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May 21-23, 2013

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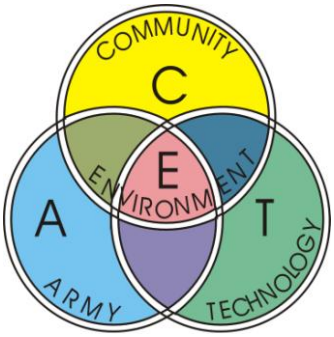

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Experience and information exchange in the field of:

- the current status and prospects of distance learning and e-Learning in the preparation of military professionals and other target groups;
- using the computer modelling and simulation, especially in the command and control process;
- current and future communication systems, their development and usage.

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CONTENT:

DESIGN OF A SIMPLE RELIABLE VOTER FOR MODULAR REDUNDANCY IMPLEMENTATIONS

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Abstract: *This article deals with modeling and design of a new fault-tolerant voter circuit. Majority voted redundancy is increasingly implemented in fault-tolerant design today. A voter is used in these implementations to determine a possibly correct result through the majority vote. The reliability of the voter circuit should be much higher than that of the other circuit elements; otherwise it will wipe out the gains of the redundancy scheme. Since almost all the circuit elements are fabricated with the same technology, the voter circuit itself needs to be fault-tolerant. In this paper, we present a novel fault-tolerant voter circuit design with a simple structure, so that it can easily be used for N-modular redundancy implementations as well as for systems with more than a single bit output.*

Keywords: reliable voter model, triple modular redundancy, TMR, N-modular redundancy, NMR, fault-tolerant voter circuit design.

INTRODUCTION

Any system which could function correctly while there exist some faults in it is called a fault tolerant system. Some reasons to build fault tolerant systems are harsh environments, novice users, high repairing costs, and large systems which should always be kept up. Adding redundant components or functions is the most common approach to acquiring fault tolerant systems. When designing a fault tolerant system, several features need to be evaluated and a trade-off among them is required. Some of these features are cost, weight, volume, and reliability. Reliability is the probability of no failure in a given operating period. Calculation of reliability is a necessary part of any fault tolerant design process.

Several techniques are available for introducing redundancy and hence improving system reliability. Underlying all these techniques is providing parallel paths to allow the system to continue its operation even when one or more paths fail. The system is called a "parallel system" when all parallel components are powered up, and it is called a "standby system" when only the online component is powered up and the rest are powered down. Practically, in any parallel system, a circuitry, called coupler or switch, is needed to implement redundancy. Couplers reconfigure various parallel components of the system after a detected failure. Since the coupler is added in series to the parallel components, its reliability significantly affects the reliability of the whole system.

In order to improve reliability of digital systems, a technique known as "voting redundancy" is used; a voter is put in series with the parallel digital components. The voter receives parallel bits from an odd number of digital components, and votes for the majority. If more than half of the digital elements work properly, the voter will decide correctly. This redundancy technique, called N-modular redundancy (NMR), alleviates the problems associated with couplers or switches in parallel or standby systems.

1. TRIPLE MODULAR REDUNDANCY AND CLASSICAL VOTER CIRCUIT

The basic modular redundancy circuit is triple modular redundancy (TMR), as shown in Fig. 1. TMR consists of three parallel digital components (modules), all of which have equivalent logic and the same truth tables. The same input is fed to the three modules and a voter gives the majority as the system output. One usage of TMR is for the protection of combinational and sequential logic in reprogrammable logic devices, called Functional Triple Modular Redundancy (FTMR) [1].

If any two of the three modules in the TMR system work, assuming the voter does not fail, the system output will be correct. This equals the reliability of a two-out-of-three system. Thus, the reliability of a TMR system, R_{TMR}, based on the reliability of a module, R_M, is:

$$R_{TMR} = P(A \cdot B + A \cdot C + B \cdot C) = B(3:3) + B(2:3) = 3R_M^2 - 2R_M^3 \tag{1}$$

where B is the binomial (Bernoulli) distribution. The assumption that the system fails when a majority of modules fail is pessimistic; there are instances where a majority of the modules fail but the network is nonfailed [2].

If we assume a constant failure-rate λ for each module and a perfect voter for the TMR system, then each module will have the reliability $R_M = e^{-\lambda t}$, and the reliability of the network will be:

$$R_{TMR} = 3e^{-2\lambda t} - 2e^{-3\lambda t} \tag{2}$$

In the development of (2), it is assumed that the voter circuit is an ideal one with reliability $R_V = 1$. However, practically, all the circuit elements including modules and the voter are fabricated with the same technology and therefore all have almost the same failure rate. Since the voter is placed in series with the modules, its reliability is a limiting factor on the reliability of the network:

$$R_{TMR} = R_V(3e^{-2\lambda t} - 2e^{-3\lambda t}) = e^{-\lambda_v t}(3e^{-2\lambda t} - 2e^{-3\lambda t}) \tag{3}$$

The conventional TMR voter circuit is shown in Fig. 2. In design of this circuit, no provisions are made to make it 100% reliable. We need a voter circuit which itself can tolerate faults, and hence improve the reliability of the whole system.

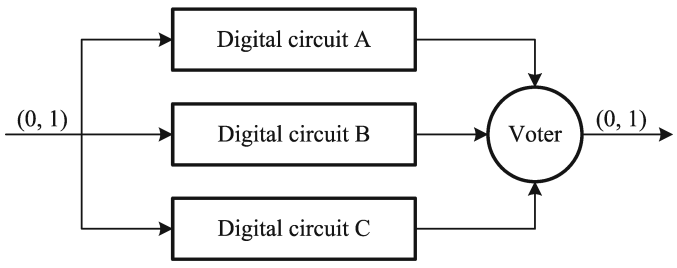

Fig. 1. Triple modular redundancy
Source: own

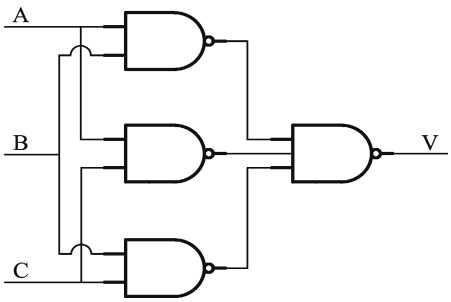

Fig. 2. Circuit realization of a classical TMR voter
Source: own

2. DESIGN OF A FAULT-TOLERANT VOTER CIRCUIT

Failure of the voter circuit results in failure of the TMR system, while failure of one module can be tolerated. Therefore, a fault-tolerant voter will improve the reliability of the system significantly. There are several fault-tolerant voter circuit designs in the literature (e.g., [3,4]), which generally suffer from the following problems:

- Complexity: inclusion of components like priority encoders or multiplexers in the voter circuit reduces its reliability and makes the voting process time-consuming.
- Inextensibility: a good design should make it possible to extend the voter circuit to be used with more modules easily.
- Dependency on one component: while the purpose of introducing redundancy to the voter circuit is that the series-connected voter decreases the reliability of the TMR, the existing voter designs extend this problem to the inside of the voter circuit. In these designs, one final component like multiplexer, whose failure will result in the failure of the network, is needed to be put in series with the rest of the components to produce the final output of the TMR.

In this paper we introduce a novel fault-tolerant voter circuit design that overcomes the above-mentioned problems. This voter circuit implementation uses wired logic, and is shown in Fig. 3(a). In order to observe the source of the defects that may occur in this circuit and hence make it unreliable, the transistor level of the open-drain gates used in wired logic is shown.

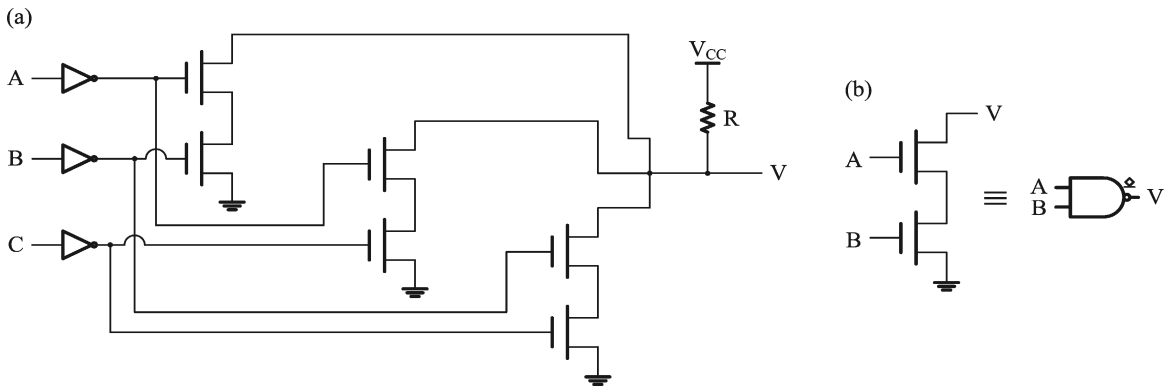

Fig. 3. Novel fault-tolerant voter circuit:
(a) circuit realization (b) open drain CMOS NAND gate
Source: own

Almost all the single fault types occurring in a gate include only one transistor in the gate, e.g., open p-MOS drain, grounded n-MOS gate, broken p-MOS gate bridged, and etc. If a gate is always supposed to have equal input values, then the series-connected transistors can be used in a simple reliable design, while the parallel-connected transistors, which directly connect the output to their sources, make the design unreliable. Therefore, an open-drain CMOS NAND gate shown in Fig. 3(b), which possesses only 2 series-connected n-channels, can be used in design of a simple fault-tolerant voter.

As shown in Fig. 3(a), we use open-drain CMOS NAND gates to build a fault-tolerant voter circuit. This voter circuit votes for majority when it is fault-free; if the three inputs are low, all n-channel transistors are on and hence the wired output is low, and in case the three inputs are high, the n-channel transistors are off and the wired output is high. This voter circuit also works properly when one inverting gate and/or the two transistors connected to that inverting gate fail; when input values are low, there is at least one fault-free open-drain gate to ensure that the low value is provided for the wired output, and when input values are high, the second transistor (which is fault-free) will block any connection to ground.

The structure of Fig. 3(a) can always tolerate the failure of one component. This structure will fail if any two series-connected transistors stop functioning (the failure of an inverting gate can be regarded as the failure of the two connected transistors.) Assuming the constant failure-rate of λ for every transistor, and using the first two terms of Maclaurin series expansion of e^{-z} about $z=0$ (which results in the simplification, $e^{-\lambda t} \approx 1-\lambda t$), the reliability of our voter circuit design in high-reliability region will be 1.

The reliability of a classical voter circuit, shown in Fig. 2, is low. Pessimistically, the structure of a NAND gate, which is composed of two parallel-connected p-channel and two series-connected n-channel transistors, will malfunction if any of the p-channels or n-channels fail. Since all NAND gates should function properly for the voter circuit to be reliable, the reliability of this voter circuit after application of Maclaurin series simplification will be:

$$R_{V(classic)} = (1-4\lambda t)^4 \tag{4}$$

where failure rates of both n- and p-channels are assumed to be λ. Comparison of the classical voter reliability ($R_{V(classic)}$) and our novel voter circuit reliability ($R_{V(novel)}$) is illustrated in Fig. 4.

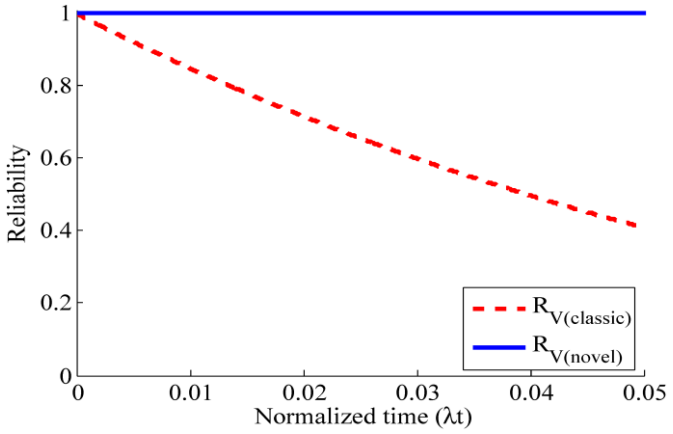

Fig. 4. Reliability comparison of classic and novel voters
Source: own (output of our software)

3. FAULT-TOLERANT VOTER CIRCUIT FOR NMR

Our novel voter circuit design can easily be expanded to be used in NMR systems where N is an odd integer ($2n+1$) greater than or equal 5. To this end, the number of open-drain NAND gates needed will be the combination of $n+1$ out of $2n+1$, with each gate having $n+1$ inputs. Such a structure can tolerate faults in n out of $n+1$ series-connected transistors in an open-drain NAND gate.

CONCLUSION

The technique presented in this paper provides a reliable voter circuit design for TMR and NMR systems using wired-logic. This design is very simple requiring only twelve transistors and one pull-up resistor for a TMR voter. In addition, using wired logic, the dependence of the network on one gate in the voter to produce the final output is removed.

One drawback of this method is that the rise time (transition from 0 to 1) will take longer than the fall time (transition from 1 to 0). For the highest possible speed, pull-up resistor should be as small as possible; the minimum resistance is determined by an open-drain output's maximum sink current. However, this longer rise time is usually shorter than the clock period of the synchronous system in which the modular redundancy system is used. Another issue is the reliability of the pull-up resistor. But since the reliability of this resistor is usually higher than the other types of components in the system, this is not a matter of concern. Our novel voter circuit, however, has higher power consumption.

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APPROPRIATE TOOL TO GET APPROPRIATE KNOWLEDGE: HOW DOES IT WORK?

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Abstract: *Learning Management Systems comprise the core in a modern virtual learning environment and can range from a system for managing training and educational records, to software for distributing courses over the Internet with features for online collaboration [5]. Language Training Centre teachers have been using LMS Barborka and Moodle in their lectures for over seven years now, and although there have been some ups and downs along the line, on the whole, the experience shows an upward trend of satisfaction that corresponds to the same trend which has affected the efficiency and improvements in technology and communications worldwide lately.*

Keywords: learning management system, virtual learning environment, online courses, electronic tools, language learners, LMS Barborka.

INTRODUCTION

The world has been developing and changing at a fast pace mainly thanks to a big technological progress and unbelievable inventions. These phenomena have an important impact on all spheres of our social life including education. Although a teacher used to play and still plays the most important role in an educational process, it is necessary to implement apart from traditional teaching tools the new ones to keep up with the worldwide trends. Thus e-learning, using the Internet and integrating web tools into teaching, is the necessity of our educational system because it enables us both to take advantage of a vast array of readymade materials, resources and important information, and motivate and engage students into the teaching process.

Living in the 21st century means finding ourselves fully immersed in the digital age, being able to manage all skills necessary to live and be successful, digital literacy and language skills belong among them. With an increasingly globalized world, language ability is becoming a more valuable skill for employees and employers, students and teachers as well. Computers have become an integral part of our classrooms, a crucial tool to get information, to study and self-study. The advent of technologies in computer networking has enabled language teachers to shift their practice in using computers for their teaching. Learners are no longer working only on stand-alone computers and CD-ROMs, but now they are also able to access mass of resources on the web. With the help of the Internet, there are many ways of becoming autonomous learners [4]. They now have opportunities to access the learning resources from anywhere at anytime.

Although advances are taking place both in technology and pedagogy, in fact to some extent, they are still taking place separately. The relationship between pedagogical and technological changes is, however, becoming more intimate. The emerging pedagogy/technology structured dialogue is both a cause and a consequence of this new intimacy. Future advances in the

dialogue - with implications for performance and problem-solving in all organizations - will combine new pedagogical and technological approaches in subtle and ingenious ways.

1. LEARNING MANAGEMENT SYSTEM

The term Learning Management System (LMS) refers to a server-based software that controls the access and delivery of online learning resources through a standard web browser. This term has several other synonyms like Virtual Learning Environment (VLE) or Content Management System (CMS). LMS takes over the role of integrating the different technologies into a common learning environment. LMS primarily focuses on managing learning and training processes, distributing the learning content, supporting the learning process, and serving as a general communication point and interface between a learner and a teacher.

LMS is often considered a substantial element of both e-learning and distance study programmes. This point of view is reasonable from a perspective of control and management, but from the perspective of education itself it is at least disputable. The imperative today is not a mere access to knowledge, but the prompt access to relevant and useful knowledge. The real value of e-learning lies not in its ability to train just anyone, anytime, anywhere, but especially in the ability to deploy this attribute to train the right people to gain the right skills or knowledge at the right time. Only then can e-learning yield a justifiable return on investment considering the costs incurred in implementing e-learning [3].

LMS usually comprises a set of web-based tools to manage information online for administrators, teachers, and learners as well. In general, the tools included in an LMS can be categorized into three main types: study skills tools, communication tools, and productivity tools:

- **Study skills tools** include the authoring modules to create activities or materials for learners. In general this category of tools covers online materials, presentations, quizzes, assignments, and tasks.
- **Communication tools** include the means of communication available for both teachers and learners. It enables students to interact with their classmates or with their teachers. The most commonly available communication tool is an announcement board (e.g. new information about the course, tests results etc.), a discussion board (messages and comments), and a chat facility (emails, instant messaging, synchronous discussion).
- **Productivity tools** cover the document management system, such as calendar, progress checks, feedback, and surveys or questionnaires [4].

Nowadays, online language learning is not limited only to informal and independent individual learning. Many language institutions have adopted online language learning that provides them with an opportunity to have students from many different places. Mostly, teachers publish their materials on their web and communicate with students via emails. Course outlines are commonly uploaded on departmental web sites [1]. Some educational institutions use commercial LMSs.

The current commercial LMSs, however, are usually designed not for the use in Second Language Acquisition (SLA) contexts. They are designed for distance education in general. Distance learning SLA contexts need an LMS that accommodates “not only input and output of the character set of the target language, but also some other learning tools, such as

discussion boards, vocabulary activities, grammar clinics, online dictionaries, and writing draft books, feedback and assessment tools; all organized around the learning activities and communicative practice in all four language skills." [6]

2. ONLINE LANGUAGE LEARNING

Teachers of English have been enthusiastic users of ICT for a long time and they quickly discovered its potential, especially the Internet, as a window to the authentic world of languages, allowing the real interaction as well as communication. Task based projects, ranging from simple Web searches in English language sites to large collaborative works in virtual reality, added a big potential to the teaching practice of language teachers. ICT has offered lots of real alternatives for delivering courses in which savings might be made in space, access to education improved, and enrolments increased.

The greatest attraction for students to engage with online learning has been the flexibility of time and space that it offers. They also appreciate the good quality of courses, the wealth of information and resources that might be found in one place, including an instant quality feedback accessible from their home computers, as well as an access to their tutor.

ICT and the Internet offer enormous potential in language learning and teaching and have brought a qualitative change to the language teaching-learning, such as the possibility for "real-life" simulations and the introduction to a larger degree of learner-centred approaches, both of which lead to learners being less fearful of failure and/or the loss of social status. However, the successful use of multimedia technology in the language teaching-learning process requires such approach to learning that harmonizes the content of the message with the technical potential of the particular technology chosen. Language learners can use different kinds of multimedia, e.g. CD ROMs, laser discs; they have an access to foreign language documents on the World Wide Web and can communicate with their teachers, classmates, colleagues and native speakers electronically.

Teachers of the Language Training Centre have used in their work different electronic tools as well as findings from the latest research to make teaching and learning languages more efficient. Nevertheless, in this article the authors want to describe only one of them, LMS Barborka. Its implementation into teaching English both full-time and distance students has been the core of our research in the last few years. LMS Barborka is a very friendly e-learning platform which offers the whole range of tools in a simple graphic version. Having logged into LMS Barborka, a user as a "Student" can see the basic tool bar which facilitates the orientation within the system and offers the user following tools: Study Plans, Textbooks (electronic supports), Tests, Tasks, Calendar, Discussion, Correspondence/emails, Tutorials, Results, System Adjustment (setting).

3. LMS BARBORKA AT THE LANGUAGE TRAINING

Electronic supports for language training in LMS Barborka have been elaborated in accordance with the requirements both for the final tertiary exams and the STANAG 6001 (SLP 2-3) NATO standardized exams. These electronic supports cover general, military, economic, and management topics; they are used for practising understanding main ideas of the texts, making notes on the main ideas, distinguishing the main ideas and supporting details

or finding specific information. At the same time these materials lead the students to improve their abilities, e. g. to communicate fluently in the target language at a higher abstract level, to form arguments and express their attitudes and opinions on different topics, such as armed conflicts, foreign missions, political situation in our country and abroad, current social problems, topics related to their profession, etc.

LMS Barborka facilitates teaching and learning English especially in combined form of study, enhances the students' orientation in the curriculum, and helps them to prepare for exams. As the electronic supports are supplemented with exercises for reflection as well as feedback, they allow the students to monitor comprehension of the studied material, either in communication with the tutor, or while their independent work. In addition, an instantaneous feedback is ensured by interactive exercises created in the Hot Potatoes program. The "Tutor" partly substitutes the role of the teacher and decreases the lack of face-to-face touch with students.

Nowadays, students can use two modules of general English, three military terminology modules, two modules of economic terminology, one module of management terminology, and two modules of special terminology:

General English Modules

- Family and Relations; Housing and Accommodation; Food, Cooking, Restaurant; Health and Diseases; Education and Jobs; Transport and Travelling; Shopping and Money; Mass Media;
- Environment; Crime and Gun Possession; Discrimination, Xenophobia, Racism; Addictions, Bad Habits; Terrorism;

Military Modules

- Military Ranks; Daily Routines and Responsibilities; Uniform and Equipment; Branches of the Army; Combat Vehicles; Terrain;
- Armed Forces; Military Service; Army of the Czech Republic; Land Forces; Air Force; Current Deployments; Peace Support Operations; Women in the Military;
- International Organizations; European Union; NATO; United Nations; Humanitarian Assistance; Problems of Today; Security Risks and Threats;

Economic Modules

- Introduction to the Economic System; Production; Business Cycle; Types of Business Organizations; Marketing the Product; Starting a Business; International Trade; Transport and Communication; People and Work;
- History of European Union; Institutions of European Union; Globalisation; Humanitarian Assistance; Problems of Today;

Management Module

- What is Management; Planning; Organizing and Staffing; Operations Management; Controlling Process; Leadership;

Special Terminology Modules

- Combat Engineers; EOD and IEDs; Intelligence; Urban Operations; Artillery; Terrorism; Cordon and Search Missions;
- Ecological Problems; Logistics; Human Resources; Generation Next; Road Accidents; Epidemics; Gas Detection; Floods; Earthquakes.

Security Management is a new module being introduced in this academic year in accordance with requirements of the Faculty of Economics and Management. The corresponding electronic supports are being developed in cooperation with specialist departments and students of the Master study programme.

Above mentioned modules are concurrently and flexibly supplemented with new topics according to the changing demands on language teaching and learning. Our objective is to offer the students a friendly learning environment, interesting topics, an eye catching design, and a chance of ubiquitous learning. The cooperation with students and teachers from specialist departments gives a chance to make our objectives realistic.

4. FINDINGS

An idea of online teaching and learning is highly supported by the findings of a continuous research conducted from 2004 to 2012. Students of full-time and combined study forms expressed their opinions dealing with ICT in the language training.

When a process of incorporating ICT/ LMS Barborka into the curriculum began, a students' evaluation was carried out. The first questionnaire was distributed in 2004 and 104 students of the full-time study programme were involved in this research. It has been found that students' acceptance and learning outcomes were very good. One of the significant aspects of students' evaluation is shown in Fig. 1. The students were asked a following question:

In my language learning I want to:

- use up-to-date technologies, the Internet, Study portal and on-line sessions in language lessons and in my self-study;
- use ICT in my self-study;
- be taught in a classical way.

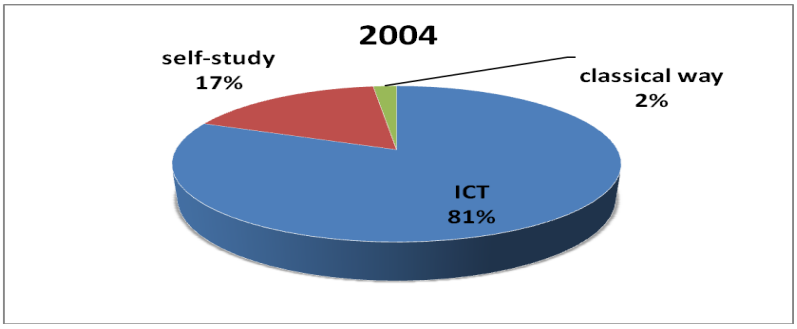

Fig. 1. Students' evaluation 2004
Source: own

More than 80 % of students preferred language lessons with the use of up-to date technologies and 17 % of students wanted to use ICT in their self-study [2].

In 2012 we wanted to know the student´s opinion on the same question, but in the case of combined form of study. The second questionnaire was distributed to 64 students, Fig. 2.

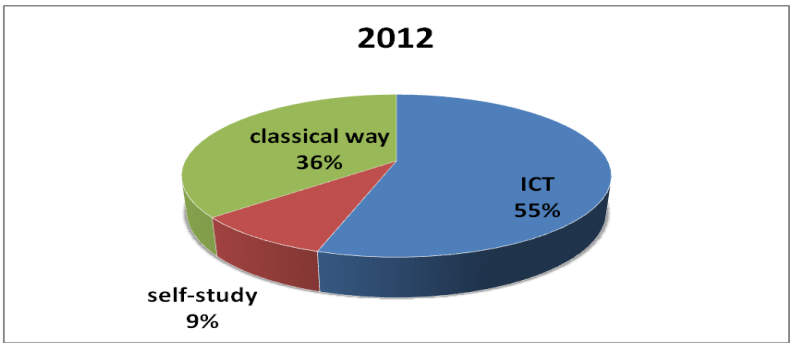

Fig. 2. Students' evaluation 2012
Source: own

The majority of students, 55 %, wants to use in their education up-to-date technologies, the Internet, Study portal and on-line sessions. But some of the respondents were influenced by their previous education and experience, and thus prefer a classical way of study, 36 %.

Then the authors concentrated in particular on LMS Barborka as a tool for language training. The second questionnaire was distributed among the distance study programme students. In this part of research 64 students were involved. It has been found that students' assessment of LMS Barborka is very positive. Majority of students regard this LMS as a useful tool for English study: 56 students out of 63 state that topics in LMS Barborka are interesting and 52 say that they are useful for study, 53 students think that interactive exercises are useful for self-study.

However, the main subject of our interest was more detailed LMS Barborka evaluation from the students' point of view. Via semi-structured interviews the authors asked students/LMS Barborka users to assess the study supports and especially to give reasons to use electronic form of study. The following items were mentioned repeatedly:

- **choice of topics** (topics which offer the possibility of learning something new, interesting, relevant and topical);
- **variety of topics and tasks** (up-to-date topics with interactive exercises that enable to practise grammar, vocabulary, listening and writing);
- **consistent content** (relevant materials, sequential, logical, topical and interesting);
- **attractive presentation** (rich choice of pictures, videos, fresh colours, and varied tasks support the students' motivation and desire to study);
- **place and time** (courses can be taken where and when they are necessary);
- **pace** (students can skip material they already know, they can study how long they want and repeat some complex matters).

These findings prove that our chosen way seems to be appropriate and an online support of language lessons is beneficial both for students and teachers.

CONCLUSION

Generally the authors can state that LMS Barborka and the designed modules of military, economic, management and special terminology create a dynamic, interactive environment, motivating students for their further study and at the same time contributing to open discussions on the educational content, and opening the space for deepening cooperation between teachers and students. This is the trend the authors would also like to follow in the

future. Rapid evolution of communication technologies has changed language pedagogy and language use, enabling new forms of discourse, new forms of authorship, and new ways to create study materials and participate in communities. Teachers must weigh up benefits and drawbacks of using different technologies in their teaching practice. There is no one way, one option or one solution. Each teacher adjusts teaching and learning materials, both in electronic and paper forms, in accordance with his/her students wants and needs, and creates own learning materials to make the educational process as effective as possible.

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(DISTANCE) LEARNING FOR DEVELOPING STUDENTS' CREATIVE ABILITIES

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Abstract: *The article describes the content and teaching methodology for students' work with information sources. The author presents the structure of two courses and the approaches leading to the development of autonomy and creative abilities of students. The term of creative ability is analyzed. SW Tovek Tools have been applied as a process tool. A discussion is held on whether to provide the students with detailed care, or rather let them struggle on their own to find a creative solution to tasks.*

Keywords: analysis, information, teaching, creative ability, ICT, Tovek Tools.

INTRODUCTION

The article reports on the experience from the courses called 'Analysis of information sources' and 'Designing communication and information systems (CIS) - Information management' at the University of Defence in Brno. The courses are a part of the Master's Study Programme. Their goal is to master work with Tovek Tools (TT) created by TOVEK [2] and established within the Ministry of Defence of the Czech Republic. Students gain knowledge from using the TT. They undergo orientation training and then they can manage the information resources workflow. The course has been designed to contribute to the development of creative abilities of individual students. There is also a course book [3] available for them. The courses are suitable for both face-to-face instruction and distance learning.

After the introduction, the article analyzes the concept of creative ability, introduces the tools used for teaching, and discusses the courses and teaching methods, which should ultimately contribute to the development of students' creative abilities.

1. CREATIVE ABILITY

A number of information sources dedicated to creativity and creative thinking (for example [6]) agree that there are many definitions and explanations of this term. A widely accepted definition of creative thinking describes it as a process leading to the production of a result, or a concept, that is unique and usable [1]. This particular definition incorporates the common themes found within a number of pre-existing theories of creativity; 'effective novelty' and the requirement for the end-product to be 'original and useful' appear to be of most importance. Two essential processes, which occur during the act of creative thinking, include the cognitive process (what we know) and the non-cognitive one (what we feel). Hence, the thinker's emotional state is intrinsically linked to the effectiveness of creative thinking.

Some information sources, such as dissertations [5], refer to the source [4], in which the concept of creativity is divided into four parts. It defines creativity as 'Imaginative activity

fashioned so as to produce outcomes that are both original and of value.' Creative processes necessarily involve behaving and thinking imaginatively, positing alternative solutions to problems, thinking around situations, and engaging in mental play. They are a form of purposeful activity, an active, engaged application of imagination to meet a particular goal. They involve the generation of something original, which may be original in relation to the creator's own experience, that of her peer group, or just uniquely and historically original. Finally they must be of some value, as defined in relation to the original objective of the process. For a creative activity to be valuable it doesn't have to produce something good, or beautiful, or useful, or possess any other subjective quality; instead value is assessed on an individual basis, and requires 'judgment and criticism [and] critical thinking'.

For our considerations on developing creative skills in the process of teaching, we anticipate such sort of assignments that enable the students to implement their own (unique) procedure for the analysis of information resources and to obtain unique results from the analysis for a set of documents using a given software tool.

2. TOOLS APPLIED

The TT software is applied for professional work with information resources in class sessions. The TT is set of modules for advanced search and analyses of information in various textual data (documents, messages, records, etc.).

It includes:

- Index Manager (IM) to index data.
- Tovek Agent (TA) to advanced search in data sources.
- Query Editor (QE) to create complex structured queries.
- Harvester (HA) to identify significant keyword groups and their time trend in retrieved documents.
- InfoRating (IR) to analyze and visualize relationships among the content of retrieved documents.

Working with the data source starts with indexing using the IM. Data sources are marked; it is necessary to distinguish the language in them and to set it in the IM because of the correct lemmatization (editing words into a base form) and then the sources are indexed. All other activities in the analysis of information are already underway over the indexed collection. Of course, there is an access to the source document, if it is needed in any of the TT modules. The query takes place in the TA. A query can be made in the form of a Boolean expression, in the form of free text and as TOPIC – the result of work in the QE.

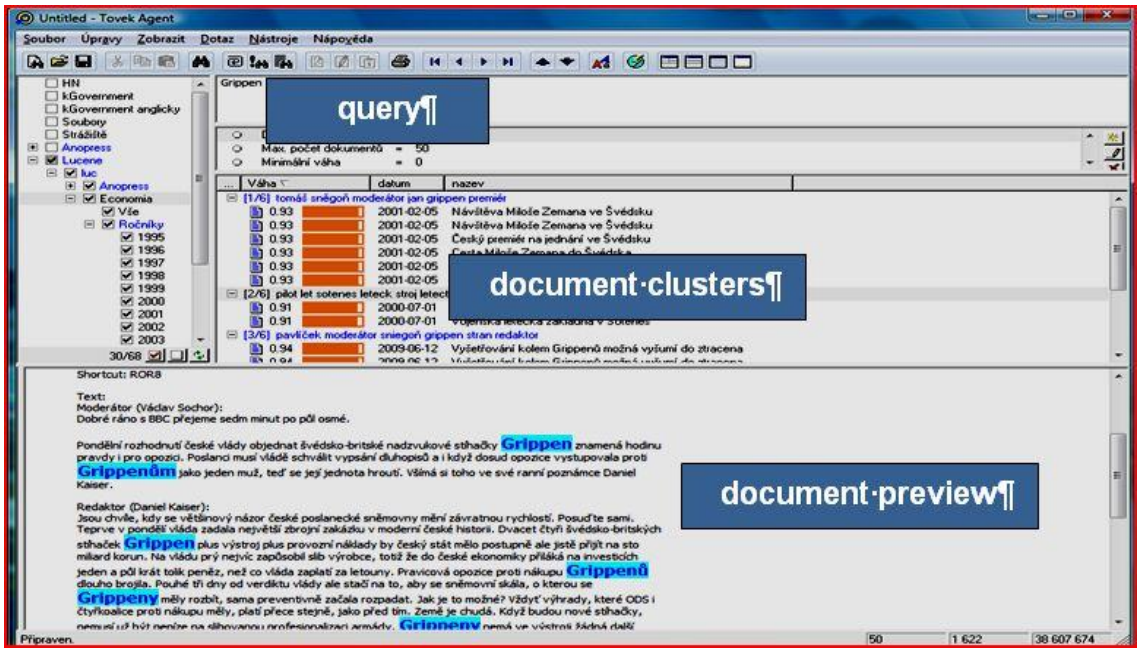

Fig. 1. Search interface of the Tovek Agent
Source: own

To create a query the Verity Query Language (VQL) is used; it contains a set of operators to determine the content of the request in detail. The search interface of the TA component is shown in Fig. 1. For the actual document analysis the IR and the HA modules are further applied. Into their environment, a set of selected documents from the TA is exported. The IR is a module for context analysis; the user interface is shown in Fig. 2.

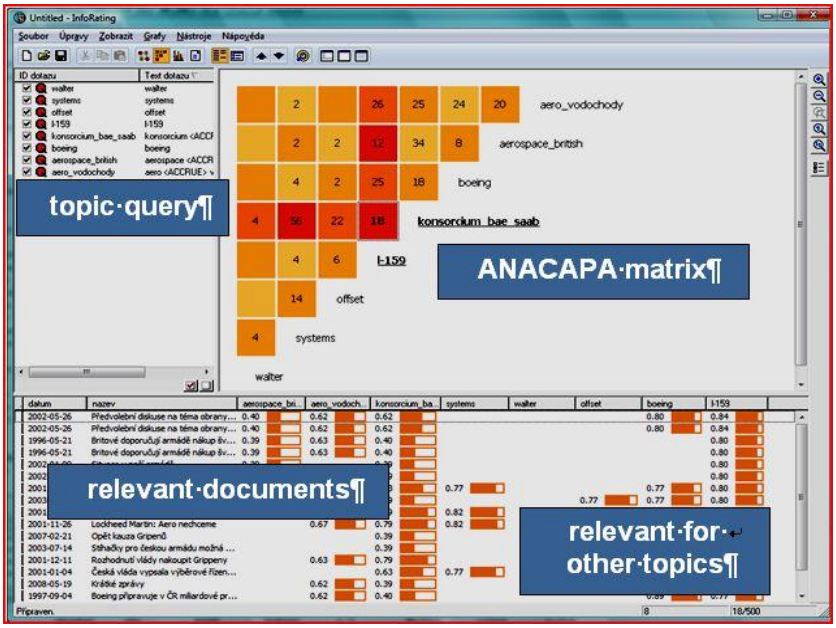

Fig. 2. InfoRating for a context analysis
Source: own

It analyses the context of the selected words, their neighbour words and displays the context in the table or graph. The HA is a module for content analysis. The interface to the analyzed documents offers individual words and their successors and predecessors, and the graph of the terms occurrence in the documents; see Fig. 3.

The actual analysis of the documents and the process of their analysis is based on specified goals and is not predetermined. It will be affected by the current results of the analysis, when the exploration may be conducted in different directions to obtain:

- lucid and detailed information,
- contexts in documents,
- the relationships between analyzed events and their actors,
- trends of the reality being analyzed.

The analysis of the documents is a creative issue, and thus its teaching allows students to develop creative abilities. It is 'only' necessary to prepare an appropriate assignment. An ideal form is blended learning, in which the theoretical part is explained in face-to-face instruction and individual work continues through distance learning.

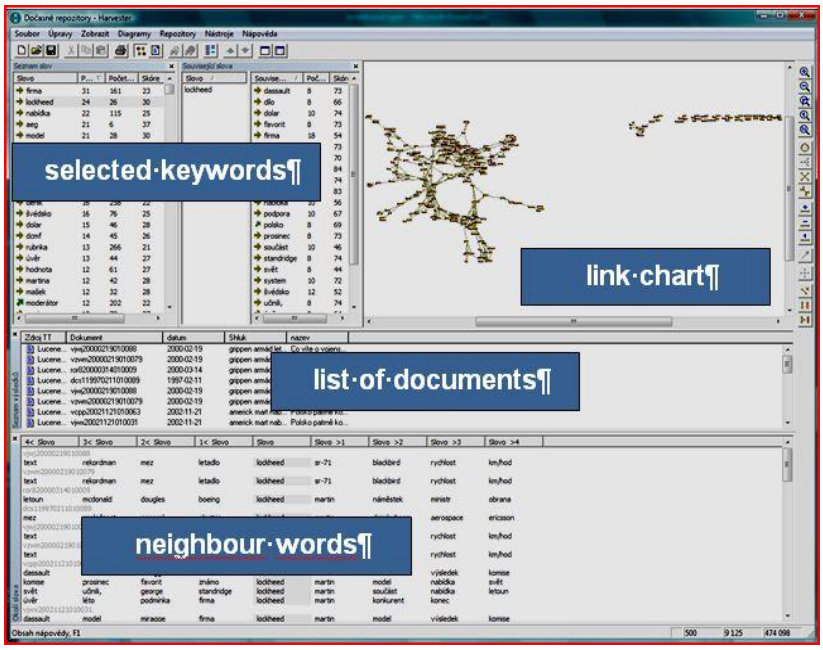

Fig. 3. Harvester for a content analysis
Source: own

3. CONTENT AND METHODOLOGY OF TEACHING

The class instruction includes well-proven teaching methods: lectures, exercises and practicals, as well as training for mastering the SW. The initial session is focused on the information system (IS) issues. The following topics are covered: concept of the IS, its meaning and structure; data – information – knowledge; metadata; unstructured and structured data; databases and data structures of database systems. Also, the historical horizon of data search is mentioned: from library index systems through Boolean to the concept search.

The further teaching block deals with Document IS: individual phases of text processing and the respective approach to it are explained. Then the teaching block of the key topics follows; it explains working with TT modules when searching and analyzing information. The teaching takes the form of training. Working with TT modules is at first tried on a small Czech document base which includes about two hundred documents. The indexing of

documents proceeds within a few seconds after the document base is identified, which does not pose a slightest problem for the students.

Searching in the document base is performed at first with individual key words, then with a pair of words linked with different operators (OR, AND, NOT, ACCRUE). The search result is explained and students must always understand it. ACCRUE becomes the favourite operator for students' future work (it searches using the operator OR and arranges the search results by the operator AND).

Working with VQL is solved through the individual exercise. The students are given an assignment and a review of VQL commands in a table. Then they search in the documents as required by the task. After that the creation of more complex queries in the form of TOPIC follows; it is arranged in a hierarchical query structure, see Fig. 4. The last part of the lecture is the use of the IR and the HA modules. The application of both modules in analytical work is illustrated by examples.

Another teaching block includes controlled individual work with all modules with a small English document base subsequently followed by independent work of the students who analyze a large English document base, comprising several thousands of documents.

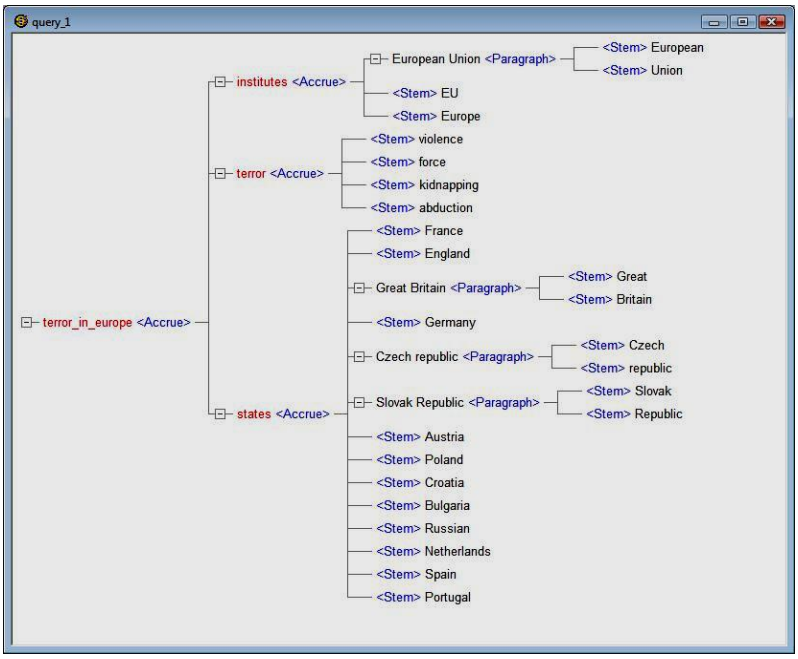

Fig. 4. TOPIC for a complex query
Source: own

4. DEVELOPMENT OF CREATIVE ABILITIES

The search in the extensive base of documents and the analysis of the demanded text in particular are focused on developing independence and creative abilities. The students receive a brief specification of the task and are only roughly methodically guided. They pick a topic from a list of documents subject to analysis. The topics include issues which appear in the news with greater frequency, for example, terrorism, the war in Afghanistan, NATO's missions abroad, corruption, economic crisis, etc.

The document base changes; the latest lectures included text news and commentaries on world events obtained from the web news. The students will first develop the strategy of the work procedure and consult it with the lecturer. It is an individual process. They mostly start with approximate analysis, which determines the documents dealing with the respective topic. Then they create the areas of interests covered by the topic while applying the TA and the HA modules.

For the creative implementation of correct procedures, the approaches and processes of Competitive Intelligence can be applied. It is necessary to ask appropriate questions, which will direct the students to the desired result. The WHY? question will be responded by stating the goal of the analyzed activity. The HOW? question will be answered by explaining the way to achieve goals. The WHAT? question leads to a task list. To the WHO?, WHEN? and WHERE? questions the students react by finding the subject, time and place of the analyzed activity. During the analytical process, the persons, organizations, things, events, resources, places are determined and adequately categorized.

Afterwards, the students focus on individual areas of interests and develop the sets of keywords, which best characterize the selected range and then they apply these words to build the TOPIC in the QE. Subsequently they verify the context and content of the analyzed interests using the IR and the HA modules. The students record the applied procedures in a protocol. The conclusions of the analysis process present summary information about how the student arrived at the results and what was actually found out.

CONCLUSION

The article presents the content and experience of teaching the analysis of information sources. It introduces the TT modules and approaches which develop independence and creative abilities of students. Many teachers believe that they must 'serve' the students with the task together with accurate and detail instructions on how to solve it. This approach, however, does not force the students to think and find their own way to fulfil the task. Thus, when the first problem and uncertainty occurs, the students receive detailed support, they ask for clarification of the instructions and want to be literally 'spoon-fed'. The method of developing a creative approach is, on the contrary, based on the precondition that the students get rather vague assignment with the desired result. It is their task to determine the process and the teacher does not intervene in this activity. The teacher ignores students' requirements to explain the tasks; they have to cope on their own. In their lives, there will not be a tutor available all the time to provide them with explicit instructions.

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OPTIMAL BALANCE OF ANALYTICAL AND NUMERICAL METHODS IN TEACHING OF ELECTROMAGNETISM

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Abstract*: The Faculty of Electrical Engineering and Information Technology at Slovak University of Technology educates professionals in the field of electronic, automobile electronics, telecommunications and robotics. The article deals with the experience and results of teaching electromagnetic fields by help of e-courses in the study of electromagnetism in several related subjects. Set of e-learning courses was built in the LMS system Moodle connected together with a common name „Electromagnetism". The courses including theoretical explanations, practical guides to experiments and modelling of real problems of electromagnetic fields in devices and in various environments were built. High-level language and interactive environment MATLAB was included into problems solving.*

Keywords: electromagnetic fields, e-learning, analytical modelling, numerical modelling, MATLAB.

INTRODUCTION

The electromagnetic phenomena stay in the base of almost all phenomena in nature. The study of the electromagnetic fields theory is the base for understanding the phenomena occurring in the nature and also in functioning of technical equipments. The electromagnetic principles were used by professional designers in the construction of various devices such as power supplies, communication devices, measuring devices, control devices. The propagation of electromagnetic waves is e.g. the basis for radar systems, the information transmission systems used also for defensive purposes [1]. In order to be successful in their work positions as electronic specialists students of all study programmes have to get familiar with electromagnetism as a whole. In the frame of study the Faculty of Electrical Engineering and Information Technology at Slovak University of Technology provides education in all study programmes also in the field of electromagnetism.

We in the Institute of Electrical Engineering teach a chain of subjects dealing with electromagnetism. We created courses connected into one unit called "Electromagnetism" as special parts called "Transient Phenomena", "Electromagnetic Fields", "Polarization", "Numerical Methods in Electromagnetism", "Propagation of Electromagnetic Waves". We feel, that the classical education with studying literature in paper form is not sufficient. In the cases when it is possible, it should be supplemented by new means [2].

We use the courses with a view to do things more interesting and more illustrative; starting with electric circuits as a special simplified case of electromagnetic field we continue with static fields, dynamic fields to the propagation of the electromagnetic fields in various media. We would like to discuss our experience and results of teaching electromagnetic fields by help of e-courses in the study of electromagnetism in several related subjects.

1. SPECIAL FEATURES OF ELECTROMAGNETIC FIELDS STUDY

Electromagnetic field theory knowledge is the basis for creation of electronic equipments and transmission systems. Its usage is not only useful but necessary. The electromagnetic theory is very complex discipline and needs very good basics in mathematics and physics. In comparison to other areas of study the good understanding of electromagnetic field problems needs more imagination and creativity of students and teachers. This fact brings more problems and inconvenience, but on the other hand it brings bigger challenge for innovation of learning.

At our faculty there are taught topics related to statical and dynamical electromagnetic field, electromagnetic waves propagating in various materials, light waves propagating in optical waveguides. We offer to students in the first place the theoretical explanation of physical models. Then we confirm simplified physical models by laboratory experiments, by analytical solutions of fields in these physical models when it is possible and also by numerical simulations of the models. For better study comfort we created several e-courses.

2. E-COURSES

The electronic courses belonging to subjects dealing with electromagnetic fields theory and electromagnetic fields applications are located at the server of the Faculty of Electrical Engineering and Information Technology at Slovak University of Technology on the following link: http://kme.elf.stuba.sk/moodle. They are connected in one group of subjects with one common name "Electromagnetism". The courses are called: "Electromagnetic fields", "Numerical Methods in Electromagnetism", "Polarization of Electromagnetic Waves", "Propagating of Electromagnetic Waves". Fragments from the courses are shown in Fig. 1 - 4. Because the courses are preferentially created for Slovak students, they are written in Slovak language, in the future we intend to write it also into English. It would be a suitable contribution to help students be better oriented in English special literature.

Fig. 1. Front page of the e-course „Numerical Methods in Electromagnetism"
Source: own

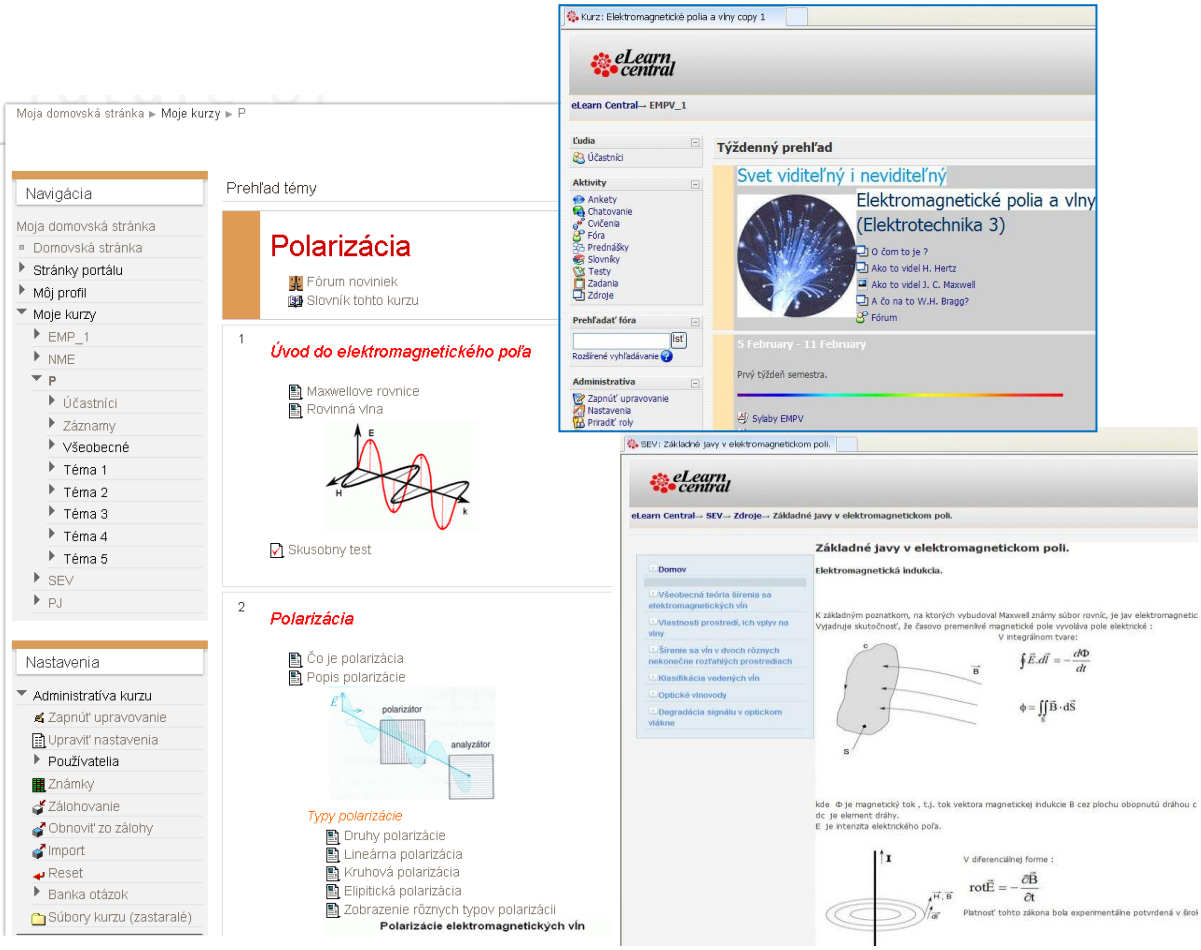

Fig. 2. Fragments from the courses from the teachers view
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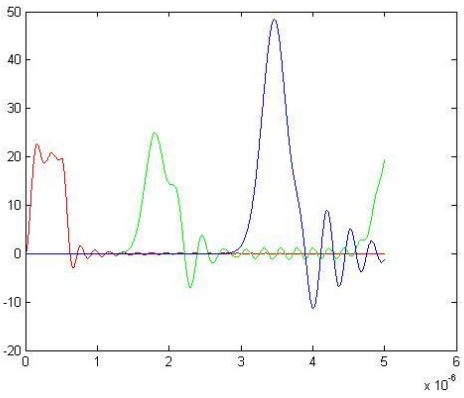
3. NUMERICAL METHODS

In the frame of study of electromagnetic fields we start with electric circuits as a special kind of fields, continue with static electromagnetic fields, and then to dynamic fields and electromagnetic waves propagation. In the subject "Numerical methods of electromagnetism" the curriculum goes over these topics: analytical and numerical models, finite differences method, finite elements method, Monte Carlo and Exodus methods, method of moments, interpolation, fast Fourier transformation, FTDT method [3].

We give attention to suitability of various mathematical models in various conditions in various environments. We discuss limits of these models, suitability of used solving methods. There are two main sources of errors: one is the simplification of physical reality, the second is, that the numerical simulation of the models contains errors caused by the numerical method itself [4]. In the lessons we show the difference in obtained results accuracy in the case, when we use sparse or dense area net. The explanation of dynamic fields we start with exploration of the pulse propagation in homogeneous transmission lines. We explain dispersion as a physical phenomenon and dispersion as a numerical effect. The example of numerical dispersion is shown in Fig. 3a. One important chapter is devoted to interpolation, we show the possibilities of suitable and nonsuitable kinds of interpolation functions. The example showing aliasing phenomenon is shown in Fig. 3b.

a) 

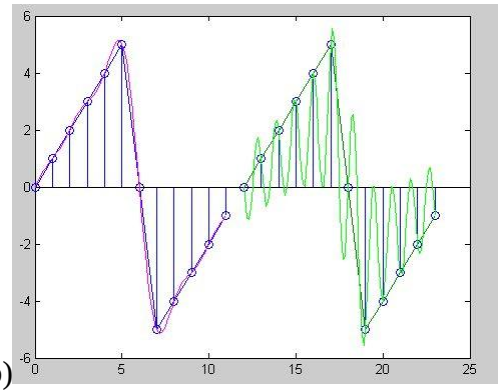
b) 

Fig. 3. a) Example for numerical dispersion b) Example of aliasing
Source: own

3.1 MATLAB and Electromagnetism

In teaching of electromagnetism we start with analytical methods and with simple problems to solve, and then we continue with more complex problems and exercises and move from analytical solutions to numerical solutions. Students in study programme "Mathematical-computer modelling" in master degree of study learn analytical methods of solving electromagnetic fields tasks in subject "Electromagnetism" and numerical solutions of various tasks in the subject "Numerical methods in Electromagnetism".

The general use of computers and many kinds of software available give rich possibilities to make interesting tasks for solving. One possibility to understand electromagnetism is to use completely specialized software, which is designed for solving special complex tasks. We decided not to use this way of education. We wanted to combine mathematics and physics with our own programming in one complex. We have chosen he best possibility for us, it is to use general software designated for solving of mathematical problems programmatically. Specialised software offers professional level of reaching results in solving more complex problems. But the experience in programming of owns algorithms for problem solving is very good way to professional usage of commercial specialized software. Students are more involved in the problem itself when they code it by themselves. They are better able to consider the suitability of used method. For that reason we decided to use high-level language and interactive environment MATLAB [5] as a suitable tool in reaching multiple goals – to understand fundamentals of physics, to use mathematical tools as much as possible and to improve ability of students to change viewpoints when reaching solution limits [6].

The basic task for teacher is to find the right balance between usage of analytical and numerical solution of problems and to point out limits of every method. The right balance is needed also between various available possibilities in graphical illustration of solved tasks. MATLAB provides us satisfactory ways of achieving the balance in using analytical and numerical methods and also satisfactory graphical representation.

We want to support free software spreading. We recommend to our students to use also freeware software like Octave or SciLab in their home working places [7]. The side effect of this recommendation is that students recognize the equivalency of charged and free software. They recognize also differences in the functionality of various programmes.

CONCLUSION

We created in Moodle and implemented e-learning courses “Electromagnetic Fields”, “Polarization”, “Numerical Methods in Electromagnetism”, “Propagation of Electromagnetic Waves”. These courses give students better possibility to understand explained study material and related materials, which can they find in various places of interest. Students better cooperate with teachers and with members of their groups. Every explanation, every problem and task is available all the time. Students can solve tasks in teams in the time which suits them. Forums usage gives better collaboration among all participants – students group and teachers. Most students give us optional proposals. Some of them are more interested in mathematical viewpoint, some students are more interested in physics and many students are interested in programming. The good balance between these demands is achievable. Most students express their satisfaction with achieved results of balance and appreciate the possibility to improve their computational MATLAB skills, which will be useful in many kinds of their other future activities.

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NEW FORM OF E-LEARNING – ADAPTIVE E-LEARNING

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Abstract: *Process of informatization and establishment of information technologies hasn't bypassed education. Nowadays in a world of information society we cannot imagine education without its electronic form. In the last few years we can observe continuous trend of individualization of study programmes, in both full-time and combined form. By merging these two trends – electronic form of education and individualization - into one, we tend to create 'individual electronic education'. This paper deals with complex proposition of learning management system, which will be able to guarantee individual electronic education. It is learning management system so called virtual teacher, which can automatically adapt to individual student characteristics and learning style. It adapts the process of education to static and dynamically changing characteristics of student. In order to adapt the learning process to changing characteristics, system needs to have a sufficiently rich supply of different styles and forms of teaching, styles of learning, memory types and another student characteristic. The information about these characteristics as well as methods for creation of adaptive learning materials are also contained in this paper. It is one of the new trends in individualization of education. It enables adaptation of learning materials, not just to adapt to user environment or passage thorough these materials.*

Keywords: virtual teacher, learning style of student, optimal style of education, current style of education.

INTRODUCTION

E-learning is one of the new modern forms of education. It is used in many forms, from the easiest (presentation of learning materials as a .pdf files on websites) to modern software systems leading the education and many follow-up teacher and student activities (Learning Management System – LMS). In both of these classic examples are the individualities of students concealed, it means his preferences during leasing, his learning style are not taken into account.

Improvement of education via adaptive e-learning education should be visible in two levels. Acceleration of knowledge gain and more natural way of studying for every student, thanks to taking individual characteristics of students into account. Optimal adaptive procedure should respect students differences based on identified learning style with consideration to the changing knowledge and skills of student during course. Based on identification of personal characteristics and attributes there will be a studying material handled in a form that matches student as much as it can. Adaptive form of education is area often mentioned recently, but not fully explored and practically unrealized yet.

1. OUTCOMES OF ADAPTIVE EDUCATION THEORY

Adaptive e-learning theory (Kostolányová, monography 2012) comes out of past theories from well-known psychologists and educators - Komenský, Gagné, Bloom, Kolb, Tollingerová, etc. Terms like upbringing, educating, teaching and learning occur in the works of great educators from different nations. Adaptive education theory connects with their terminology and develops it in nowadays conditions and in conditions of electronic education.

Definition of learning style term is key to clarify adaptive education. It is precisely this kind of individual characteristics on which we adapt the education, personalize it.

Many authors dealt with classification of learning styles. They focused on various attributes of students which are related to learning and according to them classified types of students. In this case learning style is set of selected attributes which can be taken into account in e-learning and which define learning of each individual.

2. PEDAGOGICAL PRINCIPLES AND INDIVIDUAL E-LEARNING EDUCATION

Adaptive e-learning education theory is based on principle of programmed teaching, adaptive hypermedial systems and principles of Gagné's event education. Adaptive education theory shares basic principle with programmed teaching (Tollingerová, 1968): Division of curriculum into small units, verification of these small units and reaction of educational system at student's understanding of the curriculum. From the adaptive hypermedial systems (AHA), whose essence is reaction on user behavior and control of his movement in the system, adaptive e-learning theory takes monitoring of the student (we further mention logging of education process) and feedback implementation. Gagné's theory gave origins to structure of adaptive study material (see below).

3. PREPARATION OF ADAPTIVE EDUCATION

System has been divided into three parts from the practical point of view:

- student's learning characteristics diagnose, current education and testing of students (student module),
- structuring educational supports, creating methods for adaptive studying materials making (author module),
- design of adaptive algorithms for optimal formation of customized learning environment (virtual teacher module) and recording education process.

Each part deals with several sub-problems:

- In order to react on different learning characteristics of students, controlling educational software must know the student information, the ones which influences the learning process. All of which are they?
- How to get information about learning characteristics of student?
- How should educational support material look like to be able to adapt to student learning characteristics?
- How should teacher (virtual) teach each type of student?
- These problems are solved within each module of adaptive education system.

4. ADAPTIVE EDUCATION MODEL

Theoretical model of adaptive e-learning education can be represented graphically, as seen at figure 1. System consists of three parts – student module, author module and virtual teacher module.

In the **Student** module (right part of scheme) system discovers and enrolls each student characteristics into student database. System tests every student or gets data via proper questionnaire.

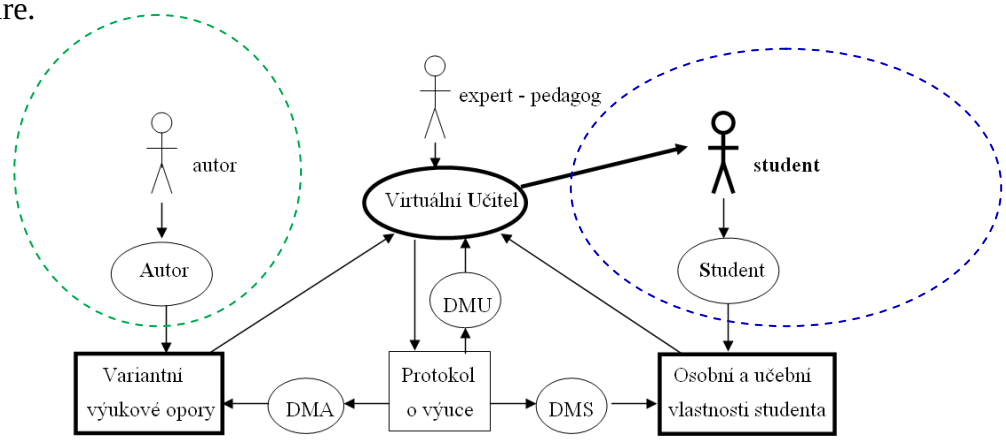

Fig. 1. Virtual teacher system scheme
Source: own

Second backup module is **Author** (left part of scheme). It serves as a tool for saving or modification of educational support materials into author database. Database contains not just educational papers, figures, media etc., it also stores sufficiently detailed information about them, so called metadata. This metadata contain every part of educational material. For example if it is definition or motivation of student, even task etc.

Controlling software itself called **Virtual teacher** (black ellipse in the middle above) will then load all of the necessary information about a student, all relevant information about structure of learning material and with that knowledge determines optimal way of education. This requires pedagogical and psychological knowledge mentioned in the previous chapter. Based on them software assembles a plan of educational process. It is some kind of expert system. It contains basic pedagogical rules and from them, it creates optimal educational style for specific student and optimal passage through specific educational material.

Because preliminary questionnaires testing students may not be always reliable, or pedagogical rules also may not be optimal, system enables student to control education in his own way. Student can load different parts of education in different order than the system would suggest. Virtual teacher files every student's steps in so called protocol. Protocol contains time spent on each part of education; time spent on thinking, task solving time, student driven transitions into another part or detour from suggested order.

With all that protocol becomes important source of information. His statistical evaluation, or via more advanced methods of data analysis (bottom part of scheme) we can get feedback about each individual student, about types of students, about teaching materials quality, and we can get better view on rules an virtual teacher's algorithm accuracy. Analysis results can

retroactively influence all of these information and gradually improve the system quality. The analytical part is understood as part of a virtual teacher module.

4.1 Student Module

After extensive analyzes of pedagogical information sources have been carried out (Kostolányová, ICTE 2010), attributes, which define learning style of student and are influencable in e-learning form of education, have been found. After consultations with teachers and psychologists we divided these attributes into following groups with values:

sensory perception: verbal - visual - auditory - kinesthetic
social aspects: likes to work alone - in a pair - in a group
affective aspects: internal motivation to study, external
learning tactics:
systematics with values: preferred order - freedom
methods with options: theoretical derivation - experimentation
approach with options: analytical - holistic
tactics with options*:* deep - strategic - surface
autoregulation with values*:* works according to the guidelines - separately.

In order to work with these attributes scientifically we need to identify them and introduce a scale for their measurement. We chose a scale for each attribute (eventually for each value). Scale ranged from < 0, 100 > or < -100, 100 >. These 13 attributes are static, dynamic one is student success. Unlike other attributes we measure success with these values:

2 = average comprehension, sufficient is normal textbook interpretation
3 = reduced comprehension with a need for slower, more detailed interpretation
1 = keen understanding, often with a need for wider, more detailed range of information.

For students learning style identification a made-to-measure questionnaire is used.

4.2 Author Module

Author module is designed to preparation, storage and maintenance of adaptive studying materials. We use common type of division into chapters and subchapters for our educational support material. We considered adaptation option when compiling our methodology for creation of studying materials, so we used principles of textbooks for distant types of studies. The curriculum was divided into so called frames – it is a partial unit of information (means one term in classic textbook). Furthermore, we know that teaching methods are composed of sequence of elementary steps of learning - the beginning of instruction, interpretation, practicing, testing, termination. In order to use that principle in the field of adaptive education we divide educational process according to R. Gagné. We divide particular parts of frame into so called layers. They will be of three kinds – interpretation, testing and others. Interpretative ones are related to presentation of curriculum - interpretation, semantics, examples practicing, solved examples, summary. Test layers are formed by examples for solving, questions and by tests. Other layers include motivation layer, navigation layer and layer with expanding literature.

Sensory preferences of students (verbal, visual, auditory and kinesthetic) and concept of information processing (depth, strategic and surface) are taken into consideration when talking about adaptability of studying material. According to sensory preferences and depth

interpretation of the curriculum 12 variants of frames will be created, each divided into individual layers. Interpretation control is done by selecting sensory form and then selecting the order and depth layers. This creates an optimal combination of learning material parts according to learning style.

4.3 Methods of Adaptive Supports Creation

Adaptive textbook creation is much more difficult than creation of classic e-learning textbook. It is good to have at least one classic textbook as a source. Then it is highly recommended to proceed according to following algorithm:

1. For each lesson execute objectives, content and level; lesson content split into elementary units – frames and name them. They form our basic framework, source of further processing. Until now it is common procedure, it is appropriate to abide it when writing any textbook.
2. Divide each basic frame into layers for normal interpretation in depth 2, processed „classically", it means in verbal form:
   - define frame objectives,
   - define frame content,
   - divide frame into layers, we separate theory (definitions of new terms, new statements, new rules, new procedures, etc.), explanation of theory, fixation layer (other interpretation formulations, setting into previous lessons context etc.),
   - add layers with solid exercises and examples from daily routine,
   - add questions to test new knowledge – or eventually groups of questions,
   - add exercises for practice to test new skills – or eventually group of,
   - think and add motivation layer,
   - think and add navigation layer,
   - if needed add a literature.
3. If basic frame division is done into layers in depth 2, we assemble option for depth 3 (step by step, really simple explanation) and also option for layer 1 (more detailed, with interesting facts, extensions).
4. If all three options (all 3 layers) are done, we implement other sensory variations for each depth:
   - For visual variation we add or replace suitable part of interpretation and testing with figures, charts, tables, animations and other visual features,
   - for auditive variation we replace suitable parts with spoken word (live or automatically by reading software) or by video with live performance of subject,
   - for kinesthetic variation it is needed to think how it can be realized via computer; particularly questions and exercises give more options.

For comfortable and structured production of learning materials a template was made for making educational support materials in MS Word (Kostolányová, 2012). Author of this template records both content of education and also records appropriate metadata needed to control adaptive learning.

4.4 Virtual Teacher Module

We know the attribute set, describing learning style of student. We are able to identify their values and to indicate the leasing type of student. We have a structured educational support, able to adapt to any of the student's current needs. We need to solve another part of the

adaptive learning environment: How should the (virtual) teacher teach when he has a certain type of student in front of him?

To solve it we must first describe the learning style suitable for every type of student. This is done using teachers' teaching styles and educational methods.

Then it will be necessary to formalize this description so it can be used automatically by the virtual teacher. The management process of teaching is very demanding and for author and teacher actually invisible. Only student will receive an interpretation of curriculum and verification tasks differently than other students.

We already caller controlling software that properly assembles education and its understandings verifies as a **virtual teacher**. It must perform with each student following activities step by step:

- It must find to logged student his **learning style** (US), thus the characteristics influencing his learning. It must identify and add to his learning style his **personal learning style** (OVS), a procedure that will best suit the student:
  US → OVS
- Optimal personal learning style may not be applicable for every real frame of the current educational support. In the current lesson, some variants of frames may not exist; some frames may not use all types of layers. The next step of virtual teacher is application of personal learning style of the student to the current lesson, therefore determination of **current learning style of the lesson** (AVS). Result is determination of closest sensory variation for each lesson frame and specified sequence of layers and their depth to actual frame:
  OVS → AVS
- Based on the optimal lessons AVS passage plan virtual teacher controls the learning process, i.e. it submits to student continuously frames and of them selected layers of depth and sensory forms.
- Another problem of the virtual teacher is steering **system's response to the student's wrong answers**. If the student answers the questions and verification tasks correctly, it proceeds according to the current learning style. But if the student answers incorrectly, the situation must be appropriately addressed in the context of the current situation.
- The last function of the virtual teacher is logging of the whole learning process so that the analysis of the situation could get feedback of the correctness of student's characteristics, to verify the suitability of educational supports and also to verify the accuracy of expert rules of virtual teacher.

4.5 Formal Structure of Adaptive Rules

To determine theoretically optimal learning style for particular student means to choose the most suitable sensory variation and to that identify optimal order of layer types and depth for each (theoretically complete, with all type soft layers) frame. This option and the order of layers in it is used generally for each lesson frame.
Personal sensory variation is defined by the strongest type of sensory perception, i.e. a form with a maximum value from verbal, visual, auditive and kinesthetic preferences. For the other characteristics we formulate elementary rules of the general form:

if student has attributes V1 = a and also V2 = b
use order of layers and depth X, Y, Z, …

where X, Y, Z each layer (theoretical, semantic, …)

V1, V2 characteristics of learning style (motivation, autoregulation …)
a, b values of each characteristics.

The rules assigning order and depth of the layer. These are expert rules set by expert - teacher and expert on adaptive learning. There is a lot of such "elementary" rules - one for each value of each attribute, or eventually some of their combinations.

Rules assigning order and layer depth when displaying framework are based on static and dynamic attributes of the student. These are expert rules set by expert - teacher and expert on adaptive learning. There is a lot of such "elementary" rules - one for each value of each attribute, or eventually some of their combinations.

Based on the teaching methods and learning styles of teachers, which are applicable in electronic form of education, and identified learning style of student we determine the optimal personal learning style.

The algorithm for finding the optimal personal learning style:

1. filling the questionnaire by the student
2. round to the nearest virtual student
3. selection of learning „method“ for each student attribute
4. counting the number of learning „ways“ for each student attribute
5. organize the counts according to occurrence frequency
6. list of „ways“ of learning – recommended, additional and not recommended.

Example:
Student A [20, 20,20,40]; [-100,0,0,0,0]; […]; …

Title	Type or characteristics	Sensory perception				Affective aspects			…
		Verbal	Visual	Auditive	Kinesthetic	Is aversed to study	Shows no interest	…	…
Verbal methods	lecture	100	100	100	x	x	-50	…	…
	explanation	x	100	100	100	-100	-50	…	…
	…	…	…	…	…	…	…	…	…
Practical methods	Kinetic and working skills	x	100	100	100	-100	-50	…	…
	…	…	…	…	…	…	…	…	…
…	…	…	…	…	…	…	…	…	…
attributes VS	Focuses on detailed interpratation	100	X	100	x	x	x	…	…
	…	…	…	…	…	…	…	…	…

Table 1. Analysis example
Source: own

Based on algorithm we discover if the student is kinesthetic, has aversion to studies, etc., so the virtual teacher assigns him „way“ of explanation, kinetic and working skill, etc.

This creates a number of rules for optimal learning style. Based on an algorithm there will also occur suggestions how to create educational support materials, based on the learning style of student.

CONCLUSIONS

Paper dealt with complex concept of system which should be able to ensure the individual electronic education. Virtual teacher adapts education to static and dynamically changing attributes of student. Based on a rich supply of various styles and forms of education a number of rules is created, assigning to a particular student his optimal learning style. The rules are the basis for adaptive learning and also a design for authors of educational support materials.

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THE ROLE OF ICT FOR DEVELOPING AN "INCLUSIVE SOCIETY" – NEW MEDIA IN THE LIGHT OF DOCUMENTS OF THE ROMAN CATHOLIC CHURCH

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Abstract: *In any case, direct, face-to-face conversation, direct experience and direct interacting in the social educational sense prevail over media communication, virtual experience and interactive actions on a computer. Nevertheless, it should be emphasised that the Internet and computer offer significant opportunities for a society to develop in the direction of an "inclusive society". The documents of the Roman-Catholic Church draw a very optimistic image of the Internet: In the Messages of the World Communication Day 2002 John Paul II compared the Internet with the forum in the antique Roman world and in 2003 he pointed out, that communications media do a service for truth, justice, freedom and love, therefore peace and – together with the willingness to share knowledge – an "inclusive society" can grow.*

Keywords: values, inclusion, inclusive society, heterogeneity, tolerance, Messages of the World Communication Days, Pacem in Terris.

INTRODUCTION

Where is society heading to? Is it going in the direction of "social competition" or in the direction of "citizen of the earth"?

The aim of theological ethic is "lucky life" – like Jesus said, "I have come that they may have life, and have it to the full" (John 10,10). The aim of the theological ethic is the luck of *our* life: my individual life but more the social life in community.

Therefore the main question is: How is it possible to achieve life in happiness for as many people as possible?

How is it possible, to get from one's own little world to the "global" thinking and acting, to a "planetary awareness" (Boff 1996)

1. TO OVERCOME BORDERS IN YOUR HEAD – HELPING TO CREATE A "NEW SOCIETY"

A mother asked her first-class pupil,
"How many foreigners have you got in your class?"
The child asked back, "Foreigners?"
Mother, "You do have foreigners in your class?"
Child, "We don ´t have foreigners, we just have children." (Feldbach, VS2)

This honest reply of a six-year old child exactly points out what inclusive pedagogy is all about: not to categorize and not to label (Feiner 2008).

L. Boff raises the postulate of a new planetary awareness, "The growing planetary awareness turns us, who so far were inhabitants of this or that country, into citizens of this one earth. We form a society of fate. The human fate is indissolubly connected with the fate of the planet and the cosmos; we are asked to become global and universal beings" (Boff 1996, 32.38f).

Only such an openness will help to form a "new society".

2. "IT IS NORMAL TO BE DIFFERENT" (F. V. WEIZSÄCKER)

The Salamanca–Statement has smoothed the way to see heterogeneity not as an obstacle but as a chance. According to the guiding principle of the UNESCO this chance should be given to any marginal person. The marginalisation of minorities does not take us – as society – any further. In 1994 representatives of 92 governments and 25 international organisations agreed on a clear educational direction under the patronage of the international organisation for education of the UN, "The guiding principle … is that schools should accommodate *all children* regardless of their physical, intellectual, social, emotional, linguistic or other conditions. This should include disabled and gifted children, street and working children, children from remote or nomadic populations, children from linguistic, ethnic or cultural minorities and children from other disadvantaged or marginalized areas or groups" (UNESCO 1994, 6).

The worldwide United Nations Educational, Scientific and Cultural Organization (UNESCO) believes and proclaims that:

- "every child has a fundamental right to education, and must be given the opportunity to achieve and maintain an acceptable level of learning,
- every child has unique characteristics, interests, abilities and learning needs" (UNESCO 1994, VIII).

With that a milestone was set towards inclusion, with the aim to make a general standard, an educational aim of general pedagogy out of it.

Out of the Salamanca Statement the Index for Inclusion developed – which was published in English in 2000 (Booth – Ainscow) and has now been translated into 40 languages on all continents. It is a pioneering piece of work that aims at a pedagogy for a mankind that does not exclude but welcomes everybody.

The Index contains "a detailed analysis of how learning barriers can be reduced and overcome and how the participation of all pupils can be guaranteed." It is a "tool" to create an inclusive model (Boban - Hinz 2003, 8).

Maybe the idea of inclusion stays a vision; but we should move there and even further.

We are convinced that the term integration is not enough anymore to show what school should aim for today. The issue, by far, is not just about the integration of people with disabilities. Since the political change in 1989/90 new necessities concerning school have come up in Austria: How can pupils be supported whose mother tongue is not German? How

can they bring in their cultural and religious identity to the enrichment of all? And: How can each of them develop their talents and integrate them into social contexts (Feiner 2011)? Which chances does the perception of heterogeneity offer?

What is the contribution of the Internet for the realisation of this vision? What opinions are mentioned in the documents of the Roman-Catholic Church concerning this question?

3. A NEW AGORA OR FORUM

In the Message of the World Communications Day 2002 John Paul II mentioned the Internet being the new "forum": "The Internet is certainly a new 'forum' understood in the ancient Roman sense of that public space where politics and business were transacted, where religious duties were fulfilled where much of the social life of the city took place ... It was a crowded and bustling urban space, which both reflected the surrounding culture and created a culture of its own. This is no less true of cyberspace, which is as it were a new frontier opening up at the beginning of this new millennium" (John Paul II, 2002, 2).

The Pope states his point of view with clear and positive words: "The Church approaches this new medium with realism and confidence. Like other communications media, it is a means, not an end in itself" (John Paul II, 2002, 3).

And further: "In a culture which feeds on the ephemeral there can easily be a risk of believing that it is facts that matter, rather than values. The Internet offers extensive knowledge, but it does not teach values; and when values are disregarded, our very humanity is demeaned and man easily loses sight of his transcendent dignity" (John Paul II, 2002, 4).

In Internet "the stimulus for deeper thought and reflection may be lacking. Yet human beings have a vital need for time and inner quiet to ponder and examine life and its mysteries, and to grow gradually into a mature dominion of themselves and of the world around them. Understanding and wisdom are the fruit of a contemplative eye upon the world, and do not come from a mere accumulation of facts, no matter how interesting. They are the result of an insight which penetrates the deeper meaning of things in relation to one another and to the whole of reality" (John Paul II, 2002, 4). The main question in the future will be, "how are we to cultivate that wisdom which comes not just from information but from insight, the wisdom which understands the difference between right and wrong, and sustains the scale of values which flows from that difference?" (John Paul II, 2002, 4).

Further the Pope asked: "How can we ensure that the information and communications revolution which has the Internet as its prime engine will work in favour of the globalization of human development and solidarity, objectives closely linked to the Church's evangelizing mission?" (John Paul II, 2002, 5).

There has to be a place for human being and humanity, "for if there is no room for Christ, there is no room for man" (John Paul II, 2002, 6), the Pope John Paul II said.

4. THE CONNECTING WORLD WIDE WEB

The web is a symbol for connection; the Internet connects people all over the world. Pope Benedict XVI highlighted the role of the Communications Media as a "network facilitating communication, communion, and cooperation" (2006). Pope Benedict XVI said, that the Internet "conquered time and space, making communication between people, even when separated by vast distances, both instantaneous and direct. This development presents an enormous potential for service of the common good. It necessitates both seeking and transmitting what is the ultimate foundation and meaning of human, personal and social existence (…). In this way the media can contribute constructively to the propagation of all that is good and true" (Benedict XVI, 2006, 2).

Pope Benedict XVI was also optimistic about the medium: "To encourage both a constructive presence and a positive perception of the media in society", Benedict XVI wishes "to reiterate the importance of three steps, identified by my venerable predecessor Pope John Paul II, necessary for their service of the common good: formation, participation, and dialogue (…). Formation in the responsible and critical use of the media helps people to use them intelligently and appropriately (…). Participation in the mass media arises from their nature as a good destined for all people. As a public service, social communication requires a spirit of cooperation and co-responsibility (…). Finally, the promotion of dialogue through the exchange of learning, the expression of solidarity and the espousal of peace presents a great opportunity for the mass media which must be recognized and exercised. In this way they become influential and appreciated resources for building the civilization of love for which all peoples yearn" (Benedict XVI, 2006, 4).

He said, that he has been "confident that serious efforts to promote these three steps will assist the media to develop soundly as a network of communication, communion and cooperation, helping men, women and children, to become more aware of the dignity of the human person, more responsible, and more open to others" (Benedict XVI, 2006, 4).

5. THE COMMUNICATIONS MEDIA AT THE SERVICE OF PEACE

In 2003 Pope John Paul II published the Message "The Communications Media at the Service of Authentic Peace in the Light of *Pacem in Terris*". First he remembered Pope John XXIII's Encyclical Letter *Pacem in Terris* (1963) and four pillars of a peaceful society truth, justice, charity and freedom as (ibid., 37).

He wrote, that "peace, justice and social stability are still lacking in many parts of the world" – but "the power of the media to shape human relationships and influence political and social life, both for good and for ill, has enormously increased".

The Pope saw the ambivalent effects of the enormously media power increase: "The mass media (…) constitute the modern arena in which ideas are shared and people can grow in mutual understanding and solidarity (…). In fact, the media often do render courageous service to the truth" (John Paul II, 2003, 3).

Sharing (ideas) offers the chance for empathy and solidarity: "By accurately reporting events, correctly explaining issues and fairly representing diverse points of view, the media have a strict duty to foster justice and solidarity in human relationships at all levels of society. This

does not mean glossing over grievances and divisions but getting at their roots so that they can be understood and healed" (John Paul II, 2003, 4).

Peace can only be realised, when freedom is given: "Freedom is a precondition of true peace as well as one of its most precious fruits. The media serve freedom by serving truth: they obstruct freedom to the extent that they depart from what is true by disseminating falsehoods or creating a climate of unsound emotional reaction to events. Only when people have free access to true and sufficient information can they pursue the common good and hold public authority accountable. If the media are to serve freedom, they themselves must be free and correctly use that freedom" (John Paul II, 2003, 5).

Pope John Paul II pointed out, that the communications media do a service for truth, justice, freedom and love, therefore peace can grow: "Men and women of the media are especially bound to contribute to peace in all parts of the world by breaking down the barriers of mistrust, fostering consideration of the point of view of others, and striving always to bring peoples and nations together in mutual understanding and respect - and beyond understanding and respect, to reconciliation and mercy!" They are "called to be agents of truth, justice, freedom, and love, contributing by their important work to a social order 'founded on truth, built up on justice, nurtured and animated by charity, and brought into effect under the auspices of freedom' (Pacem in Terris, 167)" (John Paul II, 2003).

6. SHARING THE KNOWLEDGE – THE TRUE UTOPIA OF COMMON KNOWLEDGE

We are convinced, that the Internet supports realizing a true utopia of common knowledge. Franz Nahrada e.g. considers "open source" in software development as a "true utopia of common knowledge" (Nahrada 2005). Certainly Bill Gates and many others have become financially rich through monopolization and protected copyright of its products. Nahrada speaks instead of "wealth by copyleft". Making knowledge available on the Internet in the last two decades has become a matter of course. Sharing knowledge creates a great treasure for all internet users - a great chance for an "inclusive society".

Among a number of strategies and measures taken, nowadays there appears to be an effective tool for the inclusive society to be developed. It gives a hope and a hand to those who want to have "a clue" and integrate into the inclusive society. This tool is Open Educational Resources (OER).

As Fred Mulder, a holder (since 2002) of the UNESCO chair in OER states, the original concept of OER is to "develop a universal educational resource for the whole of humanity" (Mulder 2012). The OER movement is not carried anymore only by believers, engaged practitioners and educational or digital experts; it's a movement of many institutions and a growing number of governments that are aware that OER is important for them as well (Sekret – Feiner 2013).

CONCLUSION

A new society to put it in the words of Gestalt pedagogy: We could say that at the beginning of the third millennium a tendency towards the "good character (Gestalt)" can be felt in

society, where exclusive thinking can slowly be overcome and where society aims to reach a "good character (Gestalt)" in the form of inclusive communities, that people more and more define themselves as "citizens of one earth" in which also regional identities can be accepted.

Inclusion is the vision of a new society which accepts and integrates all people in their difference and through that also a piece of an eschatological dream of a new heaven and a new earth; this dream can never be fully made to come true, but we are encouraged to help it realise, "If one dreams alone, it is only a dream, but if many dream together, it is the beginning of a new reality" (Dom Helder Camara).

In 1972 the astronaut John W. Young, looking down from the moon, expressed the new awareness with far-reaching words, "*The bottom is the earth. This blue-white, beautiful, radiant planet – our human homeland! Here from the Moon, I think of him with bare hands. From this perspective, there is neither black nor white, there is no division between East and West, there is neither capitalist nor communist, neither North nor South. All we form a single planet. We need to learn this planet from which we are a part and a piece is to* love" (cit. in: Boff, 1996, p. 31).

In pedagogy we postulate a school for the future, a vision of a school that excludes nobody but is open for everybody; a school that promotes everyone according to his / her individual abilities, talents, interests and diverse intelligences.

In such a way the guiding principle of the UNESCO Salamanca statement of the "inclusive society" can be realised more and more.

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ROAD NETWORK GENERATION FOR VIRTUAL SIMULATORS

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Abstract: *The paper deals with problem of road network generation and visualization. The paper discusses basic principles of construction of 3D representation of the road from digital geographic data, automated algorithm for generation of road intersections and algorithm of smoothing the roads using the B-spline curves.*

Keywords: simulation, visualization, simulator.

INTRODUCTION

Many military applications in the field of simulations and simulators visualize the road network. It does not need to be vehicle simulations only but also simulations for soldiers or helicopters need correct road network for the orientation in the virtual terrain.

In the digital geographic data are roads replaced by connected line segments called polyline. The precision of the road interpolation by the polylines is done by the digital data creator subject. The road intersections are not defined as a special object, the polylines just simply crosses in the place of the intersection. If we convert these polylines into 3D objects we could experience visually non-correct crossing.

Fig. 1. Roads in form of polylines
Source: own

1. INTERSECTION CONSTRUCTION

Simple convert algorithm from 2D polyline into 3D object reveals visual artefacts in the place of the polyline crossing. The main problem is seamless connection of the textures that in this simple type of converting leads to the holes in the generated roads. The user expects that crossing roads forms an intersection.

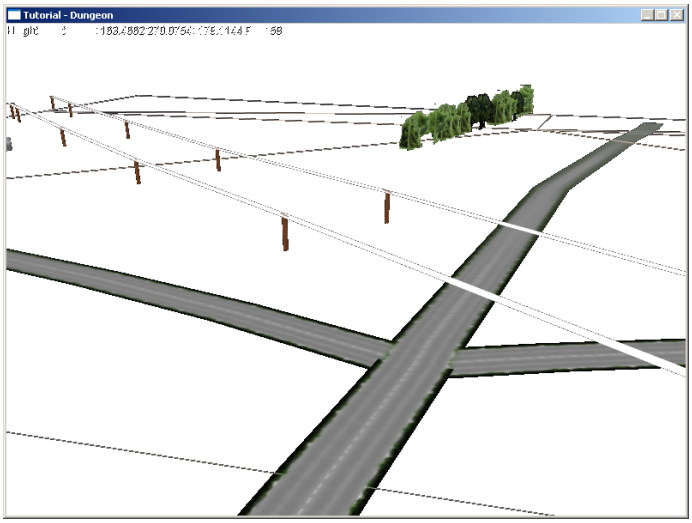

Fig. 2. Simple intersecting roads
Source: own

For generation of the correct intersection it is necessary to identify all points where the polylines in the digital terrain data cross. These points have to be identified as an intersection points and the associated polylines must be trimmed in the adjacent line segment ends in some distance before the intersection point.

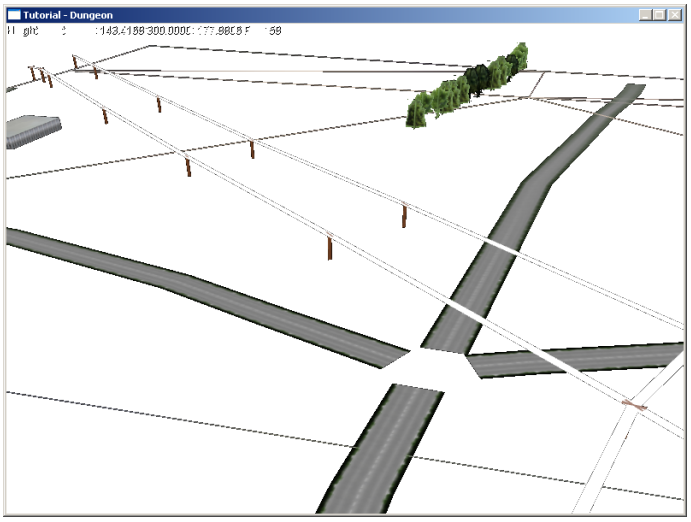

Fig. 3. Trimmed line segments in intersection
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The created hole should be filled by the generated intersection. It is necessary to triangulate the hole' area and connect the adjacent roads together.

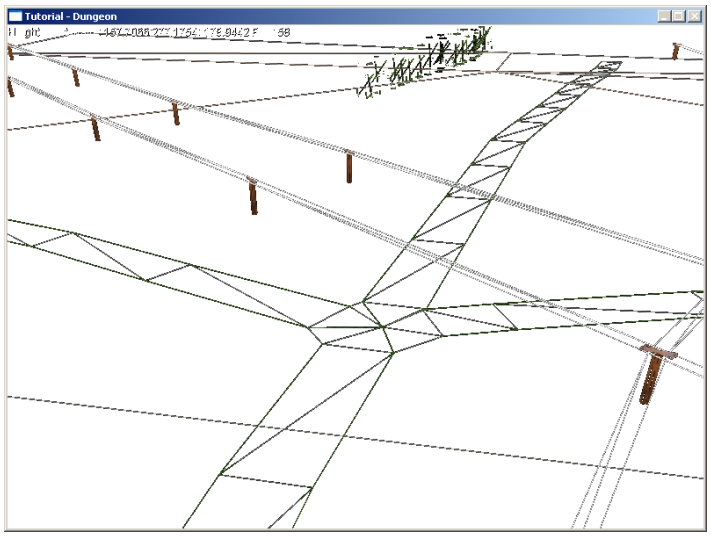

Fig. 4. Triangulated intersection
Source: own

As the next step it is necessary to cover the intersection by the appropriate textures and generate the texture mapping coordinates to obtain seamless texturing. The texturing of the intersection consists of computation of the texture coordinates for all triangle points forming the generated intersection.

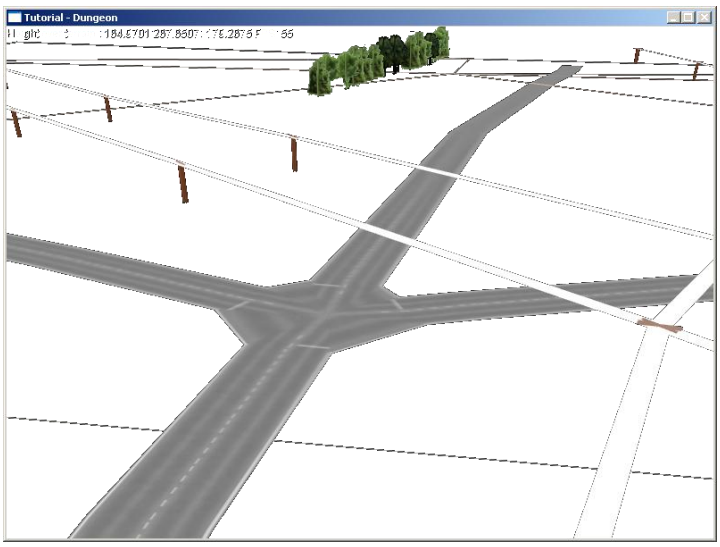

Fig. 5. Texture mapped intersection
Source: own

Using this algorithm all crossing of the road network polylines must be converted into the intersections. The size of the generated intersections should be corrected according the number of crossing road polylines in the intersection. The texture of the intersection is chosen by the type of the intersecting roads.

2. ROADS INTERPOLATION

The next problem connected with the road network visualization is the interpolation of the digital terrain data. In the digital terrain data are the roads represented by the polylines that

consists of connected line segments. These line segments connect in the simple points. The road is interpolated by this polylines but because the number of polyline points is limited the road corners are not smooth but are made from number of straight segments. This road network representation is not possible for vehicle simulator. So the polylines forming the roads should be replaced by smooth spline curves representing the roads.

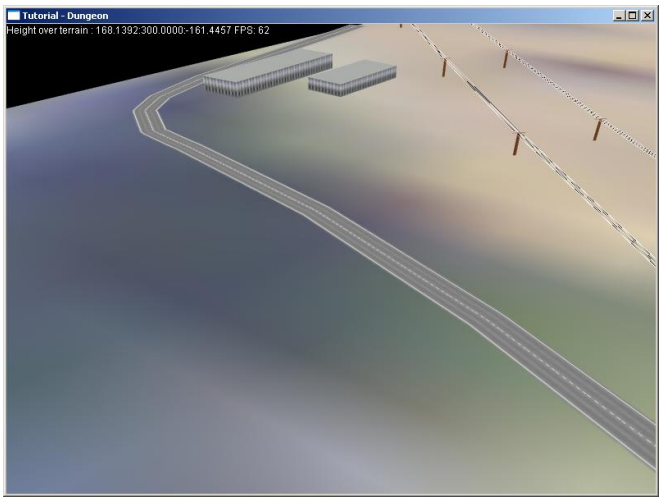

Fig. 6. Sharp corners in roads
Source: own

For this interpolation it is possible to use Catmull-Rom spline curves. These curves fall into B-spline category and they are known as the interpolation curves.

The curve is defined by the points P_0, P_1, ... , P_n. It starts in the point P_1 and ends in the point P_{n-1} so it does not interpolated the first and the last point.
The curve is computed using this formula:

$$Q(t) = \frac{1}{2}[t^3, t^2, t, 1]\begin{bmatrix} -1 & 3 & -3 & 1 \\ 2 & -5 & 4 & -1 \\ -1 & 0 & 1 & 0 \\ 0 & 2 & 0 & 0 \end{bmatrix}\begin{bmatrix} P_{i-3} \\ P_{i-2} \\ P_{i-1} \\ P_i \end{bmatrix}$$

The computation is sequential, at first the points P_0, P_1, P_2, P_3 are computed then points P_1, P_2, P_3, P_4 and so on.

In case of double instance of the first and the last point for example P_0, P_0, P_1, P_2, ... , P_{n-1}, P_n, P_n the curve will interpolate all points. The disadvantage of this type of curves is that they generally did not fit into the convex hull of their points. But according to relatively high amount of the road polylines points this property is not a problem.

Using this curve it is possible to smooth the polyline and provide the natural road shape. The smoothing is done in steps by polyline parts. The interpolated part is converted back to the polyline but with step of one meter. Using this algorithm the whole road is smoothed.

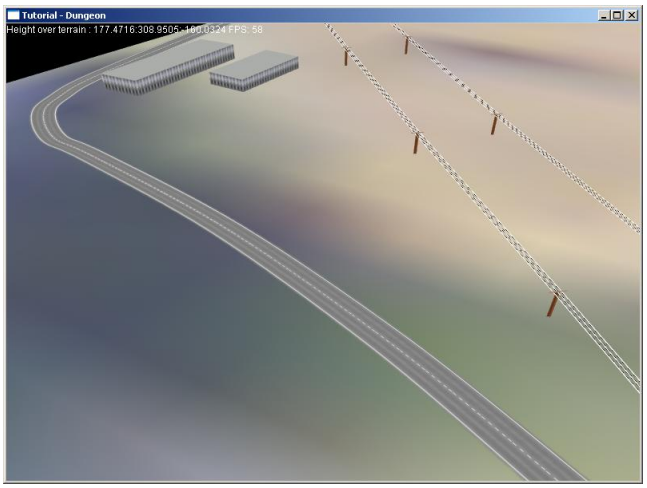

Fig. 7. Roads smoothed by spline curves
Source: own

By applying this smoothing algorithm there can be slight offset in position in the road corners. This position offset is hard to detect because the aerial photography has resolution 25 cm per pixel so if the offset would be one meter it would be placed just 4 pixel away of the original position.

The real road is not just inserted into the scene alone, but around the road there is a lot of objects such as mile stones, trees, traffic signs and so on. These objects are not defined in the digital geographic data but must be inserted manually. But doing it object by object would be very time consuming so it is good to automate this work.

Fig. 8. Roads with road objects
Source: own

CONCLUSION

The road modeling is an important part of the terrain database generation process. The realistic roads are essential for some types of virtual simulators. Also for areas that are covered by low-resolution aerial or satellite images can be the roads from vector data generation very important.

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DESIGNING A MICROWAVE FILTER BY STUDYING AND SIMULATING THE DISCONTINUITY IN THE WAVEGUIDE

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Abstract: *This research aims to design a microwave filter by studying and simulating the discontinuity in the waveguide. We suggest a filter consists of three waveguides connected to each other and different dimensions. Changing the dimensions of the waveguide will change the conditions of propagation of microwaves and in our suggested filter we have two discontinuity regions affecting on the modes of frequencies propagated through the waveguide. We apply Galerkin method for studying the discontinuity region in the waveguide. We have modelled all the calculations and results by Matlab program so we could simulate the filter and study and the effect of changing the dimensions on the propagated modes, calculate [Z] matrix and scattering matrix [S] for the designed filter and find the relation between transmission coefficient (T), reflection coefficient (R) and the frequency (f) to determine the properties of the designed filter.*

Keywords: microwaves, microwave filters, waveguide, Galerkin method.

INTRODUCTION

Microwaves are radio waves with wavelengths ranging from as long as one meter to as short as one millimeter, or equivalently, with frequencies between 300 MHz (0.3 GHz) and 300 GHz.

We have many uses of microwaves (heating, communication, medicine and astronomy) and when we use microwaves we often need to use microwave filters. To design these filters we have two cases: the first case is when the frequency is lass than 10 GHz, in this case we can easily design microwave filters by using traditional circuits consist of common elements such as resistances, coils and capacitors, but in the second case when the frequency is more than 10 GHz, in this case and because the frequency is very high the wavelength will be small and close to the real dimensions of those elements (resistances, coils and capacitors), therefore we can't use them in designing microwave filters and this is a problem.

That problem was solved by waveguide technology and in our research we suggest a filter consists of three waveguides connected to each other and different in dimensions and the aim of our research is to determine the type of this filter weather it is low pass filter, high pass filter, band pass filter or band stop filter.

1. PREVIOUS STUDIES

The discontinuity region of the waveguide is the region where the dimensions of the waveguide are changed as it is shown in Fig. 1.

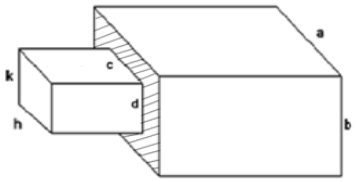

Fig. 1. The discontinuity region in the waveguide
Source: own

When the dimensions of the waveguide are changed the conditions of propagation of frequencies will be changed, that means frequencies after the discontinuity region will not be the same of frequencies before it and there are some researches have been made to determine the effect of the discontinuity region on the propagated frequencies and they applied different methods such as Green method [1], Integration method [2], and Determined Differences method [3], all of these methods study the effect of the discontinuity region and determine which frequencies will be attenuated and which will be passed.

In our research we have applied a new method (which is Galerkin method) on the discontinuity region as it will be explained later.

2. STEPS OF RESEARCH

In our research we suggest a filter consists of three waveguides connected to each other and different in dimensions as it is shown in Fig. 2.

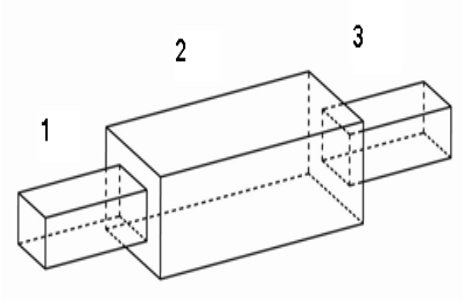

Fig. 2. Suggested filter consists of three waveguides
Source: own

When we apply a band of frequencies into the input of the first waveguide each frequency will propagate according to many modes through this waveguide and when frequencies reach to the discontinuity region and because of changing the dimensions the conditions of propagation will be changed, that means some of these frequencies will be attenuated and the others will be passed to the second waveguide and when they reach to the second discontinuity region the same behavior will be repeated, as a result the frequencies at the output of the third waveguide will be different from frequencies at the input of the first waveguide. Fig. 3 shows longitudinal section of the filter.

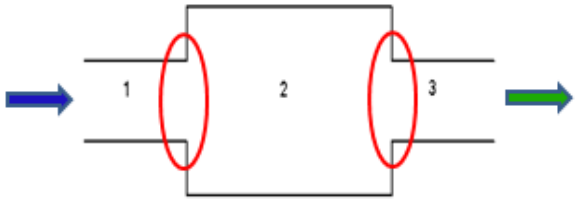

Fig. 3. Longitudinal section of the filter
Source: own

That means this form will behave as a filter and the aim of our research is to determine the type of this filter weather it is low pass filter, high pass filter, band pass filter or band stop filter and to do that we have followed two basic steps:

- Studying the effect of the discontinuity region on the propagation of frequencies and for that we have applied Galerkin method.
- Calculating the scattering matrix of the filter.

2.1 Galerkin Method

This method depends on the equivalent electric circuit of the discontinuity region and using of Kershof laws [4]. Fig. 4 shows the equivalent electric circuit of the discontinuity region.

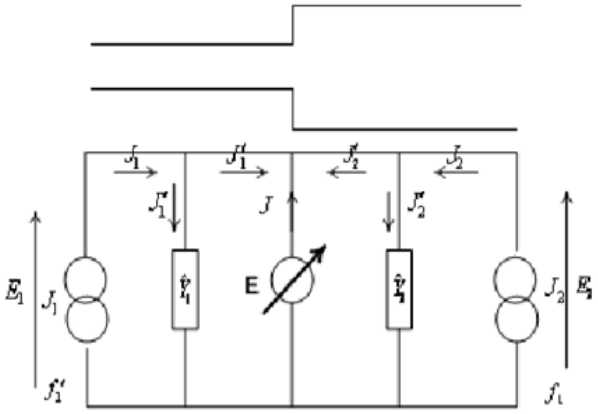

Fig. 4. The equivalent electric circuit of the discontinuity region
Source: [4]

From the equivalent electric circuit we can see that:

$$E = E_1 = E_2$$
$$J + J_1^{'} + J_2^{'} = 0$$

From the last two equations (Kershof laws) we can derive the impedance Z of the discontinuity region to the propagated frequencies.

$$[Z] = \begin{bmatrix} [A] \\ [B] \end{bmatrix} [D]^{-1} \left[[A]^t \; [B]^t \right]$$

[A] is a matrix related to the frequencies propagated in the first waveguide.
[B] is a matrix related to the frequencies propagated in the second waveguide.

[D] is a matrix related to the frequencies propagated in the first and second waveguides.

So by applying Galerkin method we can calculate the impedance of the discontinuity region to the propagated frequencies, thereby we can determine which frequencies will be attenuated (when the impedance is high) and which will be passed (when the impedance is low or zero).

2.2 Calculating Scattering Matrix

We have calculated the scattering matrix [S] of the filter depending on the impedance matrix [Z] of the filter. Fig. 5 shows the impedances of the filter.

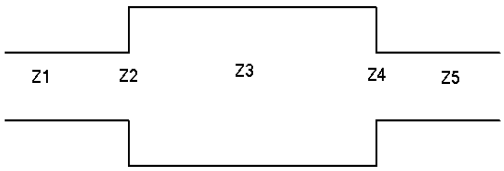

Fig. 5. Impedances of the filter
Source: own

We can see in figure 5 that we have five impedances of the filter:
Z1, Z3, Z5 are the impedances of three waveguides.
Z2, Z4 are the impedances of two discontinuity regions.
For Z1, Z3, Z5 we can easily calculate these impedances by using common laws [5] and for Z2, Z4 we can calculate them by applying Galerkin method mentioned above in (2.1).

After we calculate those five impedances we can find the equivalent impedance matrix [Z] of the filter, then we convert it to the scattering matrix [S] of the filter by using common laws [6] and in the next paragraph we will know why we calculate the scattering matrix.

$$[S] = \begin{bmatrix} S_{11} & S_{12} \\ S_{21} & S_{22} \end{bmatrix}$$

3. RESULTS

We have modeled all the calculations and results of our research by using Matlab program, so we can apply real parameters for the dimensions of the filter and simulate it.

We have considered these parameters to the dimensions of the filter:

- Dimensions of small waveguide: L1 = 75 mm, d = 40 mm, c = 60 mm
- Dimensions of big waveguide: L2 = 150 mm, b = 110 mm, a = 130 mm
- Input frequency band: (1-5) GHz.

Fig. 6 shows S11 and S12 according to frequency.

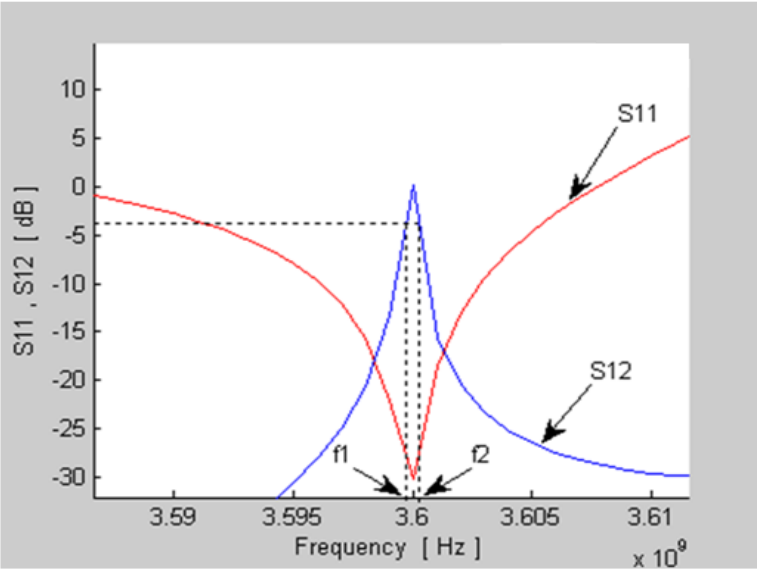

Fig. 6. S11 and S12 according to frequency
Source: own (output of our software)

We have calculated the scattering matrix [S] because this matrix has a property that when S11 (reflection coefficient R) has a maximum attenuation at one frequency and S12 (transmission coefficient T) has a minimum attenuation at the same frequency, that means this filter will be a band pass filter and that frequency (3.6 GHz as it is shown in figure 6) will be the center frequency (f0) of that band.

To determine the passed band of this filter we can find in figure 6 that when the attenuation is (-3 dB) f1 = 3.59975 GHz, f2 = 3.6002 GHz and the passed frequency band will be (f2 - f1 = 450 KHz). This result matches with the common law:

$$f0 = \sqrt{f1 * f2} = 3.6 \ GHz$$

which prove that our result is correct.

We know the type of the filter (band pass filter) and we have our software (by Matlab program), so we can easily study the relation between the dimensions of the filter and the center frequency. Fig. 7 shows the studied dimensions of the filter.

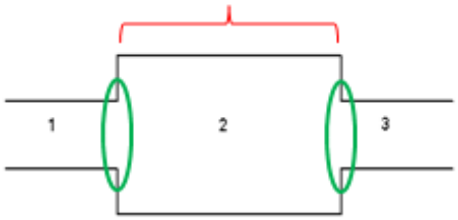

Fig. 7. The studied dimensions of the filter
Source: own

We have studied the relation between the center frequency and the length of the second waveguide and got the results shown in Fig. 8.

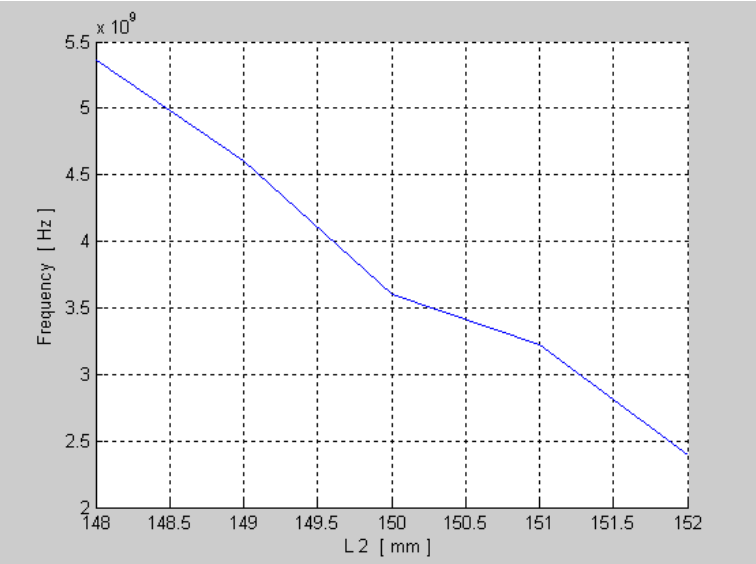

Fig. 8. The relation between the center frequency and the length of the second waveguide
Source: own (output of our software)

We have also studied the relation between the center frequency and the dimensions of the discontinuity region and we got the results shown in Table 1 and Fig. 9.

c [mm]	**d [mm]**	57	38	58.5	39	60	40	61.5	41	63	42
f0 [GHz]		3.745		3.681		3.6		3.544		3.487	

Table 1. The relation between the center frequency and the dimensions of the discontinuity region

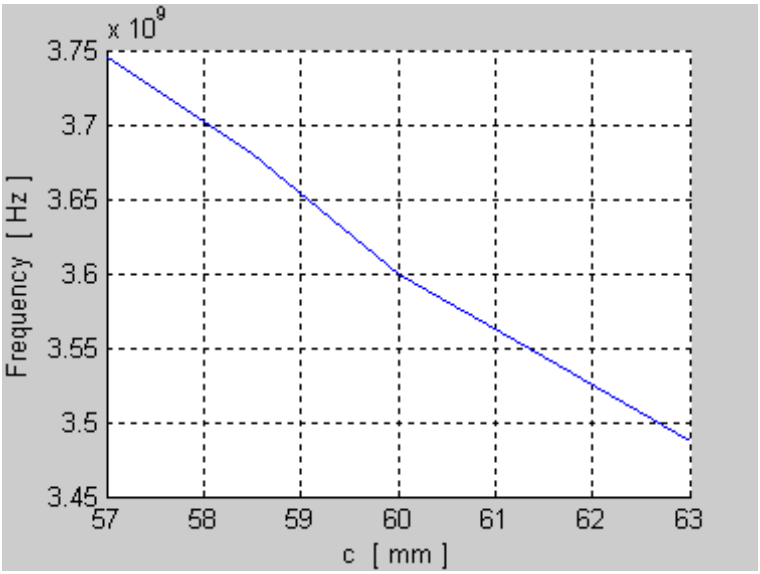

Fig. 9. The relation between the center frequency and the dimensions of the discontinuity region
Source: own (output of our software)

CONCLUSION

We have suggested a filter consists of three waveguides connected to each other and different in dimensions and studied the effect of the discontinuity region on the propagated frequencies by applying a new method (Galerkin method). We have modeled all the calculations and results by Matlab program so we could simulate the filter, determine its type (band pass filter) and study the relations between the center frequency and the dimensions of the filter. The most important thing is that by using our software and using those relations we can easily determine the dimensions of the filter according to the desired center frequency. In other wards, we can design this filter.

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EXPERT SYSTEMS IN LEAN COMPANY PROJECT

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Abstract: *Companies have to find new ways how they can improve their management and how they can make their performance more efficiency. The way how they can reach their aims can be the implementation of the effective managerial methods connects with Information technology based on Artificial Intelligence technologies. There are very progressive current trends. We can find application of these technologies in Expert Systems, Business Intelligence or Data mining. The terms Artificial Intelligence, Knowledge and Knowledge Management are often used in the connection with new competitive advantage. We can conclude that ICT plays a significant role in process of transformation to the Lean Company status. Due to the Information System manager get the right information in right time that means that they work with actual information in real time. Because of this company is able to gain the competitive advantage and settle up with the increasing rate of competition. On the other hand it is important to realize that every company has to think economically.*

Keywords: Lean Company, Business Intelligence, Expert Systems, Knowledge Management.

INTRODUCTION

In present, quickly changing economic conditions the managers at all levels have to meet higher and higher requirements. The intensity and the speed of decision-making are getting higher and higher. To make a large number of decisions in extremely short time requires getting, processing and evaluating of a large amount of information. At the same time, the number of alternatives of the solutions of the problems increases. It is important to predict the solution condition, namely due to the ever increasing uncertainty. Considering the complexity of the operations that are carried out, the price of the wrong decisions can be very high.

Information and the knowledge in the information society are the source of the power and the fortune [5], [6], [17]. Who is owner of the information sources, who is able to transfer information into knowledge is in the advantage, he has power. Aiming at lowering the risk, removing routine work etc., the importance of the ICT (hereafter Information and Communication Systems) and efficient methods like fuzzy logic for the support of decision-making implemented in Expert Systems (hereafter ES) at all levels of management grows.

The managers solve both exact and non-exact issue. As far as exact issue is concerned, they can use exact processes for management support, exact methods. No exact issue can be solved by means of the probability theory, fuzzy sets, expert valuations, heuristics these can be part of the ES [4], [15]. We can see on the Fig. 1 the management level which is demonstrated as the combination of problem-tasks types and the level of management in the decision-making process.

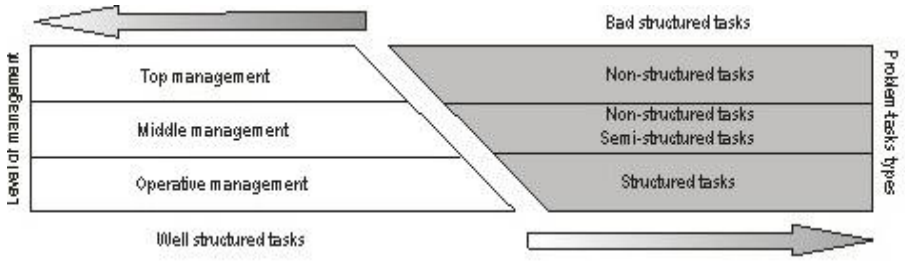

Fig. 1. Decision-making problems and level of management
Source: own

New modern ICT enable flexible management of individual parts of multinational companies because they are able to facilitate quick two-way information exchange between the headquarters and the branches. Besides the internal information flexibility, information technologies also play an important part in organizing relationships between the companies and sub suppliers. Especially the development of the conception of the Lean Company (hereafter LC) based on procedural management system and just-in-time system, aiming at limiting store time and adjusting material supplies with the production phases, requires very precise coordination [18], [19], [21].

Purposefully oriented data, information and knowledge are a key source of and condition for successful task solving. Moreover, we have to presuppose that the interval of applicability or stability of certain solutions is becoming shorter and therefore all the solutions made can only be regarded as temporary. In today's turbulent and chaotic environment, the lack of relevant information and knowledge available at the right time and in the right place or incapability of taking advantage of it can be "fatal" for entrepreneurs as well as managers [9], [14].

1. EXPERT SYSTEMS

The ES and Knowledge Work Systems represent a developed area of Artificial Intelligence (hereafter AI) and, at the same time, an area which is generalized into practice, namely on all the levels of management and even the machine management and devices. ES replaced in a way, expert consultation prior to decision, and managers can then use the conclusions of an ES before the final decision. ES are also used to support decision making at the level of senior management. At present, along with other applications of AI, such as Business Intelligence, it is a dynamically developing area of ICT, which are considered a key factor influencing the information society.

Most of the specialists in this area define the ES as computer programs that simulate the decision-making activity of an expert by the complex task-solving. At this opportunity, they use properly coded special knowledge which they acquired from an expert, aiming at achieving his level of quality in decision-making in the chosen problem area [12].

The ES are used to extending the very rare sources of information, and for the improvement of the consistence of results. Such systems can function better than the expert himself, who provides opinions, usually in a specific or resp. close area. This possibility has an important influence both on the professional advisers (financial analysts, lawyers, tax advisors, technicians, etc.), and the organization management [8], [11]. The power of ES is derived from their specific knowledge which is installed in the formalisms and in used derivative

schemes. ES can be characterized by the following six basic terms: Expert opinion, Expert, Expert Opinion Transfer, Judgment, Rules, Explanation ability.

One of the first special languages which have been developed and used for the AI was LISP. PROLOG language was also developed for the application of AI. Since 1990, no other tools for creating ES called shells (e.g. empty ES) and thus eliminating the burden of complex programming. This allows the nonprogrammers create and use ES [3], [16]. In terms of development tools for building ES, this can be seen above process is in essence already been terminated. At present, the creation of ES used mainly empty ES and specialized development environments, because the ES program is ineffective. Well-chosen empty or ES development environment for building ES will significantly reduce the cost of the resulting ES and improve its quality. Blank ES already contain the inference mechanism to work with the knowledge that is necessary to translate the rules into the knowledge-based system [1], [7], [9]. When choosing a development environment is necessary to consider several important factors: the specific application of ES in the sense that it will be solved, then the size and complexity of the planned ES and, ultimately, financial options. From the viewpoint of obtaining a competitive advantage becomes especially important application of ES in areas that have not yet been comprehensively described and dealt with ES. One of area where the application of ES is not widespread is the concept of LC.

2. LEAN COMPANY

It is already clear that the nearest goal of companies that want to remain on the global market and then run effectively once the crisis subsides should be their meaningful, pointed and systematic "learning". One of the ways how companies can reach their targets deals with the minimum of costs is their transform to the LC state. The main aim of this concept is to reduce waste and due to this reduce costs, performance improvement, quality improvement and limiting period necessary for the realization of production. Waste means activities that do not add value during the production process. Nowadays the following types of waste are identified: overproduction, waiting, transport, unnecessary processing, stocks, unnecessary motion, corrections. As the most dangerous are considered over production and corrections, because other types of waste can come with them together.

At first the philosophy is important than company have to create efficient processes, focused on the people and partners and last to solve incurred problems. The main principles of the LC concept you can see on Fig. 2 below.

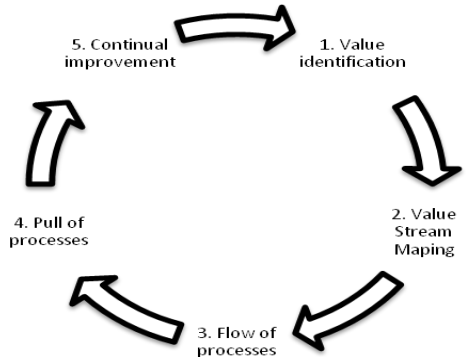

Fig. 2. The main principles of the Lean Company concept
Source: [13]

From a number of characteristics we assessed as best for our project the following characteristic: “Leanness of company means to do only such activities that are necessary, to do it correct on the first occasion and to do it faster than others and therewithal spending less money” [13]. The conception of LC can be characterized by the following 5 basic principles [2], [13], [20] [21]: value identification, mapping the value chain, creation of the flow, permanent improvement, creation of the move. It is always necessary to apply the conception of LC as a whole to achieve desired effect. We can’t say if methods with greater importance exist. It is always important to have everything in a whole as one system that applies to every day and in the same way. Intermittent application of complete system won’t have the desired effect.

3. LEAN COMPANY PROJECT

The main objective of the introduction of LC concept should be to create an ES to evaluate the state of implementation of the concept of LC in all major areas of business, such as Lean administration, development, production and logistics. Models for individual areas will be defined based on individual. Before creating an ES we have defined all models of slenderness for the individual enterprise. We have defined main metrics and criteria of the LC concept. There is developed model for the individual company based on these metrics and criteria. Model will be finally transferred in the form of rules in the knowledge base of ES. The aim of the empirical part is based on theoretical research to create models of the concept of LC for the individual company. Model had transferred in the form of rules in the knowledge base of ES. These steps have created a pilot knowledge base in ES. Based on the consultation process with the ES had entered the required data inference mechanism derived the final results of the degree of implementation of the concept of LC in the company. Another objective is to test the ES on specific dates, then identify the degree of achievement of the concept of LC in selected enterprises.

4. PROPOSAL OF EXPERT SYSTEM FOR EVALUATION OF LEAN MANUFACTURING

We decided to design knowledge base for measurement of Lean Manufacturing using empty (shell) ES NEST which includes inference mechanism [10]. NEST provides a graphical user interface (GUI) for: recording of existing knowledge bases, setting the access processing of uncertainty, management consulting (how to obtain data from the user), the target evaluation and recommendation statement with an explanation of the findings. More, NEST is able to solve different diagnostic problems. Knowledge base is created by the NEST editor and saved in XML file. NEST is the program designed primarily for the academic purposes, which puts emphasis not only on the appearance, but also to the functionality of the program aimed at creating a knowledge base, comparing the results of consultation in the selection of various types of work with uncertainty, etc. The knowledge base of ES we propose to convert to the two models for the overall assessment of the introduction of lean manufacturing.

The first sub model identifies different types of waste in production processes. We want mention for purposes of the model wasting including these following 8 types: overproduction, inventory, scrap, movement, processing, waiting, transportation, and potential of employees.

Questions focus on the use of procedures that are generally considered in the manufacturing processes for efficient and therefore desirable. These procedures are not accompanied by measurable indicators of lean production (for example OEE / CEZ, VA index, etc.).

The second sub model of Lean manufacturing is focused on the use of recommended methods and tools for introducing the concept of Lean manufacturing. An enterprise may, upon prior analysis of waste according to the above model show very poor results, it is important to determine whether planned or already beginning to establish appropriate methods and tools for reducing waste in the process of slimming down. We want to represent this model of Lean manufacturing into the ES using rules to create a knowledge base for assessing the attainment of Lean manufacturing. Using the ES would then be possible answering questions immediately and it will be possible to evaluate the situation from the perspective of LC status in manufacturing. We would like to test this basic model on real data after creating a knowledge base.

CONCLUSION

We can conclude that ICT plays a significant role in process of transformation to the Lean Company status. The main objective of the introduction of LC concept should be to create an ES to evaluate the state of implementation of the concept of LC in all major areas of business, such as Lean administration, development, production and logistics. Lean Company Project and its case study deals with the measurement of Lean manufacturing principles using expert system NEST. NEST is an empty expert system (expert system shell) for diagnostic applications based on rules. The main advantage of the shell is possibility to create our own knowledge base. We have defined the key Lean manufacturing principles. Consequently we have created the knowledge base which can be used for qualified assessment of measurement of Lean manufacturing principles in real company. The expert system derives results based on the responses received concerning the defined parameters of Lean manufacturing principles. In the future, the knowledge base can be improved using the expert system NEST, or any other expert system that supports the imposition of knowledge base using XML.

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DISPLAY TECHNOLOGIES AS A PART OF ELECTRONIC EDUCATION

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Abstract: *This paper shows author's motivation and experience in design and realization of interactive e-learning course "Display technologies". The course deals with the basic information about the current display technologies, working principles, advantages, disadvantages and new trends in these technologies. The main focus is on the e-paper, Organic LED and Liquid Crystal Display technologies. This e-learning project will be available for free after the review process and will be accessible on the educational portal "eLearn central – journal". This portal uses learning environment Moodle with integrated original authoring tool.*

Keywords: e-learning course, Display technologies, interactive flash animation, eLearn central portal, Moodle.

INTRODUCTION

The display technologies became important part of our lives. We use them every day in common life, in devices like e-book readers, mp3 players, televisions, projectors but also in military devices such as head-up displays (HUD) [1], control display units (CDU) [2], smart display units (SDU) [3] or military simulators [4]. The development in the field of display technologies (OLED, E-paper, PDP, LCD) is very fast. That’s why the complex overview about these technologies is not available.

Our students meet for the first time with the basics of Display technologies in their third year of a bachelor study at the Faculty of Electrical Engineering and Information Technology, Slovak University of Technology in Bratislava. Time range assigned for these technologies in subject Optoelectronics is short, students don’t have the opportunity to gain comprehensive knowledge about this issue.

One of the ways how we can help our students to improve their access to information, to motivate students and to raise efficiency of education about „Display technologies”, is to prepare interesting materials, full of excitement data - to create an e-learning source of information, the interactive course "Display technologies". This paper shows author's motivation and experience in designing and realization of this interactive e-learning project.

1. COURSE "DISPLAY TECHNOLOGIES"

The e-learning course "Display Technologies" deals with the information about the current display technologies, working principles, advantages, disadvantages and new trends in these technologies. This e-learning project will be free available and accessible on the educational

portal "eLearn central – journal" (Fig. 1) mainly for our students, but also for all who are interested about display technologies (users just need to fill in a simple registration form and are provided with a free full access).

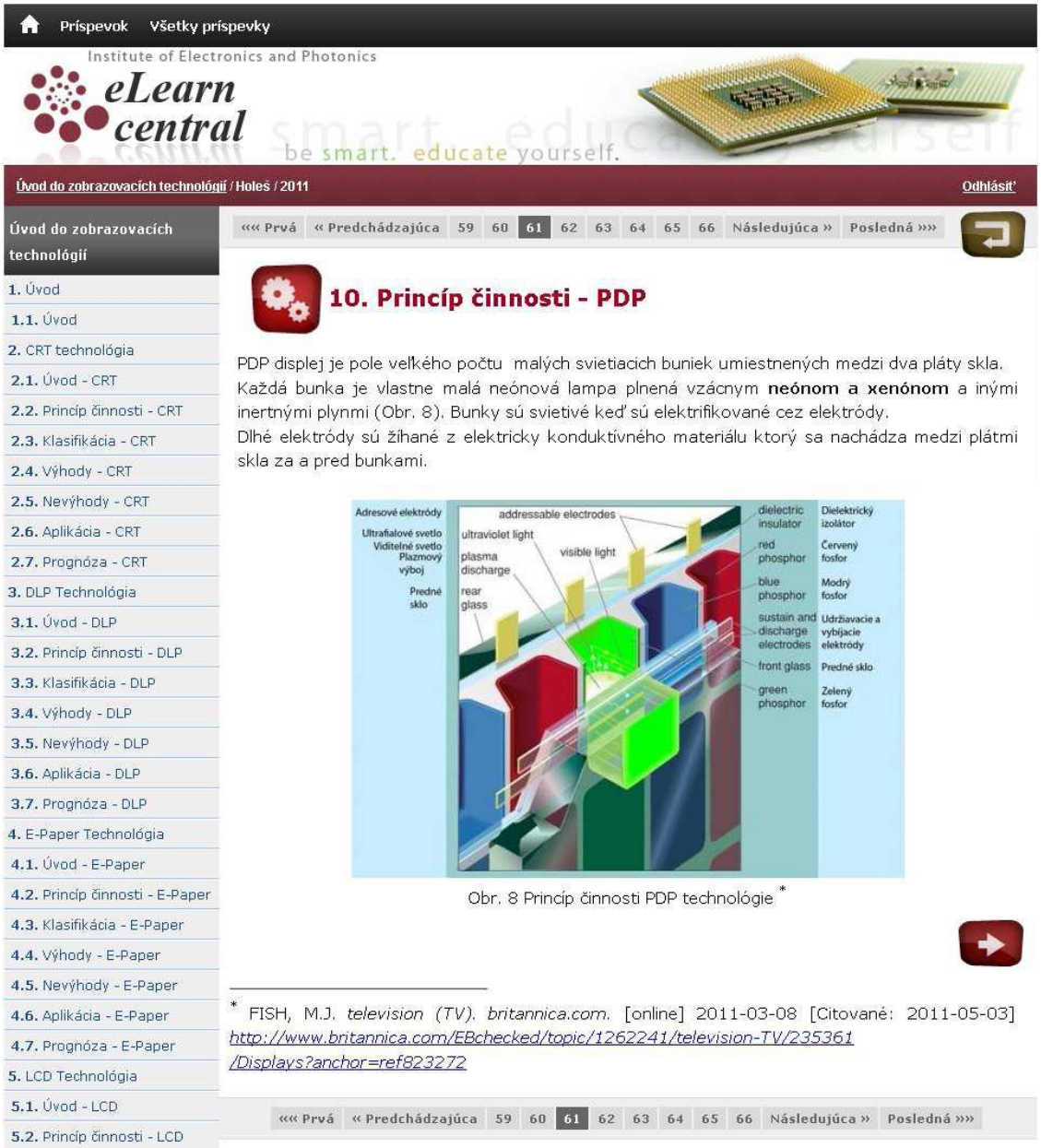

Fig. 1. Student's view: The principle of operation of Plasma display panel technology with picture, cited reference and navigation elements
Source: own

1.1 A Learning Enviroment - Educational Portal "eLearn Central Journal"

The educational portal "eLearn central journal" is second portal from three educational portals called the "eLearn central" prepared by eLearn central team. This portals were created as a supporting method of conventional "live" education or distant education to enhance the quality of traditional teaching methods. But also these portals are successfully used for lifelong education and for popularization of science and technology for children and youth. The development team issued from the fact that the e-learning has a huge potential as a motivational and effective tool for acquiring knowledge in an enjoyable way.

The portal “eLearn central journal” created in June 2011, accessible through the hyperlink: http://kme.elf.stuba.sk/elearn used a CMS Moodle 1.9. with integrated authoring tool. This tool acts as a support to create courses for authors with no further experience in creating professional e-learning educational materials with implemented citation option and the review process by specialists. The author has very intuitive and easy-to-use tool to prepare quality e-learning materials with strong technical background. The review integrated in the portal is an important prerequisite that ensures quality of published courses of "eLearn central journal" portal. The access to all material on this portal is free, users need only formal registration on this portal.

1.2 The Course Content

The e-learning course "Display Technologies" includes 8 lessons, 24 interactive flash micro-animations, glossary and number of hypertext references. The principle structure of the course is presented on Fig. 2. Lesson titles are following:

1. Cathode ray tube technology – **CRT Technology**
2. Digital light processing technology – **DLP Technology**
3. Electronic Paper technology – **E-paper Technology**
4. Light emitting diode display technology – **LED display technology**
5. Liquid crystal display technology – **LCD Technology**
6. Liquid crystal over silicone technology – **LCoS technology**
7. Organic LED display technology – **OLED display technology**
8. Plasma display panel technology – **PDP technology.**

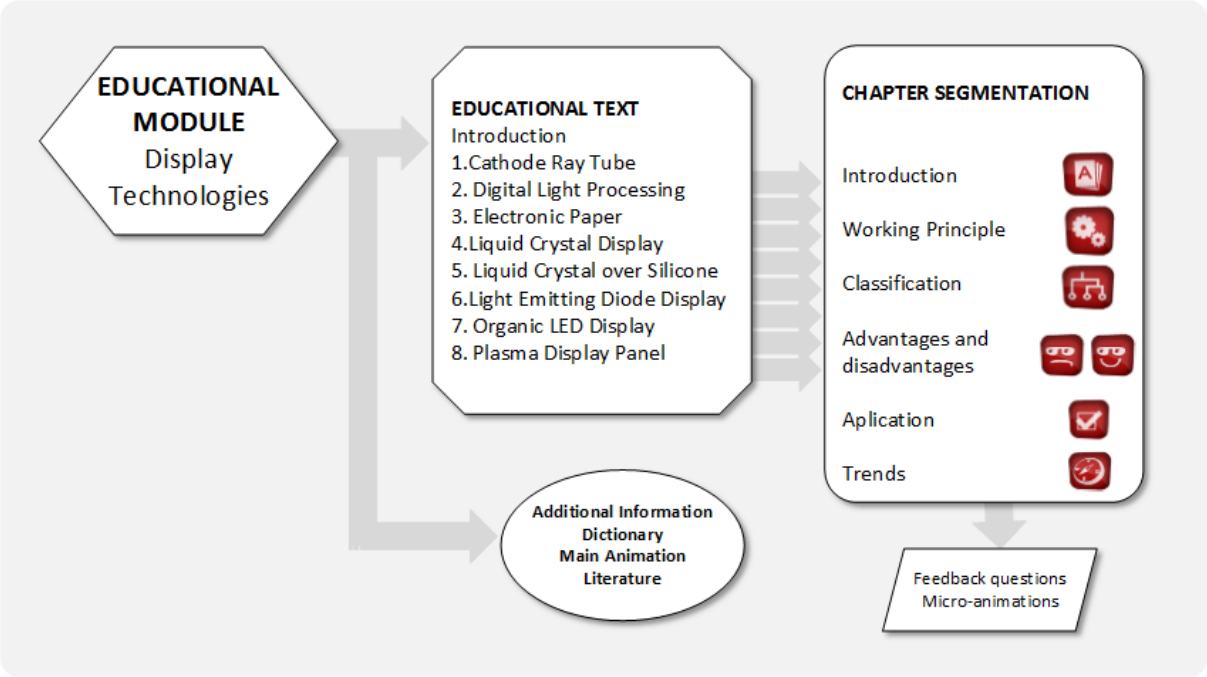

Fig. 2. The principle structure of course "Display technology"
Source: own

Each course lesson starts with a definition of study objectives. The lesson wordings were divided into short well-defined units enriched by a content-related illustrations (Fig. 3), graphs, schemes and images focusing student’s attention to the particular issue and promoting the ease of orientation in the text. Some of the educational texts are amended by topic-related questions and tasks. Demonstrative features, such as interactive animations, are implemented

directly in the lesson content. The educational texts have been enriched by numerous navigation elements, such as the active navigation menu bar on the left side of the screen. It provides a full course content overview, so that student just selects the topic, and the selected study section immediately appears on the screen. Further navigation elements include the arrows, or numbers in the page heading and footing.

Fig. 3. Student's view: a) section "The basic conceptions" and b) section "The introduction of Cathode ray tube technology" with pictures, cited references and navigation elements
Source: own

The section Introduction presents a basic classification of display technologies and basic concepts, such as colour gamut (Fig. 3a), native resolution, viewing angles, response time...

Section CRT technology introduces Cathode Ray Tube technology as a display technology which uses electron ray closed in cathode tube for imaging (Fig. 3b). This technology was used in most of TVs, monitors oscilloscopes and projectors. B&W display uses only one ray for imaging, colour (RGB) display uses three rays (each for one colour). Today CRT displays were replaced by another younger technologies like LCD, OLED, PDP but gamut (chromatic diagram) of CRT display is still used for comparison with other technologies.

Section Digital Light Processing technology characterizes micro-electro-mechanical system - MEMS called digital micro-mirror device – DMD, which DLP Technology uses. DLP technology can have high refresh rate, the switching time is 10us and lower, and may use variety of wave-length. Meanwhile DLP is mainly used as projection technology (home, corporate, military usability) but Heads-up displays with DLP chip are under development for military and medical application as well.

Very interesting is section Electronic Paper technology. It's processed in detail and topical. E-paper technology permits to produce light, flexible and thin devices. It merges advantages of classic paper and modern digital technologies, which means re-writing with dynamic data entry. Basic properties of e-paper technology (Fig. 4) is minimal or null power functionality, great readability at direct sun or panel integration with photovoltaic cells. E-paper technology

is well suited for mobile devices. In military segment an electrofluidic (electrowet) displays with chlorophyll pigments is under development to create a perfect adaptive camouflage [5]. Most common E-paper display are electrophoretic, electrowet and bichromal.

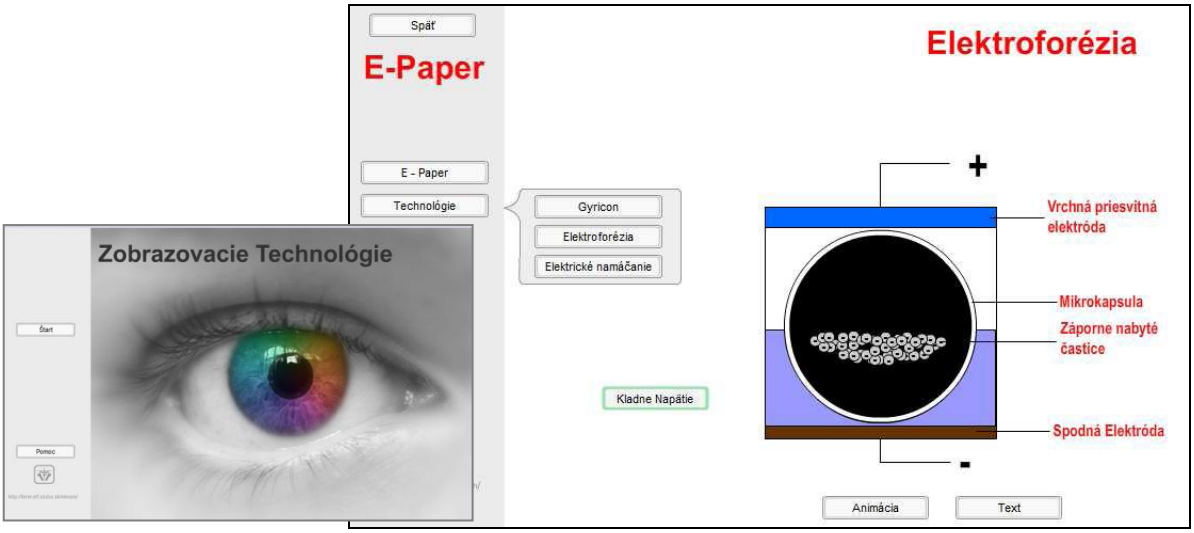

Fig. 4. Flash animation "Display technology": Intro part and e-paper
Source: own

LED display technology is based on red, green and blue light emitting diodes. LED panel is small display or part of larger one. LED display technology can be divided by design to segmented (seven segment display), monolithic (large monolithic panels), intelligent (luminescence of display depends on surroundings) and linear LED panels (information led panels in bus or trains).

Attention has been focused to most common display technology used in many devices - LCD technology. LCD technology is manufactured in two variants – TFT (thin film transistor) – with active and passive matrix. LCD display devices has native resolution which means that in this resolution the display will gain optimal image properties. LCD panels can be divided in to In-plane switching, X Vertical Alligment and Twisted nematic - TN.

Liquid crystal over silicone technology is technology mainly used in micro-projection and micro displays. It's reflective technology same as DLP but uses liquid crystal instead of micro-mirrors. Common military use of LCoS is for HMD's and HUD, nightvision, rangefinders and other applications (Holoeye systems Inc.).

Same as LED, Organic LED display technologies are semiconductor solid-state devices. They are 100-500nm thick and single layers are 200times thinner than human hair. Most commonly used oled displays are passive-matrix OLED – PMOLED and active-matrix OLED - AMOLED. PMOLED are suited for displaying of text or icons and are mainly used for small displays (2-3 inches) in mp3 players or PDAs. Refresh rate of AMOLED is best suited for displaying a video playback. Amoled display technology is used for viewfinders and transparent OLED are used for HUD and HMD devices (LitEye LE450) [6].

The last section introduces plasma display panel technology. This technology is well known for it's great colour gamut and luminosity. Colour PDPs uses technology of digital greyscale and can show more than 256 shades of grey.

1.3 The Course Interactive Flash Animation and Micro-Animations

The interactive animation labelled "Display technology" have been developed for this course in Adobe Flash with use of effective graphics creation strategy [7]. This animation was intended to show the nature of chosen electronic effects and main working principle of display technologies (Fig. 4). The animation is composite from 24 interactive flash micro-animations. These were designed in such a way that details of a given object are shown to students and so it will contribute to knowledge obtaining much easier and faster. The complex animation is located inside of the course, and micro-animations are parts of education text.

CONCLUSION

We have created an interactive e-learning course "Display technologies" with use authoring tool integrated to LMS Moodle on the educational portal "eLearn central – journal" (http://kme.elf.stuba.sk/elearn). The course deals with the basic information about the current display technologies, working principles, advantages, disadvantages and new trends in these technologies. This course includes 8 lessons, 24 interactive flash micro-animations, glossary and hypertext references. The main focus is on the e-paper, OLED and LCD technologies. Work with the authoring tool clearly simplifies the process of preparing a course, providing the author with general support and effective tool for creating courses. This course mainly serves for FEI students as an support source of information. This course will be available free to wide public in May 2013 after successful completion of review process.

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LVC INTEGRATION FOR THE CZECH ARMY TRAINING

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Abstract: *This paper presents outcomes of the project solving the interoperability issues of live, virtual and constructive simulation systems used in the Army of the Czech Republic. The focus is on live-virtual integration challenges and unified representation of Command and Control system at all three levels. A test bed enabling experiments and preparing for the next integration phase has been developed.*

Keywords: Live simulation, virtual simulation, constructive simulation, LVC integration, C2-SIM integration.

INTRODUCTION

The project SIMPRO touches fine aspects of live, virtual, and constructive simulation systems integration. Its scope was limited due to budget constraints to assembly of a test bed that will help to refine requirements, gather the experience, and to prove usefulness of model changes implemented in current project phase.

There are changes affecting not only interfaces of legacy simulation systems or individual models. Bringing together live, virtual, and constructive simulators must involve also command, control, and communications components at the tactical level. Besides that there is vast amount of data to spread among all live simulation participants using wireless channels. This is quite a challenge because the bandwidth must offer high capacity data links to every single dismounted soldier scattered in jagged terrain or in buildings.

Training evolution tends to higher complexity scenarios, better adaptation to variety of situations, closer connection to real combat situation, faster implementation of lessons learned as well as making borders more transparent where gateways convert information flows between different hierarchy level systems.

The technology boundaries keep moving. Legacy systems may not be prepared for new role in integrated federation for different reasons. Obviously, the closer is a simulator adapted to specific hardware or weapon system the sooner it will have to be replaced by newer, state-of-the-art system. This is considerable risk for such project because procurement processes are generally started and endorsed asynchronously, depending on highly unpredictable budget constraints vs. priority list. Continuity in reaching all necessary capabilities of live, virtual, and constructive simulators at one time, within their favorable life-cycle phase is then jeopardized. Further, we must consider that an extension in number of parameters may induce new, higher quality of cooperating systems, too. The integration opens whole box of possible problems. The need of control or supervising functions is different in a single-hierarchy level system from multi-layered ones.

With more interoperable granularity levels it follows that the common denominator must be based on high-detail representation. Only this principle is able to prevent a model from generating "stuffing" data that exceed the complexity of one or more components. Such disproportions in model level of detail happen frequently when simulation federation contains both platform-level and aggregated players. LVC integration by nature puts stress on detailed models.

1. LIVE COMPONENTS

The Army of the Czech Republic has in use two Laser Engagement Systems (LES):

- MILES (Multiple Integrated Laser Engagement System), delivered in 2002. Weapon systems equipped with MILES include:
  - Assault rifle Sa 58
  - Machine gun Uk 59
  - Grenade launcher RPG-7
  - Anti-tank Rocket Launcher KONKURZ
  - Infantry Fighting Vehicle BVP-1, BVP-2
  - Tank T-72
  - Armored Personnel Carrier BRDM.

The list suggests that the system is not suitable to meet future LVC training needs, a few systems will go out of service. In addition, the system would need communication module to reach online capability. Another drawback (when planning to use within buildings) is narrow laser beam decreasing the probability of enemy sensor hit in close combat. We will suppose a new generation of MILES (or compatible equivalent) is going to fill in the gap to grant contemporary live training, including training range communications for online capability, as well as Area Weapon Effect Simulators (AWES) to model mine fields, NBC effects, and IEDs.

Very important area where we need to enhance our training infrastructure is MOUT (Military Operations in Urban Terrain) training capability. This is out of scope of project presented here:

- SSTBV/M system is intended for combat vehicles (tank T-72, BVP-2), thus not usable inside buildings. It does support instrumented range live exercises.

1.1 IED Simulation

IED in live simulation is very sophisticated device (in fact, full functionality plus wireless communication capability with GPS locator minus the real explosive filling is required). Its control must be available both from EXCON and the deactivator (jammer). Status of the device (armed, disarmed, deactivated, blown) must be indicated at all levels of simulation in unified way.

2. VIRTUAL SYSTEMS

ACR simulation centers use full-mission simulators as well as reconfigurable virtual simulators (designated VS-II/SP – this version simulate dismounted infantry). First type simulators can be federated with constructive systems fairly easily. But, with regard to small

number available they cannot be a centre of gravity for LVC integration. The prime benefit we seek is in linking various dismounted infantry activities (regardless simulation platform), especially those under MOUT umbrella.

Virtual scene in MOUT is based on the data from constructive simulator thus all functions built in higher-level system have to be included, and from the visual point of view elevated to fine-detail level.

Virtual projection is modeled in two ways:

- Trainee's view
- Observer's view.

The observer should be able to see through walls and roofs, at the same time the view must zoom in to see adequate details of the interior. When observer decides to attach the view to specific infantryman the coordinates of such virtual camera have to be close enough to the simulated entity to have the same view through doors, windows or other openings. In this case the opacity must be turned off.

The virtual simulator is to be completed in the area of individual entities added to constructive system (country people, terrorists – male and female, AT and AA rocket shooter, policeman, prisoner, unarmed person, VIP person, etc.) including their positions and postures.

2.1 Improvised Explosive Devices

IED models in virtual simulators have to deal with following aspects:

- Unified modelling across all LVC systems, explosion effect depiction
- Transportation of IED to its position, installation: This opens number or elementary tasks we cannot control and visualize in required detail now – individuals need capability to take, carry, place on a surface or into another object, dig an object into ground, get on/off a vehicle carrying an object, lay a wire.
- Activation mode: By timer, pressure, remote control (radio or wire)
- IED protection means (radio jammers).

2.2 Impassable Forest

One significant difference between live and virtual simulation lies in forest representation. Impassable forest virtual model is its 2D projection bordered by a wall that cannot be penetrated neither by dismounted infantry nor by fire. Such reduction is far from the real forest properties, another solution has to be found. On the other hand, it would be extremely difficult to model forest as an aggregation of individual trees of certain height, trunk diameter, and spacing.

All terrain data in virtual simulation is derived from constructive system database, so the change must be correlated in both simulations.

3. CONSTRUCTIVE SIMULATOR

The ACR CSTT (Centre of Simulation and Training Technologies) uses as the main CAX tool system OTB (OneSAF Testbed Baseline). This system or its successor, OneSAF, is the

constructive counterpart reflecting all new features in live and virtual systems we developed during the project term, and those in our future plans.

OTB/OneSAF evolution follows the task list correlated with LVC integration trends (simulation of small unit activities in urban terrain including buildings). Unfortunately, not all changes in system architecture or particular models support smooth building up the capability to handle wide spectrum of combat and non-combat tasks, high-detail scenarios for patrolling teams training as well as large-scale joint forces operations.

4. C2 ASSETS

The tactical-level C2 system integrated in combat vehicles (BVIS – Combat Vehicle Information System) is important part of ACR simulation. It has been used during tactical CAX supported by constructive simulator.

Our trainees driving and operating the latest combat vehicles become accustomed to contemporary way of communication and operation picture presentation in real systems. So, the same interface should be at least simulated when training. This is true for both new tank T-72 and PANDUR full-mission simulators but it not built in virtual simulators VS-II.

The unit commander in simulated vehicle uses standard BVIS terminal, too. All virtual simulators will be equipped with simulated Commander Display Unit (CDU), see Fig. 1. This device has the same LCD display (1), keyboard (3) and "traffic lights" LED indicator (2) concentrating diagnostics information.

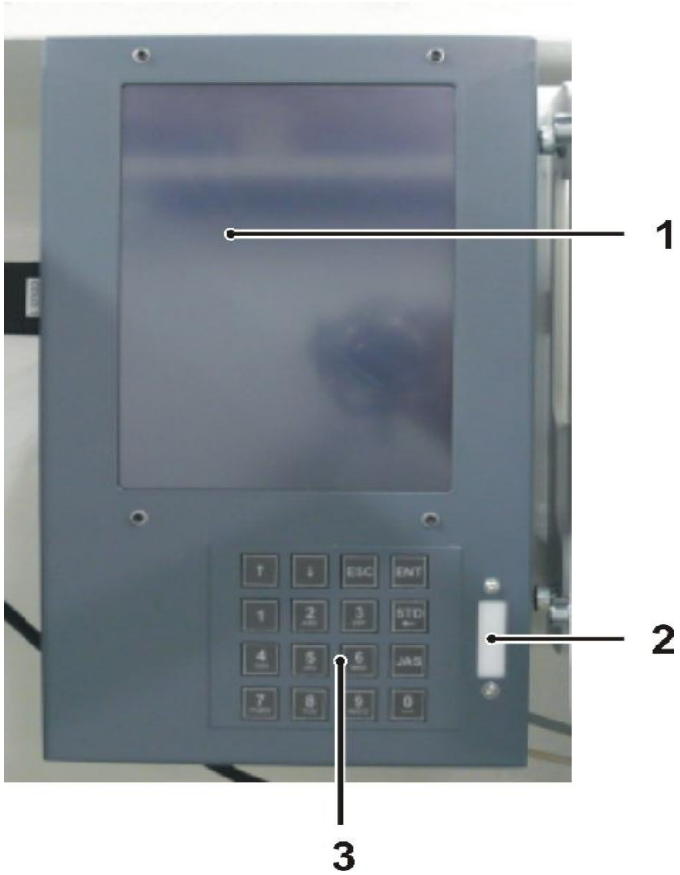

Fig. 1. Commander Display Unit
Source: own

A CDU deliver to vehicle commanders their portion of Common Operation Picture – map, overlays, route information, messages, signals, data from Fire Direction Center (targets assignment, priorities). The simulated CDU in virtual simulators does not display vehicle diagnostics info with the exception of fuel, ammunition and NBC sensors data.

Another, smaller display with limited number of control buttons, Driver Display Unit (DDU) is part of driver's simulator. Fig. 2 shows the DDU display in navigation mode. Its diagnostics mode supports only limited number of parameters like the simulated DDU unit does.

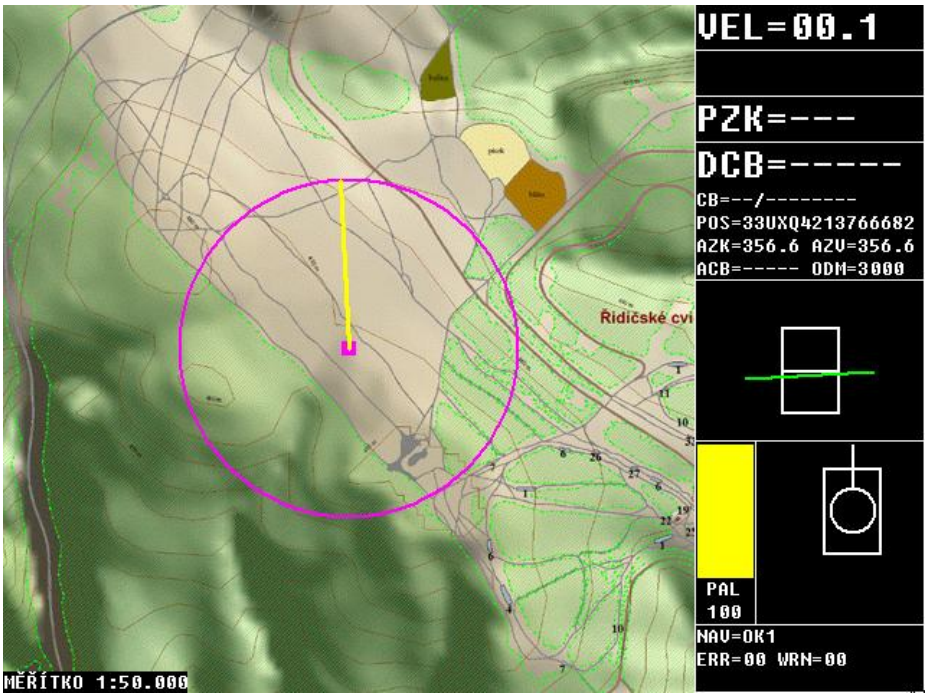

Fig. 2. Driver Display Unit
Source: own

5. STIMULATING LIVE PARTICIPANTS

There is significant industry effort to develop high-resolution 3D goggles/glasses for live simulation participants that will satisfy number of opposite requirements. If a head-mounted display or glasses is heavy-duty enough to survive live training conditions its weight and/or connecting cable is likely to become negative factor diminishing benefit for trainees. Another difficulty comes from human senses area which is much more difficult to overcome or trick. A human in live combat training would difficultly get accustomed to seamless viewing of both real and virtual scenes. The deeper one immerse in virtual scene the more intensive is the training. But real scene is much more complex, and human brain cannot easily accept them both without negative effects. If the virtual picture should not limit our vision too much semitransparent glasses can be the solution. Also, this problem becomes more bearable when integrating 3D with night vision goggles. The visible spectrum limitation and shift can help trainees in overcoming these disturbing differences.

CONCLUSION

Operational requirements set new tasks for training staff, procedures, and systems. The project output – LVC test bed will support experiments one step closer to full interoperability of all three levels of training assets. The project goal did not include bidirectional live-to-constructive link. Changes in virtual and constructive simulators to adopt new entities and their particular tasks responsive to live training needs, simulation of IEDs, and overcoming the gap in modeling forests in virtual systems are the first steps on the way.

Leaving out the technology limitations plus unwanted physical, physiological and psychological side-effects there is common obstacle – insufficient project budget. Stereoscopic virtual scene projection in live simulation is more complicated and far more expensive. Nevertheless, if the test bed should reach its full intended capability it is unavoidable to get the complete technology chain. In our case this should be linked with the update of our obsolete offline laser engagement simulator.

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CREATION OF INTERACTIVE MULTIMEDIA STUDY SUPPORTS

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Abstract: *What's unique about the educational portal "eLearn central", is its original interactive multimedia study supports - animations. More than 35 flash animations have been developed in very close and creative cooperation between students and teachers from "eLearn central team". These animations are freely accessible in "Interactive flash animations" e-learning resource library. This paper deals with authors' experience in the creation, design and usage of interactive flash animations as a versatile tool to reduce students' knowledge differences, to get over the lack of students' motivation to learn, to raise education efficiency of technical subjects and to enhance the quality of traditional teaching methods. The authors discuss the main challenges and opportunities in context with the creation of interactive multimedia study supports in Adobe Flash with the usage of effective graphics creation strategy.*

Keywords: Adobe Flash, portal "eLearn central", e-learning, interactive multimedia study supports, interactive flash animations.

INTRODUCTION

A human being has an inborn ability to learn through his experience. Interactivity is based on a natural human ability - gamesomeness. That is why interactivity started to be broadly used in education. Its application not only widens the students' ability of content perception but at the same time, it decreases the time students need to acquire certain knowledge or skill. The usage of interactive animations turns study into a very interesting process of gathering new knowledge.

Adobe Flash is known as a tool for creating interactive multimedia animations. This software enables the creation of virtually everything, from simple animation, to a complex interactive web application. It is possible to enrich the Flash applications by adding pictures, sounds or video. Adobe Flash is an excellent answer to request for the smallest size of animation. And besides, an output format of Adobe Flash animation can be easily added to web sites. With the help of Adobe Flash, the authors are able to create vector graphic, which is keeping its quality even at higher resolutions. Speaking about Adobe Flash software, the affordability, working comfort, good functionality and wide possibilities are taken into consideration. Thanks to its possibilities and abilities, flash animations have become most widely used platform for creation of interactive study supports [1 - 3].

Today we are working with three portals called "eLearn central". These portals are using the Moodle learning environment and today are located on the server of the Institute

of Electronics and Photonics, Faculty of Electrical Engineering and Information Technology, Slovak University of Technology in Bratislava. Multimedia components for courses and modules on portals "eLearn central" are original and unique interactive animations. The flash animations have been designed in such a way that they will show animated details of a given object and so help obtaining the knowledge much easier and faster. More than 35 interactive animations were initially developed for education purposes among which are animations of passive devices, passive filters, diodes and their usage in electronic circuits, as well as BT, HBT, FET transistors, amplifiers, real and ideal MOS structures, examples of planar technology produced diodes, bipolar junction transistor and CMOS gate, optical storage media, digital circuits and gates. These animations are freely accessible in "Interactive flash animations" e-learning resource library [1] on "eLearn central" portal for everyone interested.

Even military professionals can benefit from such learning method. Much of the military hardware uses the same principle as common everyday tools and the existing flash projects can easily be adapted, changed or updated to comply with military standards.

In this paper we would like to present our experience in the creation, design and usage of interactive flash animations in educational process. The attention is focused on main challenges and opportunities in context with the creation of interactive multimedia study supports in Adobe Flash with the usage of effective graphics creation strategy.

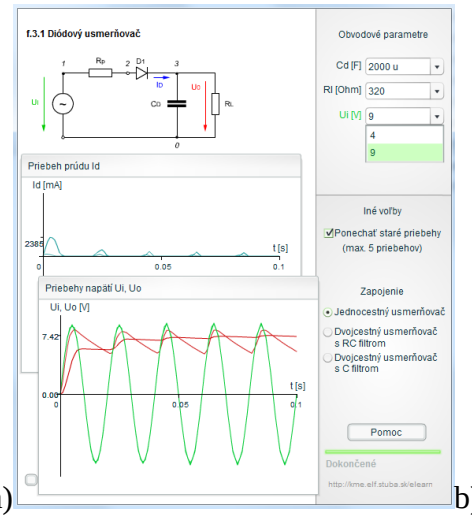
1. IMPORTANT FEATURES OF ELEARN CENTRAL ANIMATIONS

We started to create the first interactive animations in 2003. At that time we had no experience in this subject whatsoever, and we could not find any similar projects on the web either. Our ambition was to assist the students in understanding of inner processes in semiconductors and electronic circuits through interactive animations. Static pictures and characteristics do not support students' imagination of such inner processes as much. We have created our own libraries of symbols, defined a template of colours and shapes for carrier charge, the depletion layer, the type of semiconductors, and other features for these animations.

The animations were created by Adobe Flash tool or by Adobe Flash and SPICE (Simulation Program with Integrated Circuits Emphasis). The animations were created by Adobe Flash and SPICE (Fig. 1a) work as a format converter of SPICE output files into graphic Internet browser show format [4]. We've created the output files for a variety of input parameters by simulating in SPICE application and so we were able to provide a high degree of interactivity for our students on "eLearn central" portal. This way enables a better demonstration and understanding of the principle of the basic electrophysical effects.

So, why is interaction in animations so important? Because everybody knows that their own experience is the best teacher. Interaction means getting some answer from my interaction and this answer is like an experience. And of course, people like to control everything and to interact in our application means also to control. That is the same kind of interaction as in games (Fig. 1b), but in this case, it is connected with much information which is useful for study. And interactivity gives also an opportunity to change many parameters. We wanted to create as intuitive interaction as possible.

Authors of these e-learning projects were members of "eLearn central team". This development team was built from teachers and students.

a) 

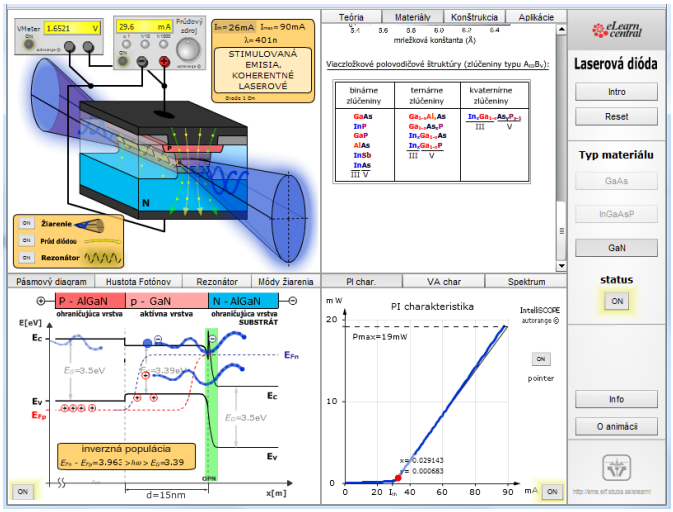
b) 

Fig. 1. The level of interactivity in animation a) "The half-wave and full-wave rectifier" (Adobe Flash and SPICE), b) "Photodiode – Photovoltaic mode" (Adobe Flash)
Source: own

The teacher-student cooperation has excellent advantages. Teachers are experienced in teaching, they have expert skills, they can find the most appropriate ways to obtain new knowledge and they have enthusiasm. Students have the necessary practical skills with software, they are able to quickly learn how to work with new programming tools, such as PHP, HTML, Adobe Flash, and they have creativity, new views on a topic, and enthusiasm as well. We have organized routine meetings, consultations and Flash courses [5]. A very positive experience and outcome come from formation of a strong student base. Students together helping each other were able to solve some of the software problems. Great benefit of this community can be seen in all created animations. Our new students have used the Flash software and created complex animations in a very short period of time. They have used prepared animation templates created by their elder colleagues, attended Flash courses and worked with the usage of effective graphics creation strategy.

We set the same sequence of steps for newcomers to the student team: First he/she chooses a topic, second he/she does analysis of the current state (text and multimedia material, Internet), third he/she learns Adobe Flash software and examines the source files of created animations. We're already organizing 5th year of Adobe Flash course – creation of animations using effective graphics creation strategy. Fourth, student creates "storyboard" for animation in such a manner as creating an animated film (where the basic condition is high level of interactivity! Fig. 1) and at last we discuss form and physical details.

2. NEW TRENDS

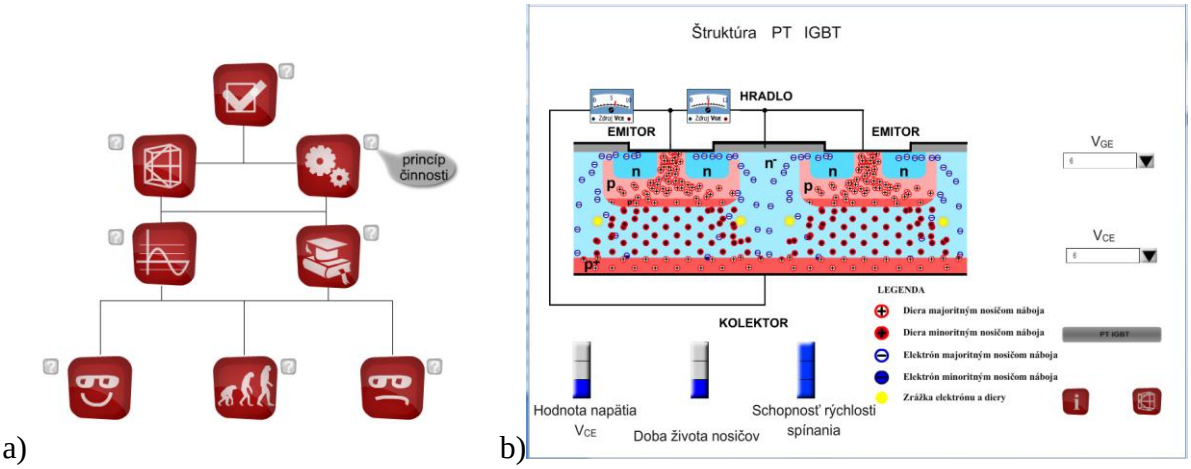
Technology trends in engineering education in a blended and distance learning head towards Virtual labs, Simulators and Remote labs, games. E-learning technology is evolving rapidly. Nowadays many interactive animations are available on the web. Majority of which are very simple, or they have little level of interactivity. Some of the animations are very professional, didactic and with high interactivity. At first our animations were very simple and displayed only one effect or process (Fig. 1a). Over time, as we gained experience with animation creation, more complex animations were created. These by themselves formed education module about a chosen topic (Fig. 1b).

Our interactive animations are successfully used not only for self study on exercises, but also by teachers on lectures. These animations are very useful tool not only for learning, but also for increasing the interest in presented topic. By using these animations in education process, we also discovered weaknesses of our animations. Of course, mistakes were found in some of them, some were unclear about presented topic. Some didn't explain presented topic enough, some were missing user help or had complicated control of elements. A big issue of more complex animations is that when they are put into text, a lecturer has to go through the whole animation from the beginning. On the other hand very simple animations were often not enough for student to understand the context. While some of our animations were excellent six years ago, there are now only average and often outdated. It is necessary to renew these animations following new guidelines. We also need to regularly update the content of these e-learning projects.

The new challenges offer very interesting possibility to implement object oriented approach present in ActionScript 3. Flash has many built-in functions, which makes it productive and simple at the same time. We can mention special effects, which can be added to an object very simply. Flash has brought entirely new options to the process of creating modern educational and teaching tools. It has made possible to develop educational tools with a certain level of internal intelligence [6]. Great advantage is also in the ability of direct communication with external systems right in the client computer without the need of any server application [7]. According to this concept, Flash applications are either launched from the web and after that running in web browsers or they can be run as desktop applications. Both of these variants can even work together on the client computer. Flash brings us some other significant advantages. It provides an opportunity for graphic designer and computer programmers to closely cooperate which leads to quality improvement of final applications in terms of user-friendly environment and control. The use of object-oriented approach is very important even for graphic design. This enables to create graphics including internal intelligence and it will significantly extend the possibilities of its development and use.

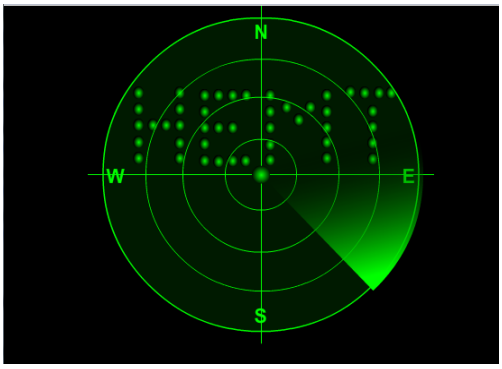
2.1. New Concept of "eLearn Central" Animations

The new interactive animation is created as a composition of many interactive microanimations (Fig. 2). These micro-animations are designed in such a way that details of a given object are shown to students and so it will contribute to knowledge obtaining much easier and faster.



a) b)

Fig. 2. Animation "IGBT": microanimations a) Map and b) Structure PT IGBT
Source: own

a) 

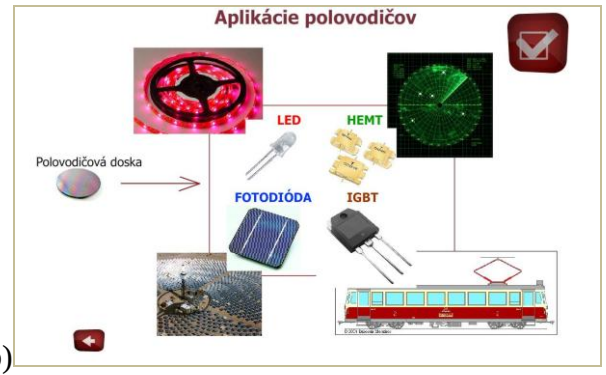
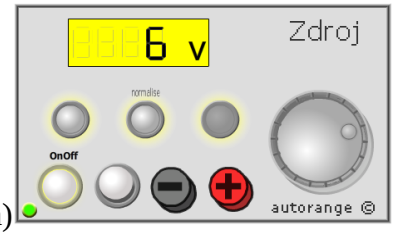
b) 

Fig. 3. Microanimations: a) "Intro" ("IGBT"), b) "Application" ("Semiconductors")
Source: own

A complex animation is located inside of the course, and micro-animations are parts of educational text. The first microanimation in a course is “Intro” (Fig. 3a). Animations have a strong motivational power, and it is intro animation that should motivate and take student to continue in study with offered animation. The most common microanimations are activity process, advantages, disadvantages, history, construction, application (Fig. 3b)… It all depends on a given problematic. Most of our animations were created for electronic. That’s why it contains many recurring parts. Thanks to OOP in ActionScript, there is a possibility of preparing classes which can be used by new developers. For example components like Power supply (Fig. 4a), Analog needle (Fig. 4b,c), Display (Fig. 4d), Drawing mechanism on the screen of oscilloscope. These classes use input parameters for setup. For example Power supply class it is minimum, maximum, run time of signal, initial value, description label (“V”, ”Voltage”,…), source mode (dc, ac, square wave), normalized or real values broadcasted. Value is set by rotary button to make it look like a real device. It has 2 modes – it can either broadcast its value at a change or periodically at given interval.

a) 

b) 
c) 

d) 

Fig. 4. Classes - components a) Power supply, b) and c) Analog needles d) Display
Source: own

Classes currently in development are oscilloscope, pn diode, bipolar transistor, unipolar transistor etc. Our goal is to create the richest library of classes, which will enable our developers to effectively create new animations. Animations created in this manner will offer a student uniform design, interactive access to data at any time, which could be obtained only experimentally or by simulation otherwise. This way the time to handle simulation program can be removed as well as costs for obtaining such a program.

CONCLUSION

Interactive multimedia study supports as interactive Flash animations, didactic games and various interactive applications have a very important role in educational technologies nowadays. Interactive Flash animations improve the possibilities of explaining even very

difficult phenomena as are inner processes in electronic structure. The creation of these interactive animations becomes available even for standard users and not only for professionals as it was not long ago thanks to the development environment of Adobe Flash.

We created "Interactive flash animations" e-learning resource library for "eLearn central" portal. For the time being, the interactive animations cover the basic part of electronic devices, systems and applications. These interactive animations were designed to help students to understand details of electrophysical problems, devices and circuits in an easy and illustrative way. New interactive animations have been inserted continuously after they were finalized. The access to this library is free not only for our students, but for anybody who is interested in this area. All animations are regularly used for education in courses located on the portals "eLearn central" from 2006. Feedback from students and users is very positive and inspires us in our work.

At present, we are creating new animations and renewing old animations following new guidelines. New concept of "eLearn central" animations is based on object-oriented approach. The new interactive animations are created as composite of many interactive microanimations. New authors use the created animation templates, library of symbols and classes developed by their predecessors. We put the emphasis on the standardization of shapes, colours, templates, level of animation interactivity and intuitiveness. We would like to add sounds to the interactive animations to make them more attractive and easier to use.

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LECTURES AND TESTS FOR EFFECTIVE EDUCATION BASED ON TREE STRUCTURE

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Abstract: *This paper is centred on advanced learning activities for the support of an optimal way for knowledge and skills creation. Teachers use default activities in order to access educational documents by web links. Activities like tests, surveys or chats help with communication between students and teachers. The next question is regarding implementing suitable learning activities as guides. Inspiration is based in Business Intelligence (BI) benefits for a steep learning curve, the support of easy migration between environments, and flexibility. The optimal resolution is brought by a lecture. This learning activity is implemented in the course operating system via the Moodle platform. The aim is to offer an effective method for controlled study based on actual knowledge and skills. Students answer on questions. If an answer is incorrect, then the student is referred to available education materials and videos. The reason is the need to repeat a given topic and to improve achieved knowledge.*

Keywords: effective education, information technology, learning activities, lectures, tests, tree structure.

INTRODUCTION

Effective learning uses information technology (IT) products for better support of educational activities with a friendly interface for students and teachers. The design of the implemented system's uniform interface (user environment) helps to streamline communication. Rules of communication between students and teachers influence the quality of training and practical usage of educational platforms [8] like Moodle. Students appreciate courses designed with available educational materials and learning activities. A positive feature of education is friendliness and help based on questions, positive messages and information about possible errors. Relevant communication must respect the context so that information is sufficiently detailed and factual. Respect for a student's level of experience and focus has its important place. The style and form of communication must match a student disposition.

Requests about education quality affect ways of communication. Education needs to maximize the reliability of communication. The standard is clearly to define a task (request), process it for an optimal solution with declaration of achieved results and benefits. Students must also be offered a guide on how to proceed in further steps, and repetition with verification is optimally based on video simulations, tests, or lectures. Information volume [2, 5] must be optimized with regard to a range of topics and allocated time. There are two limits; much of the information overwhelms students and, on other hand, a lack of information leads to misunderstanding and errors.

IT development is dynamic and further interest is focused on advanced educational activities. These activities primarily offer supportive and balanced access to education based on an optimal process for knowledge and skills creation. This style of teaching respects learning

activities that convert strategy into objectives in relation to established performance metrics. Passage of learning materials is based on correct answers. Important factors are time and navigation. Students must work without any limitations, and the actual education process must be based on the current situation and knowledge quality [6, 7].

1. IMPACT OF MODERN EDUCATION ON THE GLOBAL INFORMATION SOCIETY

After active and successful training, students must understand the necessary theory and practical use of new knowledge in solving tasks. [9] A similar approach is evident in teaching IT. Students need to master the following knowledge and skills:

- To explain frequently used terms and concepts.
- To characterize the importance of selected software.
- To define the procedure for implementation of selected applications.
- To describe defined strategies for implementation.
- To know important tasks for active application.
- To create needed objects with the support of a guide or programming language.
- To navigate in a wide range of applications and IT products,
- To select a suitable resolution based on case studies and examples.
- To respect needed modularity for solution-defined goals.
- To quickly realize administration tasks in high quality.

Every learning is tied with cognitive processes. [15] The process of learning is a lasting change in behaviour, based on habit. This ability is developed on the basis of a reasonable load. Learning activities create conditions for functional adaptation in the actual environment. These processes are defined as processes of information processing. Information science develops cognitive functions in relation to artificial intelligence, computer science and psychological disciplines. Learning activities offer various processes for acquiring knowledge and skills with regard to:

- The type of task for knowledge mining (to understand the role of knowledge, to describe existing context and to classify via examined cases).
- The complexity of the solution based on representation.
- The comprehensibility of discovered knowledge for users.
- The efficiency of obtained knowledge in classification of new cases.

The starting point is mutual cooperation between various disciplines, which are remote at first sight (psychology, neuroscience, cybernetics, artificial intelligence, linguistics, philosophy of mind). Practical application of learning activities builds on observations and measurements with the aim to create mathematical, computer, or physical models. [10] Courses for students must respect all these conditions, but course creation is not an intuitive matter. A dynamic information society requires application methods with links to verified methodology and IT support. BI products offer an inspiration for the effective resolution of defined tasks.

2. INSPIRATION FROM BUSINESS INTELLIGENCE PRODUCTS

Modern database servers offer extensive support of BI tasks. The purpose of BI is to transform stored data into knowledge that is useful for users in firms, organizations and individuals. These skills are often used for decision making. This process is not intuitive and

easy because information is stored in a set of records. BI products bring positive inspiration and interest to monitor trends of selected objects and to search between stored data of hidden relations. [3] Information is usually stored in database systems; therefore, database systems include tools to support data warehouses, an OLAP (Online Analytical Processing) analysis and data mining. Such tools work with data that are stored in different sources with varied texture, quality and character. Data sources build database files (like dBase, MS Access), databases maintained by a database server (like Informix, MS SQL, Oracle) and also other data from mail, videos, or figures. Expected reports and analyses use standard office software (well-known MS Excel and MS Access) for better management with visualization support. [12]

Processed and analyzed quality data requires a systematic approach [4] for database system implementation in relation to the tools supporting Business Intelligence. This approach searches essential characteristics of existing systems with the aim to define appropriate models for simulation of existing reality. The result has an influence on the following tasks:

- To specify optimal requirements.
- To analyse selected reality for better simulation specification.
- To implement the resolution based on details in programming.
- To test the correctness.
- To adopt the implemented system into operation.
- To realize default system maintenance and development.

The Internet contains a series of case studies about usage of BI products and about existing benefits for practice. [11] The standard situation shows the need to resolve service offers for a wide spectrum of customers in firms and organizations. Customers are users with different needs and preferences. [16] The question is setting rules for the effective management of development, marketing and product design with regard to detailed analysis of user needs. The common benefits include high productivity development, a steep learning curve (shows the ability to work competently with a selected software or tool), support easy migration between environments and flexibility in development and modification, an effective management system with the support of a small team of IT specialists. Similar benefits are also suitable for learning.

3. LEARNING IN INFORMATION TECHNOLOGY FIELD

Learning in the IT field reflects preferences of IT product users with links to needs of the global information society. [9] There are analogies for student's needs and benefits with the support of learning activities. Education must resolve service offers for a wide spectrum of students [13] with the aim of optimal application in various firms and organization. Students have different needs and preferences. One of the important question is setting rules for effective education management and course design with regard to detailed analyses of societal needs.

Education also requires suitable quality and benefits. The common benefits include a steep learning curve, ability to work with selected software or tools, support easy migration between environments and flexibility in development and modification. Teachers appreciate effective management of the realized courses with the support of a small and dynamic team of specialists. E-learning offers optimal activities [14] for the support of effective education such as:

- Controlled communication with students via interview, forum, chat, or QuickMail.
- The opportunity of conclusive evaluation of realized work.
- Evaluation of students by online activities such as tests or survey.
- Control over process of studies in the form of lectures.

The following text will concentrate on lectures. Lectures are learning activities for better control of the process of studies. This activity is created with the support of an easy guide via forty items. Many of these items have defined default values. The teacher fills in such items as Name, Number of strings (response), Setting markings, and Control passage of lectures. A specific lecture is accessed by a web link, please see Fig. 1.

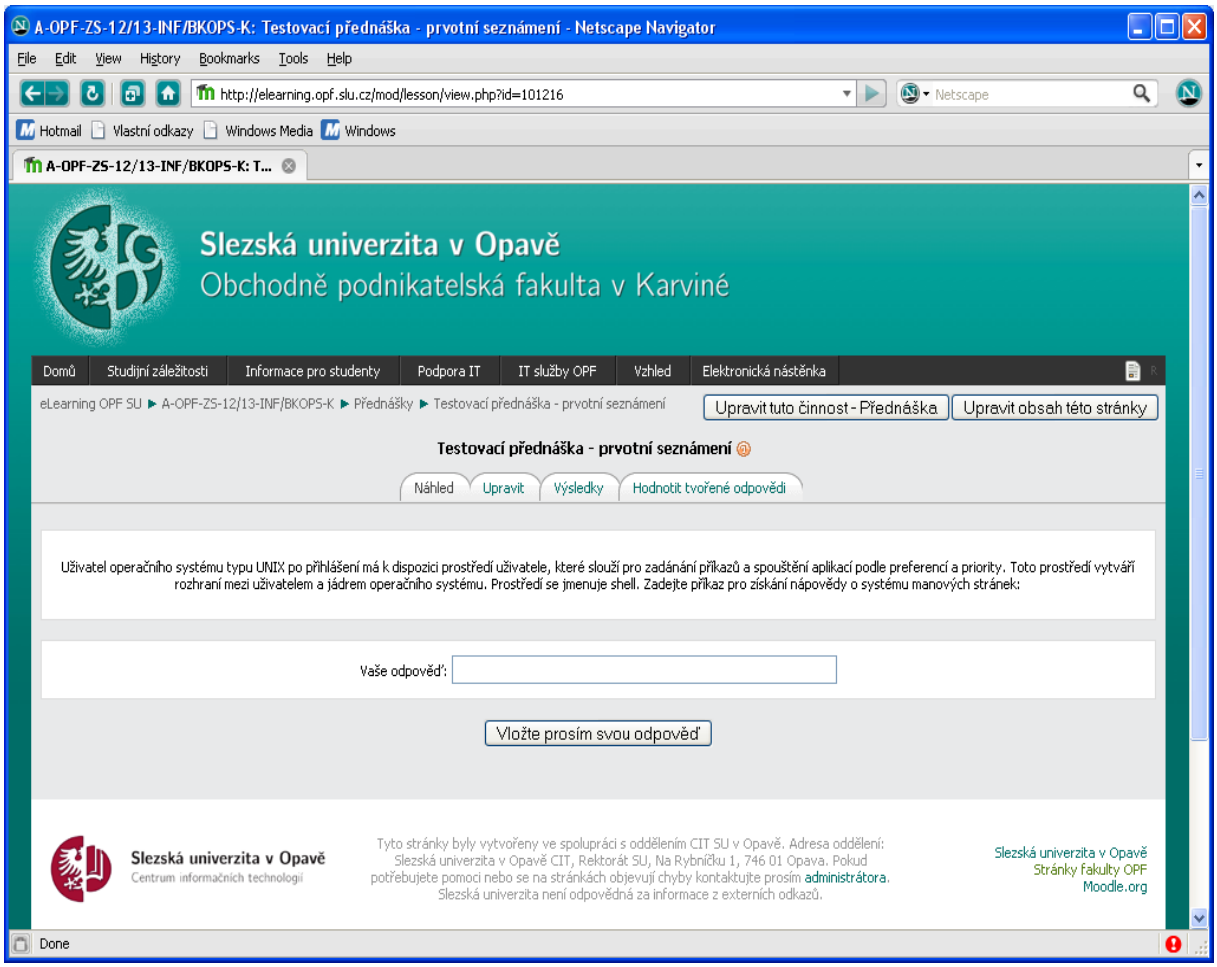

Fig. 1. Lecture activity for Operating Systems course
Source: own

Initial lecture creation reflects the teacher's experience from previous lessons and seminars. Furthermore, modernization will be based on achieved results, student suggestions, realized tests, surveys, or analyses with the support of Petri Nets [1]. The benefit is to control the path of studying via correct answers. If a student enters an incorrect answer, then s/he is referred to available education materials and videos.

CONCLUSION

Modern education reflects the current state of science and e-learning with the use of motivational interviewing, well-formulated stories, and well-designed educational materials. Education with IT support offers a spectrum of methods for necessary progress in skills and knowledge. Teachers often work with the education platform Moodle. Moodle is a system used to support education based on learning activities like lectures, surveys and tests. For example, a lecture uses guideposts and questions for a tree structure of lectures. The benefit is that this way of study materials is controlled by orientation on obtained results (correct answers to questions). The teacher controls the passage of a student through the education materials. Such an approach leads the student interest to needed materials, videos and case studies for better understanding. The aim is to find a way of dynamic and flexible work with study activities via an optimal number of places and transitions for suitable education.

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E-LEARNING IN VIRTUAL UNIVERSITY ENVIRONMENT

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Abstract: *A possible model of a virtual university environment is identified with the analysis. Furthermore, matching e-learning models are expressed. The desired objective of the research is the expression of the model interface of the technical and social environment for the creation of a new cybernetic concept of e-learning.*

Keywords: e-learning, artificial intelligence, virtual environment, education.

INTRODUCTION

The new knowledge-based economy will be increasingly based on quality information, knowledge and systematically defined modern model of virtual university environment with appropriate information literacy of the socio-technical environment. Contemporary classical economics will be increasingly influenced by the action of the new economy, especially dynamically growing environment of information and communication technologies and new intelligent models for knowledge discovery on the principles of systemic understanding of real physical processes and the possibility of using new mathematical methods of theoretical and applied cybernetics and use of artificial intelligence methods for systems in the field of electronic learning (e-learning). [1]

The systemic defining of education as a cybernetic system model and corresponding model of environment of information and communication technologies (ICT) is the basis of the research activities in the given project FP-S-12-1.

An integral part of the project is creating of:

- **the model of the technical interface** represented by technical means of education model - so by means of technical cybernetics and modern tools of information and communication technologies,
- **the model of the social environment** represented by students as the users environment and also by means of technical cybernetics (especially ICT). Generally living organisms (e.g., describable model of homeostasis of user experience of e-learning).

This paper deals with the interaction of these two models with the use of artificial intelligence in the new **system-integrated e-learning concept** with respect to the information literacy of present and future generations of users in the process of e-learning.

The topic of this paper can be included in the modern concept of e-business in the area of business and trade with information and knowledge.

The paper is based on an analysis of information sources of virtual libraries where the principles, that form the corresponding program of cyberculture, are mentioned:

- interconnection (uniformed **interactive environment**),

- **virtual community** (involving groups of people with similar interest, knowledge and plans)
- **team intelligence** (a new concept of entities interaction).

Internet is interpreted as an tool of global systems integration of data, information and knowledge in environment of education. [3]

1. TECHNICAL MODEL AND SOCIAL INTERFACES FOR E-LEARNING

The general systems theory, which organizes knowledge about the systems, describes, classifies and defines them, has been the basis of project FP-S-12-1 solving. It defines them on real objects, examines their properties, structure, and behaviour. The means of communication is language. Native language is characterized by too much ambiguity - so verbal (verbal descriptions) of systems are very complicated. Our task has been the use of artificial language (mathematical language) for the model creation of technical and social interfaces for e-learning. [1]

Each process of model creation and follow-up modelling or simulation of virtual university environment has got the **character of a cybernetic system** with model's feedback into the real life environment of a virtual system. The whole process of identifying and modelling, or rather simulating and evaluating must be carried out in real time (i.e. in the time when the physical parameters affecting the environment are useful - they have their regulatory or control value). Therefore, at present, to model the project (or simulations), we use powerful computer systems. As well as identification of environment recognition is performed by using the intelligent technical environment sensors. [1]

In Fig. 1 the representation of the virtual environment - a directed graph of organized elements of the virtual system - is given. This system is recognized by means of identifying the virtual system and we perform the model creation and modelling, or rather model simulation, in a suitable computing environment. The results of this process are used to specify the model, with a new identification (analysis) of real environment or a utilization of modelling results to change that part of the virtual system, which we consider essential for the optimal operation of virtual university environment for improving the quality of e-learning in accordance with that cyberculture.

Use a systematic approach to cybernetics as a science that examines the general characteristics and management patterns in biological, technological and social systems. Besides theoretical cybernetics (using control theory, information theory, automata theory, learning theory, game theory, theory of algorithms, etc.) it will be mainly applied cybernetics (known in the areas of technical, medical, economic, military, and others). [1]

Based on the analysis, i.e. identification of defined cybernetic system, cybernetic system has been recognized with using selected modern methods and the corresponding subsystems and elements of hierarchical structures, where it has been gradually created an adaptable model of future virtual university environment. Implementation of education has been specify on existing information and communication media, taking into account learning as a dynamic process of change in the assumed cyberculture of new information and knowledge society.

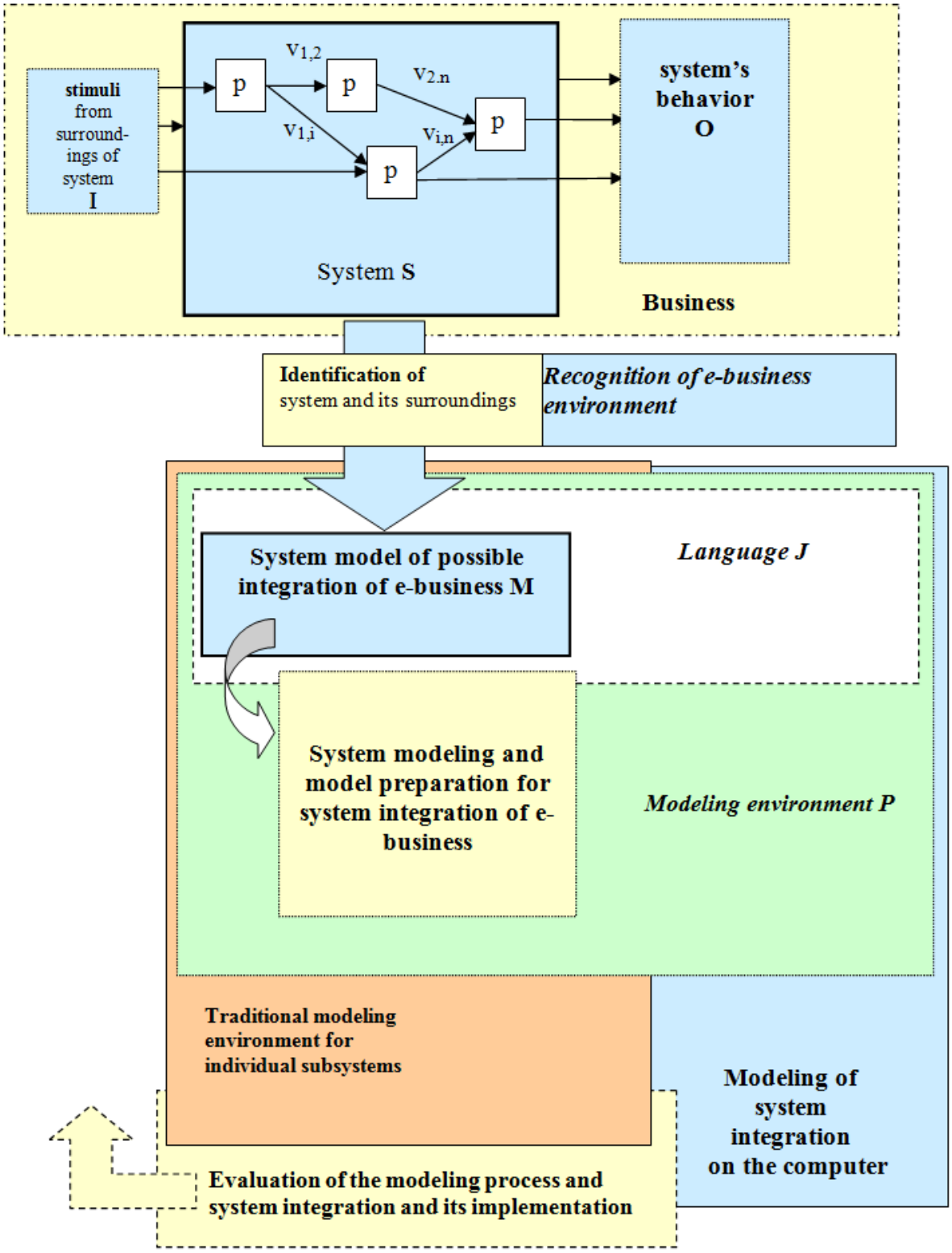

Fig. 1. The principle of modelling for the project FP-S-12-1
Source: own

Dominant homeostasis will play a substantial role in creating the conditions for interaction with technical cybernetic systems. The role of a living organism (humans and nature in general) and the non-living environment (machinery and equipment, mainly ICT) is supporting the relationship of these two models.

Corresponding cyberspace e-learning in a virtual university environment will be represented by mainly new concept of interactions between these cyber systems. Above all, if will be the model of cybernetic interface on means of physics - solid (silicon, carbon) and gaseous (gas diffusion environment), crystalline (crystalline structure) and other modern atomic structures (base changes in the energy structure of atoms, etc.). Another divisive environment will be use of electronic properties of the environment (current ICT resources), the optical environment (optical processors and optical fibers suitable for the transmission of information), bionic environment (molecules of living organisms - bionics, etc.). [4]

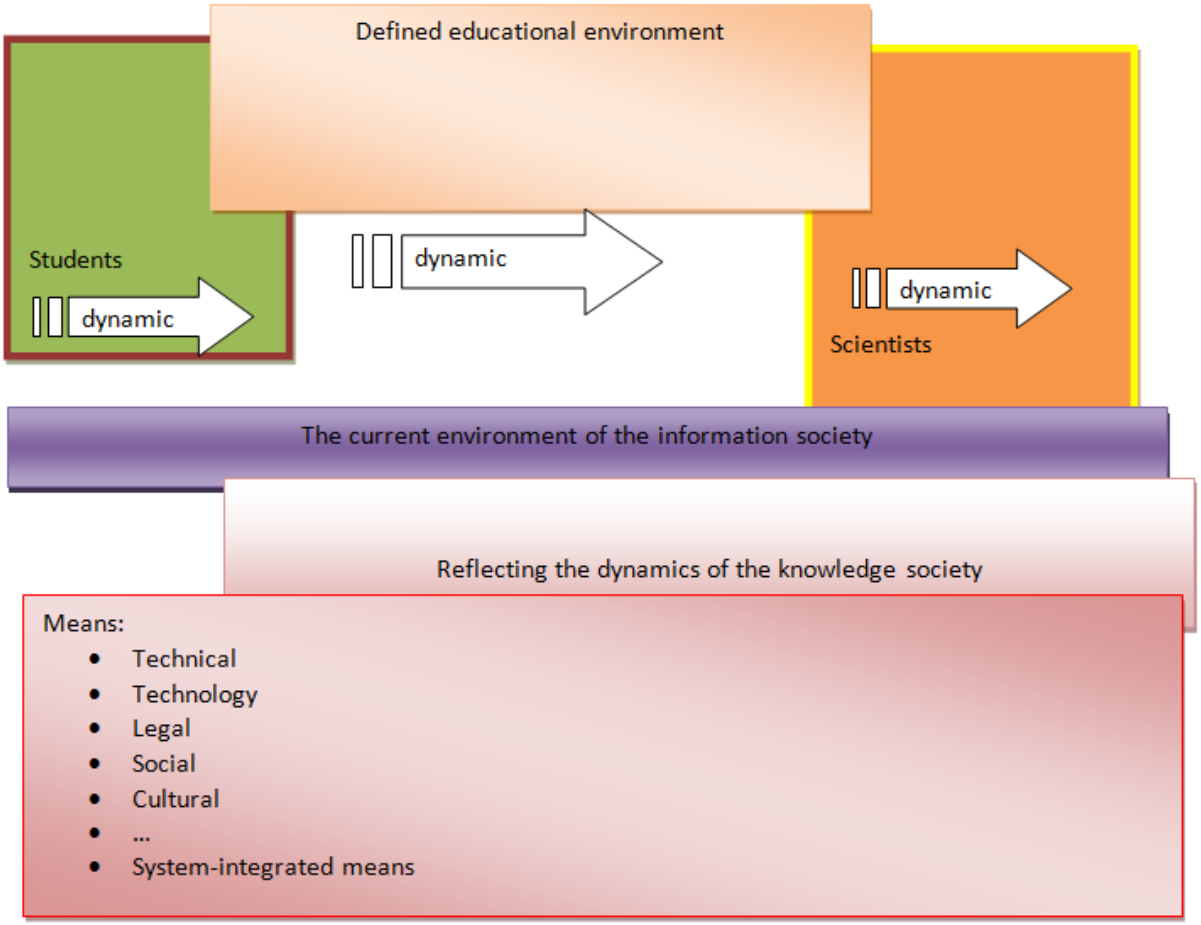

Fig. 2. Model definition of the virtual environment
Source: own

New look at the interface of the technical and social environment will be use of modern methods and means of artificial intelligence. The development of this promising field in the given project is closely linked to the rapid development of today's modern systemically integrated ICT and socio-technical means of detection of scenes and environments. Artificial intelligence technologies for dealing with problem of this specific research are currently very diverse. We expect that there will be representation of applications primarily from biology (such as neural networks and genetic algorithms), physics, mathematics and logic (such as technology modelling and identifying chaos and technologies using fuzzy sets). These technologies already form groups which are based on computer models of problem solving with a supply of expert information (expert systems) etc. Domains of artificial intelligence are well known expert roles, formal tasks (games and simulation tasks), other tasks - such as recognition of artificial languages (mathematical language) and natural (maternal) language, processes of perception, etc. [1]

Among the artificial intelligence technology used in the project:

- **Neural networks** simulate the workings of the human brain. You can use a number of representations of neural networks and their interpretations.
- **Genetic algorithms** - can be used to evaluate the outputs of neural networks.
- Technology with fuzzy logic.
- Systems for identifying and modelling the chaos. [1]

Based on these options defined systems and their possible models expressed in modern methods of artificial intelligence for the modelling of complex processes such education is expressed in Fig. 2 and 3.

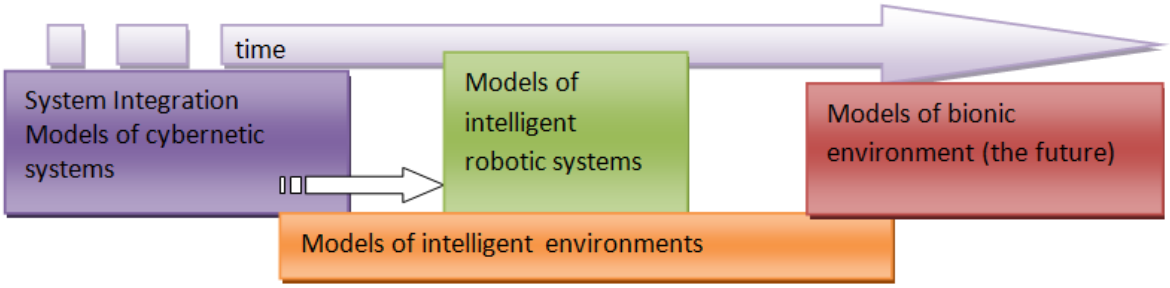

Fig. 3. Creation of intelligent virtual education environment
Source: own

CONCLUSION

In the future it is expected that the new economy (e-economy) will be associated with intelligent models of e-learning. The key to success will be the ability to innovate and continuously improve virtual environment of e-learning in integrated environment of universities.

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COMPUTER NETWORKS REMOTE LABORATORY

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Abstract: *The article describes an issue of remote access to laboratory equipment within the Cisco Networking Academy project. Two variants are presented, the first is very simple and required no special means; on the other hand, it has some significant limitations. The second variant is more complex and uses special technical appliances. It allows performing configuration tasks by the same way as in case of local console access, including unknown passwords recovery. The application software is being developed at present, which will permit better completion of administrative and organizational tasks, particularly time and access management (schedule, supervision, abnormal situation solutions etc.).*

Keywords: networks, remote, access, teaching.

INTRODUCTION

The Cisco Networking Academy (CNA) has been established at the University of Defence fourteenth years ago. That project allows very effective teaching of basic and advanced issues of computer networks, network security, etc. - both theoretically and especially practically.

1. CURRENT STATUS

There are three currently running CNA courses at the University of Defence. The first, fundamental one is CCNA Exploration (where CCNA stands for Cisco Certified Network Associate), the next is more complex program CCNA Security and the third, most demanding, is the CCNP (Cisco Certified Network Professional).

CCNA Exploration course consists of four teaching blocks, called semesters (not in academic sense). Their content is a general network theory, switching, routing, local area network, wide area networks, wireless networks, basic network security configurations etc. CCNA Security course deals with building secure networks, traffic monitoring, setting elements such as firewalls or intrusion detection systems, etc. The CCNP is focused on non-trivial themes as routing in large networks, security, multilayer switching, troubleshooting etc.

1.1 Laboratory Exercises

An important part of all CNA courses are laboratory exercises that can be realized by one the following ways:

- using simulation tool called Packet Tracer
- on real devices.

1.1.1 Packet Tracer

Packet Tracer allows creating a relatively complex simulated network consisting of routers, switches, other devices and connection lines. Of course, its usage is limited because it does not support all the features which have true devices, so it is not suitable for more challenging topics. In contrast to most real devices, Packet Tracer configuration can be also done using the graphical interface. On the other hand, it allows the visualization of certain events (such as packets transportation) and it also has reach pedagogic features (adjustable time limits for task completion, automatic accuracy evaluation, full student activity recording etc.).

1.1.2 Real Devices

The behaviour of real devices, however, can not always be accurately simulated, as well as the same types exist in many modifications, may differ in hardware configurations, types and versions of operating systems etc. Dealing with real devices is irreplaceable, because it is the only way to get real skills [2].

All currently used Cisco networking devices are equipped with console port (which is simplified version of the V.24/RS232 serial interface). The network device is managed by the medium of a terminal (which is usually software emulated - putty, HyperTerminal). For completeness' sake, the newest Cisco devices are also equipped by the USB port.

The laboratory exercises use predefined topologies, comprising mostly of 3-5 devices such as routers, switches, access points, firewalls, etc. These topologies are usually fixed within a one semester.

2. REMOTE ACCESS

There are about 60 devices in the laboratory available. This amount allows preparing several sets of identical or different tasks. Contrariwise, it brings some especially organizational problems.

First of all, quite large number of students in the laboratory and in the same time declines effectiveness, as students must understand actual arrangement; moreover, they lose time connecting devices (although it brings indispensable troubleshooting experience) and disturb each other. Furthermore, they cannot visit the laboratory without the supervision, i.e. after regular working hours, during weekends, etc. In order to eliminate these problems, several different methods of remote access to equipment in the laboratory have been proposed and verified.

2.1 Remote Access Using Computer and Remote Desktop

It was the first, rather experimental remote access variant, based on a personal computer equipped with larger number of serial interfaces, to which were attached console ports of managed devices. Remote access was accomplished by taking control of the entire computer by the help of tools such as VNC (Virtual Network Computing), see Fig. 1.

There were available five serial interfaces in computer, one built-in and four implemented through a USB hub and USB/serial converters. Thus it was possible to simultaneously control

up to five network devices. Major disadvantage of this solution was limited number of serial ports; hence it would need to schedule user access very carefully.

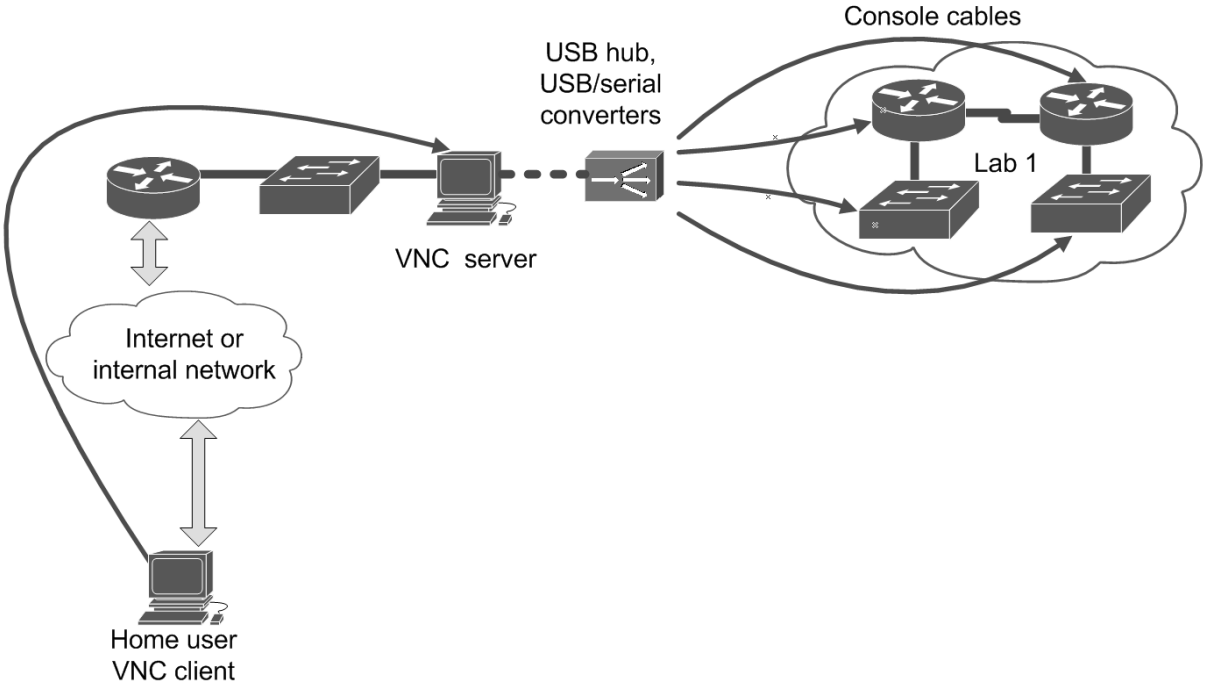

Fig. 1. - Arrangement of remote access using computer and remote desktop (VNC)
Source: own

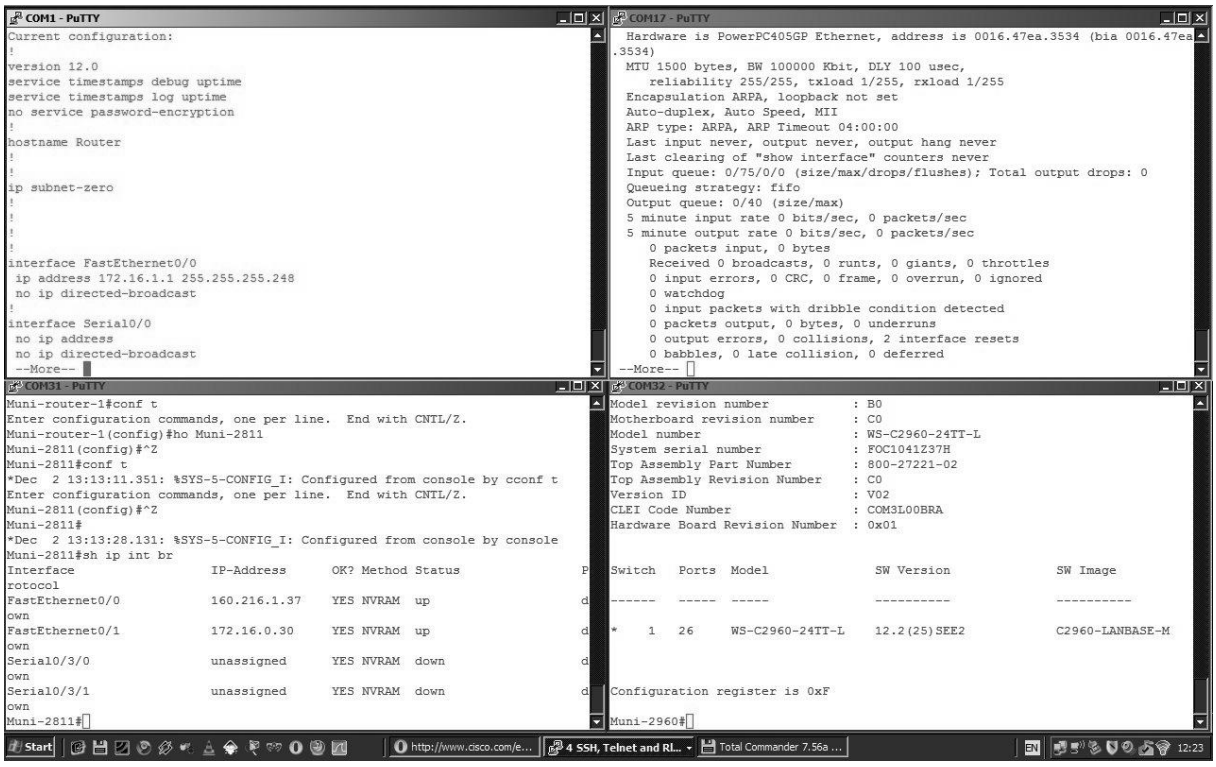

Fig. 2. Example of four remotely managed devices using remote desktop (VNC)
Source: own

2.2 Remote Access Using Specialized Equipment

This variant addresses two relevant problems:

- remote access to greater number of devices
- unknown password overcoming (password recovery) - in case of routers, currently not when switches are applied.

Remote access to more devices has been achieved by using specialized equipment, which is based on console server Moxa NPort 6610-32. This server offers a plenty of possibilities, some of them are very useful for the intended purposes.

Console server Moxa NPort 6610-32 basic features

- 32 serial ports for high density environments
- DES/3DES/AES for highly secure data transmissions
- IPv6 support
- Network protocols: ICMP, IP, TCP, UDP, DHCP, BOOTP, Telnet, DNS, SNMP V1/V2c/V3, HTTP, SMTP, ARP, PPPoE
- Security protocols: DES, 3DES, AES, SSH, SSL
- Configuration options: serial, telnet and web consoles, Windows search utility.

Console server Moxa NPort 6610-32 operation modes

- Standard: Real COM, TCP server, TCP client, UDP, pair connection, RFC2217, terminal, reverse telnet, Ethernet modem, printer server, PPP,
- Secure: Secure Real COM, secure TCP server, secure TCP client, secure pair connection, SSH, reverse SSH.

In the given case, it is necessary to allow remote user access through a computer network to the console port on the managed device.

The remote user uses protocols such as ssh or telnet, but not targeted on their standard ports (i.e. 22, 23). Instead student selects a specified (configurable) TCP port, which is linked with the console server serial interface; thus student also selects the appropriate device in the laboratory. For example telnet to TCP port 4001 is bound with serial port 1 of the console server, TCP port 4002 with serial port 2 etc. This functionality is sometimes called reverse terminal (reverse telnet, reverse ssh). Of course, student must be aware of the laboratory scheme.

2.3 Password recovery problem

It is not uncommon in real life that the device console port is protected by password, which is lost for some reason. One of the laboratory tasks is devoted to the password recovery, i.e. deletion or changing of an unknown password. This can be done only if physical access to the device in question is possible (more precisely, the physical access to the console port of that device). Console server provides such access to the console port. Next, the device (router) must be cycled off and on and the Break key on connected terminal must be pressed during certain period of time. Router then enters into ROM Monitor mode, in which can be booting process modified by the change of configuration register content. The idea is to skip the router configuration file, which holds all passwords; thus no security will be applied and privileged access can be granted. However, the content of original configuration file can be then changed and passwords overwritten.

Therefore it is necessary to fulfil two conditions:

- to be connected to the console port
- to have the means to cycle router power off/on.

Console server allows to meet the first condition, but it is not able to turn the router off/on. For this purpose another device need to be used, which is an APC Switched Rack Power Distribution Unit (PDU), AP8959 type [4].

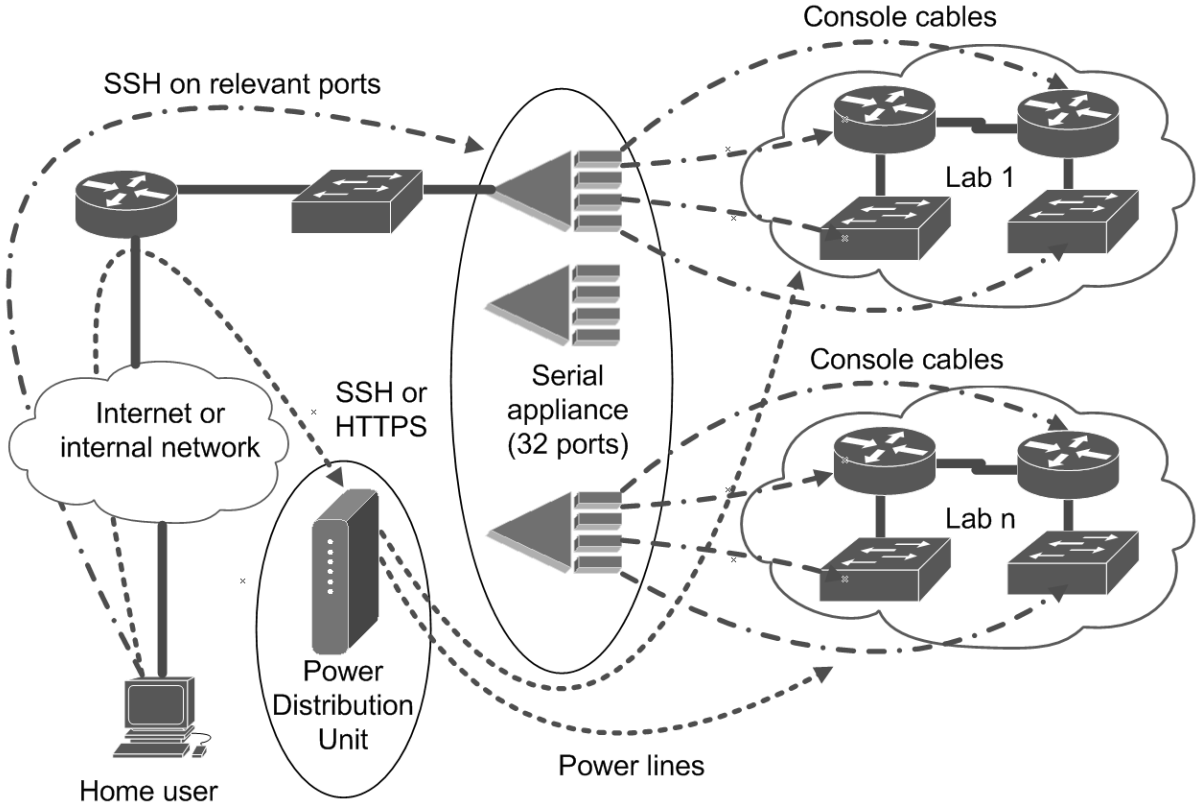

Fig. 3. Arrangement of remote access using console server and power distribution unit
Source: own

It enables advanced, user-customizable power control and active monitoring. Remote outlet level controls allow demanded power off/on functionality for power recycling. Power sequencing delays also allow defining the order in which to power up or down attached equipment. Avoid circuit overload during power recovery and extend uptime of critical equipment by prioritizing the load shedding. Current metering provides real-time remote monitoring of connected loads. Besides all, switched rack PDU includes real power monitoring, a temperature/humidity sensor port, locking IEC receptacles and low profile circuit breakers. User-defined alarms warn of potential circuit overloads before critical IT failures occur. Users can access, configure, and control switched rack PDU through secure Web, SNMP [5], or telnet interfaces and is usually complimented by APC Centralized Management. In case of laboratory remote access will be an independent application created.

The straightforward way how to recover unknown password, is following:

- remote access (using Moxa NPort 6610-32 console server) to the desired console port, i.e. to the connected device - by the same manner as if it was plugged in locally
- cycle router power off/on using the AP8959, transition to the ROM Monitor mode and boot sequence modification.

3. NEXT INTENTION

The current setting allows performing of almost all required tasks, but it suffers from management fragmentation and the cumbersomeness of use. Therefore, development of an integrated application, which should allow better comfort for students and improve teachers' ability to manage entire system, was already initiated. That application will include identification and authentication facilities, scheduling and reservation components, administrative tools for redeployment, laboratory exercises monitoring, etc.

Another objective is to get the ability of management of all devices, i.e. including password recovery on switches. The different approach will be necessary as password recovery procedure on switches is other than on routers. After the power is cycled off (power line unplugged), it is essential to press and hold the button marked Mode, then cycle power on and wait for the transition to the switch ROM Monitor. Should be it carried out remotely, it would be necessary to make a switch hardware modification (pulling out the button contacts or implement a relay and - in particular – to obtain remotely controlled trigger device). Using SNMP is also an option for full remote control including device reload [5], but it would need appropriate setting, which can not be always guaranteed.

CONCLUSION

Proposed and implemented solution enables practical remote management of real network devices. Students can use genuine laboratory equipment in the time that they want; they are not limited by working hours or depended on supervisor presence. Experimental usage takes place now; routine operation will be possible after the finishing of the application software. It is a suggestion to constantly reserve a subset of network devices, especially the older ones, for remote laboratory purposes.

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INVOLVEMENT OF LONG-TERM SICK STUDENTS TO TEACHING PROCESS

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Abstract: *Long-term sick (more than 2 weeks) students find it difficult to get materials from missed lessons; it is a practice at primary and secondary schools. This paper deals with the interpretation of results of a rather robust quantitative research of teachers and students about the transfer of the learning materials, and the potential using of LMS. In the second part this paper discusses the experiment: an absent student was involved in a lesson at school through webinar and the teacher prepared e-Learning for him.*

Keywords: e-Learning, webinar, long-term sick students.

INTRODUCTION

The long-term sick (more than 2 weeks) students find it difficult to get materials from missed lessons; it is a practice at primary and secondary schools. Students receive learning materials only after they are back at school. In most cases a sick student is able to devote himself to study for most of his duration of illness (convalescence process), only his direct participation at school is impossible. The uniform approach to communication between schools and sick students (or for another reason for long-term absent pupils/students) doesn't exist in the Czech Republic. Effective use of e-Learning could engage the absent student in teaching and shorten the time they miss the lessons in school due to their illness/absence.

A lot of authors devote themselves to defining e-Learning, e.g. [10] [9]. E-Learning places new requirements on the creator and tutor. E-Learning must contain more active and motivating elements than the classical frontal teaching, for its effectiveness. Teaching face to face is often irreplaceable. If it is not possible to concentrate teacher and students at a given time in one place, it is possible to lead teaching through webinars. Webinar was created by the word combination of seminar and web. Webinars take place over the Internet using a web browser [2]. Spoken, written and video communication takes place in both directions [7]. The teacher can also provide a ready-made presentation, or their screen to the students.

1. PERCEPTIONS OF E-LEARNING FOR BASIC AND SECONDARY SCHOOLS IN THE CZECH REPUBLIC

The perception of e-learning among the teachers in primary and secondary schools in the Czech Republic is at a very diverse level. The author conducted research at 90 schools, from 2010, which showed that 35 % of teachers perceive e-Learning only as the publication of study materials in electronic form. 40 % of teachers understand the concept of e-Learning slightly wider, in addition to study materials, they included electronic testing. Only 25 % of teachers understand e-Learning comprehensively.

In 45 % of the responding schools there is not a uniform environment where the direct teaching could be supported by electronic materials. Some teachers have their own private website where they publish materials for students at these schools. These websites have a very varied quality, in terms of form and content, and updates happen sometimes only one time a year. Websites of 35 % of schools provide space for individual subjects through which teachers can publish materials for students. It is mostly an admin system that solves the uniform design, and users can change only the content (in accordance with access rights). Only 20 % of schools have LMS that is available to the teachers. They are mostly an OpenSource Learning Management System (LMS) Moodle [6] localized into Czech. Courses led here have very differing quality. Teachers are not encouraged to give the courses in the LMS their time and effort. The finest courses contain the correct structure, time determination, motivation, active elements and discussion possibilities. The author did not find even one course that could be called a comprehensive e-Learning course in her research.

2. RESEARCH AND RESULTS INTERPRETATION

2.1 Research Methods

Research is a series of planned and purposeful activities aimed at obtaining new knowledge [3]. When planning the research it is necessary to establish the research subject, research object, research strategy, research methods and research techniques [1] [5]. The questionnaire is a structured method consisting of questions. The most important is the content and question formulation. The experiment is a classic scientific method, where the independent variables are changing and variable dependent values are observed. [8]

2.2 Realized Research

Realized quantitative research was conducted in the years 2011 to 2012. The objects of research were teachers and students. The object of the research was to determine how and whether communication between the absent students and their teachers happens, how the information and materials transmission for the missed topics happen, whether the school uses an LMS, whether the teachers would be willing to present online teaching to absent students, which way ill students spend their recovery time and whether the students would have an interest in engaging in online teaching at the time of their convalescence. The object of the research was also to find out whether schools and households have adequate technical equipment. The question formulation was simple, they were multiple-choice questions of type 1 from N. Teachers answered a total of 7 questions, students 6 questions.

Research was undertaken by 120 teachers (from 110 different primary and secondary schools) and 450 secondary school students. A dominance of teachers (60 %) has a length of pedagogical activity 6-20 years, 25 % within 5 years and 15 % over 20 years. Among the interviewed teachers dominates a (55 %) focus on the teaching of ICT subjects, 30 % are specialized in science and 15 % in humanities. 90 % of responding teachers register long absent students in the lessons. Only one third of these contacts the long-term absent students on their own. The remaining activities of the teachers leave the students. If the students or their parents contact the teacher (by phone, e-mail, or in person) they inform them about the subject matter in their absence and alternatively provide additional materials (printed, electronic).

Compared to 2010, the number of schools that have LMS has risen to 35 %. The reason may be the massive education of ICT school coordinators and the EU project money for schools within the Operational Programme Education for Competitiveness. At schools where they have LMS, it is from 90 % LMS Moodle and only 10% of schools have another system. It is always a commercially produced system, so called bespoke for each school.

Research also showed that only 10 % of teachers would be willing to mediate on-line education to absent students. 60 % of teachers see it as a very demanding activity that makes teaching more difficult and on-line education could drain the teacher´s capacity, which is needed for direct teaching. 30 % of teachers do not see any benefit in such activities.

From the 450 students who participated in the research 85 % have a computer connected to the Internet with a camera, microphone and speakers. 97 % of responding students were sometimes absent from school for more than 2 weeks. 45 % of students, from this number, several times a year. Students spend recovery time (when the illness lets up but they still can not go to school) mostly by reading and using Internet services (web sites and communications through social sites). Less they are watching TV and movies. The least they deal with creative, handcraft work (gluing models, ...) and sleeping. 98 % of students reported that they have the radio on only as an audio background.

Students were asked whether they would take advantage of the option to join the lessons through Internet and if they would prepare themselves using LMS in the time of their absence. 25 % of students would welcome this possibility with reasons that they would not have such a handicap in missed lessons after returning to school. 35 % of students said they would be willing to engage in lessons, only when they were forced to by the school or parents. 40 % of students radically rejected this option.

Research has shown that both schools and students have sufficient technological equipment. Support of teachers by school management, creating a motivating environment and an appropriate grant scheme by the Ministry of Education would certainly greatly help to expand the use of LMS by absent students in engaging in lessons. At least 25 % of students would actively use it, and it would significantly reduce the handicap in knowledge and skills created by absence of the student from the lessons.

3. EXPERIMENT

Research also monitored the type of school of respondent teachers and students. In the group of students who would welcome LMS and online involvement in lessons there were mostly students from grammar schools. Also, the teachers who are willing to devote their time to LMS and the online teaching of absent students were mostly from grammar schools. Therefore, a grammar school was chosen for the experiment. Based on qualitative research – a guided interview with 15 teachers was chosen with one particular teacher for the experiment, who is already at least partially using LMS Moodle. This teacher himself suggested two students from the same class who are people with health restriction and are often absent from lessons, but both have a high study morale and almost the same study results.

The experiment took place at a time when both students were absent from lessons, but their health status enabled them to join the lessons.

The teacher prepared complete training material in LMS, which contained metadata, well-structured text, multimedia, links to supplementary materials, practice questions and examples. There was also a chat and discussion possibility in LMS.

Approximately half of distance learning was included on on-line education via webinar. Because the school does not own a commercial system for organizing webinars, and investment in this system only for one experiment would not be effective, the option of a free web environment on anymeeting.com [4] was chosen. The environment does not require any installation on a local computer, runs in a web browser and at a limited number of participants is free. On-line education took place parallel with regular teaching in the classroom with a computer and data projector. The computer had a camera pointed at the space where the teacher and speakers were. The teacher had a microphone. The teacher projected a prepared presentation on the interactive whiteboard, which offers above-standard control options. The webinar participant – the student, saw, thanks to the camera, the teacher, heard all that was happening in the classroom, and saw the presentation on the desktop of his monitor, and had the opportunity to ask questions via a microphone. Another part of the materials was available in LMS after the on-line education.

Only one student had access to the above-mentioned materials in the LMS and participated in the described on-line teaching. The second of the selected students did not change his activity at the time of his illness. He just found out from his classmates which curriculum was discussed in school and studied at home individually from current materials. He found out from the teacher what exactly was needed to catch up only after returning to school. After that both students were tested on their knowledge of the subject matter at the time of their illnesses. The student that had available materials in the LMS and participated in on-line learning achieved an excellent rating in the test, the second student achieved only an average rating.

A final controlled interview of the teacher and both students happened after the experiment. The teacher admitted the benefits of the experiment, but stressed high time demands for preparing materials and mental demands on the education where a student is connected via a webinar. The student that participated in the experiment, appreciated the benefits and clearly said that he felt no handicap, thanks to the experiment, after returning to school. He would welcome this kind of teaching during each time of his long absences from school. The student that did not have the materials and on-line education said that the worse test outcome was also caused by the fact that he did not understand the part of the topic. The possibility of communication with the teacher would have prevented it. He also had shorter time to study the topic. The described experiment might be a suitable model for the involvement of long-term absent students in education with the target of minimalizing their study problems after returning to school.

CONCLUSION

The described research has shown that students are able and willing to devote themselves to preparation for teaching during their convalescence. Students have appropriate technical equipment at home to be present at teaching through webinars. Teachers are ready to communicate with absent students and to use the possibilities of e-Learning. Most of the teachers are reluctant to engage the absent students in teaching, but they are able to do it if they were motivated by school management. Technical equipment at schools is at an

appropriate level. Free LMS and webinar SW are available. A suitable grant project from the Ministry of Education could support the implementation of a proposed model.

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ADAPTIVE EDUCATION PROCESS SIMULATION IN ELECTRONIC ENVIRONMENT

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Abstract: *At the Pedagogical Faculty, University of Ostrava, a team of academic workers and PhD students has been specializing, within the scope of the departments research focus, in adaptive e-learning. The research is based on the pedagogical-psychological grounds of the so-called adaptive education theory that is going through adaptive modeling process before it will be tested in real education. The modeling, with the help of virtual students and study supports, should uncover possible errors in the expert rules formulation that have been formulated for assigning the ideal and real study material to the students according to their identified learning style.*

Keywords: simulation, modeling, adaptive education model.

INTRODUCTION

Today's society can be described as informational, digital, society of life-long learning, progressive, knowledge society, society of networks and a few other characteristics. One of the causes of the current changes has been the unprecedented development of science and technology in the second half of the twentieth century, especially of information and communication technologies (ICT). The development of ICT has been reflected not only in the industrial domain but also in the process of education. Besides the introduction of ICT into classic education, substantive attention has been paid to the now common electronic form of education – the so called e-learning.

We know, from classic education, that mass education at school may restrain and bore some students, while being too fast for others, who do not manage to understand everything. Some students may like the pace of education but not the education style of every teacher, which is why they give up on some teachers and subjects, leading to their unnecessarily worse results. These several reasons lead to the idea of learning process optimization through individualization of education. The individualization of education respects each student's way of learning with respect to their current knowledge, abilities, and learning style. It means, in essence, the synchronization of education pace with the time and intellectual abilities of the educated. This approach is practically impossible within full-time education in traditional classrooms. It is unreal to approach each student individually. The teacher can adapt education to be suitable for the majority of students; however, it is not in the teacher's power to adapt to each student's individuality (Brusilovsky, P., 2001).

The issues of education individualization are solvable in several various ways. From the technical point of view, it is possible to apply the principles of neural networks or expert systems. From the perspective of categorization of individualization type, it is possible to adapt the education process according to various criteria, e.g. according to learning styles, multiple intelligences, special education needs, talent, etc.

Interconnecting electronic learning and personalized education requirements leads us to the term automatic adaptive learning. We inquired if it was possible to model the automatic adaptive learning procedure, i.e. go through electronic study course that suits the student's preferences and learning style. Optimal adaptive approach will respect the dissimilarity of students on the basis of their identified learning style with respect to the changing knowledge and skills of the student during their participation in the study course. Based on the personal characteristics and skills, the students will be given study material in a form that will most suit them (Kostolányová, Šarmanová, Takács, 2010).

We assume that made-to-measure education that respects the requirements and preferences of the student, with the emphasis on positive sides of learning (we do not support superficial means of preparation, learning without understanding, etc.), will become the optimal and effective form of education. It will help to learn and retain knowledge more easily and for a longer period of time.

The theoretical basis of adaptive e-learning was published in the monograph of the same name (Kostolányová, 2012) and in many articles in Czech and foreign media (Sak, 2007; Tolingerová, 1968; Kulič, 1992). The theory is followed up by this article. Its most important part is the modeling and simulation of adaptive education process.

1. ADAPTIVE EDUCATION MODELING

In the frame of adaptive education model design, the whole process was divided into several partial problems that are solved step by step by a team of experts consisting of pedagogues, psychologists, and IT professionals. The issue of identifying skills and characteristics of the student and thereby the frame of their learning style has been – after an extensive research of information sources dealing with the field of learning styles – resolved by our own questionnaire. The questionnaire is designed to measure selected useful abilities. These are the characteristics of sensual preference, learning tactics, the depth of study material conception, etc. Combining the values of these characteristics define a certain learning style of the student.

A suitable study material is designed, tailored to the student's abilities and characteristics. The methodology of designing a study material capable of adaptation was created (Šarmanová, 2012). According to it, for each part of the explanation – so called frame – several variants are created. The variants differ in the depth of explanation, adaptation to sensory types and, finally, are structured into parts – layers, so they are able to adapt to each student. The design of various variants of study supports is more demanding for the author than the design of long-distance study material.

The adaptive education process itself will take place in the electronic environment on the basis of the identified student's learning style and the assigned most appropriate study material. The assigning of the correct study material is executed according to the entered expert pedagogical rules and with the help of two algorithms. The rules were created by pedagogues and psychologists on the basis of generally accepted pedagogical and didactical principles and pedagogical experience.

It is not possible to fully "tweak" the rules in real education – sufficient amount of adaptive study materials is currently not available (their design is much more elaborate than regular

long-distance study materials) and not all student types will be present in the education process. Therefore, an independent module was designed and implemented into the existing adaptive LMS that will allow to model and then simulate the education without real study supports. The education style for all student types was simulated in this way. We verified the correctness of elementary rules formulation and the algorithm for acquiring the so called personal education style, that is the succession of layers and depths of the study material.

2. VIRTUAL TEACHER

The information about the student's learning style – the values of characteristics determining learning style – and information about the structure of study material are the inputs into the managing education program called the **Virtual Teacher (VT)**. Its primary task is to determine the optimal means of education based on this information. For the management, VT needs pedagogical-psychological knowledge (the so-called theoretical starting points of adaptive education) based on which it compiles a detailed plan of the education process. It is the kind of expert system that contains basic pedagogical rules from which it compiles an optimal education style for a particular student and an optimal passage through a particular education material.

The education management process is demanding and for the author, teacher, and student invisible. Its modeling is pivotal for proving the correctness of suggested adaptation rules.
VT's work can be described as follows:

1. VT searches out the logged student's learning style (LS), i.e. the characteristics influencing their learning.
2. It assigns the personal education style (PES) to the student's learning style, i.e. a general procedure that will suit the student best. The optimal personal education style does not have to be equally applicable for each real frame of the actual study support. In an actual lesson, some frame variants may not exist; some frames do not have to use all layer types.
3. VT applies PES for each frame of the actual lesson, i.e. identifies the actual education style of the lesson (AES). Replaces non-existent variants and layers with the most similar ones, omits theoretical parts if there is no replacement.
4. Based on the knowledge of the optimal passage through the lesson plan, AES, the **virtual teaches manages the education process**, i.e. successively provides the student with frames of the chosen depth and sensory form and in them defined sequence of chosen layers.
5. Another VT's task is to **manage system responses to false answers of the student**. If the student answers testing questions and exercises correctly, it proceeds according to the actual education style. But if the student answers incorrectly, the situation has to be resolved accordingly, namely in the context of the actual situation.
6. Recording the education process.

As entry questionnaires testing the students do not always have to be reliable or pedagogical rules may not have been optimally set, the system allows the student to manage the education by themselves. The student can open individual parts of education in a different order than the one offered by the system. In order to reflect on the information about the progress of education, managed by the system or modified by the student, the virtual teacher records all student's steps into the so called **protocol**. The protocol also records the time spent over individual parts of education, time spent thinking over an answer, time spent solving an

exercise, the student managed change to further part of education and digressing from the order set by the system. The protocol is an important source of additional information. With its statistical evaluation, it is possible to obtain feedback about individual students, student types, education material quality, and the correctness of rules and managing algorithms of the virtual teacher. The protocol analyses results can retroactively influence all this information and gradually improve the quality of system's functions.

3. VIRTUAL TEACHER FUNCTION MODELING

To fully tweak the first three virtual teacher functions (model and consequent simulation of recommended education), we need to define all basic virtual student types and all variants and layers of an education support.

Virtual students are assigned learning characteristics. The combination of their values (2–4 values for each characteristic) provides approximately 2000 possible student types. For these types, individually or grouped by the same value of one or several characteristics, we then simulate education. **A virtual support** is modeled only with the help of their metadata.

We decided to create our own modeling tool suitable for the solution of our problem after the background researches and analyses of modeling tools. The tool uses the already mentioned expert rules and algorithms to determine PES and AES. It can visualize the advance through study material for different student types and allows their education style check. At the same time, it is also the basis for the analysis of the frequency of advances through individual parts of the study support. Special method of visualization of the PES and AES result displays a template of all theoretical variants of one frame (sensory perception and explanation depth) with all possible layers. As a polygonal chain connecting individual layers in the suggested order and depth (see Fig. 1) it draws into the template the procedure of education suggested by the virtual teacher.

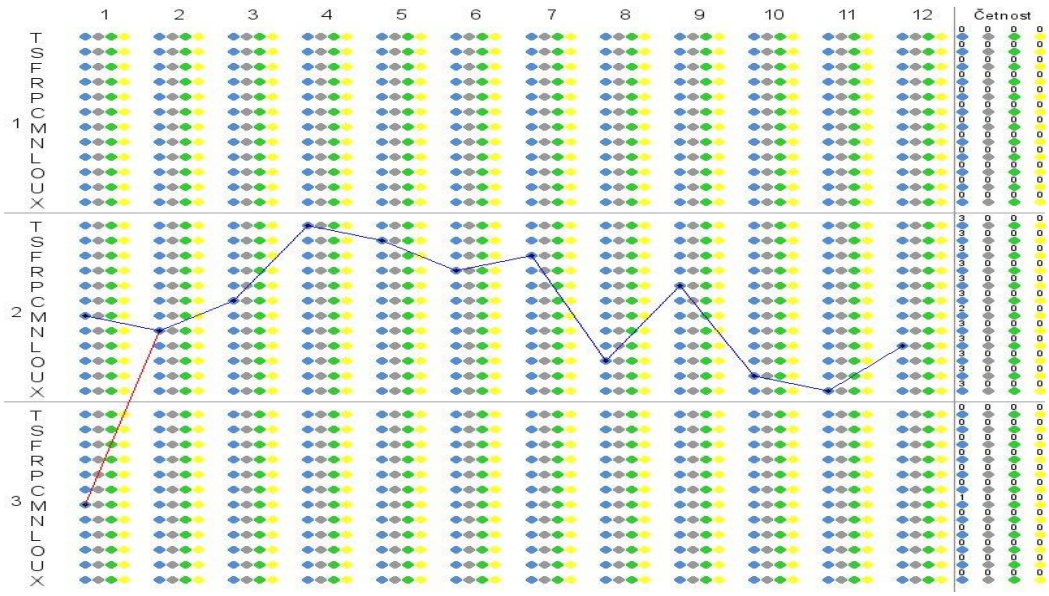

Fig. 1. Visualization of personal education styles of average students with different motivation to study
Source: own

The graph is then called the adaptive education process trace, in short the **education trace**. Each trace corresponds to one education style for one student type. The tool can draw more education traces with a common parameter (individual learning style characteristics can take place of the parameter).

4. IMPLEMENTATION OF MODULE FOR ADAPTIVE EDUCATION SIMULATION

A new function called *Education model* has been designed and implemented to set a particular simulation. It enables the user to choose one student or a group of students, choose a particular education method and start the simulation. The algorithm for the determination of PES is used for it, which is the first tested object.

For pilot modeling of education process, the elementary rules are tested first; therefore, individual abilities of the student are included gradually into modeling, not all at once. The chosen characteristics were motivation, learning conception, learning depth, self-regulation and success rate. Values of individual characteristics are set mostly to three values (0, 50, 100 or -100, 0, 100): minimum, average and maximum.

We use **complete study support** (substituted by metadata) with no missing variants and layers for the modeling of functionality and correctness of all elementary rules.
Modeling procedure of the individual elementary rules:

- education simulation for the student "average" in all characteristics (their PES should be the classic means of education used in most textbooks),
- education simulation with the change of the tested characteristic value to high and low and the check of functionality and correctness of suggested expert rules. This procedure is chosen for one student at first, then for a group of students with the given value of the monitored characteristic and other characteristics on average,
- if the graph does not correspond with the expert's concept of PES, an error is registered (an incorrectly formulated expert rule or incorrect PEStyle algorithm function).

The same modeling tool verifies if the rules are correctly proposed even for the case when it is necessary to combine several rules corresponding to various student characteristics. The combination of two, three and four characteristics in all variants was gradually selected for modeling. E.g. for two characteristics – motivation and auto-regulation the following combinations were tested: average values of motivation and auto-regulation; low motivation and high auto-regulation; high motivation and low auto-regulation, etc.

In the course of elementary expert and compound rules modeling, no errors were found in the rules or PEStyle algorithm. However, problems related to the combination of two particular characteristics appeared, namely the depth of curriculum and the student's success rate. The situation was not sufficiently and appropriately analyzed from the pedagogical point of view; there are some deficiencies in the rule formulation according to the preferred curriculum conception in connection with the student's success rate. The deficiencies were solved by pedagogical consideration at first and then by the rule reformulation and the introduction of priority rules.

5. MISSING VARIANTS AND LAYERS SUBSTITUTION MODELING

The AEStyle algorithm functionality and correctness was tested during the second stage of modeling. In real education, VT does not have the ideal study material that would contain all layers in each variant of explanation at its disposal. During the third stage of modeling, we focused on the use of correct substitutions of variants and study material layers if we do not have theoretically complete study support at our disposal.

In the algorithm determining AEStyle, it was necessary to map the situation of existing variants and layers and in the case some of them were missing, to deal with the situation: substitute the missing layer with a different "closest" one if it exists or omit it altogether if it does not exist in any other variant.
In the template, the missing parts will be marked with a small black dot; existing layers of corresponding variants remain in color (see Fig. 2).

Fig. 2. education trace with missing layers of motivation and navigation for unmotivated students with low auto-regulation value
Source: own

Experiments proved many correctly implemented substitutions or layer omissions except for the following exceptions:

- during the substitution of missing layers, they were faultily duplicated, instead of omitting the repeated layer
- in the case of missing preferred sensory variant, the substitution was carried out with a different sensory variant, not with the second most preferred one.

The identified errors were eliminated by the layer duplication check and by abolishing the repeated layer in AES. The AEStyle algorithm was corrected in the way that the missing sensory layer is replaced by the second most powerful sensory variant in the order given by the student. In connection to this, the situation with some identical sensory values of the student was resolved: the substitution is in this case searched for "from left to right", in other words, the substitutions are searched for in the order: verbal → visual → auditive → kinesthetic.

CONCLUSION

The original modeling tool, designed and implemented to simulate the education process without the need of creating real study supports and of participation of real students, fully proved its function. It allowed to simulate the compilation of a personalized adaptive study support for all basic virtual student types and expertly prove their correctness – agreement with pedagogical principles formulated in the theory of adaptive education by an expert.

To conclude, we can state that the modeling of virtual students and virtual study supports, the simulation of preparation of education process with their help and, finally, the visualization of the resulting personalized study material, was successful and uncovered some errors.

Without the mentioned simulations, the tweaking process of expert rules and virtual teacher functions would most probably take several years. The tweaking based on real students and adaptive supports would require participation of all student types (from the point of view of their learning styles) and existence of all types of study supports. As the compilation of adaptive supports is highly time consuming, the willingness of authors to compile them just for the adaptive education tweaking cannot be expected. Some errors could therefore have remained uncovered for a long time.

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GESTURE RECOGNITION TECHNOLOGIES IN EDUCATION

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Abstract: *The paper includes a description of the contactless interface technologies by example of Kinect sensor, Samsung Smart TV and Leap Motion Controller, showing both their capabilities and weaknesses. Based on the existing applications and authors' Kinect programming experience we present both OpenNI and Microsoft SDK capabilities. Last part of the paper is focused on the discussion on the use of contactless interfaces in the classroom education and the distance education.*

Keywords: Gesture recognition technologies, Kinect, Samsung Smart TV, Leap Motion, Software Development Kit.

INTRODUCTION

The emergence of Kinect motion sensor in 2010 was a substantial step in the development of interfaces. There are two main factors which essentially lead to the contactless interface: control via voice and gestures. This device was initially available only for the Xbox console and had no interface for programmers. It seemed that Kinect was build first of all for casual gaming and its main use is jumping in front of the screen. Since then, the contactless interfaces are implemented also in television technology, such as the Samsung Smart TV. According to the 2012 NMC Horizon Report [9] released by the New Media Consortium and the Educause Learning Initiative, gesture-based computing is one of the 6 ideas which may change the face of classroom learning in the near future. The others are: Mobile Apps, Tablet Computing, Learning Analytics, Game-based learning, and Internet of Things. The goal of this paper is to carry out a critical analyze of these issues.

1. SOME GESTURE RECOGNITION TECHNOLOGIES

1.1 Kinect

Kinect (originally called Project Natal) is a kind of devices, which provides a Natural User Interface (NUI) [1]. It means that we may interact with Kinect using body motion, gesture and also verbal communication. The main components of the Kinect are:

- **color camera** - it is responsible for capturing the color video stream (from 30 frames per second at resolution of 640x480 pixels to 12 FPS at 1280x960)); vertical and horizontal view ranges are 43 and 57 degrees, respectively;
- **depth sensor** - it consist *Infrared (IR) emitter* and *IR depth sensor* (PrimeSense's technology [11]) the infrared light in a 'pseudo-random dot' pattern is projected to the

objects and the reflected stream is caught by the IR sensor - the depth information is calculated at resolutions of 640x480, 320x200 o 80x60 pixels, with precision 1mm;

- **array of four microphones** - it allows to identify the source of the sound and recognize the voice;
- **tilt motor** - main unit of the Kinect is tilted vertically on the base to the correct position of the human skeleton within the room.

Fig. 1. Kinect sensor
Source: http://xbox.about.com/od/projectnatal/ig/Microsoft-Kinect-Image-Gallery/

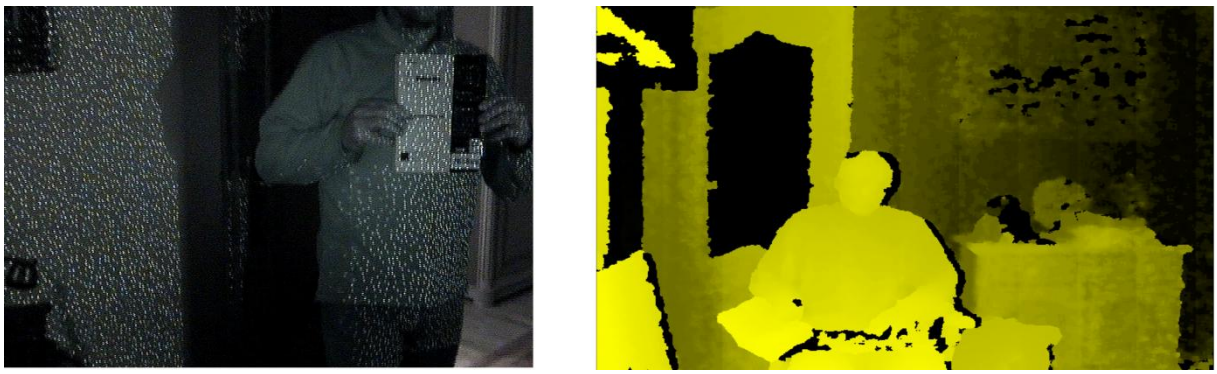

Fig. 2. IR pattern (left) and depth image (right)
Source: own

Kinect is one of the top 5 fastest selling consumer products ever. Capabilities of the Kinect are described in the section 3.1.

1.2 Samsung Smart TV

Generally speaking, a smart TV (’smart’ like ’smartphone’) is a TV set or a top-box device integrated with Internet capabilities. From technical point of view this means, that there is some hardware build-in TV set (dual-core processor, camera and microphones) and some software installed in the TV set memory (a kind of an operating system), that allow running advanced applications. In such a way we get access to many network services previously available only on computers or smartphones. Nowadays common capabilities of the Smart TV are:

- Access to user-generated content (UCC) and interactive network applications;
- Search the Web resources, the local cable or satellite TV channels and the local storage drives;
- Control through natural user interface: motion control, voice control and face recognition.

Samsung Smart TV is one of several Smart TV platforms which are available at the present time. It this case users can turn on (off) a TV set by voice command (it is possible to use about 30 languages) and login into their personal profiles using built-in cameras to face recognition. Then, it is possible to issue voice commands like ’channel 3’ or ’guide’ to control the TV. Finally, they can also use gesture controls for Web browsing, adjusting the volume and more. They may activate gestures recognition in any time by swiping with an open hand facing directly to the TV. As you can see, some Smart TV capabilities are very similar to those in the Kinect, but it use only 2D camera to hand motion detection. People who tested gestures with this device found that this technology requires still more work to be effective and usable.

1.3 Leap Motion Controller

As can be found at Leap Motion home page [7] the idea of this sensor comes from frustration with 3D modeling - molding clay took 10 seconds in real life but 30 minutes with a computer (keyboard and mouse). It uses infrared light to calculate depth information in the volume of 8 cubic feet (60x60x60cm). Its most spectacular feature is a precision, that is equal to 0.01 mm. Main purpose of this sensor is to tracking of fingers. So, Leap Motion sensor can solve problems that are impossible to be solved by the Kinect. The Leap Motion Controller will begin shipping the week of May 13.

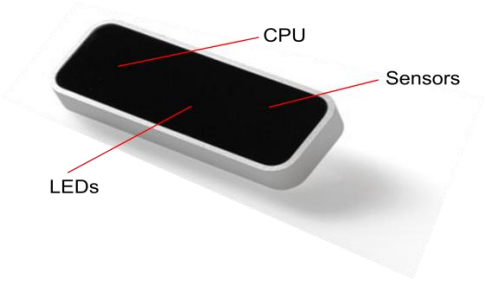

Fig. 3. A photo of the Leap Motion sensor
Source: http://www.trollingstones.net/leap-motion-may-be-the-world-most-precise-motion-sensing-technology/#!prettyPhoto-1797/0/

2. HOW TO USE THESE MOTION CONTROLLERS?

2.1 Kinect SDK’s

The real potential of Kinect equipped with both the color camera and depth camera (Zbufor) coupled with motion sensor were revealed after releasing of two versions of the SDK (Software Development Kit): Microsoft and OpenNI. They enable developers to use C++, C#, Visual Basic (Windows) or Java (OpenNi) to create applications.

The *Kinect for Windows SDK* (the current version (v1.6) was launched in October 2012), runs only on the Windows operating system (Windows 7,Windows Embedded 7, Windows 8). The Kinect for Windows sensor will also work on Windows operating systems running in a virtual machine such as Microsoft HyperV, VMWare, and Parallels [1]. The minimum configuration required for programming using Kinect for Windows SDK includes the following components: Dual core 2.66 GHz processor, dedicated USB 2.0 bus and at least 2 GB RAM. Moreover, for development we need the following software:

- Microsoft Visual Studio 2010 Express or higher editions of Visual Studio,
- Microsoft .NET Framework 4.0 or higher,
- Kinect for Windows SDK.

It is worth noting that actually there are two kind of Kinect now: for XBox and for Windows. There are a few differences between them from developer's point of view. Generally speaking, Kinect for Xbox is mainly for gaming purposes and the one for Windows should be used for application development. Moreover, if we want to develop a commercial applications we must (have to?) use Kinect for Windows device. However, the most important is that Kinect for Windows can work in *Near Mode*, which means it is enable to track objects as close as 40cm in front of the sensor. It is quite good for hands tracking. In the case of Kinect for Xbox the smallest depth value that the Kinect SDK returns is 850mm. The most important features of Kinect for Windows SDK are [1]:

- capturing and processing the color image data stream,
- processing the depth image data stream,
- capturing the infrared stream,
- tracking human skeleton and joint movements,
- human gesture recognition
- capturing the audio stream,
- enabling speech recognition,
- adjusting the Kinect sensor angle,
- getting data from the accelerometer,
- controlling the infrared emitter.

It is also necessary to mention that Kinect may be used as a 3D scanner. This possibility is based on Kinect Fusion - a tool for reconstructing a 3-D model of an object by combining a continuous stream of data [12]. The Kinect Fusion will be soon included in Kinect for Windows SDK. According to [10] 'the OpenNI framework is an open source SDK used for the development of 3D sensing middleware libraries and applications'. It may be installed on Windows and Linux systems. Until now the OpenNI drivers (current version 2.0) do not support yet all of the necessary features of Kinect for Windows, so they work only with Kinect for Xbox. Particularly we have not the *Near Mode* here. The OpenNI SDK work together with many additional middleware libraries, tools and applications. The most important middleware is the PrimeSense NiTE, that includes many advanced algorithms for computer 3D vision. It supports a few hand gesture types: click, wave, swipe (left and right), raise, move. As you can see it does not support fingers detection directly. However, there are two solutions of this problem.

The first one uses two Kinect devices located 1 meter above the desk, to avoid problems with occlusions [15]. It is provided with an open API and a number of example applications. The second one is based on two research papers [3, 4] and was developed in the Computational Vision and Robotics Laboratory, ICS, FORTH [5]. In this case we need only one Kinect and to initialize fingers tracking we have to move the hand to match the virtual hand on the screen. Weakness of these solutions are a need to buy two Kinects, and an unsatisfactory precision, respectively.

2.2 Samsung Smart TV SDK

If we want to create applications on Samsung Smart TV platform we need SDK (current version 4.0), that includes: Eclipse based Editor (HTML, CSS, JavaScript), GUI Editor, TV Emulator, Dubugger and the S Client Emulator, a tool for testing applications on remote TV Emulator servers [13]. It is possible to programming on Windows, Linux and Mac OS X platforms. From programmers point of view there are 3 main categories of application: Basic Application (to create it is enough to work with Visual Editor), JavaScript Application and Flash Application. The Samsung Smart TV SDK enables recognition a few basic gestures: flipping, pointing, and grab (closing). A new SDK (2013) also includes more advanced gestures. It is possible to use two hands to zoom and rotate, make thumbsup to press 'like' button on Facebook and much more. The gesture control functions work in the range from 1.5 to 5 meters in standard light conditions.

2.3 Leap Motion SDK

We are still waiting for this sensor, so until now we have no experiences with Leap Motion SDK programming. However, there are quite many developers who already tested the sensor in many environments like game engines, software for graphics and augmented reality software. The results can be easy found on Internet.

3. GESTURE CONTROL IN EDUCATION

There is a wide range of Kinect's applications: entertainment, health care, robotics, security systems, education and many others. Let's have a quick look at the possibility of using these technologies in learning process. Educational applications can be grouped according to several criteria. From a technical point of view it can be distinguished:

Applications that require tracking fingers - their precise implementation is possible only with the Leap Motion in the area close to the sensor. Kinect technology can be leverage only in cases where less precision is allowed. Nevertheless, in both cases, the required distance from the sensor is relatively short. A good example is the implementation of the virtual chemical laboratory in which the tracking of the whole body is not necessary, but precise grasp of objects, for instance to pour liquid into flasks, is required. It is possible (and necessary in this case) to enrich the scene with the virtual objects - we call such a system an augmented reality. The simplest technique for creating an augmented reality is so called markers. In fact their implementation requires only the color camera. Markers are usually square patterns that may be recognized and tracked by camera (we use here specialized algorithms for feature detection in images). Then, a three-dimensional virtual object can be put into their location. Leap Motion technology makes markers unnecessary in the area close to the sensor.

Applications that require tracking the skeleton - it is currently only possible with Kinect, wherein the Kinect for Windows SDK provides a bit more accurate algorithm than the OpenNI SDK, locating and tracking 20 human skeleton joints. Typical example in this area is a virtual room, in which we track one or two humans. Additionally we may substitute a real human with an avatar (the whole body or any of its part). It is quite natural to implement an augmented reality in this case as well. Although we can track people doing, for example, physical exercises, the tracking precision is still not quite satisfactory.

Applications that only require detection of simple gestures in the plane parallel to the screen - in addition to the Kinect we may also use here Samsung Smart TV camera. As an example, we have here a Flash-type application, integrated with camera, in which we may control a 2D menu by gestures.

Another criterion may be the age range of the target recipients. Based on the data from the web page [8] we can see the following quantities of Kinect-based educational application in different age groups:

- age 0-5**: 20**,
- age 5-10: **90**,
- age 11-13: **52**,
- age 14-18: **24**.

Evident that educational opportunities of the Kinect first of all are addressed to age group 5-13, people who still need to have fun. This confirms that the Kinect is a device used primarily for entertainment.

As it comes to teaching subjects we can see a sharp domination of the applications related to science, mathematics and language art, but lack of applications for chemistry. It probably results from the aforementioned need to precise tracking of fingers.

In the group of applications for mathematics, more than 50 percent are for 5-10 year old children, indicating that they have rather simple learning scenarios and gestures are limited to the plane parallel to the screen. In the language art group most of applications are for older age people. As expected, there exists many applications related to physical activities - sport and dance. For geography and history we see slightly fewer applications because they require precise and nontrivial scenarios, combining substantive knowledge with physical activity.

A separate group of applications is made to help people with disabilities. In this area capabilities of the Kinect are practically unlimited, although this does not mean that there exists many adequate applications. The reason follows from a need to develop subtle scenarios, which require understanding of Kinect capabilities. Even more difficult is to develop applications supporting rehabilitation of non-motor functions.

To complement the subject, it is worth to emphasize that in the group of adults the potential use of Kinect focuses on developing physical fitness and control of the process of training in various disciplines. A lot of these applications can be found at [6].

A few selected examples

Reh the Dragon, a rehabilitation application that transforms tedious rehabilitation exercises for children into a fun and engaging game-like adventure. This project was made by students from Team Flexify (Adam Mickiewicz University in Poznań, Poland) and won the third place in thy category **Kinect Fun Labs Challange** at Imagine Cup 2012 (Sidney) - a Microsoft's premier student technology competition (see http://www.youtube.com/watch?v= eavePuYiOkc).

Dev Kit and Single Camera – the video available at http://www.threegear.com/ getStarted.html shows capabilities of the 3GearSystem's Development Kit - in particular

finger-precise hand-tracking. The API is free for academics, hobbyists and small commercial entities.

KinectMath – an another application made for Imagine Cup 2012 (Washington University, Bothell). It opens a new perspective to teaching mathematics, demonstrates an interactive way for teachers to teach abstract concepts and gives the students an easier way to visualize the mathematical concepts by using a real time display (see http://youtu.be/5GXdNQzoPrk).

River Crossing – provided by Kinems a Kinect educational game for younger children with many scenarios and levels of difficulty. This application is available for download at http://www.kinecteducation.com/blog/2013/02/12/kinect-educational-app-river-crossing-by-kinems/.

NI Mate - a real-time motion capture and sound control tool, that enables capture data from an OpenNI compliant device such as the Microsoft Kinect, Asus Xtion or PrimeSense Carmine and turns it into two industry standard protocols: OSC (Open Sound Control) and MIDI (Musical Instrument Digital Interface. Demo), that shows a scene with avatars is available at http://www.ni-mate.com/case/case-study-1/.

Many other examples are *available on web portals:* http://www.microsoft.com/education/en-us/products/Pages/kinect.aspx#3, http://www.xbox.com/en-US/xbox360?xr=shellnav and http://apps.kinecteducation.com.

CONCLUSION

In conclusion, it should be noted that, although the potential for the use of motion sensors in the education is huge, the preparation of a valuable educational applications requires a lot of effort and should be implemented in the following stages:

1. Writing a scenario taking into account the motion sensor capabilities - the cooperation of the teachers and developers is strongly needed. The experience of one of the authors, who was for a time involved in the project for a virtual chemical laboratory based on Kinect technology indicates that this step is crucial to the ultimate success.
2. Implementation of the project cost estimate - a scenario, graphics (including animations) and audio files and application's code.
3. Proper testing of the applications with end-users.

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E-LEARNING SUPPORT IN ENGINEERING EDUCATION OF ROBOTICS SPECIALISTS

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Abstract *The study programme "Industrial Informatics" at the Faculty of Electrical Engineering and Information Technology at Slovak University of Technology educates professionals in the field of robotics. Several e-learning courses developed in e-learning system Moodle are used in the education. In these courses students learn about electrical circuits, transient phenomena in electrical circuits, processes of measurement and control of electrical parameters in electrical circuits. The paper presents special resources used in these courses prepared in MS Excel, LabWindows/CVI and LabVIEW software. In measurement interactive applications created in LabVIEW students learn about measurement methods of various variables, measurement errors and some measuring instruments. Simulation programs available in Moodle could be simply adapted for real measurement and used during practical exercises too.*

Keywords: e-learning, Moodle, LabVIEW, electric circuit, interactive animation, simulations of instruments, heterodyne spectral analyzer.

INTRODUCTION

Robotic and control systems used in area of industrial informatics or cybernetics may be simple, but also very complicated equipments. The entire system contains sophisticated electronic circuits as well as complex mechanical elements. Quality of operation of the equipment then depends on reliability, accuracy and appropriate functionality of both mechanical and electronic elements. Designer of an operative robotic system or control system should have deep knowledge from several disciplines to be able of invention needed during creation of new equipment. Constructers are faced with electrical parameters of designed equipments. They need to know how electric circuits operate and how they are influenced by properties of power supply, how the equipments behave in the case of failure, how accurate the output values could be for different types of circuits used and so on.

For education of robotic experts it is necessary to pay attention to a series of problems of mechanics, electronics and measurement. The role of teachers in this field of education is to help students to get complex view about design of equipment. The first step is study of circuit's theory. This is the open gate to construction of own devices. The area of measurement of electrical and non-electrical quantities, measurement accuracy determination is next important part of accurate devices design. Those are areas we are dealing with at our Institute of Electrical Engineering. Several subjects have been created for study programme "Industrial Informatics" at our institute during tens of years. We teach subjects "Electrical Engineering", "Measuring Information Systems" and "Measurement Methodology" in bachelor study programme. Subjects "Electrical Engineering" and "Measurement Information Systems" are included in the second year of bachelor study while the subject "Measurement

Methodology" in the third year. Students gain first hands-on experience with electric circuits and measurement especially during practical exercises. The subjects dealing with measurements introduce students into the area of measurement. So they deal with basics of measurement methods and errors, description of special measurement devices like a digital multimeter, analogue and digital oscilloscope, PC based measurement procedures, hardware and software. Many practical experiments should be accomplished during the lessons and therefore knowledge of many fundamental issues is expected. We pay attention to this area therefore a special team of teachers was created oriented on teaching measurement methods for several study programmes. For the program Industrial Informatics e-learning courses have been created to ensure high quality of education and to enable students to get prepared in advance for exercises. Finally e-learning is not used only for subjects related to the measurement but also for subject oriented on electrical theory and circuits. Moodle e-learning environment has been used for years at our institute. In this paper we would like to discuss special resources used in these Moodle courses prepared in MS Excel, LabWindows and LabVIEW software, which have been employed for improved teaching process.

1. MOODLE

E-learning is good answer to question how information technologies involved in education process. For e-learning state-of-the-art is system Moodle [1]. Two e-learning portals exist at the Faculty of Electrical Engineering and Information Technology at Slovak University of Technology in Bratislava available on following links: http://kme.elf.stuba.sk/moodle [2] and http://elearn.elf.stuba.sk/moodle. There are many reasons why Moodle is so popular and several possibilities how to support a teaching subject using Moodle tools. It is easy to establish special window of content for every topic, to present PDF or DOC documents or to add illustrative images. Besides materials for study other activities like animations, tests and quizzes can be added. If special animation is needed to clarify some technical principle, Flash animations could be used [3]. Teacher in role of editor of e-learning subject can simply publish complete dedicated applications downloadable for students.

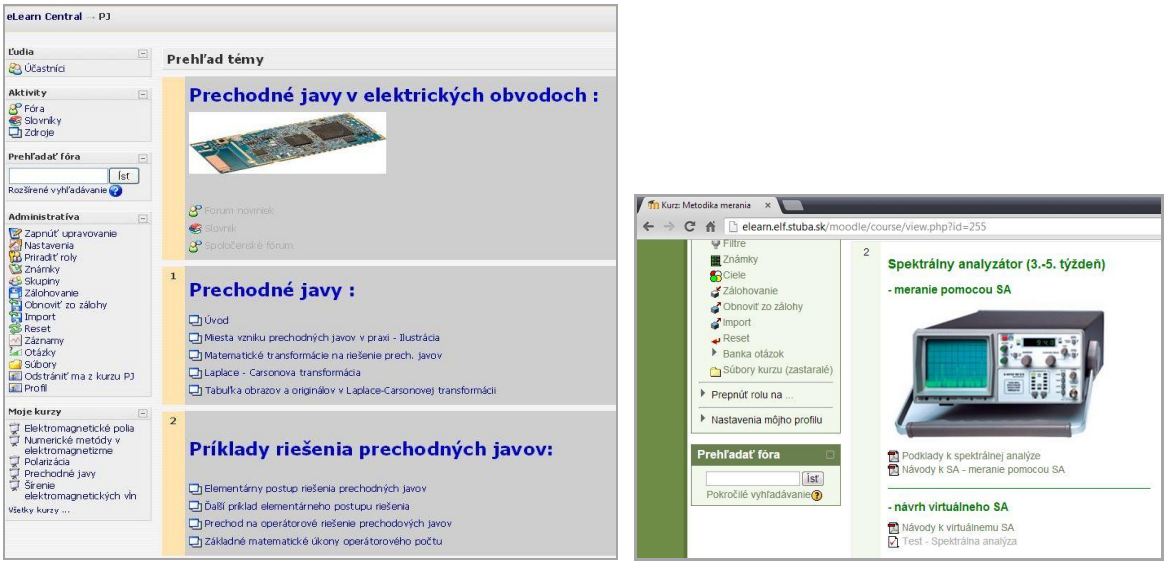


Fig. 1. View of the course "Transient phenomena" and "Measurement Methodology"
Source: own

In Fig. 1 we can see snapshots of two examples of our e-learning courses. The course "Transient Phenomena" available for the subject "Electrical Engineering" is published on the portal http://kme.elf.stuba.sk/moodle while the course "Measurement Methodology" is accessible from http://learn.elf.stuba.sk/moodle. Despite the fact that those courses are built in identical software environment the appearance is quite different using simply other visual theme. However interactivity of Moodle environment gives the teacher more tools not only to bring important information toward the students (like in shown examples) but also to get feedback of their understanding of the issue, e.g. interactive self-testing modules.

2. SPECIAL RESOURCES USED IN E-LEARNING

Besides materials given in a form of documents many additional resources has been created by our teachers or even by students to improve education process. Such special applications involve models of real circuits, practical measurement problems, evaluating of measurement errors, etc.

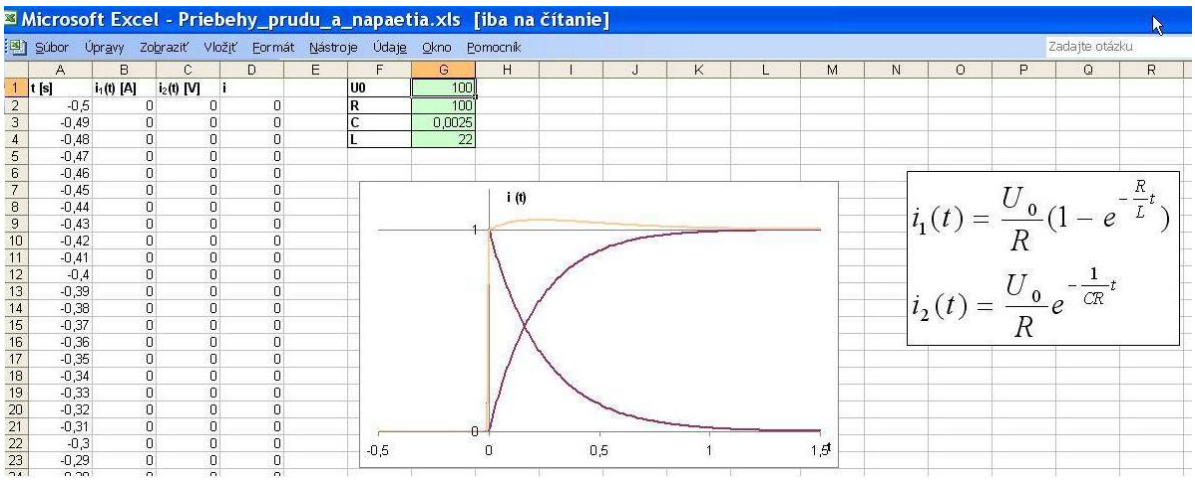


Fig. 2. The solution of an exercise using Excel
Source: own

Several special software aids have been created during years of development of e-learning courses. The simplest form is represented by spreadsheets prepared in Microsoft Excel environment, Fig. 2. Excel spreadsheets are simple to use as spreadsheet application are common among all PC users. Then it means no problem for students to make some changes to given parameters or tables and to immediately observe how the changes affect results or shapes of curves depicted in graphs. Such tool is useful especially for understanding of fundamental theoretical rules.

Understanding of concept of errors and accuracy is the bare expectation for successful completing measurement subjects. Therefore there is a necessity of building interactive graphical applications which could help to correctly perceive the concept of measurement error. Several animations have been developed especially in program LabWindows/CVI (from National Instruments) [4]. As depicted in the Fig. 4 the application considers accuracy parameters of a real specific devices like e.g. presented digital multimeter GDM – 4185 or multimeter HP 34401A. The application could be downloaded and installed on the own PC by several simple steps.

3. LABVIEW APPLICATIONS

Software tool LabVIEW [5] is widely used in measurement applications because it is designed as a high level programming language and supports lot of measurement hardware. For creation of measurement courses LabVIEW offers many libraries oriented to measurement, communication, data processing etc. It also supports lot of measurement hardware therefore it is widely used in teaching process. Our students get familiar with this environment during practical exercises where real experiments are performed.

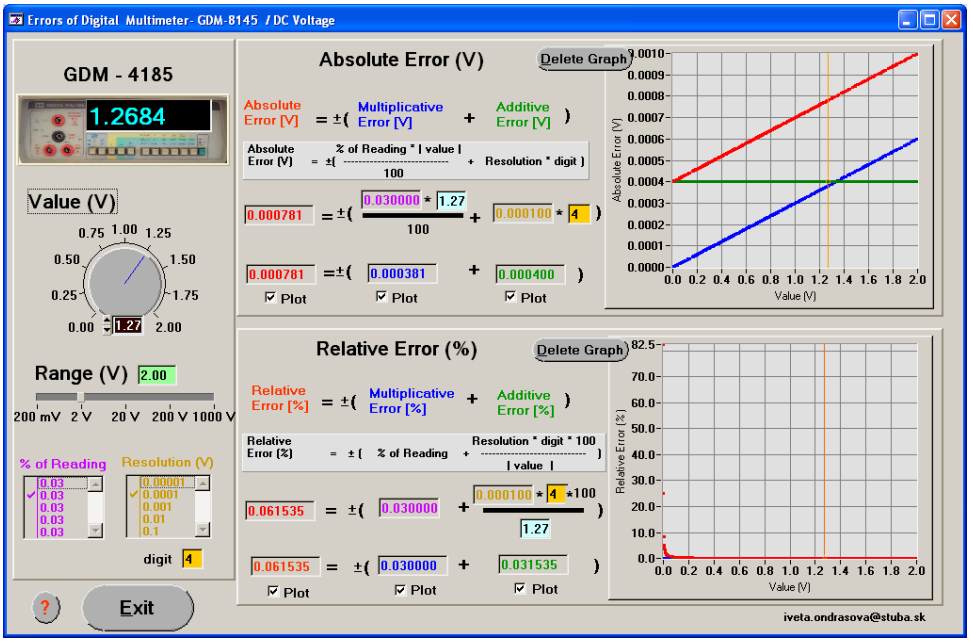
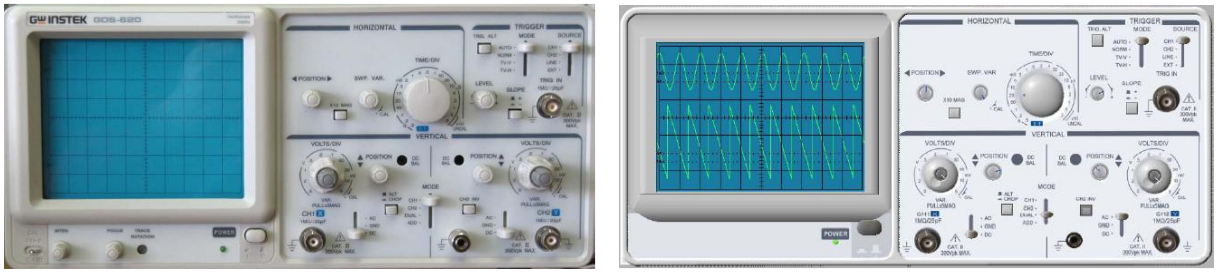


Fig. 3. Evaluation of measurement error for digital voltmeter
Source: own

However there are also simulation blocks available in LabVIEW libraries which make it possible to run applications even in simulation mode. Simulations could be inserted into Moodle course and help students to get prepared for incoming topic or to understand measuring devices and related complicated processes or technologies. Programs once available in Moodle could be simply adapted for real measurement and used during practical exercises too. Thus LabVIEW becomes important tool improving quality of our courses.



a) b)

Fig. 4. a) Real oscilloscope GOS 620 and b) Simulated oscilloscope in LabVIEW
Source: own

Oscilloscope is considered as the best instrument in displaying waveform of signal. Students must learn to work with oscilloscope in the first part of a measurement course to be able to participate later on more complicated measurements. The oscilloscope is a relatively complex device that requires some skills for its proper use. It is an example of a device for which a LabVIEW simulation could substitute a real unit. Our laboratory is equipped with the oscilloscope GOS-620 [6] (Fig. 4a), but it is available for student only during lessons. To provide more time working with the device of a virtual oscilloscope of this type has been created in LabVIEW as a bachelor thesis [7]. It is available in Moodle and after downloading LabVIEW Run-Time Engine has to be installed before opening the program. As could be seen from Front Panel of the application shown in Fig.4b even visually the simulation truly imitates the real GOS-620 and allows students trying almost all the features of a real oscilloscope.

Several animations or simulations have been created in LabVIEW for our measurement courses. Examples are simulation of voltmeter – ammeter method of resistance measurement [8], calculation of signal integral characteristics and of waveform factor depending from the waveform shape, amplitude and offset, etc. Especially in our advanced measurement subject "Methodology of Measurement" taught for specialization "Industrial Informatics" LabVIEW is used more extensively. The topics of this subject consist of: Multimeters, Logic analyses; Spectral analyses, Communication with measuring devices and Temperature measurement in closed control loop. For all of those topics design of LabVIEW application is one of task for students. They need to deeply understand principles of device functionality to be able to create their own virtual measurement device. This would be difficult task without previous handling with simulation application.

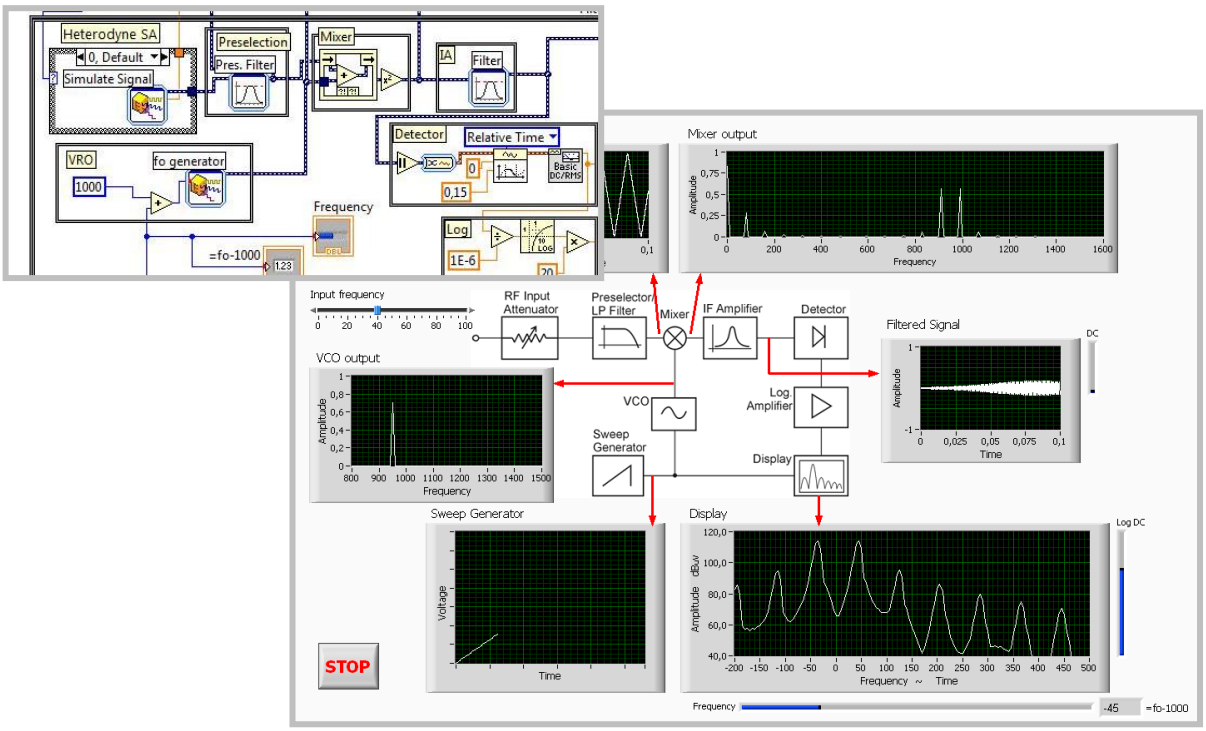


Fig. 5. Spectral analysis in LabVIEW
Source: own

In Fig. 5 front panel and block structure of heterodyne spectrum analyzer simulation application is depicted which is published in Moodle course. Front panel arrangement

includes block structure of heterodyne analyser and signals from several points of the measuring channel. Parts of block structure of the program are separated in the way that individual blocks could be distinguished here too. From this simulation program student learns how to realize e.g. mixer or intermediate frequency (IF) amplifier, how the blocks work together and what are important properties of entire virtual device. Similar program but using real data acquisition card is then created by students during exercises. This way of study may lead to better understanding of the principles and help to obtain skills with measuring (or other) hardware used in connection with PC application.

CONCLUSION

The paper presents special resources used in e-learning courses in our institute prepared in MS Excel, LabWindows and LabVIEW software. E-learning courses were established to support practical exercises in full-time study of subjects taught at our institute especially for study program "Industrial Informatics". Main topics of the subjects involve electrical circuit's theory and problematic of measurement. Courses are built in Moodle e-learning system. The interactivity of Moodle environment gives the teacher the right tool to bring important information toward the students and to get feedback of their understanding of the issue. However several additional software resources have been employed during years to improve quality of education of critical topics. LabVIEW software is inevitable tool for practical exercises in measurement subjects as it has support for most of today's PC based measuring hardware. Software libraries include simulation function which makes possible to create programs in simulation modes. Such demonstration applications have been published within e-learning courses and after download they could run on individual PCs of students. This helps students in preparing for exercises and to understand given technologies. Students then design their own virtual measuring devices during lessons using real measuring hardware and perform real experiments on it. As an example of this kind of device principal study a simulation of heterodyne spectral analyzer has been presented in the paper. More similar applications have been just integrated into teaching process and we hope, that it will improve knowledge of students and their sympathy to given topic.

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DATA CREW BOX FOR COMBAT VEHICLES

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Abstract: *The paper deals with the design and simulation of the new concept of Data Crew Box for combat vehicles. A crew box interconnects a soldier system and other systems with the communication gateway of the vehicle (this gateway includes intercom and data services). Complete system is based on only one multifunctional unit. This unit can be configured by its firmware to fulfil the needs of the latest combat vehicles allowing the number of crewmen and radios, functionality and adaptability to be tailored to the required environment. This software defined system uses digital audio signals to enhance speech quality and intelligibility (it converts analog voice and PTT from the radio to VOIP packets and conversely). The system also serves as an Ethernet switch to exchange IP frames between the soldier system, the radio, the other crew boxes and the vehicle interface (like BMS). The system follows the principles of VETRONICS. The main idea of that next generation system, the basic unit and its selected functions are going to be briefly described in this paper. The paper is also going to show the simulation configurations of that data based system.*

Keywords: CAN, Combat Vehicle, Data Bus, Data Communication, Ethernet, Intercom, VETRONICS.

INTRODUCTION

Combat vehicle systems process huge amount of data that can be provided to each other or this data can be also stored in the board system memory, which is assessed after the end of a combat action. Nowadays, real-time monitoring appears more and more. The basis of correct combat vehicle behaviour is to provide reliable communication and data transfer between units, modules, devices and subsystems. This is done through data buses. There are many buses which are used in combat vehicles.

Modern communication devices inside combat vehicles are a part of the whole system of electronics, part of on-board system architecture specified by the principles of VETRONICS (Vehicle Electronics Systems). The multimedia transmission network is built in the vehicle within this architecture. This network should be capable of transmitting audio, video or other data signals to the crewmen and it enables efficient driving and conducting combat operations. The aim of the research is to design data communication for suitable data buses such as Ethernet, CAN and FleyRay, respectively RS-232.

1. BACKGROUND

1.1 Vehicle Electronics Systems (VETRONICS)

Military vehicles include numerous electrical and electronic systems that are controlled and monitored by the crewmen. In current vehicles voice communication, system control and monitoring is facilitated by standalone user interfaces that are specific to an individual

subsystem. As vehicles became more complex, the number of standalone controls and displays has increased. Combat vehicles also include a variety of optical systems, which are used by the crew for driving, local situational awareness, surveillance and for target acquisition. Furthermore, recent net-enabled operations allow a considerable amount of information in relation to the crew's environment (for example own vehicle position, system status, contact detection, etc.) to be available through both internal and external sources. Net enabled operations also allow information to be available to dismounted crew, other nearby vehicles, and the Command and Control (C2) system [1], [2]. Modern vehicle systems integration (VETRONICS) is based on distributed control, network sensors and communication systems which provide the ability to integrate all vehicle functions through a common Operator-Machine Interface. This interface is also exploited to support other combat functions including communication, commands and control.

So, VETRONICS is the integration of all electronic components and subsystems architectures inside combat vehicles. This is a combination of several layers of electronic systems (weapon systems, fire control system, reconnaissance equipment, protective systems, navigation, communication system, etc.) through a single data bus (usually Ethernet).

1.2 Internal Communication System

An internal communication system (an intercom) inside combat vehicle used to be stand-alone voice communication system that operates independently of any other communication network. Nowadays, it is a device designed for voice and data communication among vehicle crewmen and other combat sections. A purpose of intercom system used in combat vehicles is to ensure safe and clear communication inside and outside of such vehicle. Current intercom systems consist of different types of units and accessories.

Modern intercom system should be a part of the whole system of vehicle electronics, part of complex airborne system architecture specified by the principles of VETRONICS. Within this architecture a multimedia transmission network should be built in combat vehicle, it should be used to transfer text, audio, video and other data signals to enable effective management of crewmen and vehicle combat operations. The basis of all modern combat vehicles is ensuring reliable communication and data transfer between the modules, units, devices and subsystems. It is possible through the data buses. There are numbers of buses used in combat vehicles.

For that huge system, like multimedia network inside combat vehicle, it is suitable to use an existing local area network (LAN) architecture based on Ethernet bus. However, the internal communication device should be able to stand separately in the system – for example, when it is incorporated into an older vehicle without implemented LAN architecture in case of partial modernization [3]. When the intercom is a part of vehicle electronics it is also profitable to use other buses than Ethernet – almost every modern combat vehicle is equipped by CAN bus, eventually FlexRay bus [4]. These buses can be used for direct communication through them or as a reserve solution when the primary bus is broken.

Presented system of internal communication (Fig. 1) is a part of VETRONICS. The system is based on only one universal unit. As a primary bus is used Ethernet, reserved buses are CAN and FlexRay. For data radio connection is used serial RS-232 interface.

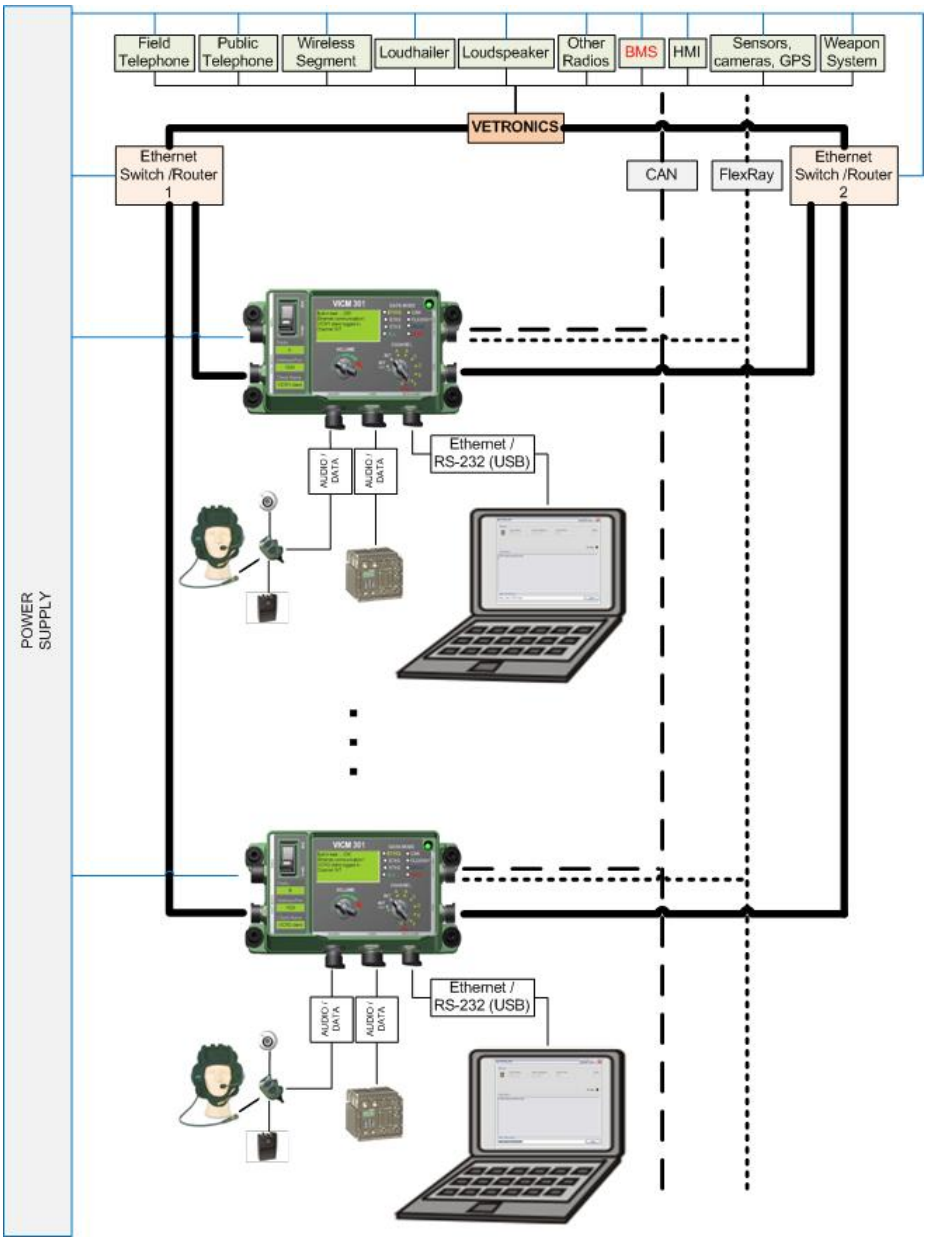


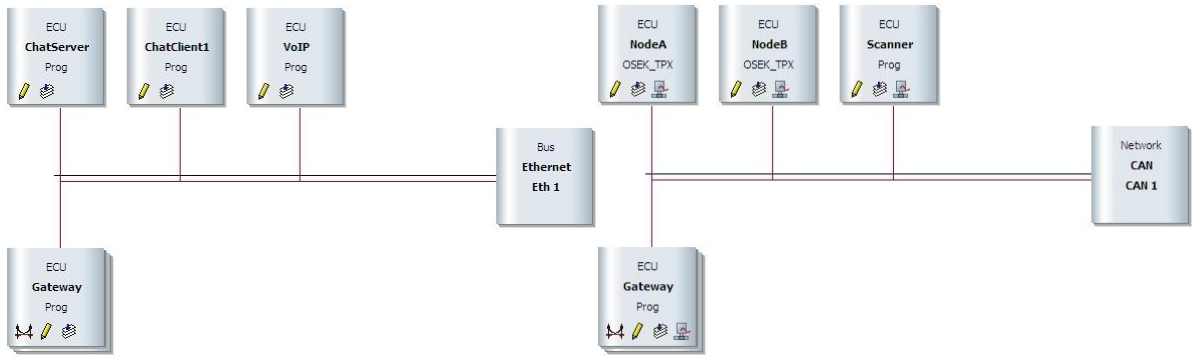
Fig. 1. Designed intercom as a part of VETRONICS architecture
Source: own

2. DESIGNED AND SIMULATED INTERCOM

The whole intercom system was simulated in the software CANoe (from Vector Informatik GmbH). CANoe supports three phases of the development process, ranging from simulation of the entire network and remaining bus simulation to analysis of a real network. This requires all control units in the network to be integrated as network nodes in the simulation setup. The bus communication is defined via integrated databases (for example DBC, XML) [5]. In CANoe different options are available and may be used in any combination for the different bus systems – it supports all needed buses like CAN, FlexRay and Ethernet, respectively RS-232.

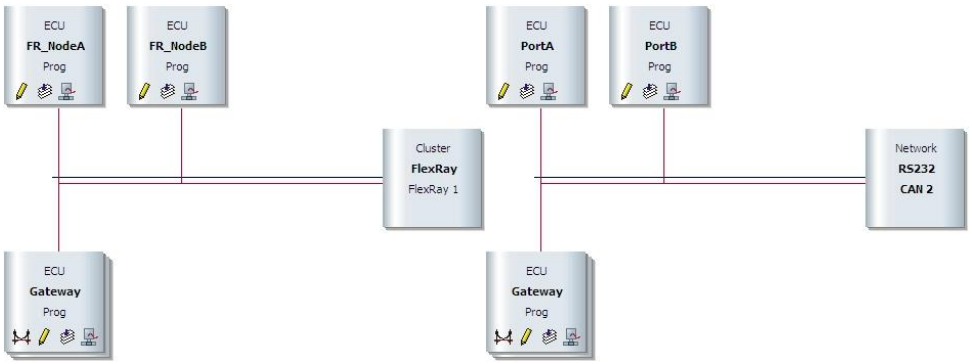
Intercom unit allows data communication over Ethernet (primary and secondary network interface), CAN bus, FlexRay bus and serial RS-232 interface (Fig. 1). The default method of communication is through Ethernet 1, but the user can also choose a different offered data communication. The intercom system processes, manages and presents massive amount of data arriving from various sources into a user-friendly format (audio messages).

As was mentioned before, the new intercom system was designed in CANoe. In this software tool the network topology was also specified and the design was refined down to the level of the network nodes. All functions of intercom are represented by nodes connected to the desired network (see Fig. 2 and Fig. 3). CANoe has no limit on the number of nodes that can be simulated or the number of interconnected networks. Each simulated node has its own corresponding CAPL program (CAN Access Programming Language based on the C programming language). In addition, CANoe supports multiple network system simulations. For our purposes we required different networks with multiple nodes in each network – we are able to simulate all networks at the same time. Simulated intercom system can be also used as a gateway for sharing data from different networks – a connection element among different buses.



a) b)

Fig. 2. Simulation of: a) Ethernet 1 configuration, b) CAN bus configuration
Source: own



a) b)

Fig. 3. Simulation of: a) FlexRay bus configuration, b) RS-232 configuration
Source: own

The emphasis in modelling lies in the description of the node‘s bus behaviour (in CAPL language). It is also very useful to create “graphic panels” for both inputs and outputs from/to the buses (Fig. 4). These inputs/outputs were interconnected with corresponding bus’s

messages to visual and analyze them. In addition to the voice (realized by VoIP) and data communication among crew members the designed intercom system is able to process signals originated by BMS (Battle Management System connected through Ethernet) and generate warning audio messages, it is also able to process OBD-II (On-Board Diagnostics) signals generated by vehicle electronics (connected through CAN bus) and generate appropriate audio warning messages. The system is also able to forward the data to the other bus through implemented gateway.

Fig. 4. Designed intercom system
Source: own

CONCLUSION

As results of this research are the design, simulation and implementation of a new concept of intercom system with higher data throughput incorporated into the VETRONICS. The aim of this paper was to show the first step in the design of that complex system – full / partial simulation. The modern intercom system is not just a device for voice communication inside combat vehicle among crew members. That system can be used as the central device inside combat vehicle which is able to integrate and manage all voice, video and other data communication inside and outside the vehicle, communicate with other combat vehicles and coalition forces, utilize BMS and collaborate with other elements of VETRONICS. The goal is to elevate the intercom system into the system capable of exchange any type of data.

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E-LEARNING IN FOREIGN LANGUAGE EDUCATION FOR ACADEMIC PURPOSES: UKRAINIAN AND CZECH PRACTICES

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Abstract: *The article deals with a problem of e-learning in the field of the foreign language training of the academic staff considering the Ukrainian and Czech practices. The investigation is based upon the analyses of the policies on in this field and experiences of ICT implementation in Ukraine and in the Czech Republic. The authors dwell upon main scenarios of e-learning in the foreign language teaching for academic purposes - distance learning, blended learning and ICT-enhanced learning – in the countries under consideration. It allows to draw out a set of principles for elaborating a unified model aimed at providing solutions for the language training of the academic staff by means of e-learning.*

Keywords: foreign language (FL) education**,** e-learning, ICT, distance learning, blended learning, ICT-enhanced learning, academic staff.

INTRODUCTION

In a view of intensive processes of globalization and development of the common European space in economy and education, effective FL education turns to be a crucial factor for people to communicate and to achieve mutual understanding. Taking into consideration the intensive development of the European educational space and a growing demand for the international collaboration among scientists and educators from different countries, the FL education for the academic staff of universities becomes a determining factor for the success in this process. English language (EL) proficiency is viewed as a key factor for educators' further professional development, establishing international relations with colleagues from other countries and conducting mutual investigations at the global level [1, 2]. At the same time teaching a FL for the academic staff is specified by a number of factors including psychological, methodological and organizational issues which make this teaching practice more complicated in comparison to other social groups of learners [3]. Regarding the specifics of the academic staff's occupation, their social and psychological peculiarities it is suggested that e-learning can provide a wide range of possibilities to make the FL learning for the academic purposes more effective. Therefore, the purpose of the article is to analyse the FL teaching and learning practices in Ukraine and the Czech Republic as for the ICT implementation in order to work out a set of principles for the further development of a unified model of teaching a FL to the university academic staff. The methods of the research include the following: (a) analysis of the government statemenst and resolutions concerning ICT in higher education and language learning; (b) analysis of the recent publications describing current learning practices in language education enhanced by ICT in Ukraine and the Czech Republic; (c) analysis of the own teaching practice and experience; (d) observations over the strategies of learning and teaching with the help of ICT in the language education;

(e) interview of the university teachers and students; (f) experimenting with implementation of distance forms of learning into the practice of the English language teaching to the PhD students.

1. CONTEMPORARY STATE OF FOREIGN LANGUAGE EDUCATION IN UKRAINE

1.1 General Survey of the Educational Policies and Practices

Nowadays learning foreign languages is one of the educational priorities in Ukraine. Starting from kindergartens, pupils have a possibility to gain some FL skills. The most popular among FLs is English, a position of German and French can vary, but in general they share the second place after English. According to the requirements of the Ministry of Science and Education in Ukraine, pupils of secondary schools start learning a FL from the first grade.

Considering learning a FL for academic purposes we should take a closer look at specifics of the language learning at the Ukrainian universities. Due to the educational standards bachelor students of non-linguistic departments learn a FL during the first two years of their study at the university. Most master degree programmes contain a course of the FL learning which ends with an examination. Post-graduation study also implies an entrance exam in a FL and a course of a foreign language within the post-graduate programme which crowns with the compulsory examination without which no dissertation defence is possible.

1.2 E-Learning in FL Education

Nowadays, a strong tendency to innovate processes of the language acquisition is in its full sway, so teachers and learners of different levels and forms of education implement a great scope of methods and techniques of e-learning [4, 5]. If to overview the current practices of e-learning in the language education according to the traditional differentiation of e-learning into the distance, blended and ICT-enhanced it will help to obtain an overall idea of the Ukrainian experience in teaching FLs by means of e-learning.

1.2.1 Distance Learning

Distance learning is stated to be a form of the learning interaction between a student and a teacher who are separated in time and distance. If about 80 per cent of the learning period or more is mediated by technology or other means of delivering teaching/learning materials, this form of learning can be regarded as the distance one [6]. Distance learning in the FL education for specific and academic purposes is presented in the following ways.

1) *University's E-portals.* Higher educational establishments elaborate their learning platforms which provide all the learning materials to the students who are distant from the university campuses. Such e-portals usually contain a curriculum, teaching materials for self-study, references on the sources available and necessary for learning. Learning materials are in most cases presented in PDF format. Such mode of delivering knowledge unfortunately does not allow any interactivity between a student and a teacher, as well as between a student and his/her peers.

2) *English language distance courses.* FL distance courses are mostly presented by propositions from commercial schools and individuals. The most common media used in such learning is Skype. But such kind of learning services have not gained much popularity in Ukraine as learners continue to prefer face-to-face individual learning or learning in small groups.

1.2.2 ICT-Enhanced FL Instruction for Academic Purposes or Blended Learning

As it is known, learning can be referred to as the blended if about 50 per cent of the learning interaction is mediated by ICT. The amount of about 30 per cent of ICT implementation in learning is regarded as the ICT-enhanced learning. In a course of the last fifteen years different practices have been tried to implement ICT in a traditional mode of the language teaching. The main trends are as following.

Usage of the FL Learning Programmes on CD/DVD. Being inspired by potentials of the computer technologies and in order to diversify the methods and techniques of teaching and to bring "native speakers" into classroom, the FL teachers tried to implement specially designed FL teaching computer programmes in the classroom. At the universities this process was initiated and encouraged in most cases by the institutional administration. But in spite of the multiple attempts to do it at the institutional and individual levels the endeavours did not bring significant positive results. It was caused by the following reasons: 1) high value of the licensed computer programmes; 2) technical problems of installing the programme and using it on the university computers (compatibility of the software); 3) the number of the computers available in the university is limited in a comparison to the number of students/academic groups which are supposed to take a class; 4) most FL learning computer programmes are intended to develop general language proficiency while students at a technical university need language for certain professional purposes; 5) the content of such programmes is quite rigid and cannot be adjusted to various students' learning needs; 6) lessons with the usage of such programmed materials often stray away from the general logic of the learning process and are often perceived by the students as a kind of artificially implemented activity, or a leisure/waste of learning time; 7) teachers are not quite sure of the methods and techniques of implementing and enweaving such programmes into the current learning practice to make it more straightforward and productive; 8) students lack an opportunity to develop oral skills in a face-to-face communication devoting their learning time to some tasks in the mode of the computer-learner interaction.

Internet resources in language learning. With the development of Internet and wider possibilities to get access to the Internet resources [7], the strategies of ICT implementation in language learning have significantly changed.

The most common way of bringing virtual reality in the classroom of the FL learning is with the help of overhead projectors. They are used to achieve the following aims: (a) for the teacher to visualize objects and processes presented and discussed in the classroom; (b) to have access to some Internet resources (content-based websites, on-line dictionaries, Wikipedia, some reference / teaching materials) called to visualize, prove, give evidence or supply additional information on the subject discussed in the classroom; (c) for students to prepare and to show their presentations devoted to the subject discussed in the classroom as a result of some individual / group problem-based task or research. Links from the presentation to the extra Internet resources allow to make it more sound and well-grounded [8].

Most students prefer to use computer technologies on their own, outside the classroom viewing the classroom time more valuable for face-to-face communication with the teacher and peers. The following resources are mostly used outside the classroom: (a) Internet resources for teachers and teaching (Internet websites with content-based articles, lesson plans from open Internet resources specialized on providing teaching materials); (b) Internet resources for students' self-learning (e-dictionaries, websites providing learning materials, reference sources, videos, audio tracks); (c) social media (mostly for personal interaction not for learning) [9].

2. FOREIGN LANGUAGE EDUCATION IN THE CZECH REPUBLIC

The Czech Republic is a small European state which cannot prosper without ensuring qualitative and effective FL education, particularly learning the languages for the global communication. Language education in the Czech Republic has undergone significant changes for the last twenty years. After the velvet revolution in 1989 the Czech society changed to the open society which is eager to establish sound connections and interrelations with other highly-developed countries.

Increased interest in travelling and various forms of cooperation with foreign partners is continuously strengthening the demand for the effective language learning. It is especially valuable to develop students' listening skills and their readiness to communicate in a FL environment.

At the same time FL teaching has become significantly affected by the technological developments in ICT. Availability of personal computers and accessibility of Internet to the Czech population of all ages have brought a great variety of new possibilities into practice of the language learning.

2.1 Educational Policies and Practices

The Ministry of Education, Youth and Sports (MEYS) of the Czech Republic permanently supports the development of the FL education in its policies and is promoting international cooperation in this field. The Common European Framework of Reference for Languages (CEFR) is regarded as a guide in establishing educational standards for the language learning. Wide possibilities are offered not only to the Czech state, public and private schools but also to especial private educational companies focused on the language education. The list of standardized language exams is available at MEYS web pages [10].

The language education of the Czech children can start at selected kindergartens which use various specific approaches suitable for that age of the children. Then, every Czech elementary school has its own School Educational Programme (SEP), which is based on the Framework Educational Programme (FEP) formulated by the MEYS. Two FLs are taught, and the expected study outcomes are defined.

Every Czech secondary school enables the development of the language skills of their students according to its School Educational Programme. Generally, English, French and German are preferred, but certain secondary schools can also provide teaching of Russian, Italian and Spanish as optional subjects. Finally, at the Czech universities the students usually

study two FLs. These language studies are focused on the needs of a certain faculty and a branch of the study.

The specific situation is at the University of Defence (UoD) [11]. The accredited UoD study programs contain a great variety of different subjects – from social sciences to specialized technical disciplines and the English language is a foreign language No. 1. All bachelor and master graduates should pass the English language exam according to the NATO STANAG 6001 norm [12]. Every graduate should accomplish the Standardized Language Profile (SLP) of an appropriate level. The SLP of the UoD academic staff is included as the requirement to the work position. The intensive and combined language courses are offered to the persons employed by the Ministry of Defence.

2.2 E-Learning in Foreign Language Education

E-learning in the FL instruction has brought a requirement for a close cooperation between ICT specialists and FL teachers. At the UoD this process started about nine years ago [13]. The Content and Language Integrated Learning (CLIL) method was selected as a key possible method for the development in the UoD environment [14]. Nowadays the Language Training Centre (LTC) of the UoD uses its own unique e-learning study materials which are used by the students and the academic staff.

Taking into consideration the results of numerous observations and interviews, it must be noted that implementation of different modes of e-learning is determined by the specifics of the academic staff and their learning needs in the language acquisition. They are presented below:
1) The academic staff of the universities and colleges in terms of the language training specifics are a highly diversified audience;
2) Their FL needs can be structured into general knowledge of a FL and knowledge of a FL in a specific area with a certain individual focus;
3) Each member of the academic staff requires sound knowledge of at least one FL at a level which would enable him/her:

- to read and to understand the FL literature in his/her professional domain;
- to write articles for submission to professional and scientific journals in the field of his/her specialization;
- to prepare their research results for publishing in intenational conference proceedings, presenting at technical and scientific conferences;
- to analyse expert opinions for publications and other scientific works;
- to create computer presentations for conferences and seminars;
- to participate actively at conferences and seminars on the topic prepared;
- to be engaged in discussions at conferences and seminars;
- to prepare study materials for students in a FL;
- to conduct formal and informal discussions when dealing with foreign students;
- to conduct formal and informal discussions during negotiations with partners from abroad;
- to conduct e-mail communication in a FL.

Therefore, when modelling a distance FL course for the academic staff the enumerated learning needs should be taken into account in order to provide learning which would enable an academician to meet the requirements which are put forward to his/her professional activity in a FL.

CONCLUSION

To sum up the current Ukrainian and Czech experience in the FL learning and ICT implementation in the language education, a set of principles can be drawn out in order to elaborate a unified model aimed at providing solutions for the language training of the academic staff by means of e- learning. They are described as follows [2]:
1) The learning content should be determined and directed to the specifics of the professional activity of the university academic staff. In this respect it is urgent to discriminate types of professional activities, possible situations of professional communication and interaction, main kinds of professional tasks and problems which academicians are to solve, in order to create appropriate learning conditions modelling the given situations.
2) Introduction of ICT in practice of learning is not an equivalent to effective learning and learners' high achievements. ICT implementation should be motivated by the content, clear in purposes, and not too cognitively overburdening even if the learners have certain experience of using ICT for personal purposes.
3) Any new learning activity needs adaptation which can be achieved through thoroughly planned group work, mutual discussions, sharing ideas and feelings where ICT can act as a mediator of communication and a means to work out and to present the results of one's creative thinking.

As for the modes of e-learning they can be presented in the following way:
Distance Learning. It is the most suitable form for the academics who are capable to learn individually and are highly motivated. There could be only an introductory face-to-face session in every semester.
Blended Learning. It is suitable for those learners who are capable to learn individually but need regular face-to-face sessions (twice per month) with a FL teacher. Face-to-face sessions should serve for a discussion focused on specified parts of the language according to the training plan.
ICT-Enhanced FL Instruction for Academic Purposes. This form of the FL instruction can be suggested for the academics who are capable to take part in face-to face sessions regularly once or twice weekly and are not able to learn a FL in a mode of the distance or blended learning.

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NEW PROFESSION OF "MULTIMEDIA APPLICATION TEACHER" IN THE CONTEXT OF DIGITAL AGENDA FOR EUROPE

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Abstract: *Europe's future sustainable growth and competitiveness depends to a large extent on its ability to embrace the digital transformation in all its complexity. Information and communication technology (ICT) is increasingly impacting all segments of society and the economy. The European Commission signals [1] that by 2015 700,000 to 1 million ICT jobs will not be filled in Europe, due to lack of skilled personnel. Additional action is needed to boost the overall number and the employability and mobility of ICT experts. Therefore the Commission will launch a 'Grand Coalition on Digital Skills and Jobs'. That is why Project B2.2. entitled "Development of a set of national professional competence standards required by employers", which concerns the development of 300 standards of professional competence, is particularly important and necessary. As part of the project qualification standards will be developed for such contemporary innovative and necessary professions as "Multimedia Application Teacher", "Distance Learning Teacher", "On-line Examiner". The author of the article is involved in the project as a subject matter expert and in this paper will present concepts relating to the development of qualification standards for the new profession of Multimedia Application Teacher and concepts of one of the way of preparing such specialist.[1]*

Keywords: multimedia application teachers, e-learning, computer science, competences, digital agenda for Europe, project, post-graduate studies.

INTRODUCTION

The global transformation from industrial to information society as well as social and economic changes taking place both in Poland and other European countries have necessitated reforms in many areas of government responsibility. In this respect, the priorities include reforming the education system involving the implementation of modern educational technologies and modes of tuition.

Distance learning, thanks to such advantages as flexibility, ease of access, modular character, quality, cost-effectiveness, state-of-the-art technology, large audiences, social balance, global reach, the new role of the teacher, positive effect on the learner, has become a leading mode of tuition and instructional technology practically at all levels of the education system.

Europe's future sustainable growth and competitiveness depends to a large extent on its ability to embrace the digital transformation in all its complexity. Information and communication technology (ICT) is increasingly impacting all segments of society and the economy. The Digital Agenda for Europe 2013-2014 (https://ec.europa.eu/digital-agenda/en/news/digital-do-list-new-digital-priorities-2013-2014) analyses and describes such issues as: 1) A European borderless economy — the Digital Single Market; 2) Speeding up public sector innovation; 3) Very fast internet supply and demand; Cloud computing; 4) Trust and Security; 5) Entrepreneurship and digital jobs and skills; 6) Beyond R&D&I: An

industrial agenda for key enabling technologies; 7) Implementation and governance. In particular, The Commission signals that by 2015 700,000 to 1 million ICT jobs will not be filled in Europe, due to lack of skilled personnel. Additional action is needed to boost the overall number and the employability and mobility of ICT experts. Therefore the Commission will launch a 'Grand Coalition on Digital Skills and Jobs'. [1]

One solution to this problem in Poland is the delivery of the project B2.2. "The development of national occupational standards of competence required employers", which deals with the development of standards of professional competence for 300 innovative profession [3]. The project is being jointly implemented by a number of institutions and state-run and private organizations, including the Institute for Sustainable Technologies, National Research Institute (Radom), IPiSS WYG International, and other organizations. In the context of the challenges and problems facing modern Europe, the project is especially important and necessary. The project will develop standards of qualifications, particularly for modern innovative professions as "Multimedia applications teacher", "E-learning teacher", "Examiners on-line" [3]. The author, who is involved in the project as an expert, describes in this article the basic pre-provisions relating to the concept of the development of competency standards for a new profession called "Multimedia applications teacher".

1. STANDARDS OF QUALIFICATIONS FOR THE NEW PROFESSION

Standards of qualifications for modern innovative professions are developed based on the competence approach and are compatible with the demands of *Digital Agenda for Europe 2013-2014*. Key information contained in the standard for the profession include [3]: The code name of the profession and its place in the classification list, brief information about the standards, job description (the synthesis of the profession, the job description and the method of its performance, the areas where the profession is present, the working environment (working conditions, tools, OSH aspects, work organization), physiological requirements, health requirements, including contraindications to perform the profession, the education and licences necessary to work in the profession, opportunities for professional development, confirmation / validation of competencies, a list of professional competences, the relationship between the level of professional competence and qualifications in the ERK / PRK, a description of professional competences , profile of key competences (assessment of the importance of key competencies for the performance of the profession), organization and process study design, study enterprises and institutions, research plan, field of study, type of data collected, data sources, the characteristics of the respondents, and several others.

For example, the expert, i.e. equivalent of a person performing the profession of Multimedia applications teacher, according to the released version of the standards developed, must possess the following competencies (based on preliminary analysis, which will be further examined in the study):

In the field of knowledge:

- knowledge and understanding, at an advanced level, of facts, theories, methods and complex relations between them; knowledge and ability to freely use the appropriate specialist terminology in the field of information technology and pedagogy, including the English language in the profession of the Multimedia applications teacher; knowledge and familiarity with a variety of difficult operating conditions impacting educational activities (training and education), etc.

In the area of skills:

- ability to perform tasks and devise innovative ways to solve complex and unusual problems in a changing and not fully predictable conditions, choosing one's own non-standard methods and tools from the field of ICT and education; ability to plan their learning and improvement throughout their lives, including the remote mode, to communicate with others (including colleagues, clients, students, etc.), based on competence and substantive arguments, etc.

The most important professional competences that an expert working in the profession should have include the ability to use didactic multimedia applications, knowledge and understanding of the criteria for evaluating multimedia applications, knowledge and understanding of the criteria for evaluation of a distance course, knowledge and understanding of the rules and principles of developing didactic scenarios entailing the use of multimedia applications, etc. In the field of skills the required competences include the ability to search for and select information about IT equipment available on the market offers; the ability to use tools to create multimedia presentations, to carry out multimedia applications testing, to test and evaluate distance learning courses, to develop guidelines (teaching materials) relating to effective use of multimedia in distance courses, ability to deploy applications, to train teachers, tutors, trainers, to effective use multimedia applications, and a number of other competencies.

2. THE POSTGRADUATE STUDIES CALLED "MULTIMEDIA APPLICATION AND E-LEARNING TEACHER"

For the preparation of specialists in new jobs it is advisable to start qualification postgraduate studies or to start the first (Bachelor) degree.

The postgraduate studies called "Multimedia application and e-learning teacher" have been developed on the basis of current postgraduate studies "E-learning in the teachers' profession" and on the basis of results of a new Project B2.2. entitled "Development of a set of national professional competence standards required by employers", which concerns the development of 300 standards of professional competence, is run by Doradca Consultants Sp. z o.o., Institute for Sustainable Technologies - National Research, IPiSS WYG International, ŁCDNiKP, and is particularly important and necessary. As part of the project, qualification standards will be developed for such contemporary innovative and necessary professions as "Multimedia Application Teacher", "Distance Learning Teacher", "On-line Examiner". The author of the article is involved in the project as a subject matter expert and in this paper will present concepts relating to the development of qualification standards for the new profession of Multimedia Application Teacher. Europe's future sustainable growth and competitiveness depends to a large extent on its ability to embrace the digital transformation in all its complexity. Information and communication technology (ICT) is increasingly impacting all segments of society and the economy. The Digital Agenda for Europe 2013-2014 (https://ec.europa.eu/digital-agenda/en/news/digital-do-list-new-digital-priorities-2013-2014) analyses and describes in particularly 5) Entrepreneurship and digital jobs and skills and in this documents has stressed, that "The Commission signals that by 2015 700,000 to 1 million ICT jobs will not be filled in Europe, due to lack of skilled personnel. Additional action is needed to boost the overall number and the employability and mobility of ICT experts. Therefore the Commission will launch a 'Grand Coalition on Digital Skills and Jobs'."

That is why postgraduate studies called "Multimedia application and e-learning teacher", described in this article, are particularly important and necessary in the context of global Digital Agenda for Europe 2013-2014 and in the context of successful decisions concerning teacher training and other specialists' training in the area of multimedia application, ICT and e-learning in Poland, and generally in the area of digital technology.

The documentation of the postgraduate studies called *"Multimedia application and e-learning teacher"* includes all the necessary components: Aims, Forms, Techniques, Tolls, Outcomes, Contents.

Subjects have been designed with a view to the development of competencies in teaching and the humanities, multimedia application design, Web 2.0 and Web 3.0 technologies, CMS, LCMS and the methodology of the use of use informatics tools and multimedia in education.

Among more important learning outcomes of post-graduate studies we can specify: Knowledge, Skills and Societal Competences.

KNOWLEDGE

W-1. The graduate will have basic systematised knowledge of structured education, teaching and learning; will understand these processes as well conditions, and have basic knowledge of the design of situations and educational systems, with particular emphasis on the use of support systems for distance learning.
The graduate will be familiar with types of computer networks and the principles of their functioning. Will have knowledge of the architecture of the Internet, online services and the methodology to use Web 2.0 and Web 3.0 in teaching and learning, design and use of multimedia application in teaching.

W-2. The graduate will have has basic knowledge about multimedia and digital media, will be familiar with characterized by multi-media technology and provide aesthetic and technical principles for the design of multimedia applications; will know multimedia file formats and conversion methods.
Will also have knowledge about the development of multimedia educational materials for distance learning and distance courses in particular.

W-3. The graduate will demonstrate familiarity with Learning Content management systems (LMS) and Content management systems (CMS) for distance learning support, will have knowledge of the effective use of LCMS systems in teaching and learning and use the CMS for developing information and education space on the Internet.

W-4. The graduate will have elementary knowledge of intellectual property and patent law, and elementary knowledge about interpersonal and social communication.

SKILLS

U-1. The graduate will be able to obtain information from literature, databases and other sources, and integrate information, interpret it, as well as draw conclusions and formulate and justify opinions.

U-2. The graduate will be able to inspire, animate and design situations of teaching and learning in respect of computer science and information technology.
Will be able to use basic knowledge of information technology and teaching to analyse and interpret the problems of education, promote self-reliance in the development of knowledge and inspire lifelong learning.

U-3. The graduate will be able to present basic concepts of digital media technology and use it in a targeted and focused on teaching different subjects.
The graduate will have the ability to recognize and present basic psychological, aesthetic, legal, and social aspects of information and communication technologies, and will be able to develop certain multimedia teaching materials.

U-4. The graduate will be able to select appropriate models of distance education, types of courses, to carefully formulate objectives, to select content, methods, forms, conventional and digital means; will have the ability, when formulating and solving IT tasks - to discern their non-IT aspects, including environmental, economic, psycho-pedagogical and legal aspects; will have the ability to apply the principles of health and safety at work and Internet etiquette.

SOCIETAL COMPETENCES

K-1. The graduate will understand the need and opportunities for continuous training - improving professional skills, personal and social, by using e-learning in the first place.

K-2. The graduate will be aware of, and understand, the importance of non-IT aspects and results of the activity of teacher having distance teaching competencies, including the impact on the environment and society, and the related responsibility for decisions. The graduate will be aware of the importance of conduct in a professional manner and respect for the rules of professional ethics and respect for diversity of views, cultures, educational theories and teaching and learning methods.

K-3. The graduate will have a sense of responsibility for her/his r own work and willingness to comply with the principles of teamwork and shared responsibility for the implementation of tasks, and will be able to think and act in an entrepreneurial manner.

K-4. The graduate will be is aware of her/his the social role as a of post-graduate studies graduate, will especially understand the need for the formulation and communication to society – particularly via the Internet – of information and opinions on the developments in ICT and e-learning; will endeavour to give provide information and opinions in a competent and comprehensible manner.

CONCLUSION

As mentioned above, the project "Development of national occupational standards of competence required employers" in relation to standards of professional competence for 300 innovative professionals is currently in the process of implementation.

After successful completion of all its phases (probably in late 2013) and the final evaluation by experts, the list of innovative specialties as developed qualification standards will be published on the website of the Ministry of Labour in Poland. These results and the

development of standards for new occupations will more effectively and consistently support new skills training and personnel that will make up the gap that now exists in Europe, in particular Poland, in market supply of trades and professions.

The University of Silesia, in order to meet the expectations of the modern economy seeks to disseminate public education at all educational levels, while increasing the quality and attractiveness of the offered educational services and their link with the needs of a modern economy.

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A FRAMEWORK FOR SIMULATION PRICING OF MULTI-ASSET FINANCIAL DERIVATIVES

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Abstract: *We build a conceptual framework with some code implementation indications and parallelization speculation. Framework consists in a generalization of classic multi-asset financial derivatives (as a generalization of classical models only with increment arity of payoff function) to a multi-stochastical parameters (like volatilities, or semivolatilities of Heston model) and with indication of discretization method of stochastic differential equations from generalized model.*

Keywords: Automatic evaluation, algorithmic standardization, items, alternative methods, feedback particularities, target population.

INTRODUCTION

Many stochastic models for a traded asset are based on stochastic differential equations. A *stochastic differential equation* is an equation like:

(1) $F(S(t), dS(t), dt, t) = 0$

where $S(t)_{t\geq 0}$ is a stochastic process (our traded asset) and dS(t) is his differential, and F is an algebraic form with 4-arity. Famoust model in finance is the *geometric brownian motion*:

(2) $dS(t) = a * S(t) * dt + b * S(t) * dW(t)$

also known as *Black-Scholes* or *Black-Scholes-Merton model*, where $W(t)_{t\geq 0}$ is an *standard Wiener stochastic process*, a is a positive number known as *drift*, and b is a positive number known as *volatility*. A *financial derivative* is a contract with a *maturity time* T, usually we have:

(3) $now() < T,$

with a fructification function, also known as *payoff*, at maturity:

(4) $payoff: R_+ \rightarrow R$

Famoust derivatives are European options Call and Put with payoff functions:

(5) $payoff_{Call}(x) = max\ \{0, x - K\}$
(6) $payoff_{Put}(x) = max\ \{0, K - x\},$

where K is *exercise price*. The *price of derivative* is the value:

(7) price = E[payoff(S(T))].

A way to estimate the price is to discretize (2) with an Euler discretization – also known as Euler-Maruyama discretization – with d time-step and build a Markov chain:

(8) $S(t + d) – S(t) = a * S(t) * d + b * S(t) * sqrt(d) * N,$

that can be rewrote as:

(9) $S[n + 1] =S[n] * [1 + a * d + b * sqrt(d) * N],$

where N is a N(0, 1) generated random value.

1. ALGEBRAIC GENERALIZATION OF GEOMETRIC BROWNIAN MOTION

A first ideea of generalization of (1) is to change in (2) scalar values a and b with some algebraic expressions:

(10) $a \rightarrow A(S(t), t)$
(11) $b \rightarrow B(S(t), t)$

like:

(12) $dS(t) = A(S(t), t) * dt + B(S(t), t) * dW(t)$

Note that for

(13) $A(S, t) = a * S$
(14) $B(S, t) = b * S$

we obtain geometric brownian motion. For other instance of A and B we can obtain more other models (see [1], p. 1582). Reccurence (9) will be:

(15) $S[n + 1] =S[n] + A(S[n], t[n]) * d + B(S[n], t[n]) * sqrt(d) * N.$

2. ALGEBRAIC GENERALIZATION OF STOCHASTIC VOLATILITY MODELS

An extended version of (12) is to put for A and B a new stochastic parameter for volatility:

(16) $dS(t) = A(S(t), v(t), t) * dt + B(S(t), v(t), t) * dW_1(t)$
(17) $dv(t) = C(S(t), v(t), t) * dt + D(S(t), v(t), t) * dW_2(t),$

with a correlation between $dW_1(t)$ and $dW_2(t)$. For:

(18) $A(S, v, t) = \mu * S$
(19) $B(S, v, t) = v^{½} * S$
(20) $C(S, v, t) = k * (\theta - v)$
(21) $D(S, v, t) = \xi * v^{½}$

(22) $\beta(S, v, t) = \lambda * v^{1/2} / \xi$

we will obtain the Heston model and for:

(23) $A(S, v, t) = 0$
(24) $B(S, v, t) = v * S * \beta$
(25) $C(S, v, t) = 0$
(26) $D(S, v, t) = \alpha * v$
(27) $0 \leq \alpha$
(28) $0 \leq \beta \leq 1$

we obtain SABR model. For other instance of A, B, C, D we can obtain more other models (see [2]; [3]; [4], p. 4; [5], p. 258). Reccurence (15) will be:

(29) S[n + 1] =S[n] + A(S[n], v[n], t[n]) * d + B(S[n], v[n], t[n]) * sqrt(d) * N1
(30) v[n + 1] =v[n] + C(S[n], v[n], t[n]) * d + D(S[n], v[n], t[n]) * sqrt(d) * N2

Model (16)-(17) can be easy extent to a 3 stochastic differential equation with two stochastic semi-volatilities:

(31) $dS(t) = A(S(t), v(t), t) * dt + B1(S(t), v(t), t) * dW3(t) + B2(S(t), v(t), t) * dW4(t)$
(32) $dv1(t) = C(S(t), v(t), t) * dt + D(S(t), v(t), t) * dW1(t)$
(33) $dv2(t) = E(S(t), v(t), t) * dt + F(S(t), v(t), t) * dW2(t),$

where W1 and W3 are correlated and W2 and W4 are correlated. For

(34) $A(S(t), v(t), t) = \mu * S(t)$
(35) $B1(S(t), v(t), t) = v1(t)^{1/2} * S(t)$
(36) $B2(S(t), v(t), t) = v2(t)^{1/2} * S(t)$
(37) $C(S(t), v(t), t) = k1 * (\theta 1 - v1(t))$
(38) $D(S(t), v(t), t) = \xi 1 * v1^{1/2}(t)$
(39) $E(S(t), v(t), t) = k2 * (\theta 2 - v2(t))$
(40) $F(S(t), v(t), t) = \xi 2 * v2^{1/2}(t)$

we will obtain double Heston model. For

(40) $W1 = W2 = W3 = W4$
(41) $A(S(t), v(t), t) = \theta(t) - \alpha(t))$
(42) $B1(S(t), v(t), t) = S(t)^{1/2} * \sigma(t)$
(43) $B2(S(t), v(t), t) = 0$
(44) $C(S(t), v(t), t) = \zeta(t) - \alpha(t)$
(45) $D(S(t), v(t), t) = \alpha(t)^{1/2} * \sigma(t)$
(46) $E(S(t), v(t), t) = \beta(t) - \sigma(t))$
(47) $F(S(t), v(t), t) = \sigma(t)^{1/2} * \eta(t)$

we will obtain Chen model. A natural generalization of model (16)-(17) is:

(48) $dS(t) = A(S(t), v(t), t) * dt + B_1(S(t), v(t), t) * dW_1(t) + ... + B_n(S(t), v(t), t) * dW_n(t)$

(49) $dv_i(t) = C_i(S(t), v(t), t) * dt + D_{i1}(S(t), v(t), t) * dW_1(t) + ... + D_{in}(S(t), v(t), t) * dW_n(t), 1 \le i \le n$

with a correlation matrix for W(t). For

(50) $n = 2$
(51) $B_2 = 0$
(52) $C_2 = 0$
(53) $D_{21} = 0$
(54) $D_{22} = 0$
(55) $D_{12} = 0$

we will obtain (16)-(17) model.

3. MULTI-ASSET FINANCIAL DERIVATIVE WITH STOCHASTIC MULTIVOLATILITIES

For a multi-asset derivative the payoff function is p-arity like:

(56) $payoff: R_+^p \rightarrow R$

like for a mixed derivative based on a gold an foreign exchange:

(57) $payoff(s1, s2) = s1 * s2,$

where s1 is gold/euro rate and s2 euro/lei rate. Like in (48)-(49), we can model all of p assets like:

(58) $dS_j(t) = A_j(S_j(t), v_j(t), t) * dt + B_{j1}(S_j(t), v_j(t), t) * dW_{j1}(t) + ... + B_{jn(j)}(S_j(t), v_j(t), t) * dW_{jn(j)}(t), 1 \le j \le p$
(59) $dv_{ji}(t) = C_{ji}(S_j(t), v_j(t), t) * dt + D_{ji1}(S_j(t), v_j(t), t) * dW_{j1}(t) + ... + D_{jin}(S_j(t), v_j(t), t) * dW_{jn(j)}(t), 1 \le j \le p, 1 \le i \le n(j)$
(60) $v_j(t) = (v_{j1}(t), \ldots, v_{jn(j)}(t))$

or, if we suppose that:

(61) $n = n(1) + ... + n(p),$

we will obtain:

(62) $dS_j(t) = A_j(S(t), v(t), t) * dt + B_{j1}(S(t), v(t), t) * dW_1(t) + ... + B_{jn}(S(t), v(t), t) * dW_n(t), 1 \le j \le p$
(63) $dv_i(t) = C_i(S(t), v(t), t) * dt + D_{i1}(S(t), v(t), t) * dW_1(t) + ... + D_{in}(S(t), v(t), t) * dW_n(t), 1 \le i \le n$
(64) $S(t) = (S_1(t), \ldots, S_p(t))$
(65) $v(t) = (v_1(t), \ldots, v_n(t))$

4. A PHP CODE FOR DISCRETIZATION GENERATION IN A MULTI-ASSET FINANCIAL DERIVATIVE FRAMEWORK WITH STOCHASTIC MULTIVOLATILITIES

Because S-s and v-s in (62)-(63) have similar equations, we can consider an universe of all assets, and all of there stochastic parameters {S1, …, Sn} in a generalized framework:

(66) $$dS_j(t) = A_j(S(t), v(t), t) * dt + B_{j1}(S(t), v(t), t) * dW_1(t) + ... + B_{jn}(S(t), v(t), t) * dW_n(t),\ 1 \le j \le n$$

Next PHP code will be generate discretization sequence for (66)-like model:

```
<?
include "heston.php";
?>

Ecuatiile sunt: <br>
<?
for ($j=0; $j<$n; $j++)
  {
  $linie[$j]='dS' . $j . '(t)=<input type="text" name="A0" value="' . $A[$j] . '">dt';
  for ($i=1; $i<=$n; $i++)
    $linie[$j].='+<input type="text" name="B0' . $i . '" value="' . $B[$j][$i] . '">dX' . $i;
  echo $linie[$j] . "<br>";
  }
for ($j=0; $j<$n; $j++)
  {
  $linie[$j] = 'S' . $j . 'new=S' . $j . '+' . $A[$j] . '*delta';
  for ($i=1; $i<=$n; $i++)
    $linie[$j].='+' . $B[$j][$i] . '*sqrt(delta)*N' . $i;
  echo $linie[$j] . "<br>";
  }
for ($j=0; $j<$n; $j++)
  {
  $linie[$j] = 'S' . $j . '=S' . $j . 'new';
  echo $linie[$j] . "<br>";
  }
$linie="t+=delta";
echo $linie . "<br>";
?>
```

where, our heston.php file is:

```
<?
// heston
$miu=20;
$kappa=2;
$theta=3;
$epsilon=2;
$n=2;
```

```
$A[0]="$miu*S0";
$A[1]="$kappa*($theta-S1)";
$B[0][1]="sqrt(S1)*S2";
$B[0][2]="0";
$B[1][1]="0";
$B[1][2]="$epsilon*sqrt(S1)";
?>
```

and results is:

Ecuatiile sunt:
dS0(t)= 20*S0 dt+ sqrt(S1)*S2 dX1+ 0 dX2
dS1(t)= 2*(3-S1) dt+ 0 dX1+ 2*sqrt(S1) dX2
S0new=S0+20*S0*delta+sqrt(S1)*S2*sqrt(delta)*N1+0*sqrt(delta)*N2
S1new=S1+2*(3-S1)*delta+0*sqrt(delta)*N1+2*sqrt(S1)*sqrt(delta)*N2
S0=S0new
S1=S1new
t+=delta

CONCLUSION

We prove how can be generalize with algebraic construction some classic models and how can we builds simulation steps for a symbolic-numeric path construction. Many software codes embed models in code, and API offer access only to parameters. In this way, we can give model symbolic to computer. As further works, we will include N1, …, Nn generation with LU factorization of correlation matrix and we will try to force in php a complete path computing for a Monte Carlo simulation.

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TRIALS AND TRIBULATIONS OF USING COMPUTERS IN LANGUAGE LEARNING

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Abstract: *Learning foreign languages through technology has become a fact of life and some language educators are intrigued by the constantly changing challenge in this field. The paper looks at a short history of Computer Assisted Language Learning at the University of Defence, briefly summarises the results of research projects in this field in the last decade, and critically evaluates reasonable use of computers in foreign language learning, teaching, and testing.*

Keywords: CALL, foreign language, LMS, Moodle, University of Defence.

INTRODUCTION

The use of computers in foreign language instruction has expanded rapidly at Czech universities in the last decade and the University of Defence (UoD) is not an exception. However, in comparison to western countries, using computes in teaching and testing languages is still relatively a new phenomenon in the CR. In the US, for example, computer-assisted instruction was introduced as early as the 1950s and the examples of Computer Assisted Language Learning (CALL) were documented already in 1960s. In 1980s, the researchers and practitioners in the US asked a question about whether or not computers should be used in language training; in 1990s the question was modified into 'How can the computers best be used in language teaching' [3]. Nevertheless, judging from the Czech universities' e-learning research projects, Czech universities were about ten years behind western countries in posing these questions. Though some Czech foreign language academic members were engaged in CALL before the turn of the millennium, the reason why CALL did not reach its full potential earlier at Czech universities lay, in my opinion, in insufficient computer equipment in language training centres, which was also the case of the UoD. Therefore, searching for the most efficient ways in using computers in language learning is still preoccupying the thoughts and explorations of Czech language educators.

The aim of the paper is to discuss the implementation of CALL at the University of Defence. After the decade of the intensive use of computers, we should be able to learn lessons from CALL and critically evaluate its strength and weaknesses. What are the main benefits of CALL? On the other hand, what are the pitfalls of using computers in language teaching? To what extend should computers be used in the classrooms? Should we pay attention to the public outcry that the use of computers in classrooms can be destructive?

1. COMPUTER ASSISTED LANGUAGE LEARNING

One of the first complex studies on Computer Assisted Language Learning was written by Michael Levy [8]. CALL is used in a very broad sense in his book, 'as the general term to cover all roles of the computer in language learning (p. 81), including word processing,

e-mail, and use of the Internet. Levy presents the evaluation of important CALL projects from the 1960s and 1970s, conceptualises CALL and creates a theoretical framework of the field. He argues that theorist and practitioners have to adopt an interdisciplinary approach.

In my opinion, the collaboration of researchers and practitioners in CALL has been playing an enormously important role in the CALL development. CALL opens space for both vast e-learning research projects, as well as for simple class case studies leading to discussions on pedagogically sound practices in CALL and sharing e-learning material [12,14]. Most information about CALL have been published in English so far, so especially in non-English speaking countries, English language educators were in the first front in implementing various ways of using computers in education through CALL. Moreover, in English language teaching there has always been an intention to present new teaching methods in a comprehensible way that would encourage teachers to join in. The access to information on CALL was, among others, also facilitated by the Internet websites and blogs created by interest groups [2].

2. TRIALS AND TRIBULATIONS OF IMPLEMENTING CALL AT THE UoD

2.1 Technological Platform

Let's take a brief look at the short history of using technology for language learning and teaching at the UoD. In the last millennium, personal computer equipment was the privilege of the UoD managers only. It was at the beginning of the millennium when the first computer lab for students was established and when language teachers were gradually provided with personal computers. At that time, the Internet connection was provided via a telephone line, which was often annoyingly slow. Moreover, most of the educators did not have any in-service computer training and were using computers only intuitively, learning from each other. The significant change with implications for teaching and testing can be dated back to 2005. Since then, the UoD Language Training Centre (LTC) has been carrying out various research projects on enhancing the teaching process, e.g., by using technology in language teaching and testing.

UoD English language educators have been giving a regular account of CALL at the DLSC conference since 2006. From the technological perspective, they have paved their way to the current state of CALL from creating interactive exercises in Toolbook II Instructor software and posting them on the Study Portal, through performing videoconferencing, using the LMS Barborka to utilizing the LMS Moodle [10, 11]. Since 2010, Moodle has been an indispensable part of all LTC specific research projects aimed at the optimization of teaching English language to students at the FMT. Due to these projects, Moodle has been verified as a suitable integrated learning environment that enables teachers to upload and systematically organize their teaching content and self-study materials for students, to manage classes and to assess students' performance [1, 9].

2.2 Teachers' Perspective on Using the UoD Moodle System

Until the beginning of the academic year 2012-13, the use of ITC was entirely at the educators' discretion. Though the LTC management encouraged the teachers to propose and solve specific research projects on the use of ICT, the actual implementation of CALL was not obligatory. So, in 2012 there were, on the one hand, several enthusiastic users of Moodle

at the UoD LTC, who were managing their courses their own way; on the other hand, there were groups of teachers using the Barborka LMS, and a few teachers who were using neither of them.

In the past academic years, the management style showed the elements of a bottom-up approach in using computers in foreign language training, giving the educators the opportunity to participate in the project management processes. The bottom-up approach allows managers to set goals and the team members can decide on the ways of reaching the goals. The choice of methods and ways to perform the tasks is up to the members of the team. This approach is well known for providing more space for creative thinking, since the team members feel engaged into the project development and know that their initiatives are appreciated. Thus the member's motivation to work increases substantially [5].

However, in 2012, the increasing number of students at the UoD and the decreasing number of language educators at the same time, as well as changes in curriculum that should cover more specialist English, resulted in the management's decision to rethink the current state and assign the educators with the task to manage all courses of the first year students in the Moodle system. This demand was not positively acclaimed by all language educators at the UoD. Some still consider using Moodle a drawback. Let's explore some possible causes of their reservations concerning the compulsory use of Moodle.

The educators who were reluctant to using Moodle have been arguing that the requirement for using Moodle and the unification of courses undermines their academic freedom. Some of them had not used any LMS before, or had preferred the Barborka LMS system. From my perspective, there might be several reasons for their lack of enthusiasm. First, they didn't have enough training in using Moodle, and thus working in Moodle might be difficult and time consuming for them. Moreover, as some of them have not experienced the advantages of any LMS yet, they might perceive Moodle as a tool which increases their workload. Second, for those who have already developed their courses in Barborka, which is still running at the UoD, transferring their teaching content to another LMS, must be certainly painful. Third, the lack of enthusiasm could have been expected as one of the typical consequences of the top-down approach project management, by means of which the managers establish objectives and provide detailed guidelines and information. Nonetheless, the imposed processes are known for depriving people from motivation.

On the other hand, for the educators who had been using Moodle before it became mandatory the requirement did not constitute any significant change in their teaching methods. Some of them also welcome the unification of courses as the opportunity to systematically organize their courses. They believe that a reasonable unification of courses will make them clearly arranged, which will benefit both students and substitute teachers. Nevertheless, all teachers agreed on the fact that Moodle should serve the students and teachers and not vice versa.

As mentioned above, both the bottom-up and top-down management approaches have their advantages and disadvantages. Whereas the bottom-up approach in managing projects might lack clarity, control and validity, the top-down approach might result in reduced productivity and cause a bottleneck. According to experts [5], it is viable to find a balance between both approaches. Also, the management could learn lessons from the experience in other organizations, for example, from civilian universities which were facing a similar problem when imposing their virtual learning systems on their university staff.

2.3 Students' Perspective on Using the UoD Moodle System

The UoD students should be partners in adopting and improving the UoD Moodle system, so it is desirable to let them express their opinion on the use of the system. From time to time, it is advisable to conduct a survey, particularly when some changes in their study habits have been required or are expected. Since 2004, I have designed four questionnaires regarding students' attitude to the respective situations in e-learning facilitation at the UoD. In all four questionnaires, the overwhelming majority of students expressed their positive attitude to the ways CALL was executed at the UoD.

The last survey was carried out in March 2013. The sample of respondents involved all my students present at classes: 14 first year students of the Faculty of Military Technology, 16 first year students of the Faculty of Economics and Management, and 5 second year students of the Faculty of Military Technology; 35 respondents in total. The aim of the survey was two-fold: first, I intended to find out whether the compulsory use of Moodle constituted a change in their study habits in comparison with their previous school, and, second, to what extent they were satisfied with the UoD Moodle. The questionnaire contained 19 questions; 10 of them pertained to using computers at their secondary schools and 11 questions examined students' view on Moodle.

According to the results of the survey, the majority of students (64%) had not used computers in foreign language classes at all at their previous school, and only two students had used a LMS; accidentally, it was the Moodle system. The overwhelming 91% majority is satisfied with Moodle and the way the UoD teachers (in this case Ms Lenka Slunečková and the author) use computers in classes. 91% of the students appreciate the opportunity to send homework to the teacher via Moodle; most of the students have never experienced any technical difficulties when using Moodle (89%); and four (11%) students suggested that Moodle could be better arranged. Only four students (11%) would like to use computers more in the classroom; namely for improving listening and pronunciation skills by using special software or for testing.

The results of the questionnaire show that although using Moodle was for most students a new study habit, they complied with it at the UoD. Obviously, this sample of respondents has been certainly influenced by their teachers who find Moodle useful and had been using it before it became mandatory. On the other hand, it would be interesting to conduct a survey in classes of students whose teachers have reservations to using Moodle to find out to what extent the teachers' attitude to using Moodle affects their students' opinions.

2.4 Using Computes in the Classroom

According to the survey, most students are not longing for spending more time using computers in classes. This opinion resonates with the UoD educators' view. However, both teachers and students would appreciate having more opportunities to carry out testing in computer laboratories; particularly the educators who have developed their own electronic tests. They are aware of the fact that although web-based tests require quite a large amount of effort mainly in the construction stage, the automatic corrections, feedback, marking and record keeping is indisputably comfortable. Objectivity, convenient administration and almost infinite reusability and updatability of web-based tests contribute to the list of their benefits [1, 9].

The problem of electronic testing in a large scale at LTC lies in the insufficient access to a large numbers of reliable computers. The LTC owns only one computer laboratory with ten PCs for students, which is not enough to satisfy the needs of the UoD students and educators. Also, current experiments with mass test taking in the UoD laboratories outside the LTC have been problematic, since the maintenance and updates of the PCs are not provided by the same technician, and thus the teachers cannot relay on smooth course of electronic testing sessions. Nevertheless, the verification of the possibilities of mass testing, such as distributing placement tests and course credit tests are still in progress at the LTC [9].

Generally, most students and educators would agree that long hours of CALL should take place outside classroom. For instance, practising receptive skills, reading and listening, and also writing can be trained and improved via computers. LMS systems are excellent tools to distribute learning content and provide students with study instructions. The aim of using computers outside classroom in language learning should facilitate more time for face-to-face communication in classes. The computers in classes should be used, in my opinion, mainly to provide an input for communication, and to motivate students by showing them exciting authentic materials, which would capture students' interest and make them want to learn more.

Finally, let me present an observation on using computers in class I made when taking the Advanced English Course in the USA, Texas, AFB Lackland. All participants were provided laptops with an unlimited access to the Internet. They served well when the students were supposed to conduct research, verify vocabulary or carry out newspaper projects. However, some students abused the use of laptops in classes. For example, some of them used them for their personal communication with their friends, whereas others resorted to them when they were supposed to practise speaking in groups. In such cases, the communication in class was disturbed and some assigned speaking tasks remained uncompleted. Moreover, open laptops and active 'researchers' diverted the attention of their fellow students. Unfortunately, at first, the teacher did not pay much attention to it and the quality of practising speaking deteriorated. She intervened only at the end of the course, when the situation became unbearable and the course participants ceased communicating at all.

No wonder that using laptops in classes has become a research subject. For instance, based on statistics on students' performance and attention, Fried [6] argues that sustained laptop use during lecture is not recommended because it distracts student's attention and hinders their performance. Unreasonable use of computers in classes contributes to the crises of attention in the 'culture of distraction' that we are creating, according to Kraus [7]. Inevitably, using laptops in class calls for clear rules to be introduced, and university students should understand that observing them is for their benefits. Some educators offer guidelines on minimizing students' distraction and keeping them on task [4].

CONCLUSION

Computer Assisted Language Learning constitutes an indispensable part of the UoD foreign language training. Recently, this fact has been officially confirmed by the UoD management by the requirement for conducting foreign language courses for all first year students via the UoD Moodle system. In further imposing the changes in teaching methods on the educators, it is advisable to bear in mind that some resistance can be expected and that it might be

alleviated by finding a smart balance between bottom-up and top-down management approach.

In comparison with the teachers, it seems that the UoD students accepted the change in their study habits without problems. A small scale survey shows that although most of the UoD students had not used computers in language learning at secondary school, they complied with the UoD Moodle system without difficulty and are satisfied with it. Via Moodle, the educators can provide students with information, instructions, teaching materials, additional language practice, links to useful online materials and objective testing. They can also post students' power point presentations and the outcomes of class project work, which has proven valuable, particularly in teaching specialized language. Such specific e-learning objects can be reused in other classes. Thus Moodle plays an important role as a tool that enhances the range and quality of specialized learning contents. In case laptops are used in classes, their use needs to be carefully controlled. In accordance with the UoD students, the language educators consider blended learning – the combination of face-to-face and computer instruction – the best solution.

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AN EASY AND EFFECTIVE CREATION OF E-LEARNING COURSES

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Abstract: *This article highlights the practical experiences acquired in design, realization and implementation of interactive e-learning projects located on the three educational portals for students called "eLearn central" based on LMS Moodle. The second of them - "eLearn central journal" has integrated original authoring tool for preparing new courses (*http://kme.elf.stuba.sk/elearn*). In this way was created space for creative work, interconnecting "eLearn central team´s" long-term e-learning experience and pedagogical preferences of authors with little ICT skills.*

Keywords: e-learning, portal "eLearn central", authoring tool, LMS Moodle, interactive courses.

INTRODUCTION

Modern Information Technology has opened up many new possibilities in learning [1]. E-learning has become one of the most popular and progressive forms of education and easiest way for accessing a huge amount of information [2-4]. E-learning as educational method is motivational, effective, practical and allows to learn more information in shorter period and in an enjoyable way.

The obvious advantages of e-learning have inspired us in our work. We have created alternate sources of information for Faculty of Electrical Engineering and Information Technology students – three portals named "eLearn central" based on Moodle platform to enhance the quality of traditional teaching methods. The main objective of our effort is to give the students high quality study materials prepared in user-friendly way. There is also one big challenge – to train new authors and new students for active use of e-learning technology. To fulfil this vision we have created portal "eLearn central-journal" with integrated tool for authors for preparation of the new courses. By combining our long-term e-learning experience and pedagogical preferences of authors with little ICT skills we've created an environment for creative work – authoring tool for course creation.

The aim of this paper is to present our practical experiences acquired in design, realisation and implementation of interactive e-learning courses located on the educational portals for students called "eLearn central". The focus is also on our very intuitive and easy-to-use tool for authors for preparation of the quality e-learning materials with good technical background.

1. ELEARN CENTRAL PORTALS

The first educational portal called "eLearn central" has been created in December 2004. This portal was originally established mainly for Faculty of Electrical Engineering and Information

Technology bachelor students. Portal "eLearn central" uses the learning environment LMS Moodle and today is located on the server of the Institute of Electronics and Photonics, Faculty of Electrical Engineering and Information Technology, Slovak University of Technology in Bratislava (http://ec.elf.stuba.sk/).

Currently we are working with three portals based on Moodle called "eLearn central" [5]. Primary portal mentioned before "eLearn central" today labelled as "old" is based on Moodle 1.9. "eLearn central journal" portal with integrated authoring tool has been created in June 2011. It is also based on Moodle 1.9 and accessible through the hyperlink: http://kme.elf.stuba.sk/elearn. "eLearn central" educational portal based on Moodle 2.4 was established in June 2011. It is accessible through the hyperlink: http://kme.elf.stuba.sk/moodle.

Since 2004 we have developed numerous educational materials which are stored on these portals "eLearn central". By designing, realisation and implementation of interactive e-learning courses we have gained a lot of experience and valuable know-how. The main aspect of development and implementation of courses on the "eLearn central" portals is effectiveness in education. We have to create courses full of interactivity, multimedia elements, animations, self-tests, discussion forums and wiki modules. Platform LMS Moodle enables and allows us to focus on important things - learning content and context, development of explanatory flash animations [6], creating eye-opening tests, tutoring of discussion forums… Our authors and teachers now have to concentrate their attention on the quality of prepared educational materials in the first place. They have to ensure the effective use of these materials in educational process.

The courses and e-learning projects located on three educational portals "eLearn central" are successfully implemented in education process at our university since 2005. These courses mainly serve students at the Faculty of Electrical Engineering and Information Technology as an alternative source of information and support used in a blended form of study since 2005 (face to face and e-learning), students team work since 2005, a distance study since 2006, the popularization of Science and Technology between kids and young people since 2009 and team work in projects´ realization since 2009.

2. ELEARN CENTRAL COURSES

Our "eLearn central team" has developed more than 200 e-learning courses and educational modules in four basic types: The libraries of e-learning source, The standard self contained e-learning courses, One-shot courses – fast courses and Project courses - the courses "Team Projects" and “Individual projects” [7]. In our courses the main focus is on content and context of study materials. The texts are structured, supplemented by illustrative images, schemes and charts, interactive animations and other components such as navigation elements. We try to update the texts regularly and extend them by optional yet interesting information. According to our experience attractiveness of the concept of the educational materials is very important. In the past we used to work with SCORM packages for presenting the educational texts in courses, but at the moment we prefer web pages created in LMS Moodle or our own authoring tool for course creation.. We also use PDF format, for printable data download for students.

3. ELEARN CENTRAL JOURNAL AUTORING TOOL

Nowadays it is possible to work in e-learning environment, which fulfils the basic requirements for a learning management system at minimum expenses – LMS Moodle. But Moodle is such complex environment and with so many choices and setting options that often it comes to the paradoxical situation. The variability so treasured by long-term users of Moodle environment, is drawing back the beginners. The experience and skill of professional work of our teachers are proven by many years. But their handicap on the other hand is that they have only very few experience with creating professional e-learning courses. Because of this reason, in 2010 we have proceeded the plan to develop our own authoring tool for authors with no further experience in creating professional e-learning educational materials with implemented citation option and the review process by specialists. We have created our own unified design of courses, elements in animations, standards for courses´ form and rules for course creation. The author has so very intuitive and easy-to-use tool to prepare quality e-learning materials with good technical background.

The authoring tool acts as a support to create educational modules and courses (Fig. 1). This tool uses standardized elements. Uniform icons are used for editing, formatting the content and its structure, icons for selecting the type of citation, as well as the status icons showing the course's state in the review proceeding.

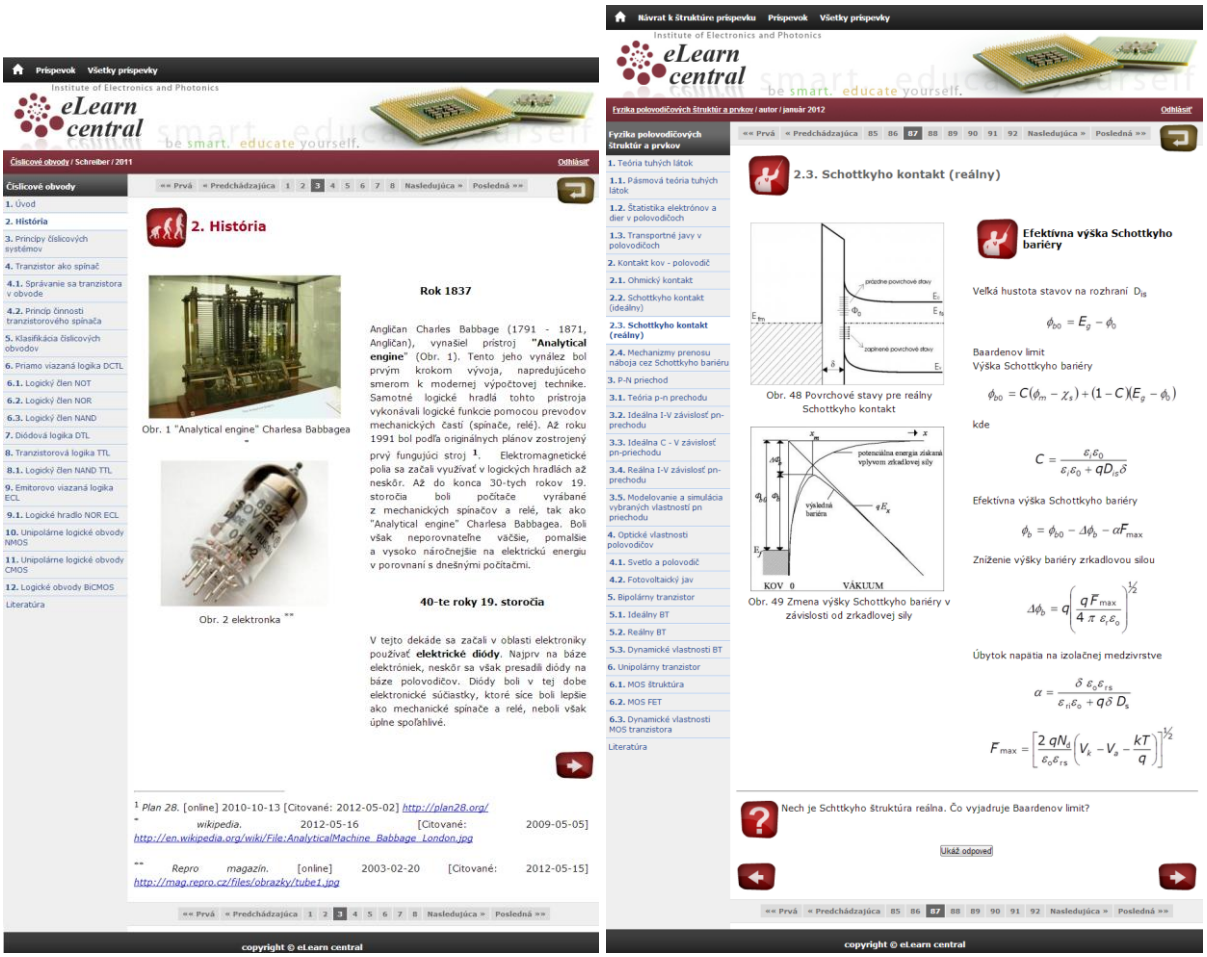

Fig. 1. Student's view: Course "Digital circuit", section "History" and course "Physics of semiconductor structures and devices", section "Schottky contact (real)" with pictures, cited references, navigation elements, equations and question
Source: own

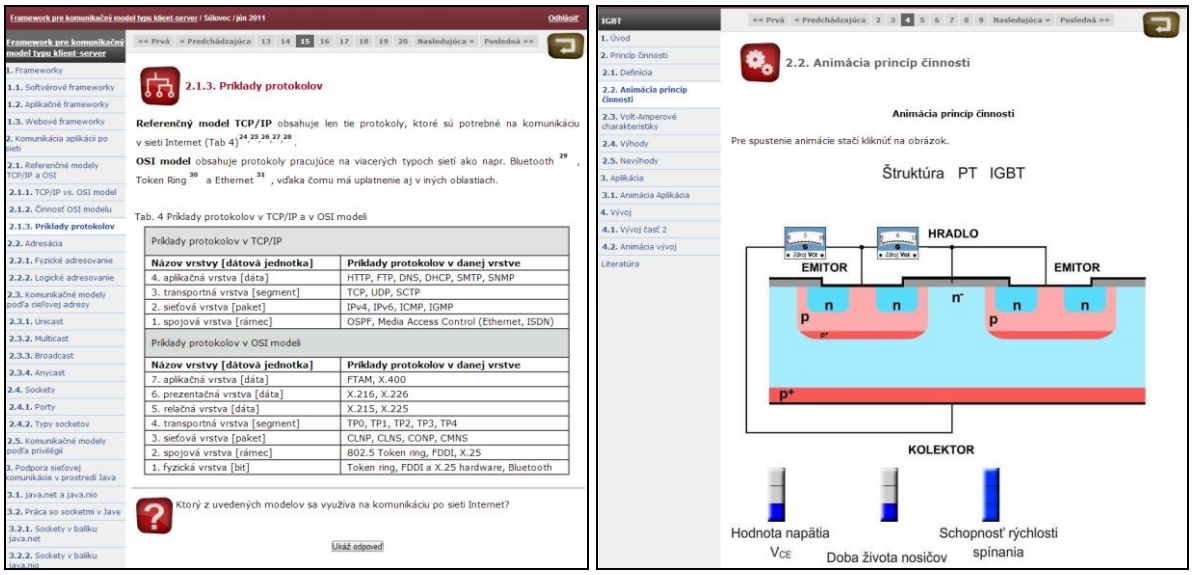

Fig. 2. Student's view: course "Framework for network client – server ", section "Protocol samples" with table, question and navigation elements and course "IGBT", section "Animation the principle of operation" with integrated interactive flash animation
Source: own

Inserting the educational text is enabled thanks to 12 pages with predefined format with different layout (title, text, image, table, and question/task). It is possible to insert predefined titles, which are editable and are displayed together with corresponding icons. It is also possible to move and delete individual pages of the educational text, except for the first initial page and the last page (bibliography) – these are fixed. All inserted elements can be edited or deleted if necessary. For the author, the major simplification is that all kinds of the paper's text (abstract, objectives, educational texts…) can be edited directly in this authoring tool or inserted from pre-prepared materials in MS Word by using the copy/paste function. The formatting of the text does not matter, because the authoring tool changes all according to selected design.

Another helpful tool for authors is the citation module – the author can insert the citation in section "Citations", by filling in the form for chosen entry. This citation is then automatically processed by the system according to standards ISO 690. The created citations may be inserted into the educational text at any time and as many times as needed by clicking the icon "Citation".

Each author has his/her own data storage place "My files", where various types of files can be loaded up to the size 70 MB per each file. Any file uploaded by one author can be used then in all his/her papers, if he/she decides to continue to work with the authoring tool and prepare more papers. Even the work with pictures is easier using the authoring tool as they can be loaded to the data storage place "My files" in jpg, gif, png and bmp format. The pictures are then inserted on the page by clicking the "Insert picture" icon. The pictures are automatically numbered according to their position in the paper (Fig. 1, Fig. 2…). The pictures can be used repeatedly and their title can be set each time when inserted. The size of inserted picture is limited to max. 1280×1024 px. The authoring tool will automatically adjust the image size regarding the chosen page format. If the image size is smaller than predefined, the picture is displayed in original size. After clicking on the picture it is opened in new window in its original size. If it is necessary to use picture with larger size, the author can ask the portal administrator to add this picture.

Everything what can be done automatically is set by the system – for example all citations inserted by the author into the text are automatically displayed in the list of citations according to standards ISO 690 and are alphabetically ordered. The pictures and tables are also numbered automatically.

Test questions, Online resources to current topic and Dictionary entries are inserted by author with a help of separate modules, which are directly linked with the Moodle learning environment. After filling in all items in the authoring tool the data are implemented directly to Moodle and the full course is displayed. The authoring tool is created so that the author has the basic idea of how the course will look like after exporting to Moodle during the whole editing process. The difference between edited and exported course is only in displaying/not displaying editing icons. This approach clearly makes the author's orientation easier during the course's preparation process.

Ten groups of specializations, for example "Electronics and Photonics", "Computer Science and Mathematics", "Electrical Engineering", "Languages", were designed and located on this portal. Only five courses are available in portal´s pilot scheme. Currently all the courses have to undergo the review process, but they are still freely available on the portal. We want the potential authors to see some examples of how our courses should look like.

Each lesson in standard courses and educational modules was processed during conversion in line with the requirements of Internet studies. Each lesson starts with a definition of study objectives. The lesson wordings were divided into short well-defined units enriched by a content-related illustrations, graphs, schemes and images focusing student's attention to the particular issue and promoting the ease of orientation in the text. Some of the educational texts are amended by topic-related questions, invoking consideration, questions and tasks. The educational texts have been complemented by numerous navigation elements such as the active navigation menu bar on the left side of the screen. It provides a full course content overview, so that student just selects the topic and the selected study section immediately appears on the screen. Further navigation elements include the arrows or numbers in the page heading and footing. In case the text exceeds the page scope, the active continuation link enabling to progress to the next page is added.

Everyone who is interested in any topic of published courses can access the portal-journal "eLearn central" (users just need to fill in a simple registration form and are provided with a free full access.). We are successfully using published courses in blended learning and our effort now is also to popularize technical subjects by opening the materials to wide public. This strategy corresponds with the aims of MOOC technology: Support better learning and instruction with high-quality, scientifically-based, classroom-tested online courses and materials [8, 9]. Share our courses and materials openly and freely so that anyone can learn. Develop a community of use, research, and development to allow the continuous evaluation, improvement, and growth of courses and course materials.

CONCLUSION

E-learning has a huge potential as a motivational and effective tool for acquiring knowledge in an enjoyable way. One of the ways of quality assurance in engineering education is application of quality e-learning. Our goal was to simplify the work for the authors of the

courses with little or no experience in this field. The authoring tool, we have developed for this purpose, has to comply with specific criteria for developing the engineering education e-learning materials. One of them is also the review process that we have integrated to Moodle 1.9. This modified Moodle has been installed on new hardware and so the "eLearn central journal" has originated. This authoring tool acts as a support to create courses - the authoring tool for authors with no further experience in creating professional e-learning educational materials. The author has now very intuitive and easy-to-use tool to prepare quality e-learning materials with strong technical background. Work with the template clearly simplifies the process of preparing a course, providing the author with general support and effective tool for creating courses. However it is only a backbone ensuring the formal level of the course. The quality of the e-learning course is always determined by the content and context created by the author.

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POSSIBILITIES OF SIMULATIONS IN E-BUSINESS

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Abstract: *Monitoring and control of a large e-business system depends on its architecture, which can be described by specific models. Creation of an adequate model in conjunction with its mathematical description and ICT support is a prerequisite for the implementation of simulations, which are now very important tools for support of decision making. Models are able to provide experts in the field of informatics and persons active in management systems large amount of information. Of course, we must always bear in mind that even today there are still many limitations that cannot be omitted in relation to e-business system development. The main goal of this paper is to present a current state of development of global e-business systems with the focus on purpose of their application, on modern approaches to modeling, and on possibilities of simulations as a fundamental support of management.*

Keywords: e-business, system, model, e-business system modeling, global e-business system, simulation, strategic plan.

INTRODUCTION

In many cases, for example in [2], e-business systems are presented as a set of online technologies, equipment and tools that are used to conduct business via the Internet. These systems help a company to make connection with customers, to process orders or to manage information. For instance, a high-profit e-business system is a web-based retail store where customers can purchase products online. In our view described in the preceding sentences, such systems are referred to as e-commerce systems. E-business systems cannot be limited only to sales activities; they should be viewed from more perspectives. E-business systems include many other activities and subsystems designed to promote and increase the efficiency of business processes, such as a variety of data management systems, CRM (Customer Relationship Management) systems, intranets and extranets solutions, production (without and with support of ICT – Information and Communication Technology), planning, project management, development activities, etc. From this perspective, e-business system must be considered as an integrated system. In connection with the development of e-business, increasing emphasis is placed on management and creation of adequate and realistic strategic plans, where possible effects of various subsystems within the supply chain must be taken into account [5]. A modern auxiliary tool for gathering data for the development of a strategic plan is for example simulation. As shown in [3], it can be effective to use multi-agent, better agent-based approach for simulation of economic systems. In general, the initial step for monitoring and evaluating the behavior of any system and its simulation is the creation of adequate model, definition of its descriptive and preferably measurable parameters, definition of simulation algorithms, definition of the input data and finding a way how to obtain it, verification that the simulation output data correspond to a reality. The main objective of the paper is a presentation of links and connections between the understanding of current state of e-business systems as integrated systems, general structure of e-business systems, modern

approaches to developing models of these systems, simulations of e-business systems and development of strategic plans based on simulation output data. The main emphasis is placed on the presentation of important assumptions and weaknesses.

1. E-BUSINESS SYSTEM

Definition of any system must be based on the basic theoretical system analysis. As mentioned in the introduction, e-business system must be considered as an integrated system. If we apply the basic methods of system analysis, we can define a system as a purpose-defined set **S = {P, R},** where elements **P = {p_i}** are elements of the system, **R = {$r_{i,j}$}** relationships between them, and **i, j ∈ K, K ={1, 2, 3,…k}.** The set **P** of all elements of the system **S** is named system "universum". The set of relationships **R** determine a structure of the system. The structure of the system may be functional, technical, information, time, organization, etc. [1] In addition to these basic assumptions, e-business systems (specific type of economic system) have to be considered as cybernetic system. Individual sub-e-business systems are subsystems of classical cybernetic system models. Currently, the primary and exclusive means for system modeling are computers as classical cybernetic systems. Therefore, the basic question is how to define a model of e-business system. Basic procedural model of the general e-business system is shown on Fig. 1.

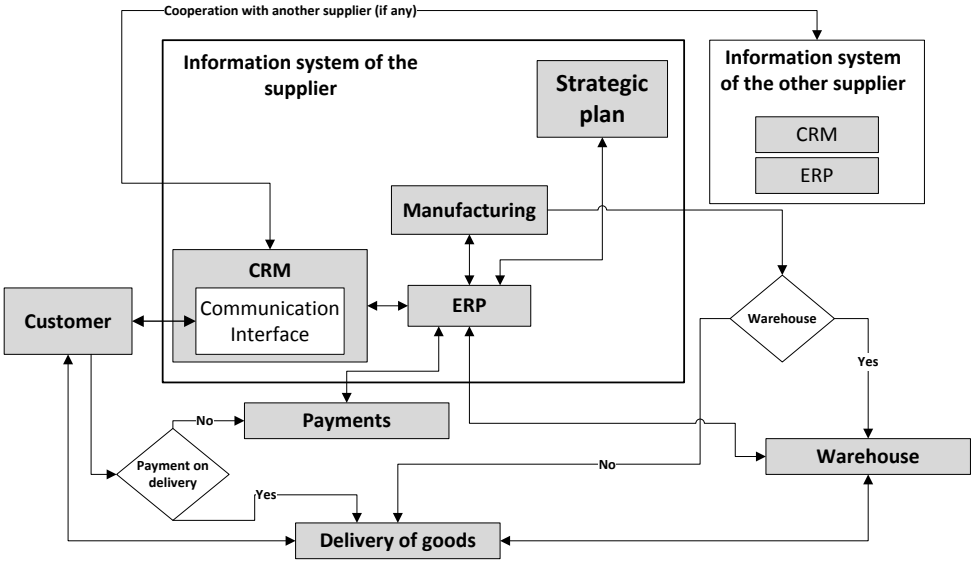

Fig. 1. Basic procedural model of e-business system
Source: own

As shown in Fig. 1, e-business system is designed as a classical manufacturing company in which different activities are realized in synergy of technology and human factor. This fact corresponds to the concept of a cybernetic system. Whereas, in the context of e-business systems in which manufacturing processes are a subset of business processes, scheme in Fig. 1 can be considered as a classical business cycle. Practice unequivocally shows, that in a successful e-business, all of its business model components work together in a cooperative and supportive fashion. If we want to ensure the optimized and required functionality of e-business system as a whole, we must ensure the proper operation of all its subsystems. Selected basic key areas of e-business system are shown in Table 1.

Marketing	Production/Operation
• Customer relationship management • Interactive marketing • Sales force automation • Feedback from customers (identification of customer needs and requirements)	• Manufacturing resource planning • Manufacturing execution systems • Process control • Manufacturing logistics • Development of new products
Accounting	**Finance**
• Order processing • Inventory control • Accounts receivable • Accounts payable • Payroll • General ledger	• Cash management • Credit management • Investment management • Capital budgeting • Financial forecasting
Management	**Information and communication technology**
• Human resource management • Financial management • Marketing management • IS/IT Management • Compensation analysis • Employee skills inventory • Personnel requirements forecasting	• Technological architecture of the information system • Production technology • Communication channels with customers • Communication channels with cooperative suppliers

Table 1. Selected basic key areas of e-business system
Source: own

2. E-BUSINESS SYSTEM MODELING

The e-business model, like any business model, should describe how a company provides a product or service, how it generates revenue, how it will create and adapt to new markets and technologies, whether the company is stabled and what are its new possibilities and opportunities. In other words, we can say that models are created for the purpose of monitoring e-business system behavior which is important for management and decision-making support. Of course, a suitable model is the basis and a prerequisite for the implementation of simulation (see Section 3). The e-business systems can be modeled in three ways:

- process oriented approach to modeling (process modeling methods are mentioned (described) by several authors e.g. [7], [9] (this publication analyzes several methodologies including MMABP which have been developed at VSE Prague for a long time);
- chain (or value) oriented approach to modeling e.g. in [14], [10], etc.;
- modeling of e-commerce systems as multi-agent systems e.g. [8], [17], etc.

Each of the above approaches provides specific possibilities to describe the e-business system from many perspectives. In order to make a comprehensive description of the e-business system, all the shown approaches should be used.

E-business systems are generally very large systems with a wide range of descriptive and measurable parameters. Some of them are presented for example in [13].

3. E-BUSINESS SYSTEM SIMULATION

Simulation is generally defined as a method for the analysis of the behavior of complex systems by monitoring the behavior of their model (currently, especially computer based). Principally, simulations are based on cyclic repetition of planned activities during which we observe individual quantitative parameters. For the purpose of simulation, models are expressed mathematically. It allows as monitoring of the system behavior and measurement of system performance parameters, or of the sensitivity to changes in input parameters and disturbances. For simulation purposes, primarily agent-based models are to be implemented. Computational social science involves the use of agent-based modeling and simulation (ABMS) to study complex social systems [6]. The purpose of an ABMS model is not necessarily to predict the outcome of a system. It is more suitable to reveal and understand the complex and aggregate system behaviors that emerge from interactions of heterogeneous individuals. An emergent behavior is a key feature of ABMS. An emergent behavior occurs when the behavior of a system is more complicated than the simple sum of the behavior of its components. ABMS techniques are suitable for the research in the area of disturbances. Together with the random number generation using different distributions, ABMS provides a framework basis for the simulation of social systems [15]. E-business is in this sense one kind of a social system. Designing an agent-based e-business system as a part of simulation experiment is a complex process in which it is necessary to define both the structural relationships between agents and individual agent behavior. Different kinds of software agents will be designed in order to keep up with the reality on e-business marketplace. One of the goals of our research is to include the possibility of mobile agents' usage in the ABMS area. Agent-based models and simulations provide us with means for computer simulation enhanced through experiments aimed at improving our intuition about the modeled phenomena. This feature is particularly important in social sciences where possibilities of experimenting in real world situations are rather limited [11]. In general, implementation of the simulation must be a subject to clearly defined principles and we must always take into account all the possible connections.

If we look specifically at the simulation of e-business systems, the biggest problem is the simulation of behavior of customers. In relation to the scheme shown in Fig. 1 in section 1, much easier is to define measurable parameters of behavior of the hard parts of e-business system such as ERP, CRM, payments, delivery of goods and storage. However, customer behavior (so called soft part of the system) is governed by different rules with a very high degree of uncertainty. Customer behavior is promptly changing and we have to take into account a range of behavior influencing factors, for example target group, geographical location of customers, customers' ability to pay, weight of influence the customer by different marketing actions, availability and the ability of customers to use ICT, customer needs and requirements, saturation of the market by a large number of products and generally the impact of competition. The effectiveness of simulations depends on finding a suitable mathematical expression of these factors including many other parameters and their values that best reflect the real world. It should be borne in mind that the described values are always only approximated.

4. SIMULATIONS OF E-BUSINESS SYSTEM AS A MANAGEMENT SUPPORT

Simulations are performed outside the real system. If we want that the simulations fulfill the purpose of their use, they must be performed on models using real data sets corresponding to

the reality. Moreover, they should be able to provide the latest information applicable in the management process. (more for example in [16] or [4]) For this reason, it is necessary to integrate simulations into the complex architecture of the system (in our case e-business system), and to define and actually create and set all channels of communication between different levels (Fig. 2) [12]. In this case, we suppose that we have a functional simulation tool corresponding to a reality.

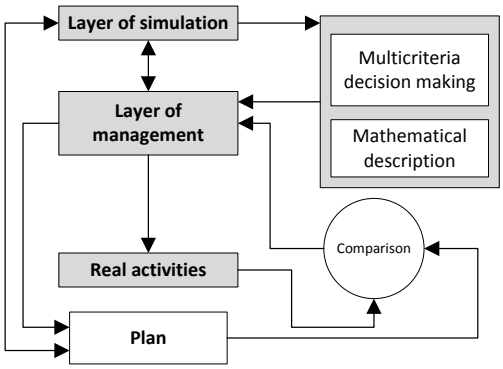

Fig. 2. Scheme of connections between layers of management, real activities and simulations
Source: adapted from [12]

In Fig. 2, Layer of management presents management control activities primarily focused on real activities. The default values that are used during the simulations used as comparative, and are contained in the plan (generally strategic plan). Real regulatory interventions are implemented on the basis of their verification in the layer of simulations.

As shown in the previous sections, the simulations can (and rather should) be used to support the management of real activities. A key aim of all modern companies is to produce the products which are of interest, to reduce price, improve services, minimize the time of delivery of goods and generally to access to a large and available inventory that presents options for the buyer. A primary objective of all firms should be the creation of so-called customer-oriented e-business systems that are able to ensure all customers´ needs and the associated requirements [12]. Fundamentals for the development of these systems must be an integral part of the strategic objectives. Generally, it is very important for the creation of a strategic plan of the e-business systems to have an understanding of the impact of the internet and e-business on various industry sectors, understanding and selecting e-business enabling technologies, planning and evaluating resources, understanding of e-market places, exchanges and developing e-procurement strategies, skills and knowledge in web based programming, web based information management, retrieval, practical applications of web authoring and scripting tools, as well as database integration, skills in the use of ERP, CRM and others, analysis of business needs and developing e-business systems, the issue of ensuring the sustainability of the system and its further development, knowledge of e-business system methodologies and packages, selection and configuration of enterprise based tools, understanding and assessing of Internet security policies, current possibilities of the logistics supply chain and of many other areas.

CONCLUSION

Simulations are modern and increasingly used tools for decision-making, and generally for management support as a whole. They are also successfully applied in the area of e-business

systems. For the purpose of the simulation, a suitable model of system has to be developed. For creating models of e-business systems, we can use process oriented, value-chain oriented and multi-agent based approaches. If we want to use simulation in practice, simulation tools must be designed so that their outputs appropriately reflect the reality. The most problematic area is the definition of measurable parameters describing customer behavior, because of the series of random values. Simulations have, and in the future will have, increasing importance in cases when they will be integrated directly into a firm management system as a specific layer. It allows a rapid feedback in verifying some of the planned decisions and helps in the creation of short-term, medium-term and strategic plans.

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INTERCONNECTION OF CONSTRUCTIVE SIMULATION WITH COMMAND AND CONTROL SYSTEM

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Abstract: *The current course of preparing the units of the Slovak Armed Forces for deployment throughout the world calls for interlinking of constructive simulations with the used combat means of command and control. Nonexistent system for interlinking the simulation tool with the means of tactical, communication and simulation systems; providing two-way communication; interoperability of the technical means; implementation of the decision-making process results when planning and conducting operations as well as the follow on response and the possibility to perform the analysis and verification of understanding the role of a supervisor are the essential drivers for interlinking the constructive simulation system with command and control system.*

Keywords: Command and Control, Virtual and Constructive Simulation Technology, Interconnection.

INTRODUCTION

As a result of globalization and the enormous growth of Information society as a whole is currently becoming very significant information product of the company or organization. The aim of management of modern organizations, as well as the Ministry of Defense is to ensure maximum safety information in the full computerization of the company.

Defence is constantly seeks to modernize its portfolio by implementing the latest systems in the field of information-communication technologies (hereinafter ICT). In the framework of the activities of the defence in 2006, began with the progressive development and building comprehensive system solutions for process automation in the field of command and control of the armed forces. The system is introduced under the name of C2SYS and forms the basic building element of the system of command and control (Command and Control – C2) land forces OS SR on tactical level. C2SYS system is designed to give priority to the planning and management of operations.

Another element of informatization defense system is a constructive simulation. The system is gradually built up within the structures of the Armed Forces Academy gen.M.R.Štefánika based in Liptovský Mikuláš and Department of simulation technology that is established and gradually built the MTA Lest. Through the constructive simulation is carried out exercises CAX, which is used to prepare a training commanders and staff officers. The system is designed based on a computer to simulate the planning and control of combat operations and operations with a view to the virtual battlefield maps.

In view of the current progress of preparation of units, which are broadcast on the deployment of OS SR in the context of crisis management, whether military or non-military nature, in

different parts of the world are increasingly defines the necessity of linking various systems of ICT. Into this category, it is possible to include the interconnection of the constructive simulations used in combat with a means of Security command and control. Non-existent system to link the simulation tool with means of tactical communication and simulation systems, ensure mutual two-way communication, interoperability used technical means, the implementation of the results of the decision-making process in planning and management of operations and the subsequent response, with the possibility of carrying out the analysis and understanding of the role of the Manager is to explore the basic tasks that need to be resolved for the full link of the systems.

1. THE BASIC DEFINITION OF THE SYSTEMS C2 AND SIMULATION TECHNOLOGIES

1.1 C2SYS – TS

System C2SYS-TS is the basic building element of the system of command and control land forces OS SR on the tactical level. Its main task is to feature an integrated and automated command and control system to ensure that the processes within the command and control warfare units. An important task of the C2SYS-TS is sharing and teamwork of staff over a common set of information and distribution of information between the levels of command. Another is to ensure compatibility of the planning and management processes with standardised procedures in the countries of NATO armies.

The system is used at the tactical level of command, which means the use of mechanized brigade staff, battalion headquarters of the mechanized battalion and nuclear, chemical and bacteriological protection. The next level of command where the system C2SYS – TS uses the space command and commander of mechanized rot crews, survey crews and crews of selected types of troops. The system enables planning and management of operations in the assembly units Armed Forces in foreign missions. The methodology used for the headquarters of the methodology is based on the work of staffs in NATO countries. [2]

The basic breakdown of the system to the individual subsystems:

- ***C2SYS -TS*** – automated system of command and control at the tactical level,
- ***C2SYS-STAF*** – automated command and control system designed to support the work of the commanders, who are available to subordinate staff, currently the Brigade, battalion,
- ***C2SYS-MIS*** – the combat vehicle information system designed to support the work of commanders without direct support staffs, i.e. the commanders of brigades and battalions to TMV [TAC] commanders, crews and teams.

C2SYS-TS system is physically broken down into the following core components:

- ***C2SYS - MIS*** – places command vehicle (tactical computer system / vehicle – TPS/V)
- ***C2SYS-STAFF*** – places command staff (tactical computer system / desk top – TPS/Š),
- Staff server (printer),
- Tactical TSB connection point (node) – 3 pieces
- Additional materials - briefing workplace.

2. THE SIMULATION TECHNOLOGY

The lack of financial resources, increased interest and a great emphasis placed on the protection of the environment as well as other factors, have become the driving elements that got the notion of simulation technology to the forefront not only in the public interest. Currently, the simulation of the fully established themselves in the training of the armed forces and in the form of **virtual**, **constructive** simulation, and also **instrumented manoeuvres' training** (often times referred to as a live simulation).

2.1 The Constructive simulation

In constructive simulation are simulated entity controlled simulated valet. Thus we can easily simulate a constructive comment one sentence. Constructive simulation is thus a kind of simulation, when the model contains everything you need to make in the course of the simulation replaces the original and even one that includes humans. In constructive simulation is thus replaced by a man-model entity. In the exercises (ideas) constructive simulation is then applied by the decisions of these simulated entities. Models on the basis of reciprocal relationships and dependencies can be divided into:

- a deterministic model that contains the only uniquely determined by the relations (algorithms),
- Stochastic model that contains at least one relationship with a random variable itself (to its implementation uses a random number generator), other relationships are deterministic,
- Model with artificial intelligence that contains at least one times the technique of artificial intelligence.

Control of that type of simulation is carried out using the user interface, the display of a synthetic environment is similar to a topographic map, although for the purposes of the processing algorithms of models also includes altitude data and other information on the characteristics of geographic objects.

Constructive simulation is used in distinguishing two levels for various types of military and non-military operations. This distinctive level means a level (size) and those directly affected by the level of detail modelled units. In general it is possible to divide the simulation applications using constructive simulation to the next level:

- Simulation applications with non-aggregated entities – such applications, where entities are the different weapon systems, vehicles, live the power. These entities, it is possible for the purpose of making the award of tasks and scenarios, the control group into the units, but each entity is in the course of a simulation run by its own model.
- Simulation applications with aggregated entities-these applications are used for higher level simulation units. The essence of the aggregation is to assign the unit as an entity at a different level. An entity can be defined as rota, but also as a brigade, for example for applications at the strategic level. Thus, the aggregate entity is then controlled by its own model. Such aggregation understandably declines the validity of the model and hence claims to detail the processing of synthetic environment.

2.2 The simulation tool OTB

The simulation system OTBSAF OTB version 2.5 is an open system hierarchical programming libraries constructive simulation. The greater part of his so called, library computer generated forces (Computer Generated Forces - CGF) are used to generate entities and semi – automatic generation of behavior. Simulated entities understand the units and their activities and behavior in synthetic dynamic battlefield that is shared by all simulators used within the joint exercise. Each entity in the synthetic battlefield dynamic simulation model of a particular element forces in the context of the other elements is semiautomatic. This means that the entity:

- together with the simulation of physics simulates the lowest degree of autonomous decision-making and behaviour as well as tactical,
- for the treatment, which requires a higher degree of tactical decision-making requires inputs from the operator simulated units.

In this way, in conjunction with input from operators to simulate the entity activity units operated during carried out exercises.

Digital terrain databases (ground) are shown with an image rendered battlefield maps. The base maps are digitized and the digitized model of the territory in scale 1:4 000 000 to 1:25 and terrain attributes, which are derived from 3D space-interest maps (include terrain slope, soil type, and elevation).

During the exercise, it is possible to obtain information about the environment containing temperature, air humidity, wind speed, light conditions. In the editor is possible to perform change of parameters. By displaying digital maps can be inserted point (eg refueling points, fortification, meetings) and line (eg boundaries, transfer routes, obstacles, roadblocks) to create objects and surfaces (eg surface targets, airfields).

Movement and maneuver units are affected by terrain, after which the units move - permeability field. Based on the attributes of the terrain can be simulated visibility and visibility units, close to reality simulation [3].

3. ANALYSIS OF THE INFORMATION TRANSMITTED BETWEEN THE C2SYS AND OTBSAF

In order to ensure interoperability of equipment simulation technology with modern command and control systems (tactical communications and information systems) must be complied with policies, which can be divided into two areas. The first area is to ensure the transmission of information about the simulated entities into the command and control system environment (tactical communication and information system), used in training to ensure a common picture of the situation, see Fig. 1.

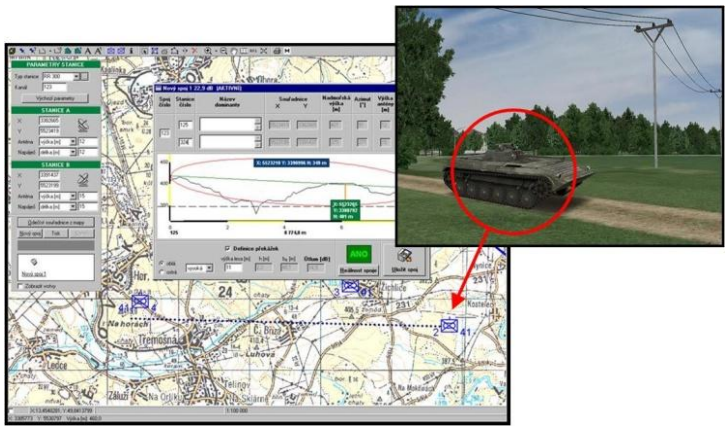

Fig. 1. The transfer of information from the synthetic environment into a system of command and control
Source: [1]

The second area is the use of a real system of command and control for the preparation of scenarios for training with the support of simulation technologies with their subsequent transfer to simulation applications, see Fig. 2.

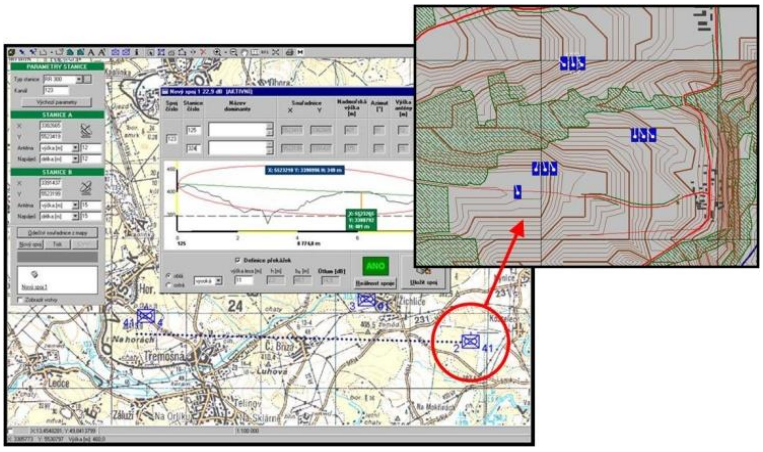

Fig. 2. Transfer scenario from the system of command and control within the simulation environment
Source: [1]

Specific requirements for the synthetic environment to ensure interoperability between simulation systems and applications, command and control are:

- Ensuring geo - references (using the same systems and cartographic)
- Ensuring compatibility with digital map series used for command and control.

4. INTEGRATION OF SYSTEMS

C2SYS system and its components are designed for direct and indirect support of decision-making tools to automate the work of staff commanders and contain on the tactical level of command and control. Its dominant use is oriented to the field conditions. Interface, communication and information systems is a set of formats and protocols, in which data are generated by a geographic information system, the data of the common situations, data

display, data structures and their simulation brands units of equipment systems, munitions, fuels and arming the protocols, which provided the data transmitted on the network C2SYS-TS.

Computer simulation using synthetic environment whose characteristics but usually correspond to a particular territory, time and weather conditions. Interface protocol simulators are DIS, which carries information about the structure of the units and their equipment, the state of the simulated units received tasks and their implementation, their position about the nature of the terrain and changes in weather conditions, time of day and year, status and updates influence of sunlight or moonlight and under. It carries all the technological basis for linking simulators using a single protocol.

The basic idea of integration solutions based on the needs and defining characteristic in common systems. Common features for both systems are: the database field, the coordinate system for positioning units, weapon systems, tactical plotting, situational marks, database of organizational structures and equipment unit, system commands, orders and reports, system information. Both systems can be connected by means of technical programming interface (interface) which has the task of shared data, documents and display formats to transform – protocols of the cooperating system.

The morphology of both the structure of computer network is similar. The main requirement is the relative independence of the mount point the user to the system and corresponds to the so-called. "Tree". From this perspective, we can conclude that the physical point of both systems can be any mount point of each of the network. Bidirectional interface must transform various data formats and protocols of one system into another. [1]

Among the most important data we can classify transformed:

- information on the position of the object,
- information on the State of the object,
- Information on situational plots - plot of joint tactical situations
- Information formalized reports and documents and their generation.

In the both systems must be the same database data terrain, structures and equipment units respectively. The databases of both systems must work together in their data and their values must be identical to each other.

Philosophy interconnection systems is based on knowledge of data structures, algorithms used to solve tasks in support of decision making commander or simulation of phenomena and processes emerging and ongoing fight over the synthetic dynamic battlefield. The aim of linking is a condition where organs using elements C2SYS can use the system without discrimination whether it is real exercise or deployment in combat. Networked Systems expects to resolve the issues:

- Common terrain databases (using a single coordinate system for positioning units or objects of interest)
- Force shared databases and resources
- Generate the necessary formalized documents (eg reports, orders, regulations, reporting)
- A common situation with plotting tactical situational united brands.

CONCLUSION

Nowadays, when the government is forced to reduce the budget chapter of the ministries of expenditure, it is necessary to streamline the defense spending of the funds for the training of the armed forces. Defense priority in this area is increasingly realized through modern training - simulations at different levels of command.

Simulations as a means of modern training, cannot be transferred without the use of computer simulations of various crises military and non-military. Originality and innovative solutions to projects such as the interconnection of command and control (C2) and simulation lies in the design of system architecture to ensure interoperability, integration of the proposed solution possible links with the simulation tool by means of tactical communications and information systems. The present systems integration to enable the determination of the method of communication, information transfer and the required data on the corresponding protocol Servability a mutual two-way interoperability closer links tactical communications and information systems with the simulation tool used in the simulation center of defense.

And increasingly effective use of simulation systems provide a uniform system of training of the armed forces, the possibility of obtaining permanent habits and their recovery and integration of operational procedures, while maintaining options for addressing a variety of standard or random situations in dealing with crisis management, military and non-military. How very convenient to link the educational process seems to be of practical activities where the use of simulation technology to its improvement, higher productivity and more efficient, creating the conditions for the preparation of common units to conduct combat operations.

A connection between the Command and Control (C2SYS-TS) means constructive simulation with the natural result of the need and necessity of the current state of network information, communication and computer technologies. The link will allow tactical training complex tasks, the possibility of mutual radio communications, and the use of technical means in real constructive simulation environment. It also allows more efficient use of funds in preparation of defense in dealing with crisis management, military and non-military.

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OPEN EDUCATIONAL RESOURCES TO SUPPORT DISTANCE LEARNING IN TRAINING OF EMPLOYEES IN SELECTED UNIFORMED SERVICES IN POLAND

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Abstract: *The purpose of this article is to analyze and compare the open educational resources supporting distance learning in the educational process of employees in the selected uniformed services in Poland. These resources include databases, e-journals, e-bibliographies, subject bibliography, e-books, and links to other open resources. They also include information on e-learning available on the web surveyed universities and schools: the platform, content and availability of courses, number of courses. The research described on the website of the Polish schools and universities educating employees of the selected military services (police, military). However, the links on the pages of the surveyed universities/schools to Web sites of other universities/schools with similar profiles allow potential users to use their resources (pooling of open educational resources).*

Keywords: e-learning, open educational resources, uniformed services, military schools, police schools.

INTRODUCTION

E-learning tools are increasingly used in university teaching, various types of schools, as well as companies around the world. Distance education is an ambiguous concept that combines learning through e-learning courses or widely understood as a science of use of open educational resources. Educational institutions (universities, schools) are getting increasingly used to achieving their goals using these two alternatives.

Current progress in the field computer science and technology is to a substantial degree due to eminent specialists of uniformed services (e.g. while working on the creation of the Internet, conducted on behalf of the American Armed Forces). "Uniformed services shall be construed as a formal entity appointed by the State or its organs, characterized by a single type of formal dress uniform. Dominant feature of these services is to act on the basis of orders (military) command and service "[1]. Schools for future uniformed professionals face the challenge, because as units popularizing modern technologies they have come out to meet it and enjoy its performance. It is therefore important to examine the state of e-learning in these units.

The purpose of this article is to analyze and compare the open educational resources supporting distance learning in the educational process of the selected uniformed employees in Poland. At the same time open educational resources (OER) should be understood as "digitised materials offered freely and openly for educators, students and self-learners to use and reuse for teaching, learning and research" [2]. The latest research shows that almost all OECD countries are active in the field of OER, mainly through involvement in various projects and programs, or of the institutions and the people involved. Currently listed in two areas of research: improving the quality of learning outcomes and expanding access to educational opportunities [3].

1. OPEN EDUCATIONAL RESOURCES TO SUPPORT DISTANCE LEARNING

1.1 Subject of Research

The study included six websites of Polish military universities and five websites of Polish police schools. The study included a web page of such entities as The National Defence Academy in Warsaw, The Jaroslaw Dabrowski Military Technical Academy in Warsaw, The Heroes of Westerplatte Naval Academy in Gdynia, Polish Air Force Academy in Dęblin, The General Tadeusz Kosciuszko Military Academy of Land Forces in Wrocław, Faculty of Military Medicine of Medical University of Lodz and the home pages: Police School in Katowice, the Police Training Centre (CSP) in Legionowo, Police School in Piła, Police Academy in Słupsk, Higher Police School in Szczytno. The study was conducted in January 2013. Material was collected on the basis of the information available on the home page (main and sub-pages) of these units and recorded in the tables. Each educational unit has been analyzed in detail, the aim of which was to gather information about e-learning and open educational resources: databases, e-journals, e-references, thematic statements, e-books, and links to other open resources.

1.2 Analysis of the Websites of Higher Military Schools in Poland

Table 1 below shows the characteristics of open educational resources of Polish military universities. E-learning courses are available in two units. Both universities have an educational platform with a closed access to training that requires user registration. National Defence University offers 121 courses. These courses are: self-service, self-service with the support of mentors, courses carried out under the guidance of a coach. However, University of Land Forces Officers prepared 41 courses divided according to the mode of study for full-time, part-time, postgraduate and others.

Units	**Open educational resources**						
	E-learning	**Database**	**Journal online**	**Bibliography online**	**Subject bibliography**	**E-books**	**Other**
National Defence University (Available at: http://www.aon.edu.pl/)	Yes	Yes	-	Yes	-	-	Yes
Military University of Technology (Available at: http://www.wat.edu.pl/)	-	Yes	Yes	-	-	-	Yes
Polish Naval Academy (Available at: http://www.amw.gdynia.pl/)	-	Yes	Yes	-	-	-	Yes
Polish Air Force Academy (Available at: http://www.wsosp.deblin.pl/)	-	Yes	Yes	-	Yes	Yes	Yes
Military Academy of Land Forces (Available at: http://www.wso.wroc.pl/)	Yes	Yes	Yes	-	Yes	Yes	Yes
Medical University of Lodz (Faculty of Military Medicine) (Available at: http://wojskowy.umed.pl/)	-	-	Yes	-	-	-	Yes

Table 1. Characteristics of open educational resources of Polish military schools
Source: Authors of the text

The situation of databases of open access which are one big collection consisting of the five groups is much better. Among them we can distinguish databases containing information on other databases, conference proceedings, institutions, research, etc., e.g. - *BazTol*, *OPI*, *SYMPO.NET*, *SYNABA*, *Deep Web Technologies*, *InfoBaza*. The second group is composed of specialized databases, often on selected single discipline sciences such as chemistry, mathematics, or specific military issues: *Fortifications Bibliography*, *EMIS*, *The Virtual Library of Mathematics*, *PubChem*, *SPORT*, *BazHum*, *Base of the Sejm*, *The European Information Center*, *On-line Economics*, *Catalogue of Polish Standards*, *Central Military Library Databases*. The third set of a multi-sector base or on groups such as humanities, sciences, etc. include: *Agro*, *ARTON*, *BazTech*, *BWM*, *DOAJ*, *The European View of the Americans*, *Academic Search Complete*, *CEJSH*, *PSJC*, *Virtual Library of Science Natural*. The fourth set of Web pages presented at military colleges to library catalogs are: *NUKAT*, *KARO*, *WorldCat*, catalogs of the National Library. The final groups is formed by their own database - created by universities: *TWÓJ*, *ZMECH*, *SZKOLA.*

Equally active collection of open educational resources are online magazines that take diverse forms. They appear in the form of a letter from A to Z online with hyperlinks to the referring party of Polish and foreign magazines or websites that provide full-text articles (*Open J-Gate*, *Dictionary of Open Access Journal*, *BioMed Central Journals*, *PloSJournals*, *Hidawi*, Polish *OA journals by DOAJ*). However, some colleges (two) provide their own publications in PDF format, or refer to the websites of other universities possessing this type of collection.

However, online bibliographies are undervalued resource. The only university that has it in its collection is the National Defence University, which prepared Publications Bibliographies of Workers of National Defense University (2000-2010), available in PDF format. An interesting proposal is the thematic statement of military issues. The leading unit in this area is the Higher School for Army Officers, which provides, a total of 117 combinations arranged in alphabetical order, and the College of Air Force, which developed nine of such statements. E-books that you can meet in only two units (WSOSP and WSOWL) in the form of PDF files posted on the university's home page or as links to sites that provide electronic publications are far less popular. The last type of open educational resources is the other group that represents links to *Digital Libraries*, *Virtual Library of Science*, e-dictionaries and e-encyclopedias, thematic websites, social networking sites like *LibraryThing* or newspaper archives about the university or library acquisitions.

1.3 Analysis of the Websites of Police Schools in Poland

Characteristics of open educational resources of Polish police schools are presented in Table 2. Five of the surveyed schools present on the websites information on e-learning. In two of them (the school in Piła and Katowice) to get that information one must also use the search engine located on the side, because the required resource is in the deeper structures. Among the results of search messages appearing on e-learning, which demonstrate its existence, however, *de stricte* tab on the website called e-learning is not found. In addition, two institutions will summarize information about the project of the Leonardo da Vinci *Learning for life* (Katowice, Słupsk). Also among the main tabs, or as an icon often there is information about CEPOL's educational program. Police schools refer to e-learning (PDF format, catalog of courses and seminars online, without hyperlinks).

Units	Open educational resources						
	E-learning	**Database**	**Journal online**	**Bibliography online**	**Subject bibliography**	**E-books**	**Other**
Police School in Katowice (Available at: http://katowice.szkolapolicji.gov.pl/)	Yes	-	-	-	-	Yes	-
Police Training Centre in Legionowo (Available at: http://www.csp.edu.pl/)	Yes	Yes	Yes	-	-	-	Yes
School Police in Piła (Available at: http://pila.szkolapolicji.gov.pl/joomla/)	Yes	-	Yes	-	-	Yes	Yes
School Police in Słupsk (Available at: http://slupsk.szkolapolicji.gov.pl/)	Yes	-	Yes	-	-	Yes	Yes
Police Academy in Szczytno (Available at: http://www.wspol.edu.pl/)	Yes	Yes	Yes	-	Yes	Yes	Yes

Table 2. Characteristics of open educational resources of police schools in Poland
Source: Authors of the text

Turning to the analysis of e-resources of police schools initially one can asses their number, as moderate. The most common documents that belong to the group are: e-books (4), online magazines (4) and others (4) - numbers in parentheses express the number of units providing data resources. E-books include publications in PDF format made by all the above schools: own publications for the selected year (Katowice), E-Library Prevention Policeman: Scientific Notebooks (Słupsk), e-library of the unit (Piła). However, online journals are seen mainly in the school home pages in PDF format in full version or in the form of articles in your library, directly by the title of the online journal (e.g. *Kwartalnik Policyjny* - CSK Legionowo publishing house; *Kwartalnik Prawno-Kryminalistyczny* - Piła; *Przegląd Prewencyjny* - Słupsk) or periodicals database with a hyperlink to the home pages of online journals (Legionowo, Szczytno). Among *Others* group there were materials, such as a list of new books and library, links to publications of other police schools, video and multimedia tab on the website (Słupsk), theses, links to digital libraries, catalogs and resources, publishers and bookstores (Szczytno).

Less frequently among e-resource were databases (2) and subjects bibliography (1). Databases occurred in the form of CSK Legionowo Journals Database, where they were sorted alphabetically, and most have a link to the home page (but there are errors: page not found). However, in Szczytno database databases have been divided into: a database of open access and available only through the university network. Among the first were such as: 1) English language: *ICL Database & Commentary*, *Legal Resource Library*, CEJSH - *The Central European Journal Of Social Sciences And Humanities*, CINCH - *the Australian Criminology Database*, *British Society of Criminology Conferences*, *Directory of Open Access Journals* (articles), *The Online Books Page*, and 2) Polish language: *Baza osób zaginionych i NN* (*Missing People Internet Database*), *Baza osób poszukiwanych* (*Database of wanted persons*), *Baza ART. Biblioteki Sejmowej*, (*Database ART. Of Parliamentary Library*), *Bazy NGO* (*Database NGO*), *CURIA - Trybunał Sprawiedliwości Wspólnot Europejskich* (*CURIA - The Court of Justice of the European Communities)*, *E-STEP Elektroniczny System Transpozycji Prawa Europejskiego* (*E-STEP Electronic System transposed European Law*),

Europeana, *E-wydawnictwo.eu - Portal Publikacji Naukowych* (*E-wydawnictwo.eu - Portal of Scientific Publications*), *Honorowa księga nauki polskiej* (*Honorary Polish science book*), *Internetowy System Aktów Prawnych* (*Internet System of Legal Acts*), *Naukowe i fachowe polskie czasopisma elektroniczne* (*Polish Scientific and professional electronic journals*), *Polskie kodeksy* (Polish *codes*), *Portal Nauka Polska* (*Polish science Portal*). Subjects bibliography occurred only in Szczytno school sites (24 subjects bibliography). These resources comes from the magazine *Policja. Kwartalnik Kadry Kierowniczej Policji* (*Police. Police Leadership Quarterly*).

1.4 The Results

In the studied units: the police schools (4) and military academies (5) a large number of online journals was observed. In both cases, they occur most often in the form of full-text, presented using PDF files. Another similarity that combines the institutions studied is the presence of a small number of e-references and thematic statements. In the military schools only one bibliography is presented, in turn, in the police schools did no such items were found. Similar is the situation associated with the presence of thematic statements (2 military, 1 police). In turn, a set of e-resource known as *Others* are similar in both cases, the subject references include new acquisitions, new publications, digital libraries, news theme, as well as references to other units with similar educational profile. The last common feature of the surveyed Web pages of schools and universities is a group of databases that have occurred within these two environments: CEJSH, *Directory of Open Access Journals*, *Europeana*, *Internetowy System Aktów Prawnych* (*The Internet System of Legal Acts*), *Naukowe i fachowe polskie czasopisma elektroniczne* (*The Polish scientific and professional electronic journals*). The difference between e-resources of military and police schools are shown in the following Table 3.

Schools	
The military schools	**The police schools**
E-learning	
E-learning is present only in two units: • Easy navigation to e-learning. • No uniform educational program. • Completely closed access to the platform (requires login).	E-learning is present in five units: • There are cases of difficult navigation, for example: an item is hidden, the element is found by search engine on the web (such as in an article). • There are references to the CEPOL and its courses. • There are open course, but also closed courses that require login.
E-resources	
Databases	
• A large number of open databases (5 units).	• A small number of web pages for reference to the open databases (2 units).
Journal online	
• Online journals are posted on the web publishers, other universities, to which the surveyed universities refer giving links. • No full text e-journals on university home pages.	• Online journals are published on the Web pages of the units. • On the home pages of schools are mainly full text journals. • There are linking, links to web pages of the e-journals.
E-books	
• A small number of e-books on the home pages of the units (2). • Schools use a reference to the author's e-book (1) and present full text of e-books on their own site (1). • Presented e-books are non-university publications.	• A large number of e-book presence on the home pages of the units (4). • E-books are mainly in the form of full-text on the home pages of the units in the form of PDF files. • Presented e-books are mainly published by a given unit.

Table 3. Characteristics of e-resources of the surveyed military and police schools
Source: Authors of the text

CONCLUSION

Summarizing, the military institutions of higher education e-learning method is rarely used. The advantage of e-learning courses is a user-friendly interface that allows you to easily search for information on distance learning. The situation in the police schools is quite the opposite. In the police schools e-learning is used more often. Information on e-learning, however, is deeply hidden, and often finding it requires the use of additional tools such as search engines. Moreover, the project is to promote education of police uniform central program called CEPOL and the presence of two types of training: closed and open. These types of solutions are missing in military schools.

There are also differences in the use of e-resources. In the higher military schools we observed a large number of databases, which in this sense are dominant e-resources. Universities, promote the use of both the world's sources of general and military knowledge and from Polish collections. In contrast, e-books are an underrated resource. Only two of the mentioned institutions provide the type of e-publication (via links to home pages, and the full text). It should be emphasized that these e-books are materials derived mainly from publishers external to the university.

In police schools the situation is somewhat different. The group in a small way for facilities access to databases to a lesser degree (only two branches). However, among the available resources there is a large number of e-journals and e-books. The advantage of these collections is their presence in the form of full texts available on the home page of the institution. Moreover, e-books consist mainly of publications of their own schools, and not other publishers.

The idea of Open Educational Resources is a major challenge for Polish academics. There still remains an open question whether co-education in this area is an opportunity or necessity. Observation and experience shows that if the true value becomes real knowledge and accurate skills, the changes may be forced onto the university by the students themselves, who will select the best centers.

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OPTICAL COMMUNICATION SYSTEMS IN MILITARY

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Abstract: *Nowadays the optical communication systems are very important component of everyday communication networks. These become more and more attractive for a high-capacity and long-distance transmission. Even though there is increasing demand for capacity of channel, security and dependability are requisite for military applications. For this reason, it is possible to use modulated light as a carrier instead of radio frequency, than an almost limitless, and so far unregulated, spectrum becomes available. Optical communications resolve these requirements. The radio frequency link is commonly used for military communications. The article deals with utilisation of optical communication in military field and comparison to usage of optical and radio frequency link. There are mentioned a few new ways where are satellite communication systems oriented in research in the article.*

Keywords: military communication, optical communication, radio-frequency communication.

INTRODUCTION

Communication systems for command and control are formed from different communication systems – systems using different frequency bands, nets, protocols, etc. The backbone of military communications for expeditionary warfare is increasingly dependent on satellites. Nowadays research of inter-satellite communication is oriented on hybrid ordering laser and microwave systems. A crosslink, or communication between two satellites, may be needed to solve certain requirements of satellite communication architecture. Integration ease issues include compactness of terminals, elimination of complex frequency planning and authorization, and RF interference issues. The optical communication systems become more and more attractive as the interest in high-capacity and long-distance transmission increases. Military communications are specific for their demanding character. There is a necessity of connection different forces.

1. MILITARY COMMUNICATION

Military communications want the same as the rest of world's communications; the requirements are to be smaller, lighter, covering more bands and carrying more voice and data than the last generation of products. Traditional tactical communications have been via specialized individuals or locations that were the hubs for information exchange using terrestrial links or more recently a combination of ground and UHF satellite communication uplinks.

There are satellite communications between ground forces, satellite systems also support near-real-time communications between low altitude intelligence satellites and ground control stations [1] [2].

2. COMPARISON OF LASER AND RADIO FREQUENCY LINK

There are significant differences between RF and laser communication systems, and much of it results directly from the several orders of magnitude difference in wavelength. This difference is most noticeable in antenna size and beam divergence. Extremely high frequency (EHF) systems (e.g., 60 GHz, with over three orders of magnitude longer wavelength than the near infrared laser communication wavelengths), require antenna sizes measured in feet versus inches for laser communication. Similarly beam divergences are measured in fractions of degrees versus micro radians for laser communications [3].

There are applications where laser communication does not compete with RF. For example, in broadcast applications, RF systems with broad-beam capability cover a much larger angular area than the laser communication links could [4]. To conduct a realistic trade off study of RF versus laser communications, the important characteristics or factors must be identified and included in the trade. The trade study must be as quantitative as possible. There are factors, however, that are very difficult to quantify due to their inherently subjective nature and this, of course, can lead to much controversy. The use of a consensus approach where several individuals establish the list of factors helps minimize the controversy [5].

The comparison laser and RF beam width depends on wave length is on Fig.1. We can see the difference in wavelength.

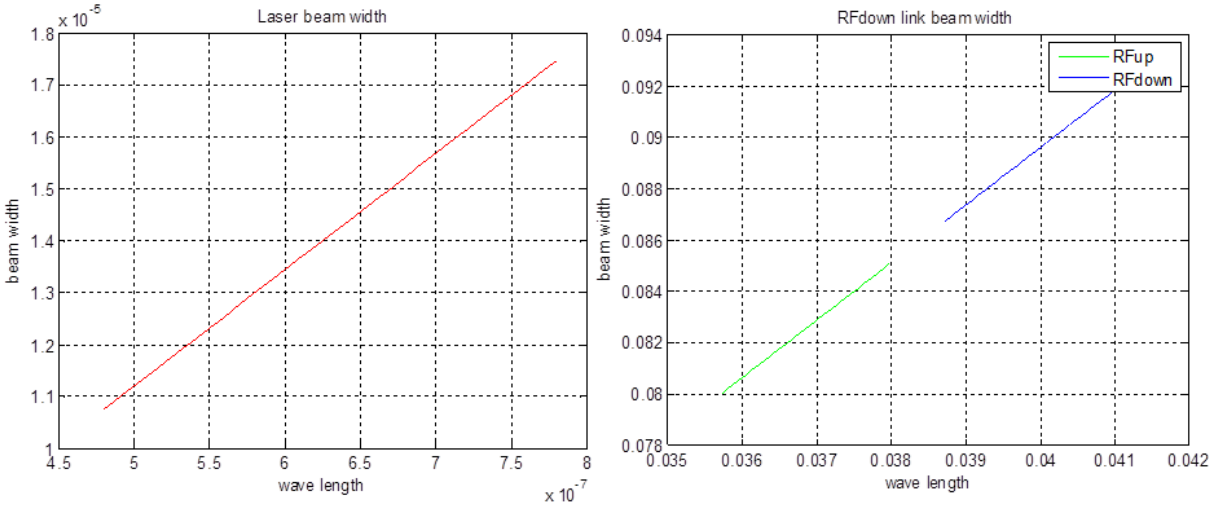

Fig. 1. Beam width for laser and for X band RF satellite communication
Source: own

3. ATMOSPHERIC EFFECTS ON LASER SIGNALS

The atmosphere is an imperfect medium for transmission of laser communication's signals. It is not homogeneous and further, it is dynamic in its behaviour. The atmosphere can be considered as producing four effects on the passage of light. The first two are scintillation and absorption/scattering. In this atmospheric channel, minute variations in the index of refraction of air cause the beam to scintillate (or vary in amplitude and phase over time) and the beam to wander. In addition, atmospheric gas molecules and aerosols scatter and absorb the light during its passage. The effect is small in many instances, but at shallow elevation angles the losses increase rapidly and become extremely large. Third, clouds reflect,

absorb, and temporally and spatially spread the incident energy [6]. The losses due to certain clouds are very large, while for other cloud types the effects are small and easily overcome. Cloud statistics are a function of location and season, which are important factors in ground-site selection. Through multiple-site diversity, cloud cover effects can be mitigated. Finally, there are aircraft boundary layer effects due to the platform speed, which needs to be understood. The degradation in transmission due to turbulent flow over the aircraft window is discussed and the losses are described for subsonic as well as supersonic flow.

Atmospheric effects are complex and the mathematics is far too lengthy to be included here. Included references can be used by the reader to delve deeper into the physics of the atmospheric channel. The engineering of atmospheric laser links can be performed by using engineering approaches of quantifying the effects. Parametric analysis curves of laser communication links for satellite to aircraft and satellite to ground are included to give the reader an understanding of the effects the atmosphere has on the links.

4. METHOD AND SYSTEM FOR COMPENSATING FOR ATMOSPHERIC FADING

A method and system for compensating for atmospheric fading is used in a communication system wherein communication signals are exchanged between first and second earth stations via a satellite link. This is without increasing power of the satellite link. The method includes determining the signal power of the received signal and the received signal signal–to–noise ratio. It is imperative to calculate the difference in noise power spectral density in the received signal from that under clear sky conditions, to calculate the downlink attenuation. It is obligated to determine the uplink attenuation, and to command the transmitting earth station to increase its transmit power by an amount to compensate for the uplink attenuation.

Atmospheric fading is caused by the attenuation in a warm physical medium. Therefore, the medium not only attenuates signals but also creates a thermal noise. Because the satellite's receiving antenna, being pointed at the earth, sees the background temperature of the earth's surface, which is approximately the same temperature as the same medium which created the fade nouse, uplink fade A_u has an insignificant effect on the total noise spectral density at the receiver. The antenna of the receiving earth station, by contrast, sees mainly the very low temperature of deep space. Downlink fade A_d therefore may cause a significant increase in total noise spectral density at the receiver.

When the parameters are known, the downlink fade A_d may be estimated from ΔN_o. Because under clear–sky conditions $A_u^{dB}=0$ and $A_d^{dB}=0$, the change in received signal strength is simply the sum of the uplink and downlink fades; $\Delta S^{dB}= A_u^{dB}+ A_d^{dB}$. Therefore A_u may be calculated when A_d is known.

If the transmitting earth station is then commanded to increase its power by only the amount of A_u^{dB}, the link will be optimally compensated for uplink fade, in the case of any combination of uplink and downlink rain fade, even if simultaneously non-zero, while the satellite transponder output power will remain constant, which is the objective.

$$A_d = \frac{\frac{G_A N_{TS}}{L_P} - kT_D}{\frac{N_o}{G} - k(T_A + T_R + T_D)} \quad (1)$$

Where
A_d…attenuation of downlink fade; N_o…noise spectral density at the output of the receiver; G…gain of the receiver; G_A…antenna gain; N_{TS}…effective isotropic radiated power spectral density of the noise generated in, or relayed by, the satellite; L_P…free – space path loss from the satellite to the receiving earth station; T_D…physical temperature of the downlink fade attenuation medium; T_A…noise temperature of the antenna; T_R…noise temperature of the receiver; k…Boltzmann's constant [2].

The atmosphere is an imperfect medium for transmission of laser communications signals. It is not homogeneous and further, it is dynamic in its behaviour. The communication with laser utilisation is possible only by the time of good atmospheric conditions. The prediction of atmospheric behaviour is necessary. The graphical prediction is used for optimization and the input parameters must be calibrated.

CONCLUSION

The differences between laser and RF communications arise from the very large difference in the wavelengths. RF wavelengths are thousands of times longer than those at optical frequencies. There are not only differences between wave length, but also lower weight, lower power, smaller antenna size etc. The article is discussing new aspects in satellite communications, which are utilized in military communication systems. There are several points of view of resolving problems related with signal transmitting between earth station. Carrier in Carrier composite carrier occupies 34% less satellite bandwidth. This is designed for geostationary satellite communication systems.

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VIRTUAL COMPANY SIMULATION FOR DISTANCE LEARNING

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Abstract: *Apart from being able to improve existing decision support systems, simulations can contribute to the teaching of managerial skills already during the education process. If simulation models could be placed into the corresponding IT infrastructure of the educational institution, they could be used also in the distance learning environment. The paper presents an enhanced software prototype of a framework based on agent-based trading company control loop. The ERP system using the REA ontology approach is used as a measuring element in the framework. The system has been developed in cooperation between Silesian University in Opava, School of Business Administration in Karvina and REA technology Copenhagen. After the prototype tests at the end of the year 2011, prototype was presented at the beginning of 2012 for the first time. Nevertheless, the intensive testing during last months has revealed new possibilities of the framework and challenges to be met in the future. In the paper, the placement of simulation tools in distance learning is shown. Further, the enhanced framework with several types of agents, negotiation possibilities and company strategies are described. The simulations covered several hundred thousand business, negotiation and accounting transactions executed in 365 simulation steps per year. Due to the REA approach to the accounting, the speed of the simulation substantially exceeds the speed of typical ERP transactions. Secondly, simulation results are presented using data obtained from real business company. The principal challenge to be overcome was the lack of some values needed for the model parameterization. In this case, randomly generated data was used. To sum up, the results obtained show, that in such case the generated model parameters must not differ from the expected mean values significantly in order to keep the model results realistic. The concluding discussion points further research directions.*

Keywords: simulation framework, decision support systems, REA, distance learning, multi-agent system, virtual company, negotiation.

INTRODUCTION

The companies have to ensure the flexibility of their behavior, speed of decisions, and customer satisfaction leading to the optimal market share, profits and other key performance indicators (KPIs) in order to survive in a global and turbulent market environment. Simulations can improve not only existing decision support systems, furthermore they can contribute to the teaching of essential managerial skills already during the education process. If simulation models could be placed into the corresponding IT infrastructure of the educational institution, they could be used also in the distance learning environment. The aim of this paper is to present the usage of the simulation framework prototype in distance learning environment.

Simulations supporting decision support systems are typically based on business process modeling treated by many researchers (Axenath, Kindler and Rubin, 2007; Davenport, 1992; Ericson and Penker, 2006; Koubarakis and Plexousakis, 1999; Řepa, 2007; van der Alst,

2004, etc). Alternative enterprise modeling methods - value chain oriented models have garnered much attention both among researchers in the accounting and later, from enterprise modeling. Value chain modeling concentrates on the value flows both inside the enterprise and on the value exchange with the environment. Currently, the most popular value chain enterprise methodologies are e^3-value (Gordijn and Akkermans, 2003), and the REA (Resources, Events, Agents) ontology (McCarthy, 1982; Hruby, 2006; Chang and Ingraham, 2007; Dunn, Cherrington and Hollander, 2004, etc.). Proposed by McCarthy (McCarthy, 1982) as a generalization of accounting with the aim to resolve issues specific to the double-entry bookkeeping; it was later expanded upon by Geerts and McCarthy (Geerts and McCarthy 2002, 2006) into the enterprise ontology. It presents an application neutral data model with the potential to be implemented within the design of new ERP systems (Vandenbosche and Wortmann, 2006).

Both process and value chain modeling methods often meet difficulties in modeling complex environments, when some social behavior like negotiation, management specific methods, market disturbances and others come into consideration. In this case, some local intelligence is needed within a business process model. This is probably the main reason, why a new software modeling paradigm came into existence – namely the multi-agent modeling approach. Modeling and simulation using multi-agent systems (Agent-based modeling and simulation) can be seen as a new approach to system modeling, especially for decision-making support systems (Macal and, North, 2005; Macal and North, 2006; Wooldridge, 2009). In (Vymetal and Schoeller, 2012) we presented a general agent-oriented simulation framework MAREA (Multi-agent REA framework).

The prototype introduced is based on the value chain and multi-agent modeling approach using REA value chain oriented approach. The prototype can be used both in standalone PC environment and in distance learning, in this case by means of CITRIX presentation platform. The paper is structured as follows. First the placement of simulation tools in distance learning is shown. Next, a general model structure is presented. In secton 2, simulation runs are described and discussed. Conclusion sums up the results obtained and outlines of the next research targets.

1. GENERAL MODEL DESCRIPTION

1.1 Model Placement in the Distance Learning Environment

Distance learning environment typically encompasses several data, information structures and the operational means. Fig. 1. presents a generic distance learning support structure. The knowledge data structures are concentrated in the “Learning materials & support” and “Knowledge database” parts, which also support data and knowledge retrieval by means of distance learning procedures and tools. Students’ tasks are supported by special functions for submitting, editing and archiving the students’ projects and seminar works. A special functional part of the distance learning support structure is concentrated in the “Simulation models” part. This part of the environment is aimed to the direct enabling of simulation configurations, changes, experiments and actual simulation runs. The students use distance learning presentation tools, typically the Moodle User interface (see moodle.cz).

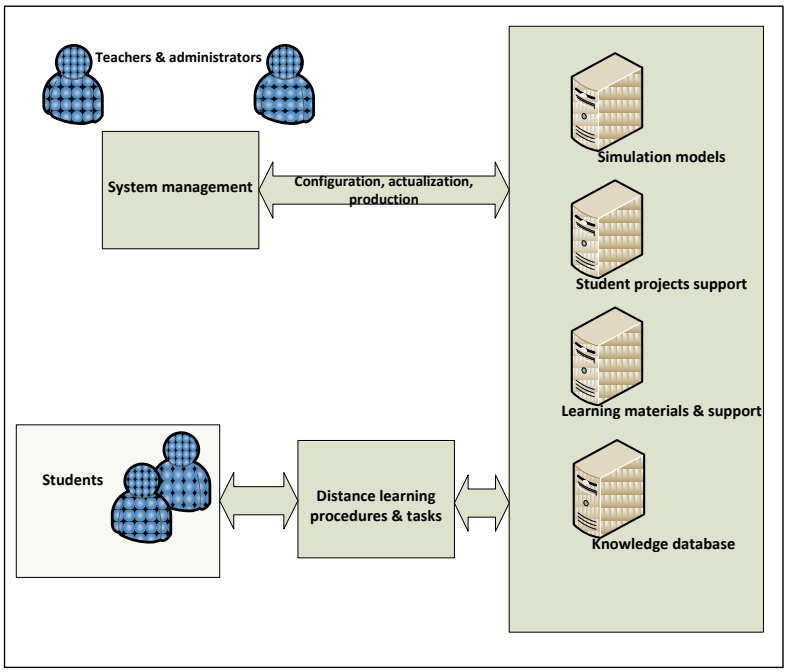

Fig. 1. Generic distance learning support structure
Source: own

For remote running of simulation framework a proper distance working tool such as Citrix (see www.citrix.cz) might be used. The teachers and the administrators govern the knowledge database part, the simulation tools and the actual user interface means. The whole system is configured in such a way, that the tools used by the students can be as much integrated as possible.

1.2 Model Structure

The model implemented in simulation framework simulates a virtual business company using the REA value chain and multi-agent approach. The general model structure is presented in Fig. 2. The model is based on the control loop paradigm. The internal parts of the company are represented by sales representative, purchase representatives and marketing agents. The outputs of the company are measured by the REA ERP system, which also records all activities of the agents. The market environment is represented by customer and vendor agents. Note that all the agents mentioned exist in a large number of instances. The difference between measured outputs and targets is sent as a feedback to the management agent, who takes necessary actions in order to keep the system in the proximity of the targets.

The interaction between the customers and sales representatives and also between the vendors and purchase representatives is a typical negotiation. This is modeled by the classical contract net protocol as shown in Fig. 3. The customer decides if he should accept the quotation based on the production function presented earlier in e.g. (Vymetal and Sperka, 2012). If the proposal is not accepted, the sales representative changes the price accordingly (this is one of the parameters that can be changed by the students.).

The production function for *m*-th sales representative negotiating with *i*-th customer is represented by formula

$$c_n^m = \frac{\tau_n T_n \gamma \rho_m}{O v_n}$$

c_n^m - price of *n*-th product offered by *m*-th sales representative,

τ_n - market share of the company for *n*-th product $0 < \tau_n < 1$,

T_n - market volume for *n*-th product in local currency,

γ - competition coefficient, lowering the success of the sale $0 < \gamma \leq 1$,

ρ_m - *m*-th sales representative ability to sell, $0.5 \leq \rho_m \leq 2$,

O – number of sales orders for the simulated time,

v_n - average quantity of the *n*-th product, ordered by *i*-th customer from *m*-th sales representative.

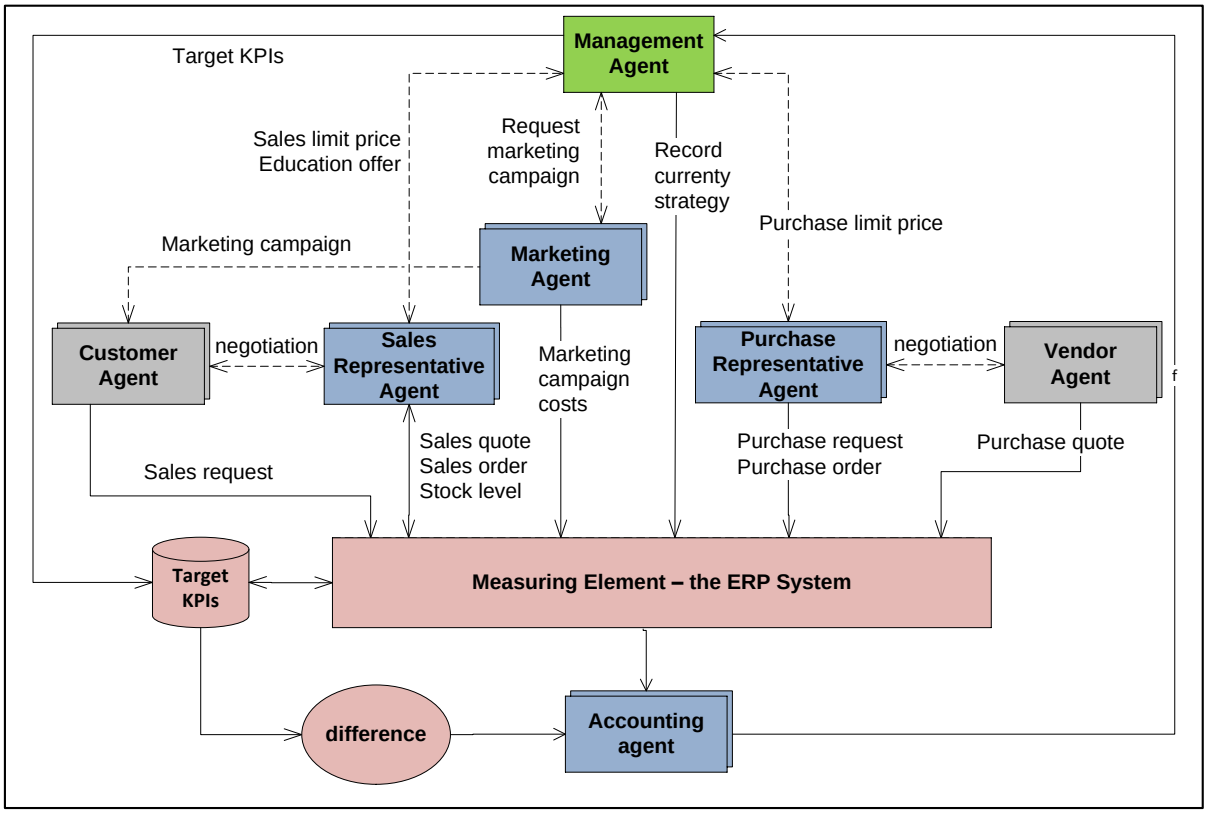

Fig. 2. General simulation model structure
Source: own

Similar production function is used in the vendor – purchase representatives negotiation. The aforementioned parameters represent global simulation parameters set for each simulation experiment. Other global simulation parameters are: lower limit sales price, number of customers, number of sales representatives, number of iterations, and mean sales request probability. The more exact parameters can be delivered by the real company, the more realistic simulation results can be obtained. In case we would not be able to use the expected number of sales orders O following formula can be used

$$O = ZIp$$

where

Z – number of customers,
I – number of iterations,
P – mean sales request probability in one iteration.

As presented later, real company data was used in the simulation runs. However, the real company was not able to deliver data on sales representative ability to sell and mean sales request probability in single iteration. This is why the simulation runs were realized using variable discrete values. In the simulation run presentation we use results of variable sales representative ability to sell.

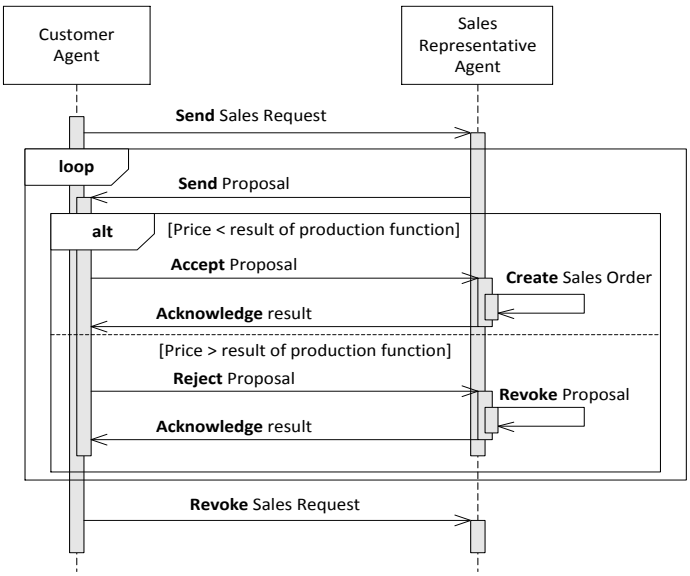

Fig. 3. Contract net protocol – example
Source: own

The management agent can change the purchase limit price, to decide upon a sales representative education, marketing campaign, and others. These interventions lead to higher profitability of sales representatives. The parameters of such action can be set by the students. With such general structure, the students are able to configure the agent types, the management action etc. and to observe the behavior of the system reacting to the management actions.

2. SIMULATION RUNS

The simulations can be run using various types of data. In this paper we present results of simulation experiments based on real data from a company selling computer accessories and materials, in this case an UTP cable sold in meter units. The company delivered data for three branch offices. However, some data has to be changed for the simulation runs in order to keep the consistency of the production function. With mean sales representatives ability to sell estimated in the delivered data and market volume estimation gained from the company, the expected market share of the company had to be corrected down to 11% in the regions, where the company sells. The data used for the simulation experiments in the first approximation are presented in Table 1.

In the presented results we show the influence of rising sales representative ability to sell. For each change, 20 simulation runs in 4 simulation run groups were carried out. The sales representative ability was changed in each simulation run group by 0,25 starting with 0,75 in the first group to 1,5 in the last group. In order to see the influence of the parameter changes, the management actions, and other parameter changes were switched off. In each simulation run there are 365 iterations (one year) realized.

Following key performance indicators were collected for each simulation run: cash level, turnover, gross profit, profit and number of active customers. All KPIs for one simulation run group were then averaged.

AGENT TYPE	NUMBER of AGENTS	PARAMETER	VALUE
Customer	100	Days for negotiation	10
Sales representative	2	Average quantity	5 m
Manager	1	Mean sales rep. ability	0,75
Accounting	1	Limit sales price	9 Kč
Marketing	1	Limit purchase price	4 Kč
		Market share of the product	11%
		Market volume of the product	2000000 Kč

Table 1. Simulation experiment parameters

The results of the simulation experiment with sales representative ability to sell are presented in Table 2.

Group	Ability	Cash level	Turnover	Gross profit	Profit	Active customers
1	0,75	15793,89	11858,99	7121,366	5793,893	57,0411
2	1	27890,4	29404,05	20969,6	17890,4	74,84945
3	1,25	30857,42	33937,89	24425,93	20857,42	82,57507
4	1,5	29612,63	33082,43	23096,84	19612,63	81,82671

Table 2. Average value of selected KPIs in simulation run groups

Analyzing the graphical form of the results obtained, we can see an interesting result: namely that the gains of the KPI values diminish with the rising sales representative ability, in the last group there is even a small decrease. Similar results were obtained during experiments with other input parameter changes such as a probability of sales order, or by advertising actions.

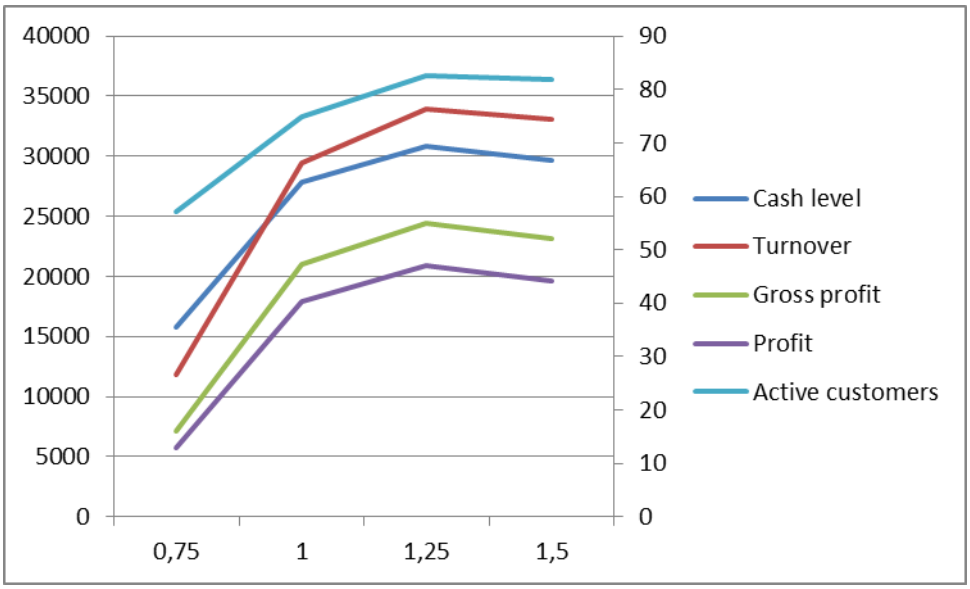

Fig. 4. Graphical representation of the simulation runs
Source: own

This rather surprising result can be explained by the corrections of some company data we had to accept in order to keep the calculations of the accepted price (production function) consistent. In other words, if the company cannot deliver all necessary data and the modeler has to take some compromises or use randomly generated parameters, the results in case of substantial change in parameters may be a cause of uncorrect simulations. This may seem to be rather obvious, but such facts has to be kept in mind of modelers when collecting data from real business.

During so many iterations and transactions done in one simulation run, approximatelly 2000 invoicing and other database transactions were performed. One would expect that a simulation run would take a lot of time. This was not our case, as one simulation run took approximatelly one minute. This can be ascribed to several factors. First, the REA database nature implies very efficient behaviour. Second, due to the aim of the simulation – the educational needs the database security measures such as recocd locking during actualizations could be avoided. Third, the whole system ran in RAM memory. However, even in such circumstances, the system runs very efficiently. A comparison can be done with e.g. MS Dynamics NAV performance analyzed in (Soltec UK, 2011). Here, 10 000 purchase invoicing transactions took 191 minutes. Thus our approach seems to be very suitable for distance learning using on-line simulations compared to runs of typical ERP transactions.

CONCLUSION

Distance learning infrastructure can support various tools as an education support. If properly configured, also simulation tools can be used, provided that the simulation model is sufficiently efficient and there are enough resources available. Presented REA simulation framework is based on the REA value chain database and multi-agent system modelling a closed control loop of an enterprise. Some randomly generated model parameters had to be used as the modeled company could not deliver some real data. A large number of simulations have been done with changing starting parameters. The results obtained show that the starting parameters have to be in the neighbourhood of the expected real values. If this is not the case,

the simulation results can be distorted or even false. Due to the REA database nature the simulation model runs very efficiently and can be used in the distance learning environment. The next research directions will be oriented to the results of management actions as a feedback in closed management loop operation.

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AN APPLICATION OF TUTORIALS AS A METHOD OF DISTANCE LEARNING

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Abstract: *The paper presents tutorials as a form of tools supporting distance learning methods facilitated through World Wide Web environment. WWW environment plays an important role in the distribution of educational materials, including complex multimedia. Tutorials play an important role in online education. The paper reviews the available "engines" - programs that generate files with animations, facilitating process of generating tutorials, and useful in creating this type of presentations. Animation shows how to adapt the network and Web environment. Particular attention was paid to the mechanisms associated with tutorials optimization and its security on the network. The materials were tested empirically using TPCIP protocol.*

Keywords: tutorial, distance education, web education systems, e-learning and content management.

INTRODUCTION

In the era of the information society, with an extensive infrastructure of broadband networks and a substantial share of wireless technologies, a significant role in education plays multimedia distance learning. Galloping computerization of the world and a global rush comes to the fact that people want to solve and perform tasks almost immediately. Thanks to the Internet and high-speed networks people give up traditional sources of information, and search for information in a network where you can now find information on everything from medical advice to complex solutions and procedures on how to operate machinery and equipment. The variety of media and easy access to the Internet means that information, knowledge and guidance "are at hand." Very convenient and popular form of message display on the web is tutorials.

Tutorial word from the English language – teaching, coaching. These are guidance articles, "step by step" type. Its popularity comes from the simplicity of the transfer of content. Thanks to the easy language and clear examples, tutorials allow fast understanding of the content.

Tutorials are interactive guides, learning by example. Depending on the context they may include a set of instructions to the interactive sessions, based on the recording technique. Tutorials can contain either a record of the attached screen or soundtrack or complex multimedia recording with intermediate files that emanate material online. It should be noted that the transparency of the presented content depends mostly on the author, rather then on the application generating material itself. Tutorials should have a strong interest in continuing and technical education, for economic reasons since the majority of schools, colleges, and centers do not provide adequate laboratory teaching facilities.

Tutorial is a type of computer application, the aim of which is to present the problem through a multimedia presentation. You can create movies and interactive tutorials where the user

receives instructions, and then performs the task and send them back. The data are saved in popular formats: Flash Video (FLV), Shockwave Flash Object (SWF), Audio Video Interleave (AVI).

FLV files can be played by using a standard web browser with Adobe Flash Player plug-in or Gnash, as well as through programs: Winamp, Moyea FLV Player, FLV Player, ALLPlayer, Mplayer. SWF files are formatted as a chart of closed vectors. They can contain animations or applets of varying interactivity and function. They are often used to create animated graphics on web pages. SWF is currently the main format of vector animations on the web. SWF files can be played by web browser with the appropriate plug-in connector offered by Adobe free of charge, as well as by other applications. Flash (FLV, SWF) files have a number of disadvantages, you can not browse for selected text, you can not preview the outline or the source frame rate, and operating systems do not index the text, for example, in a SWF file, which makes it difficult to find.

AVI is also one of audiovisual data formats. It was introduced by Microsoft as part of its strategy to adapt Windows to the media. It is part of Video for Windows technology. AVI is a special type of RIFF format. Form RIFF was borrowed how to save data by their division into parts. Each part is determined by FourCC identifier. AVI technology extends this by adding two or three "subparts." The first subpart (HDRL) is a file header and contains metadata (data about data), such as image size and number of frames. The second "subpart" contains appropriate visual data. A third, optional (idxl), collects information on the location of "parts" within the AVI file.

Tutorials are files of exchanged formats with a collection of edited frames. They are created by the application, which in colloquial language is called "engines" of tutorials. Almost all of the "engines" allows you to create soundtracks, which better affect human senses, can be better received, and the knowledge is better absorbed.

Currently on the market and in the network are many "engines" available. According to the author of this publication worth of attention are: CamStudio, BB FlashBack Express, The XvidCap, recordmydesktop, Wink.

1. REVIEW OF APPLICATIONS RECORDING TUTORIAL

1.1 CamStudio

CamStudio is an application that allows record of your computer screenshots. Recording of screenshots frame by frame, can be done for the whole screens or its separate parts. This program is easy to use. The program allows overdubbing audio track. The frames from video cameras can also be added, and media material can be enriched with additional visual elements and the visual arts. Tutorials created files are saved in AVI files or converted to SWF format. In this program, it is possible to select resolution of the final product, and thus the size of the output file. The program has a version of the freeware and commercial versions, enhanced with advanced assembly. The application is recommended by the author of the article, especially for novice users of multimedia. The main drawback of the program is monotype, works only on MS Windows Operating System.

1.2 BB FlashBack Express

Application BB FlashBack Express is the free version. Commercial versions are available under the trade names BBFlashBack Pro and BBFlashBack. The application has sufficient tools to create tutorials. During the recording session there is the opportunity to add the soundtrack. The program has a function BBFlashBackExpress which exports presentations (tutorials) to the YouTube, Blip.tv. Viddler, Revver platforms. Program allows controlling the size and quality of the generated output file. The finished product can be saved in SWF format, FLV, AVI. Just as in the CamStudio you can simultaneously record the computer screen shoots with video (video camera). It should be noted that the application optimizes the load on your computer by selecting the recording modules, tailored to the speed of your computer. The main drawback of the free version of the program is that it is not possible to edit recorded material and the lack of the ability to add comments in cages clips. Described application is not recommended by the author of the article.

1.3 XvidCap

The XvidCap Program runs on UNIX platforms. Is an alternative for users who do not use SO MS Windows. XvidCap application allows generating tutorials in two ways, screenshots and creating a movie. The resulting material is compressed by XviD codec. You can record the full screen or any selected area. The application interface is very simple to use, which is an advantage for inexperienced users of multimedia platforms. In this application there are a few basic tools missing, including adding comments or editing text frames.

1.4 RecordMyDesktop

RecordMyDesktop application is designed to work only on Linux. It has a simple interface, despite its simplicity, the application has a high efficiency. Like other applications contains graphical interface, and the ability to work in command mode since most of the code is written in C. RecordMyDesktop, like previous applications allows to enter the sound track. The advantages of this program is that during the operation substantially does not load the computer. The final files are encoded in Ogg format.

1.5 Wink

Another tested program is Wink. It is an application that runs on all platforms, Windows, Linux (x86). The program has a quite rich set of tools that enhance visualization of the presentation, fields, shapes, notes, text boxes, by which individual frames of the resulting file can be edited. Shapes (arrows) can be used in navigation of frame. The application gives you the ability to attach audio to a presentation - VAV file formats and MP3. The program is based on the interception of the contents of the monitor frame by frame, combining the file in the following formats: SWF, PDF, EXE in binary form, PNG, GIF, JPG. The possibility of such a wide range of storage allows you to archive resources or perform short presentation, thus relieving the web server. It should be noted that in a network environment that supports this type of tutorials are primarily World Wide Web servers.
The Wink program has technical support in several languages: English, French, German, Italian, Dutch, Spanish, Japanese, Portuguese and Chinese. Help and support is available at http://www.debugmode.com/wink/.

2. TECHNIQUE OF MAKING TUTORIALS WITH THE SELECTED APPLICATION (WINK)

Of all presented applications Wink demonstrated the best user usability to create this type of presentation. Their performer was the best in comparison with others, so in order to emphasize its usefulness will be further presented by the author.

Screenshots can be performed manually or automatically at pre-defined intervals. These may include projections of the entire screen or a window with specific dimensions. Any screenshot is a frame that represents the entire movie. Each frame can be individually shaped. It is also possible to use ad-hoc-Driven Input capture. This means that the screen shots are captured each time you click the mouse or press a key on your computer keyboard.

Technique of making tutorials in this program is presented in the following example, the material devoted to creating computer networks, namely configuring the network protocol. Creating a presentation begins by selecting the "File" in menu and expanding the list of options "New" or "New Project".

After these activities recording set up window will appear. The area of recording, sound recording or not, the number of screenshots in specified time intervals can be selected.

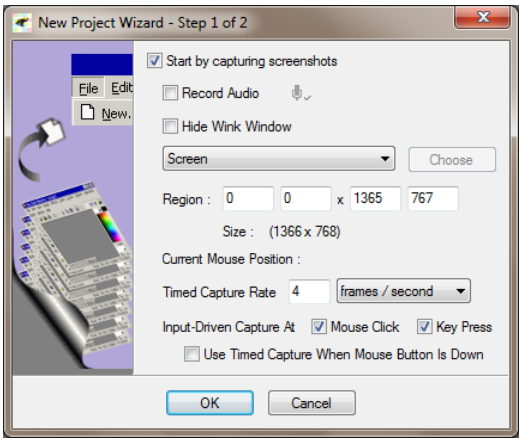


Fig. 1. New recording settings window [screenshot]
Source: author

After accepting a new window opens that displays information about the presentation being recorded. To start recording, minimize the window by pressing the key combination "Shift & Pause". After that new screenshots will be creating. By pressing the Pause key only a screenshot is creating at this moment. Combination of "Alt & Pause" stops recording. After recording, you can start editing frames. In the editing process, we have access to all screen shots frame by frame, frames are numbered sequentially. Other frames can be added as well. It is good practice to add top and end of the presentation (Fig.2). To edit the frames, the advanced programming environment can be used such as: Adobe Premiere, Corel Motion Studio 3D, Sony Vegas Movie Studio. For beginners of multimedia programs author recommends Windows Live Movie Maker.

After the recording session, a file with the extension pkt is created, with a set of basic frames (Fig. 2).

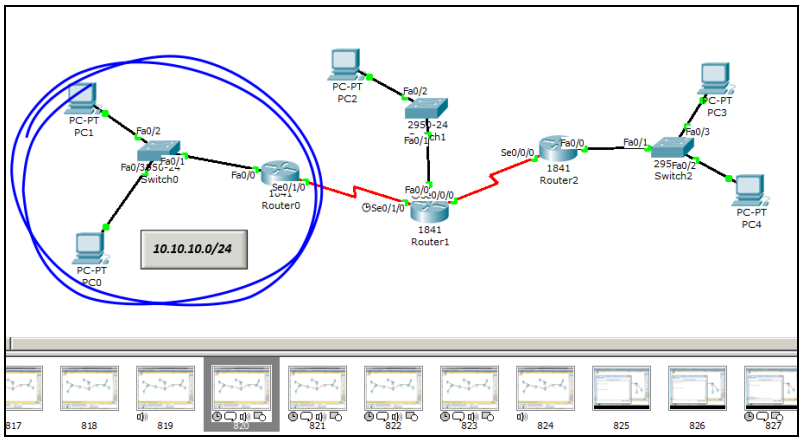


Fig. 2. View a set of frames
Source: author

Frame # 830 has been edited, entering the text boxes and shapes Preset Shape. Text fields enriching presentation (Fig. 3), complete soundtrack, which is less useful for people who are deaf or hard of hearing. To add a text box, select a frame, and then select Add Textbox.

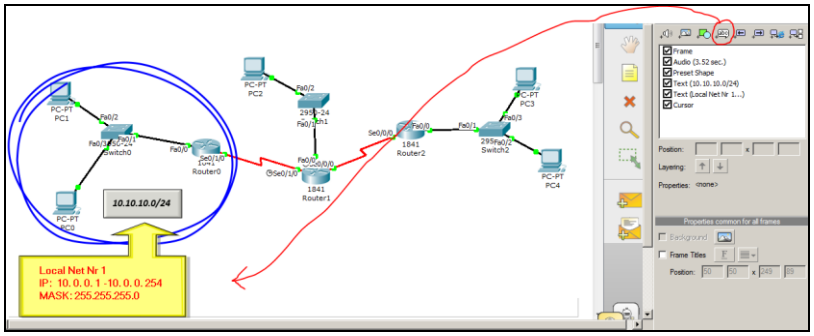


Fig. 3. A text box in a frame
Source: author

The text box changing is possible. Change through the "Position", "Layering" and "Properties". Most options can be found in the "Properties". Here you can change the shape of the field, color, and comment font. Select "Properties", then "Edit" or "Create New" and individual comments will be created, balloons.

It is important to define the time for frames, buttons, and text boxes displayed for the entire presentation. For example, to add a text field, it is important that the frame be displayed at the right time in order to enable the user to read the content of the presented material. For example, for frames with added text fields the stop has been set up for 15 seconds.

In addition to the add a text field – comments option, the sound (Add Audio), images (Add Image), hyperlinks (Add Goto URL) can be implement. The frames can be determined by common characteristics, by changing the tab "Properties common for all frames".

The final step is to export the data to a SWF file. Created presentation in flash file must be adapted to work on the network. A practical solution is to play the source files by intermediary files or protocols.

3. PREPARING APPLICATIONS FOR THE NETWORK

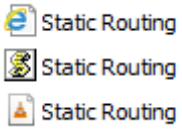
Instruction materials are condensed knowledge generated by human effort and should be especially protected. Supporting files in addition to basic functions such as organizing playback, playing a buffer role. They limit direct access to the source file. Prevent copying by the so-called "downloads" file. The procedure 1. shows one of such techniques.

Procedure 1. Access to resources rtp protocol, pcm

rtsp://195.42.153.16:554/Informatykaa/sieci_cz1.rm?cloakport=8080,554,7070
--stop--
pnm://195.42.153.16:7070/Informatyka/sieci_cz1.rm?cloakport=8080,554,7070

To handling video files plug AllVideos Plugin (plugin_jw_allvideos) was used, which play a movie from a server, and did not allows copy files in the network. *. RM file (not great 4KB), which defines the path to the right resources (procedure 1). Intermediary file can stream and exchange of high-level protocol RTSP (Real Time Streaming Protocol) and PNM (Progressive Networks Protocol). Right resource of AVI file is 132 MB.

Another option highly effective is to develop a two files with very simple html codes (hypertext) and js (scripting). The first organizes demonstration the second manages and controls the show. Intermediate files isolate the source file, which provide security in the copyright works. File structure: PostScript (js) and tags (html):



The hypertext and scripting file structure show procedures 2 and 3. Let's think about a hypertext file (procedure 2) for a moment. Tags </ center> position the playback window in the central part of the screen. <OBJECT> tag defines the object, in this case the multimedia file. This tag can define a document or static image, depending on the file format (jpg, png, gif, pdf). The object here is the material in the Flash format. Inform about it the CLASSID attribute. This attribute tells the browser of an object to be able to interpret it correctly. CODEBASE attribute defines the URL address to network resources with ActiveX. In case when computer does not have ActiveX object redirects to download the codec from indicated address. In the attributes of an object is defined playback window height and width of the window.

Further parameters of the display object are: move, play, loop, wmode and quality. Parameter move indicates the location of the movie resource – playback file, in this example, Static_Routing.swf file where the tutorial was saved. Play parameter can take one of two values: true or false. A true value means that the movie will be automatically displayed after loading the pages. False forces a play by pressing play button. Similar, loop parameter, can take only one of two values true or false. If false, the entire movie will be displayed to the end one time, and the presentation will be stopped. If true, the presentation will be restarted from

the beginning. W mode parameter takes one of three values: window, opaque and transparent. For example, Flash Player can work in two modes window and windowless. The first one is the default, it provides the best performance. Its disadvantage, however, is that you can not position the flash object into layers. Mod windowless allows positioning. We may use this mod in two ways as nontransparent opaque background or transparent. In the example, the option with the transparent background was used.

Quality parameter determines the quality of the presentation. Takes one of five values: auto low, auto high, medium, high, best. The example uses the low; this is the worst of the available qualities anti-aliasing is off in this case.

Procedure 2. Html file contents

```
<HTML>
<BODY>

<center><OBJECT CLASSID=" " WIDTH="1022" HEIGHT="556"
CODEBASE="http://active.macromedia.com/flash5/cabs/swflash.cab#version=7,0,0,0">

<PARAM NAME=movie VALUE="dhcp1.swf">

<PARAM NAME=play VALUE=true>

<PARAM NAME=loop VALUE=false>

<PARAM NAME=wmode VALUE=transparent>

<PARAM NAME=quality VALUE=low>

<EMBED SRC="dhcp1.swf" WIDTH=1022 HEIGHT=556 quality=low loop=false wmode=transparent
TYPE="application/x-shockwave-flash"
PLUGINSPAGE="http://www.macromedia.com/shockwave/download/index.cgi?P1_Prod_Version=S
hockwaveFlash">

</EMBED>

</OBJECT></center>

<SCRIPT src='dhcp1.js'></script>

</BODY>

</HTML>
```

<EMBED> Tag allows you to playback (tutorial) in other browsers than Internet Explorer, as other browsers do not support PARAM tags. So EMBED tag is used, it includes similar parameters described in the PARAM tag. JavaScript file code contains the procedure 3.

Procedure 3. Js file contents

```
obj=document.getElementsByTagName('object');

for (var i=0; i<obj.length; ++i)

  obj[i].outerHTML=obj[i].outerHTML;
```

<OBJECT> tag with included tutorial in the script file *.js takes the form of an object and overwrites itself in the variable, in our case, the variable named obj. Then, in a loop: obj [i].

OuterHTML = obj [i]. OuterHTML, changes non-interactive objects to interactive. This eliminates the clicking in the activation of the film, then re-clicking on startup.

Generated hypertext HTML and script code facilitate operating and setting up the material on the network. The presented files codes are ready to use, the reader can update only a record of their own use. The materials written in the Flash format are significantly compressed, the size of the presentation does not exceed from tens to a few hundred megabytes. File size depends on the "length" of video. For advanced users of multimedia author recommends formats converting. Format converting is not within the scope of this publication.

CONCLUSION

Education over the Internet using the tutorials on the web is an effective way to transfer knowledge because it guarantees to reach a large group of students and learners, anywhere, anytime. Materials can be played several times, and in some cases with the consent of the author can be copied and stored. Teaching through the network and tutorials certainly has advantages, increases the quality of teaching, teaching discipline, self-control and essential of learning allows as well for self-esteem. The problem is the resistance of teachers and lecturers to use this form of teaching. On proper operation of the entire system influences have: the link parameters, web server configuration, and the client endpoint parameters. Among the various dedicated forms, the most popular are the materials made as video (http://e-learning.wshe.pl).

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IMPROVED SITUATIONAL AWARENESS IN MILITARY SUPPLY CHAINS THROUGH RFID, GPS, AND SATELLITE TECHNOLOGIES

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Abstract: *In the past few years, NATO-allied forces, including the Canadian Forces (CF), have used radio frequency identification (RFID) technology to gain in-transit visibility of shipping containers and improve inventory management. However, container theft remains a widespread problem, especially for military supply chains where conventional RFID technology has been ineffective in stopping the theft problem. To resolve this problem, a research project was conducted in which RFID, GPS, satellite, and sensor fusion technologies were implemented to improve situational awareness and detect container intrusions in near real-time. The contributions of this paper are as follows: providing a completely new RFID architecture to analyze and utilize situational information, combining RFID and GPS technologies to record exact locations, and integrating RFID reading functionality into a satellite device to receive alarm and status reporting in near real-time.*

Keywords: RFID, situational awareness, fusion, container theft, in-transit visibility.

INTRODUCTION

Radio frequency identification (RFID) technology, coupled with rapid advances in information technology and communications networks during the 1990s, has gained widespread application in both governmental and private sectors. In the past few years, NATO-allied forces, including the Canadian Forces (CF), have begun deploying RFID technology within their supply chains and transportation systems to track materiel consignments and assets that are shipped to military operations around the globe. However, container theft is a widespread problem, especially for military supply chains, and conventional RFID technology has had difficulty in dealing with the theft problem. For example, a Canadian Broadcasting Corporation news article reported on January 11, 2012, that "All NATO countries have a pilfering problem with their containers. No one knows where the pilfering is occurring" [1]. Coincidentally on January 20, 2012, RFID Journal reported that "...the Exchange (formerly known as the Army and Air Force Exchange Service) often experienced a loss of product before shipments reached the military store's shelves — possibly after they reached Afghanistan, though it was unable to determine exactly where such losses occurred. Typically, thieves might break into a container to remove products..." [2]. In the worst case, container theft even happened at the battlefield: "... [for] the ground

transportation route supporting forces in Operation Enduring Freedom, theft and container tampering is a real threat for in-bound and out-bound cargo...” [3]. To resolve this common problem in military supply chains, we conducted a research using GPS (Global Positioning System), RFID, and sensor fusion technologies to improve situational awareness and detect container intrusions in near real-time.

A prototype system was developed and tested in an operational environment through two trials during a Canadian Northern military training exercise called OP NANOOK 2012. In the Northbound Trial, all the tagged containers were shipped from Laval to Inuvik through Whitehorse, while, in the Southbound Trial, three containers were shipped to Cold Lake and two containers to Laval. An incremental testing approach was used to obtain fast feedback to improve the system design and minimize the risk of late delivery. The objectives of the Northbound Trial were: 1) testing the communication and interface between an RFID tag (called CargoKeeper) and a satellite communication device (called Whisper), and between Whisper and an Iridium (commercial communications) satellite; 2) testing the stability of the tracking and reporting system. The objectives of Southbound Trial were: 1) testing the upgraded CargoKeeper and Whisper firmware; 2) testing the newly developed intrusion detection function on CargoKeeper. The first trial focused on capability and efficiency, while the second trial focused on performance and susceptibility. The trials demonstrated that the proposed solution offers substantial benefits to military supply chains. Not only does it improve asset visibility and increase data quality, but it also has the potential to reduce theft by having near real-time visibility of container situational information.

This paper describes and analyzes the results of the following: combining an RFID tag with a GPS device to record exact locations, coupling the CargoKeeper RFID with the Whisper satellite device to monitor the container in motion and receive information on the cargo’s condition in near real-time, and providing a completely new RFID architecture to analyze and utilize the newly available situation information. Please be noted that this paper only contains uncontrolled unclassified information because of the unclassified nature of the conference. If anyone would like to know more technical details, please contact DRDC-Ottawa directly.

1. SITUATIONAL AWARENESS

Situational awareness (SA) can be defined simply as “knowing what is going on around you” [4]. More precisely it is defined in [5] as “the perception of elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future.” In our case, the objective of situational awareness is to assimilate real-time data and assess a container’s current state of vulnerability based on its potentially complex and dynamic environment. Conventional RFID systems are limited to the identification and tracking of objects. It has been noted that “the current systems provide the functions for simply reading and processing ID information in little consideration of situations” [6]. Therefore, it is necessary to extend the RFID system architecture to manage the information gleaned from a variety of sensors, and interpret and determine the situational information. To achieve this goal, a novel architecture is presented that includes four modules to fuse data collected from multiple sensors and perform situation awareness (Fig. 1).

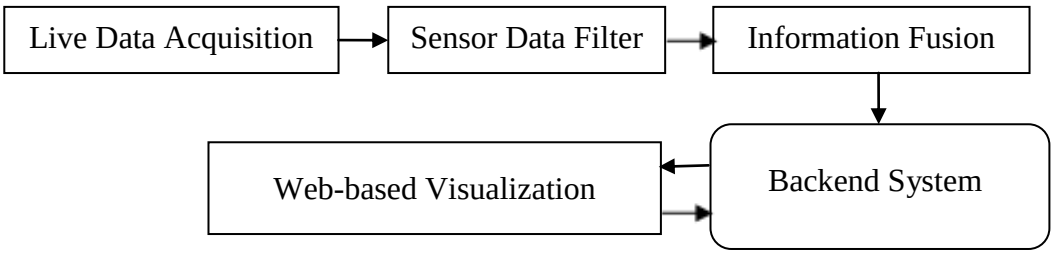


Fig. 1. Modules of the proposed system
Source: own

1.1 Live Data Acquisition

An active RFID tag, called CargoKeeper, has been developed that has multiple sensors attached with simple controllers to manage and log sensor readings to on-board memory (Figure 2). Upon activation, the sensors start to measure environmental variables and use these measurements as the baseline to detect container intrusions. The periodically sensed data are provided as input to the data filter module. Multiple sensors are used to obtain a set of robust data to monitor the container's integrity and location. However, there is a trade-off between accuracy and battery life. It is necessary to conduct real tests to decide whether to add or eliminate certain sensors in order to reduce energy consumption with a desired false alarm rate.

Fig. 2. An example of CargoKeeper tag
Source: own

1.2 Data Filter

In order to reduce the occurrence of false positives (i.e. alarms raised because of normal variations), a data-filtering module is required to deal with expected fluctuations in light intensity, temperature, etc. In particular, we used the data filtering method to remove undesired fluctuations that exceed pre-determined thresholds. It is necessary to point out that the filtering methods do not provide any additional information to the measured data and may result in considerable distortion of the input signal. Most of the time, increasing the frequency of sampling can mitigate the impact of outliers.

1.3 Information Fusion

In order to improve intrusion detection, it is necessary to analyse the data collected from multiple sensors that monitor various physical phenomena and provide complementary information. The process of combining such information is usually referred to as data fusion or information fusion. Information fusion is a method of merging the prediction of various sources to either generate one presentational format or reach a decision. The objective is to obtain a more meaningful result with improved accuracy and confidence in the final decision, in contrast to a decision based solely on an individual data source. In developing a multiple sensor fusion algorithm, the key issues that need to be addressed are the level at which fusion takes place and the rule by which a decision is made. A three-level strategy is widely used in multiple-sensor fusion. They are data-level fusion, feature-level fusion, and decision-level fusion [7]. The commonly used decision rules in information fusion include the weighted product rule, weighted sum rule, sum rule, min rule, max rule, median rule, and majority voting rule. In data-level fusion, the raw data collected from different sources are combined to produce a single representation that is expected to be more robust and informative than the inputs. Feature-level fusion operates on feature vectors extracted from the source data and merges various features to eliminate redundant information that reduces problem dimensionality and simplifies classifier design. Decision-level fusion combines individual classifier decisions to yield a fused decision.

1.4 Web-based Visualization

It is critical to visually show the information to the decision makers who need to achieve logistics situational awareness along the supply chain in near real-time. Track24 developed a visualization tool that can be accessed from any web-connected computer or tablet. Not only is it capable of accessing current tag conditions and issuing an intrusion alarm in real time, it also allows the exploration of the tag's associated sensor data history (Fig. 3).

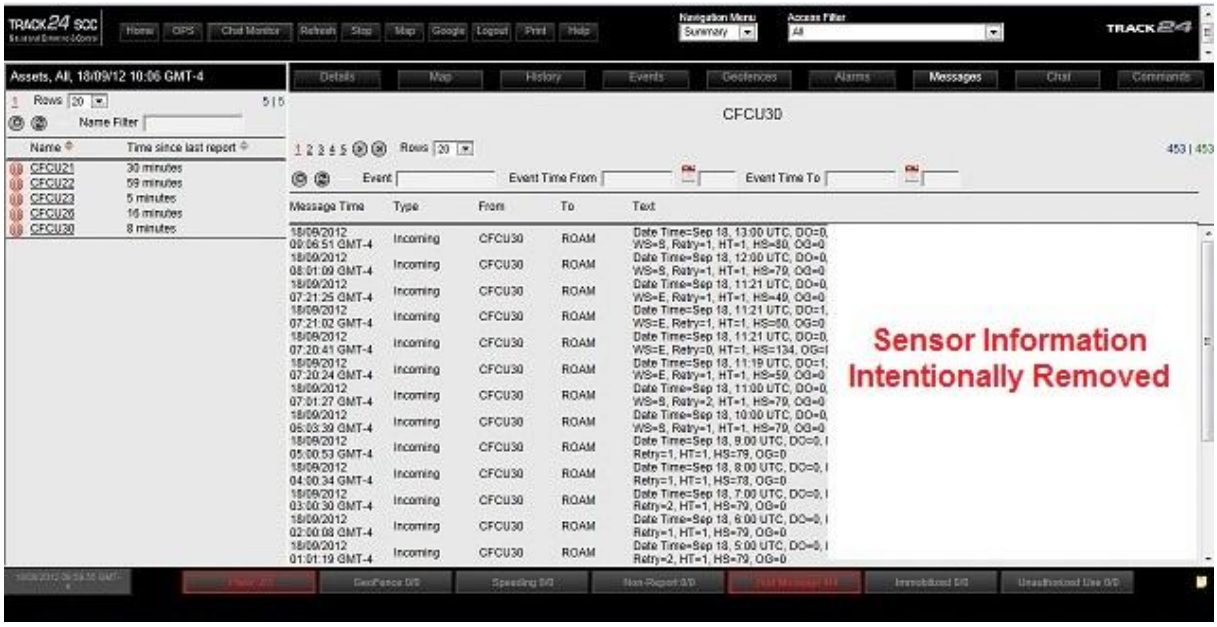
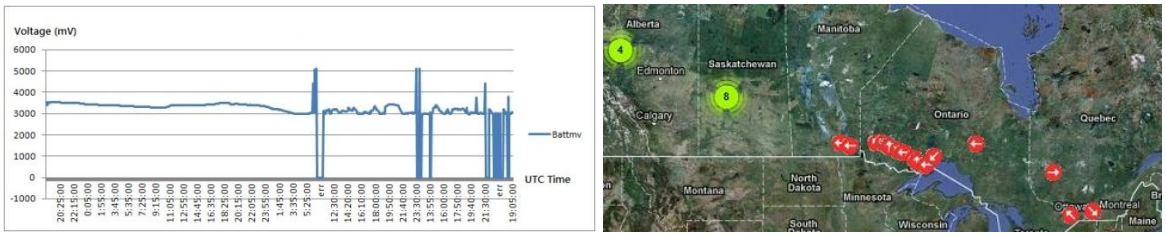


Fig. 3. Example of the tag history
Source: own

2. EXPERIMENTS

A prototype system was developed and tested in two field trials: the Northbound Trial and the Southbound Trial. In the Northbound Trial, five containers were tagged and shipped by trucks travelling over 6,000 kilometres. In the Southbound Trial, the same containers were used with the upgraded RFID tag and firmware. Two of the containers travelled over 6,000 kilometres, while the rest of them were shipped to a new destination at a distance of about 3,400 kilometres. The objective of the Northbound Trial was to test the RFID tag's stability, battery life, and communication protocols. The objective of the Southbound Trial was to test an upgraded RFID tag with intrusion detection function, and the upgraded firmware.

An incremental testing approach was used to obtain fast feedback to improve the system design and minimize the risk of late delivery. For example, all the tags ceased collecting data and reporting situational status on the way to their destinations during the first trial. We analysed the data collected from one container and found the problem was caused by power consumption of the hardwired interface. From Fig. 4, it is observed that a rapid reduction in battery voltage level (Fig. 4 (a)) results in false alarms in the first one and a half days (Fig. 4 (b)).



(a) Battery level (b) False alarms in the first 1.5 days

Fig. 4. Failure analysis
Source: own

Based on the feedback, the following modifications were made for the second trial:

1. Optimize energy consumption
    - Using sleep mode
    - Redesigning a lower-powered hardware interface.
2. Reduce the false alarm rate
    - Adjusting the sensor thresholds
    - Modifying the fusion algorithm.

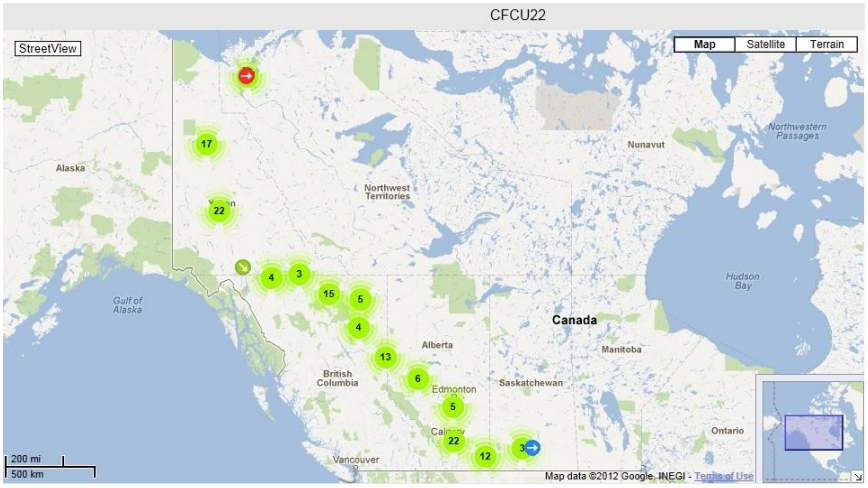


Fig. 5. An example of showing the current location, truck route, and container intrusion status
Source: own

With modifications, all the tags arrived at the destinations with live batteries and reported the door opening intrusion successfully. Therefore, the trial met the mission objectives. Fig. 5 presents an example that shows the trucks' current location (blue arrow), truck route (green circle), and container intrusion status (red arrow).

CONCLUSION

Container theft is a widespread problem and it is an especially serious threat to military supply chains. For example, it was reported that "Cargo theft is a costly and significant threat to both retail and insurance companies with a Federal Bureau of Investigation (FBI) estimated yearly price tag of $30 billion dollars" [8]. In order to resolve this problem, we conducted research to develop an anti-theft RFID technology in which RFID, GPS, satellite, and sensor fusion technologies were implemented to improve situational awareness and detect container intrusions in near real-time. A prototype system was developed and tested in an operational environment through two trials in 2012. The first trial focussed on capability assessment and efficiency, while the second trial focussed on performance and susceptibility. The success of the second trial indicated that the mission objectives were fully met. In summary, the contributions of this paper are threefold. First, we propose a completely new RFID architecture to analyze and utilize the newly available situation information. Second, we present a scheme that combines RFID and GPS technologies to periodically monitor the containers in motion worldwide and record their exact locations. Finally, we integrate RFID reading functionality into a satellite communications device to receive alarm and status reporting and retrieve event history in near real-time.

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