition of knowledge.

With using the opportunity opened by modern technologies, the most appropriate way to do this is e-learning. By e-learning we usually mean performing the educational process with the help of information-communication technology. Technology (Internet mostly) is now included into the standard perception of education as a student-content-teacher interaction. Even though e-learning itself is not a final and complete educational solution, its usage has many advantages for both *employers* (no time is spent outside the working place, expenses are often up to 50% lower in comparison with the classical training, management has a complete overview of all activities and results of education etc.) and for *students* (a student chooses when, where and how much to learn, there is possibility to check one's adopted knowledge, "Just in time support" – education materials are accessible all the time, etc.) as well as for *teachers* (no time is spent outside the working place, etc.).

4.9. EFNMS - EMTF and e-learning

Why is e-learning so convenient for acquiring competences, particularly for EFNMS-EMTF? We had already recognized that the largest sources of best quality knowledge are found in associations. But, these sources have some shortages - three predominate.

The first deficiency is extreme inexperience of association's members in education (lecturing) since this is not their principal activity. The problem is resolved by the national association of maintenance personnel through setting up its own internal education systems (standards and procedures) to help lecturers prepare (structure seminars, training methods, prepare documents, develop presentation skills etc.).

The second shortfall which associations practically cannot resolve is that a lecturer has to be absent from work to carry out a course. As a rule, top experts are important pieces in the chains of their companies, they are always busy and can hardly get some time to lecture. The solution of this problem is *e-learning*. According to the rules for making e-learning seminars, started by „EFNMS-EMTF", an expert in a particular area creates a lecture at time which suits him best, and the students will use it via Internet without further engaging the author. The author of the seminar does not have to be absent from work, appear before groups, travel to lecture etc. - he can keep enhancing the learning materials.

The third shortage appears because there are many small countries and many languages are spoken around Europe. Europe encompasses about fifty states with about seven hundred million people. Plus, almost every European country has its own language and not many understand the languages of their neighbours. There are many small countries with less than ten million people, and when you take into account the level of industrial development - then it is difficult, in most countries, to expect a substantial "critical mass" of active members which could follow all the areas of knowledge indispensable for maintenance personnel. This is true for lecturers as well as the interest of listeners.

For example „Croatian Maintenance Society“ (Croatia is a country with approx. 4,5 mil inhabitants) which in the last few years held around twenty one-day seminars („Maintenance management“, „Maintenance costs management“, „Maintenance and preservation of energy“, „Computer support to maintenance“, etc.) but there are not enough active experts to initiate work in all areas according to EFNMS document „Qualification of maintenance personnel“.

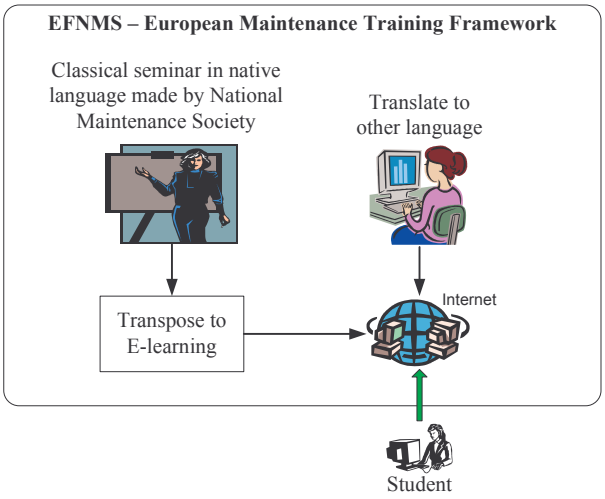

Figure 4: “EFNMS – EMTF” and e-learning

Twenty countries are members of EFNMS with about 450 mil people which is enough to reach a “critical mass”. In education, it is necessary to use experiences of EFNMS on joint projects such as preparation of document „Qualification of maintenance personnel“ or of „ValidMaint“. „EFNMS – EMTF“ must take over the leading position and allocate tasks to several interested countries, each creating lectures in a particular area(s). Lectures are given in the author’s own language and English (as the language used for internal communication). Other member countries translate finished seminars (which they buy or trade for their own) to their native languages. With such a work method all the advantages of e-learning gain on significance.

5. Conclusion

Maintenance is a significant element of each production cycle; it has to fulfil user expectations through its organisation where human resources are very important. Establishing the needed competences, their evaluation and acquisition of missing knowledge is an extensive task which due to the wide area and constant changes surpasses the possibilities of an educational institution or of a national maintenance association. EFNMS as the “supreme association” with its activities is precisely suitable as the coordinator of help to its members in this area, and e-learning is a powerful tool.

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