

## EDUCATION OF MAINTENANCE PROFESSIONALS – EXPERIENCES AND TRENDS IN SLOVAKIA

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### SUMMARY

*In the new system of study fields in university education in Slovakia, issued by Slovak Ministry of education, a new study specialisation No.5.2.2 „Maintenance of Machines and Equipments“ is defined in the 5th group - “Designing, Technologies, Production and Communications”. Maintenance of Machines and Equipments is a study specialisation, administrated by the Slovak Ministry of Education, in which graduates achieve professional competency for their profession, or they are prepared and can continue in higher university study. In article is presented system too e- learning at a Department of Transport and Handling Machines Faculty of Mechanical Engineering University of Žilina.*

**Keywords:** university education, maintenance, e- learning

### 1. CURRENT SITUATION OF UNIVERSITY EDUCATION IN MAINTENANCE

In the new system of study fields in university education in Slovakia, issued by Slovak Ministry of education, a new study specialisation No.5.2.2 “Maintenance of Machines and Equipments” is defined in the 5th group - “Designing, Technologies, Production and Communications”.

Maintenance of Machines and Equipments is a study specialisation, administrated by the Slovak Ministry of Education, in which graduates achieve professional competency for their profession, or they are prepared and can continue in higher university study.

Maintenance of machines and equipment’s can be studied in two levels of accredited study programmes of university study:

- the first level of university study (Bc. – bachelor) with standard duration of 3 years,
- the second level of university study (Ing. – engineer) with standard duration of 2 years.

For the second (engineering) level, prerequisite is completed first (bachelor) level in Maintenance of Machines and Equipments, Mechanical engineering or in some other related specialisation from the system of study fields released by Ministry of education. For bachelor level graduates in more distant study specialisation there is possibility to propose study field with standard duration of 3 years to “fill the gap”.

Graduate of study specialisation in Maintenance of Machines and equipment is qualified for profession, according to completed university study level:

- First educational level – operator (maintainer) of machines (operator manager, operator technician, maintenance operator, maintenance manager),
- Second educational level –Maintenance Engineer.

**Operator of machines** – understands problems of assembly, functioning, programming, operation and service of machines and equipment. He has knowledge and practical skills in their adjustment, programming, operation, maintenance and diagnostics. His preferred profession is in the area of service operations in industrial enterprises, in the area of service and trade concerning machines, as well as individual businessman in maintenance, service and sale of machines.

**Maintenance engineer** – has knowledge of methodology and processes of implementation and operating of machines and equipment, methodology and technology for control and programming of machinery, as well as methodology of complex care for machines and equipment in production and other systems. He has knowledge and practical skills in project management, simulation models for verification of proposed operational solutions, on methods of technical management and service methods, methods of technical diagnostics, methods and means of computer support in this area. Professional position for graduate is expected preferably in the area of management, organising and technical prepare of machinery operations, management of services and sales concerning machines, as well as individual businessman in maintenance, service and sale of machines.

Other core knowledge is determined by application area for which a graduate is being prepared. Application area can touch any industry, transport and services.

Study is finished by passing the state exam, part of which is presentation of diploma work. Generally, diploma work is an engineering project that solves given technical problem. Extent of a work is about 60 pages of text, plus appendices.

Officially a topic for diploma work is given to students in the last year of study and students during the pre-diploma seminars gradually work-out given points of diploma work. For the best possible results of diploma work it would be of high value if students could have their topics given a year before graduation so that they could be more focused on necessary theoretical knowledge concerning their diploma work (also by selection of optional subjects) and for gathering necessary information.

It is valuable if maintenance managers from companies provide topics for diploma works. Students can bring views not affected by operational stereotype and at the same time a company may find a new potential worker who proves his abilities in problem solving. University welcomes these proposals from practice as it is beneficial also for exchange of practical and theoretical knowledge and creates partnership between industries and universities.

In engineering study at a Faculty of Mechanical Engineering, University of Zilina is accredited on the present program “MAINTENANCE OF TRANSPORT MEANS (MoTM)” Graduates are able to work at profession of Maintenance Engineer. They know methods and procedures of implementation and operation of transport means, they have knowledge of design and control of transport means. They know methods of reliability analysis and evaluation of technical systems, creation of complex maintenance systems, implementation of maintenance information systems and industrial management.

## 2. E- LEARNING

Simply said it is a process that solves production of study materials (not necessarily multimedia, good texts are sufficient) their distribution to users and education management on the base of these study materials by use of computers [1].

From analyses of e-learning it can be concluded that success of e-learning depends heavily on approach of a student to educational process [2]. All other factors are secondary; educational

processes where student is not considered to be the most important element cannot be successful. It is necessary to realize that educating is both individual and societal process. Implementation of e-learning does not end-up in creating suitable technological platform but it is only beginning of the process.

Technological approach to e-learning in the past solved questions such as:

- How can education be provided at affordable price, in right time, anywhere and anytime?
- How success of education can be measured in the simplest way?
- How can administration of education be easily done?

At present need for quality of educational process cannot be ignored. This new approach to e-learning brings new questions, such as:

- Are the educational objectives in compliance with needs of a student?
- Is educational content really important for a student?
- Are the educational methods suitable for educational process?
- Will the proposed educational program lead to required results?

A new approach to e-learning requires definition of solid methodological process driven by desired objectives and focused on education recipient – student. This approach brought more critical view on e-learning process.

In a corporate education specific features of the company that make deference from competitors should be emphasized. These are not general skills, such as work on PC, work safety, communication technology and foreign languages. Corporate education has to focus on development and support of *specific corporate knowledge*. And it should be focused on the most talented workers.

## 2.1. E-learning at the Department of transport and handling machines

Education at a **Department of Transport and Handling Machines** through the e - learning way (even though in not quite classic way of) markedly improved students interest, but also interest about an individual subjects too. On the present is exploited version Moodle 2.0 at the address <http://udrzba.utc.sk/dsz> (Figure 1) for all subjects in educational program **Maintenance of transport means**.

The screenshot shows the Moodle 2.0 interface for the course 'Dopravné stroje a zariadenia'. At the top, it indicates the user is logged in as 'Vladimír Stuchlý' and provides a search bar for the language 'Slovenčina (sk)'. The main content area is divided into several modules:

- Dostupné kurzy** (Available courses): A list of course topics including 'Inovácie a obnova strojov', 'Semestrálny projekt', 'Technológie údržby', 'Projektové riadenie a manažérske techniky', 'Diagnostika a skúšobníctvo', and 'Riadenie údržby'.
- Kalendár** (Calendar): A calendar for March 2008 with a grid showing days of the week and dates.
- Mediacenter** (Media center): A section for 'Course videos' featuring a 'Latest video' player with a video thumbnail.

On the left, there is an 'Administratíva portálu' (Portal administration) menu with various options like 'Oznámenia', 'Používatelia', 'Kurzy', etc., and a search box.

Figure 1. E-learning Department of Transport and Handling Machines

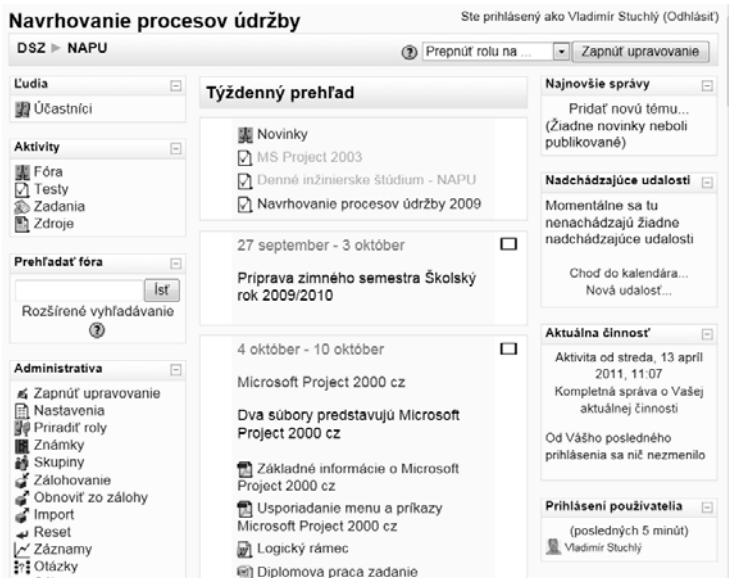


Figure 2. Example of e-learning, subject „Maintenance process design“

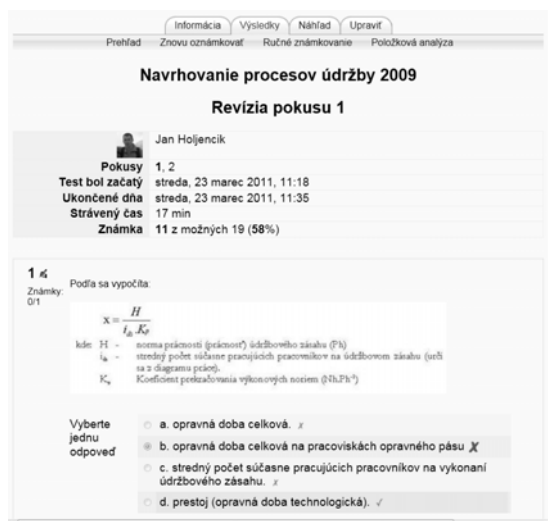


Figure 3. Example of e-learning, test „Maintenance process design“

### 3. E-LEARNING „MAINTENANCE MANAGER“

Besides standard use of e-learning within study program of “**Maintenance of Transport Means**” in engineering study, the department runs also a project of distant learning “**Maintenance Manager**” that was created for need of maintenance specialist from all areas of industry, transport, government organisations, etc. Educational programme is suitable for non-graduates from technical professional schools, university and engineering graduates.

The educational process uses technology of combined and **distant learning (blended learning)**. Distant method substitutes direct contact of teacher with student by communication via computer networks (Internet and Intranet). Distant learning gradually will transfer into e-learning system. It brings 5 main objectives:

1. Connection of training and education on real need of maintenance workers,
2. Transfer of learning closer to direct working environment,
3. Accessibility of learning 24 hours a day, 7 days a week, moreover on global scale (especially by use of Internet).
4. Achieving the highest quality of education,
5. Achieving larger extent of education at lower cost.

While introducing distant learning, main attention is paid to business problems and tasks to be solved. According to this, methods and technology should be selected that offer effective solution.

#### 4. COURSE CURRICULUM OF “MAINTENANCE MANAGER”

Table. 1 Distant learning “Maintenance Manger” curriculum.

| No                           | Subject                                      | Hours     |           | Form   | Guarantor |
|------------------------------|--|-----------|-----------|--|-----------|
|                              |  | P         | L         |  |           |
| <b>1<sup>st</sup> course</b> |  |           |           |  |           |
| 01                           | Maintenance organisation and systems         | 6         |           | Wt   | ŽU Žilina |
| 02                           | Failure modes and effects analysis           | 6         |           | Wt   | TU Košice |
| 03                           | Computers in maintenance                     | 4         | 6         | Pt   | ŽU Žilina |
| 04                           | Engineering statistics and probability       | 6         |           | Wt   | SPU Nitra |
| 05                           | Maintenance of specific equipment            | 6         |           | Wt   | ŽU Žilina |
| 06                           | Maintenance technologies                     | 6         |           | Wt   | ŽU Žilina |
|                              | Totally                                      | <b>34</b> | <b>6</b>  |  |           |
|                              | Totally 1 <sup>st</sup> course               | <b>40</b> |           |  |           |
| <b>2<sup>nd</sup> course</b> |  |           |           |  |           |
| 07                           | Quality and reliability of technical systems | 6         |           | Wt   | SPU Nitra |
| 08                           | Maintenance concepts - TPM                   | 6         |           | Wt   | ŽU Žilina |
| 09                           | Maintenance concepts - RCM                   | 4         |           | Wt   | ŽU Žilina |
| 10                           | Maintenance planning and benchmarking        | 6         |           | Wt   | ŽU Žilina |
| 11                           | Technical diagnostics                        | 6         |           | Wt   | ŽU Žilina |
| 12                           | Maintenance information systems              | 6         | 6         | Pt   | ŽU Žilina |
|                              | Totally                                      | <b>34</b> | <b>6</b>  |  |           |
|                              | Totally 2 <sup>nd</sup> course               | <b>40</b> |           |  |           |
| <b>3<sup>rd</sup> course</b> |  |           |           |  |           |
| 15                           | Professional excursion                       | <b>0</b>  | <b>30</b> | Z  |           |
| 16                           | Final “Project of maintenance in company”    | 0         | 30        | FE   | all       |
|                              | Totally                                      | <b>0</b>  | <b>60</b> |  |           |
|                              | Totally 3 <sup>rd</sup> course               | <b>60</b> |           |  |           |
|                              | TOTALLY                                      |           | 140       | <i>Notes:</i><br>1. T – tutorial; L – laboratory exercise<br>2. Wt – written test; Pt – practical test; FE – defence of project and final exam |           |

Curriculum is built-up according to practical needs for maintenance managers – to become competent for management and development activities in maintenance and for management of financially effective maintenance organisation. Aim was to specify theoretical knowledge and practical skills that maintenance manager should have and by this ensure the maintenance activities were organised and carried out in the best way in each company (see table 1).

In each course there are one week tutorials with subjects from curriculum. During tutorials fundamental problems of subject are explained and homeworks are given. Other communication between teacher (tutor) and student is done on electronic platform. Similarly text of subjects (in pdf format), homeworks, testing, study records and other communication can be carried out on electronic base [3]. See figure 1. Each subject is supported by study

textbooks in printed form, altogether 670 pages A4 size. Study is finished by submitting final project (thesis) of about 35 pages and is defended before examination commission.

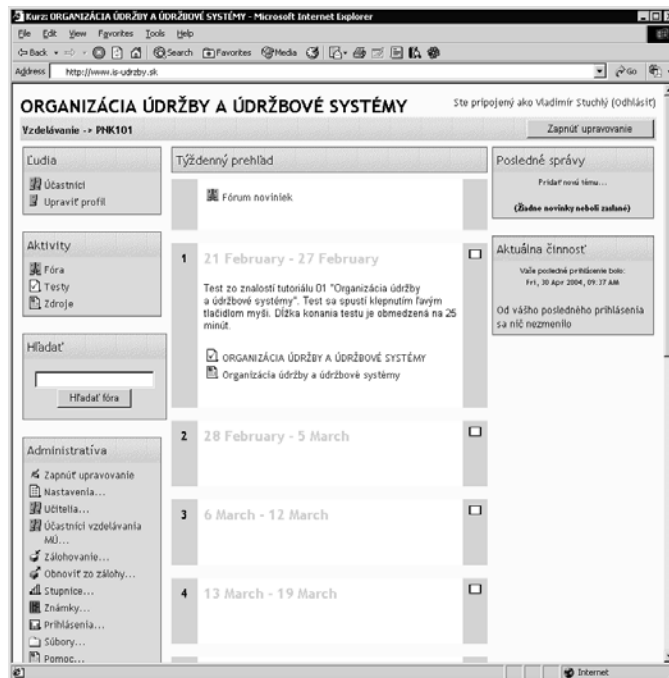


Figure 4. Example of e-learning, subject Maintenance organisation and systems

## 5. CONCLUSIONS

According to the evaluation of students who have completed at least one academic year with e-learning: **Positives:** 1 Availability from school, from home, even during the holidays. 2. A lot of information together from the subject. 3. Total transparency in the subjects during the whole learning. 4. Easy communication at transmission of semestral works. 5. Opportunity to pass semestral works at the last minute from the home environment. 6. Prompt repair unsatisfactory semestral works. 7. Transparent curriculum of the subject prepared on the whole semester. 8. Rapid evaluation of test at examination. **Negatives:** 1 Unable to enter the transfer size > 2MB (e.g. works with pictures). 2. "Comfort student" expects mail with the evaluation of the semester work. 3. Some materials that are on the website cannot be printed. 4. Bad to learn from the screen.

## 6. REFERENCES

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