VOLUNTARY EDUCATION STANDARDIZATION IN STUDY ENERGY EFFICIENCY DIRECTION PROGRAMS IN EUROPEAN UNION AND NEIGHBORHOOD REGIONS

A. Zabasta[(a)], N. Kunicina[(b)], N. Arsic [(c)], O. Krievs[(d)], L. Ribickis[(e)]

[(a),(b),(d),(e)] Institute of Industrial Electronics and Electrical Engineering
Riga Technical University, Riga, Latvia
[(c)] University of Pristina in Kosovska Mitrovica, Kosovo

[(a)] Anatolijs.Zabasta@rtu.lv, [(b)] Kunicina@latnet.lv, [(d)]Oskars.Krievs@rtu.lv , [(e)]Leonids.Ribickis@rtu.lv
[(c)]Nebojsa.Arsic@pr.ac.rs

ABSTRACT

The experience in development of compatible study programs in electrical engineering obtained by Tempus Energy project partners, in particular Riga Technical University and University of Pristina in Kosovska Mitrovica is described. The curricula developed in a frame of Tempus project is a good step forward of mutual recognition of study programs between EU countries and EU partner's countries universities. It creates a good background for Erasmus+ activity implementation – students and teaching staff mobility between EU and non-EU partner countries. The new set of study programs, module based teaching approach for undergraduate's and masters student, shared teaching library, modelling and simulation approach for the teaching process, made in the frame of Tempus Energy project are depicted. The problem issues, solutions and examples in the development and modernization of compatible study programs in EU partner's countries universities are discussed.

Keywords: education, modelling and simulation, voluntary standardization, electrical engineering, compatible study programs, TEMPUS program.

1. INTRODUCTION

The Bologna process defined the common goal: to create a European space for higher education in order to enhance the employability and mobility of citizens and to increase the international competitiveness of European higher education.

In 2010 ministers responsible for education proclaimed that European Area of Higher Education (EHEA) is constructed but the process of harmonization in EHEA continues. Tree steps were done in the early stage of the Bologna Process to solve the problem of mutual recognition of higher education diplomas, namely: adoption of a system of comparable degrees; introduction of the three major levels of higher education (bachelor, master, and PhD); introduction of the European Credit Transfer and Accumulation System (ECTS). At least in 2005 at the Bergen Ministerial Conference "A Framework for Qualifications of the European Higher Education Area" was agreed (Ferreira and Filipe 2009).

Two basic degrees, Bachelor and Master, have been adopted by every participating in Bologna process country; sometimes in parallel to existing degrees during a transition period, sometimes replacing them completely. EU countries and EU partner's countries universities are currently in the implementation phase, and an increasing number of graduates have now been awarded these new degrees.

However, a problem of incompatibility between EU countries and EU partner's countries higher education systems cause the problems for students, which desire to get courses in EU universities. For example:

- Courses taken by student in EU countries cannot be taken into account as credit points;
- Shift in time between courses;
- Different teaching time of students and master students;
- Different teaching topics for the students with the similar specialities.

2. EU EXPERIENCE SHARING VIA TEMPUS PROJECT "ENERGY"

Since 2012 Riga Technical University (RTU) the Institute of Industrial Electronics and Electrical Engineering (IEEI) as coordinator leads TEMPUS IV project "Development of Training Network for Improving Education in Energy Efficiency" (ENERGY). The project is focused on the development and modernization of a set of compatible study programs (including lecture courses, laboratory classes and appropriated didactic materials) in 4 declared directions: enhancement of energy efficiency, energy saving energy effective materials and use of renewable sources.

In this project 14 universities from nine countries will work together in order to share the best practice in academic work (see Table 1). The project will be finished in the October 2015.

Academic staff of the of EU universities is involved into coordination of the modernization and developing of unified curricula and study programs making them compatible with EU standards. Furthermore the academic staff of EU partner's universities is involved into training process in EU Members Countries (mobility), modernization and developing of compatible and unified curricula, as well as in the training of bachelor and master students (Zabasta, Kunicina and Zhiravecka 2013).

Table 1: Participants of the project Energy

Short name	The name of the university	Country
RTU	Riga Technical University	Latvia
TUT	Tallinn University of Technology	Estonia
VU	Vilnius University	Lithuania
LUT	Lublin University of Technology	Poland
KTU	Koszalin University of Technology	Poland
KU Leuven	KU Leuven Oostende	Belgium
UDJG	"Dunarea de Jos" University of Galati	Romania
KHAZAR	Khazar University	Azerbaijan
QU	Qafqaz University	Azerbaijan
NAA	National Aviation Academy	Azerbaijan
BSU	Belarusian State University	Belarus
BNTU	Belarusian National Technical University	Belarus
BSATU	Belarussian State Agrarian Technical University	Belarus
UPKM	University of Pristina in Kosovska Mitrovica	Kosovo

E – Learning platform (as e-library) has been created as a common methodological base for study subject's curricula storage and sharing tool. This platform has to integrate all courses in teaching languages into one technological platform that will allow managing them as shared recourses in daily work with teachers and students.

Furthermore, the project activities also include new course materials testing during 1 year, preparation of accreditation process on compatible curricula and networking among higher education institutions between Member States and Partner Countries.

Starting the project the leading partner' team committed with consortium team's member motivators and benefits for participants:

- Involvement into Bologna process, recognition of a curricula.
- New equipment for laboratories.
- Opportunity to travel and create own network of researchers.
- Additional salaries for teachers, interpreters and professionals.

From the very beginning Management team got an awareness about the hurdles and problem issues and first of all very different English language skill among the members of the management team. Fortunately, the majority of fellows have the second language knowledge – Russian, therefore, the Russian was used as an auxiliary tool. Personal ambitions may become a serious encumbrance for the sub teams, working on training course books, therefore compromises were achieved, sometimes thanks to sacrificing the quality. Due to the bureaucracy of the government institutions of Belarus three partners started project activities with 15 month delay, moreover, a specific public procurement legislation put additional hurdles to Belorussian partners. However, the Management team has been mitigated risks, rescheduled tasks, and found the way how to arrange students training before supplying laboratory equipment.

The first task for the partners was to find the way how to arrange elaboration of compatible with EU standards common courses. As a result of discussions an approach, which satisfy all partners was accepted. The idea, which unites all participants, despite of different background, different education system etc. is to develop ten "master" courses in English. At the next step EU partners' universities develop own courses, which comply with national legislation, university's standards and to be translated to the teaching languages. So each university may to adjust such master course to comply to existing or a new study program keeping in mind compatible with EU standards.

However, here is a risk that courses and programs adjustment to the national legislation of education systems may lead to large divergence and in realty the gap between EU and EU partners' education systems will not be bridged sufficiently.

Therefore, the assumption was made in the beginning of the project that it is possible to develop "master" modules-courses, which will be utilised by EU partners as core courses for development compatible with EU education system programs that will bring EU partners closer. The assumption was verified during the project and the results have been evaluated at the end of the project.

2.1. New training courses development:

Ten creative teams comprising academic and teaching staff representatives from all partners were nominated to develop "master" modules-courses. Management team coordinated activities of the creative teams and accepted the deliverables of their job. In order to keep in a focus creative teams activities the common workshops by course topics are held during the project. At the time of elaboration of this paper eleven workshops have been held, usually in parallel with Management team meetings. A Table 2 depicts the courses and partners in charge of these tasks.

Table 2: New "master" courses and responsible

	Course	Responsible	Course materials is in e-library
1	Distribution of power energy	KU Leuven	+
2	Effective lightening	RTU	+
3	Energy effective materials	LUT	+
4	Energy saving technologies	RTU	+
5	Power electronics	RTU	+
6	Gas- and Hydrodynamics	RTU	+
7	Heat pumps	UDJG	+
8	Hydrogen energy	RTU	+
9	Solar energy and photovoltaics	VU	+
10	Wind energy	KU Leuven	+

However, to develop a new course in the team, comprising 19 PhD representing eight partners from 7 countries (see example of the team developing master course Energy saving technologies at Fig. 1) is not an easy task. The team leader has to show leadership, competences in the subject, patience and diplomacy.

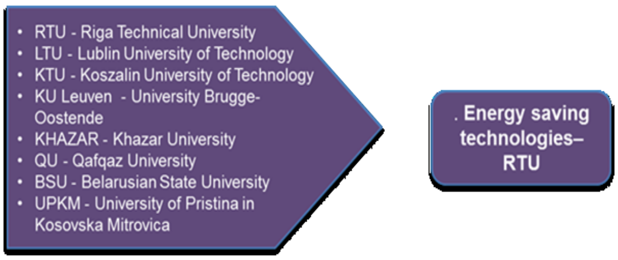

Figure 1: Example of the team developing master course Energy saving technologies

On the base of master courses in English, EU partner's universities elaborated their courses adjusted to particular university needs. According to the project targets partners now create also laboratory works, lectures materials, presentations, tests (quiz). Teaching – learning materials should be translated into teaching languages: Serbian and Russian. Unlike Belarus and Serbian universities, Azerbaijan universities provide training in English. At the time of elaboration of this paper the Energy project was in the progress, therefore EU partner universities still continued elaboration of the new training courses. The Table 3 gives a perception, how EU partner universities transformed and utilised master course materials into 30 new adjusted courses.

Due to the lack of the space only 10 course of 4 partners are shown in the Table 3.

Table 3: Example of the transformation from the "master" courses into partner's universities courses

University	Course for testing	Course materials in e-Library	Translation into national language
BNTU	Mechanics of Fluids and Gases	Not	Not
	Non-conventional and renewable energy sources	Yes	Not
	Secondary Power Resources	Yes	Not
	Fuel and its usage	Not	
NAA	Luminophors	Not	
	Algorithm of Thermo-gas Dynamic End Heat Transfer Modelling for Turbine Blades	Not	
	Physical Properties and Application of Photosensitive Semiconductor Converters	Not	
Qafqaz University	Renewable Energy (Windy Energy)	Not	
	Fluid Mechanics (Gas and Hydrodynamics)	Not	
Khazar University	Renewable Energy	Not	

2.2. New courses testing:

All of 30 new courses have been tested during two semesters. A special form of the testing report has been created taking into account RTU, EU partner's universities and other universities experience (Kirkpatrick 2009, Haslam 2010). Polling, questionnaires, interviews were applied as for evaluation of testing results. The feedback is obtain from the main teaching- training process stakeholders: students, student organisations and academic and teaching staff. For evaluation of students and student organisation feedback a quantitative method is used, but for academic and teaching staff – quantitative approach due to the small number or recipients and willingness to get much broad comments and suggestions about tested courses. The questionnaires for students have been available in English, Serbian and Russian, furthermore universities may adjust questionnaires taking into account own experience and diverging culture of project partners. An example of a questionnaire for the students is provided in the Table 3.

Table 3: A part of a questionnaire used for students polling

Nr	**Questions**	**Evaluation (1-5)**
1	The introduction makes the students familiar with the subject content and way of the final control	
2	The course was well-structured and the themes were explained in a comprehensible manner	

3	During the course its theory is highly confirmed with practical tasks, activities or laboratory works	
4	This course and the other subjects mutually supplement each other	
5	Visual material is understandable and illustrate the material well enough	
6	The assignments and activities initiated self-sufficiency in decision making	
7	The tasks and activities promoted practical application of theory and creative thinking	
8	Recommended literature sources were accessible and helped in acquiring the course materials	
9	Lecture materials and course books are mutually complementary	

New courses testing in real teaching – learning process induced one unexpected effect: EU partner's universities appeared willingness to arrange additional short term courses and workshops in order to tune and to improve the content of the courses in particular areas, in which EU universities do have competences. For example, at the KU Leuven two days' workshop on Wind energy and Effective lightening and Energy saving technologies, which was announced before testing, the number of applicants increased in twice, when courses testing was ended. Additional workshops, student trainings, and mutual visits between EU universities and EU partner's universities and also between EU partner's universities have been arranged.

2.3. Modelling and simulation approach for the teaching process

In the last few years RTU developed a program "Computer control of electrical technologies" for master degree and for doctoral degree students. This experience has been taken into account for new courses developed under RTU leadership: Energy Saving Technologies, Effective Lighting, Power Electronics, Gas and Hydrodynamics and Hydrogen Energy. In the next subchapters three examples of modelling and simulation approach for the teaching process are presented.

Example of Model-Driven Approach for Testing of Embedded Systems

One of the research topics in the focus of RTU is related to computer control of all shapes and sizes embedded systems. Embedded systems have more non-functional properties, more complex software structure and development process compared to simple systems. In the past few years, there have been a number of cases where errors in the software and hardware of embedded systems led to human casualties and massive losses. Existing methods for testing embedded systems are incomplete and do not ensure automation of the testing process or correspondence to current trends in software development. These methods are based mostly on general testing standards and do not support testing of non-functional features of embedded systems (Grigorjevs, Ņikiforova 2009).

To make development of embedded systems reliable, new methodologies, programming and specification languages have been introduced by Applied Computer Science Department. Standardized principles of model-driven architecture (MDA), the available development environments and tools stimulate automation of the entire software development cycle have been used. One of the tools used by MDA is a Unified Modelling Language (UML), which provides a testing profile to support the testing process. However, even though the testing profile was standardized in 2005, there are still no generally accepted methods for automating the testing process and generating test cases based on the system model.

As a result of the research, a method was developed for testing the non-functional properties of embedded systems, as well as the set of tools developed to ensure transformation of UML models and generation of test cases. The suggested method is based on the fundamentals of model-driven software development and general principles of model transformation. To test the application of the method, it was approbated by verification of time constraints for a real-time payment card system, for which these properties are critical for performing standard activities (Grigorjevs, Ņikiforova 2009).

Risk-based methodology for evaluation of critical infrastructures interdependencies

Critical infrastructure's (CI) (electricity, heat, water, information and communication technology networks) security, stability and reliability are closely related to the interaction phenomenon. Due to the increasing amount of data transferred, increases dependence on telecommunications and internet services, the data integrity and security is becoming a very important aspect for the utility services providers and energy suppliers. In such circumstances, the need is increasing for methods and tools that enable infrastructure managers to evaluate and predict their critical infrastructure operations as the failures, emergency or service degradation occur in other related infrastructures.

The presented method is based on a systematic approach for computing metrics and performance indices of interdependent critical infrastructures based on their information content, expert views and risk analysis capabilities. A risk-based methodology is based on generic risks and assurance levels using security properties: availability, confidentiality and integrity. Unified Modelling Language (UML) is proposed in order to define a model for research of critical infrastructures interdependences (Zabasta, Nikiforova, and Kunicina 2012).

The goal of the presented approach is to address the challenge of monitoring of the state of critical infrastructures and their interdependent services. Our hypothesis is, that it is possible to reduce the complexity of a service through abstraction to a common (risk related) set of parameters. This enables to compare critical infrastructures designed to serve a very different purpose (energy, telecommunication, water supply, transport and etc.) and composed of very different infrastructure components. It enables also to monitor important system parameters like availability, confidentiality and integrity. The abstraction to a small set of common parameters will encourage service providers to share them with interdependent providers.

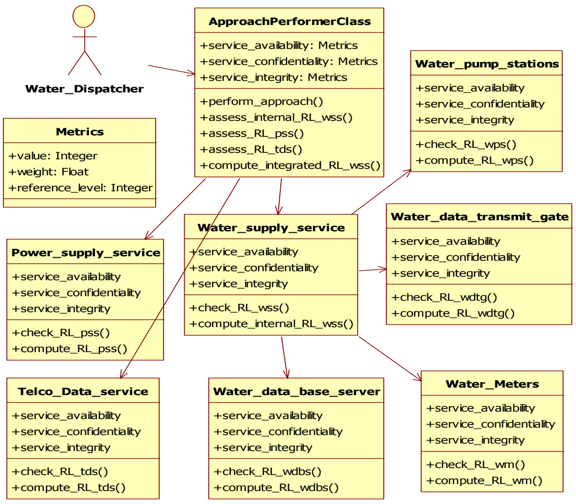

Figure 2: Interdependencies Class diagram

Fig. 2 shows nine classes, where five of them represent water supply service and its components, one class represents power supply service, one class represents data transmission service and one class (Approach Performer Class) starts and controls services risk level assessment process. Operations reflect the activities executed by each class. The parameters of attributes and operations in each class have been omitted in the interest of figure clarity. One particular class, namely “Metrics”, have been created in order to describe parameters of classes’ attributes and classes’ operations. The class has attributes “value”, “weight” and “reference level” that are referred to service parameters (availability, confidentiality and integrity). Creation of particular class makes sense since unified normalized parameters are applied to divergent CI.

The ontology proposed in Fig. 2 was created in order to study CI interdependencies of the particular city, but can be readily adapted to other cases, taking into account the specifics of each city.

The main advantage is that the model is easily extensible for including additional parameters and is ubiquitous for heterogeneous CI. Another benefit of the CI security model for businesses is the ability to compare different types of infrastructure using common risk related parameters.

The approach enabling critical information sharing among service providers allocated in neighborhood looks quite attractive, because it helps to CI owners to make more qualified decisions and to plan risk mitigation actions. However, the question is how to encourage service providers to elaborate, refine and issue critical information to other CI owner.

MATLAB® Simulink® State Flow simulation model for evaluation of critical infrastructures interdependencies

Using a simulation model, is experimentally tested a method that allows to explore the water supply network nodes the average down time dependence on the battery life time and the battery replacement time cross-correlations, within the parameters set, when outages in power infrastructure arise and taking into account also the impact of telecommunication nodes. The model studies the real case of Latvian city Ventspils. The proposed approach for the analysis of critical infrastructures interdependencies can be useful for practical adoption of methods, models and metrics for CI operators and stakeholders (Zabašta, Casaliccio, Kuņicina, Ribickis 2014).

The contribution of this research is:

- To describe how the simulation approach allows to model in deeper details critical infrastructures coupling and their behavior.
- To develop a MATLAB® Simulink® State Flow simulation model of a modern water supply system (composed of water supply nodes, telecommunication nodes and power system nodes).
- To simulate the impact of effect of power nodes outages on telecommunication and water supply nodes and to assess the impact of failure propagation, using metrics developed in previous researches.
- To describe dependences between infrastructures by polynomial and to minimize impact on water node down time.

A simulation model experimentally tested a method that allows to explore the water supply network nodes the average down time dependence on a battery life time and a battery replacement time cross- correlations, within the parameters set, when outages in power infrastructure arise and taking into account also the impact of telecommunication nodes. The model studies the real case of Latvian city Ventspils. The proposed simulation scenario describes water distribution network nodes interaction with electricity and telecommunications network nodes.

An assumption is made:

- A model allows to explore the water supply network nodes the average down time dependence on the battery life time and the battery replacement time cross- correlations, when outages in a power infrastructure arise and taking into account also the impact of telecommunication nodes.
- It is possible to examine the interaction with a polynomial, and minimize the water supply network nodes the average down time within bound parameters.

$$R_{i,j,k} = f(t, m_j^1, m_j^2, ...m_j^p, m_k^1; m_k^2....m_k^p; m_i^1, m_i^2...m_i^r) \rightarrow \min$$

$$m_j^l \in M_j; m_k^n \in M_k; m_i^r \in M_i$$, where

$R_{i;j}$ - function $f(.)$ time t. A specific set of metrics: M_j (power supply network), M_k (telecommunication network) and M_i, (water supply network), used to measure infrastructures *j, k and i* performance level.

This study uses MatLab® Simulink® StateFlow modelling and simulation tool as a popular engineering and scientific modelling tool.

Simulation data have been processed by EDAOpt experimental results processing tool developed by researchers of RTU.

The analysis of the WDN nodes average downtime ratio dependence on backup battery lifetime (BLT) and backup battery replacement time (BRT) cross-correlation parameters specified parameters is made. EDAOpt computed the polynomial coefficients of the quadratic approximation with one attempt exclusion.

$R = 2.3532 – 0.3894*X_1+0.00812*X_2+ 0.0289*X_1*X_1+ 0.0035*X_1*X_2$

The following local approximation is carried out with the aim of identifying possible local minims. Looking at Fig. 3, one can see at least two local minimums within modelling parameters set. Fig. 3 depicts three-dimensional images that demonstrate the correlation between the water WDN nodes BLT, BRT and WDN nodes downtime.

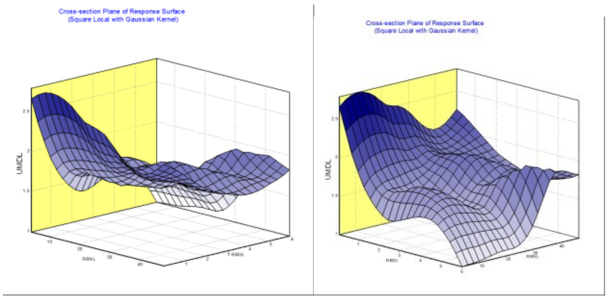

Figure 3: Quadratic approximation with one attempt exclusion following local approximation

Using *MatLaB® Simulink® Stateflow* simulation model is designed and experimentally tested a method, which, unlike the existed methods, allows to explore the water supply network nodes the average down time dependence on the battery life time and the battery replacement time cross - correlations, within the parameters set, when outages in power infrastructure arise. The impact of outages in telecommunication nodes also is taking into account. It has been proven that:

- Water nodes down time shows by a quadratic polynomial described the dependence of the backup battery life time lifetime (BLT) and backup battery replacement time (BRT) cross - correlation in parameters set;
- Although approximations graphs shows that in the explored parameter range polynomial function approaches to a minimum when BLT tends to peak, however, local minimums of the function are revealed, which are associated with a telecommunications network nodes resilience to external power supply interruptions;
- Explored that backup power sources for water supply network nodes is an effective solution, taking into account the reasonable costs, however, it is not sufficient to ensure consistent and reliable data collection, because the physical dependency ratio is 0.77 , but the time scale of physical dependency ratio is 0.67;
- The solutions that ensure consistent and reliable data collection from the water supply network objects can be: backup power source lifetime increasing or / and additional (redundant) network node installation that in this way increase the sensor network robustness.

3. EVALUATION AND INTERPRETATION

The feedback from the students shows very positive results. The student’s satisfaction by the courses was evaluated in 5 points scale: from “1” as “Strongly disagree” by “5” as “Strongly agree”. According to the Fig. 4 more than 68% of the surveyed students put the highest mark to the new courses, moreover the worse mark was not put by the surveyed students. The student organisation testing showed also very similar results.

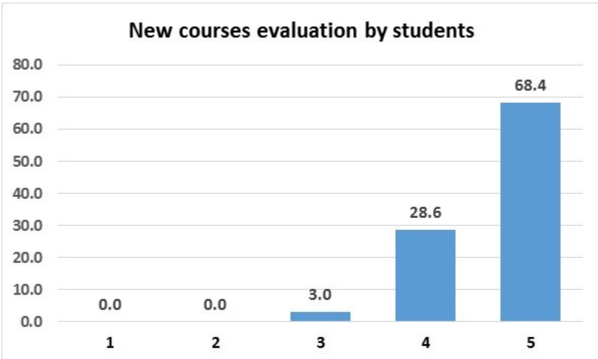

Figure 4: Students satisfaction by new courses evaluated in percent

The feedback from the teaching staff at the time of elaboration of this paper was in the progress, however the available suggestions pointed out the need to focus on laboratory works improvement. Such suggestions should be considered as sound, because the supply of labs equipment for new courses is overlapped in several partner’s universities. However presented results cannot be recognised as final one, because two EU partner’s universities of seven ones did not finish jet processing of the testing results.

We should recognise the testing results very carefully, because rather short time of monitoring of the new courses. The reason is that at the first stage of evaluation the audience could be too optimistic about new courses developed together with academic staff of EU universities. From the other side too high expectations about new courses could make the audience too pessimistic.

3.1. Conclusion related the assumption

Coming back to the assumption made in the beginning of the project that it is possible to develop "master" modules-courses, which could be utilised by EU partners as core courses for development compatible with EU education system programs that will bring EU partners closer we came to important conclusions.

First of all EU partner's universities pursued the target to develop new comparable courses and to implement its legalisation process as much as possible. It is possible now to say with certainty that EU partner's universities will fulfil new courses development by the end of the project (the minimum one, but the maximum 13 courses by one university), however legalisation, e.g. accreditation results, differ very much among the partners. Conditionally EU partner's universities could be divided in three groups depending on the maturity of accreditation results (see Fig. 5).

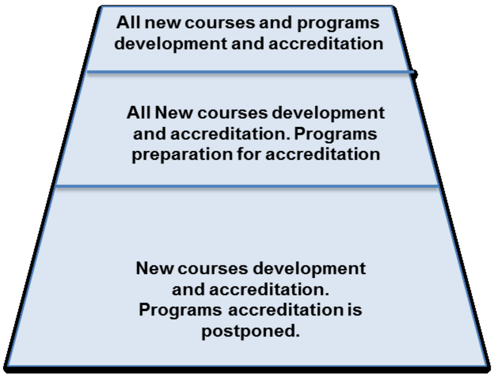

Figure 5: Conditionally EU partner's universities classification depending on the maturity of accreditation results

Only one EU partner's university was able to fulfil accreditation of the training program, named "Electrical and Computing Engineering" in the ministry of Education", so to achieve the highest level, but it happened mostly by the high autonomy status of the university. Three partner's universities provided internal courses accreditation in their universities and now made preparation for courses accreditation as a part of master students training programs. The legislation of their country and the status as private university provided an opportunity to achieve the second level according to our classification. The other tree partner's universities provided internal courses accreditation in their universities, however the further accreditation process is not clear, due to large gap in EU and national legislation related in high education issues.

3.2. Discussions and conclusions

Being aware that the project is still in a progress, thus some of the tasks are not completed yet, however the research authors may come to preliminary conclusions.

1. First of all a real progress is achieved related the main project target – to develop unified curricula and study programs making them compatible with EU standards
2. A permanent project Management team (about 15-20 persons) notably improved its English language skill. The progress could be noted at each Management team meeting.
3. Better mutual understanding and better different cultures awareness was achieved. Different academics terminology, sometime the same designations were used with total different realisation, at the start of the project led to wrong conclusions. The responsiveness, a culture of decision making of the partners, the quality of reporting is improving gradually. The regular Management meetings and quality assurance measures helped to achieve a progress.
4. Different readiness of universities and different legislation of partner's education systems impacts ability EU partner's universities to follow Bologna process. Only one project is not enough to develop study programs compatible with EU standards. The target can be achieved step by step following by notable adjustments in legislation. Mostly it is an issue of Ministry of Education of Belarus.
5. At this project stage one cannot unequivocally say that whether partner's universities resolved the problem of students training programs compatibility. Firstly, only one partner's university of seven participants provided full study program accreditation. Secondly, master student programs envisage two years learning process, therefore new courses testing and elaboration into training programs plus accreditation will require additional efforts beyond this project.

4. THE CASE OF THE UNIVERSITY OF PRISTINA IN KOSOVSKA MITROVICA (UPKM)

Faculty of Technical Sciences (FTS) as the largest educational institution within the University of Pristina in Kosovska Mitrovica (UPKM) was established in 2001 by integration of former Faculty of Electrical Engineering, Faculty of Mechanical Engineering, Faculty of Civil Engineering and Architecture and Faculty of Mining and Technology. Currently FTS operates as a Polytechnic institution with 19 study programmes in three levels of education: undergraduate, master and doctoral studies. More than 160 teachers and assistants provide proper education for more than 1200 students.

With such diversity of study programmes covering broad variety of engineering fields, FTS is struggling to adopt and implement modern curricula based on the needs of local and international labour markets.

In order to implement its vision and goals, FTS invested lot of efforts in preparation of accreditation materials for all study programmes, taking into account experiences of other fellow institutions.
Participation in international projects proved itself as the best way for incorporation of good practices and experiences of foreign universities. Student and staff mobility, workshops and trainings enabled gaining of new knowledge indispensable for creation of new curricula with the aim to make it compatible with EU educational practices.
In this regard, one of the most popular programmes has been Tempus programme of the European Commission. It proved itself as a very useful tool for harmonization of educational practices of EU and partner countries.
With this idea as a guide mark, FTS participated in several EU-financed programmes, one of which was an actual Tempus project "Energy" under coordination of Riga Technical University.
Rather large consortium of EU and partner countries higher educational institutions, this project under the leadership of RTU invested significant human and financial resources in order to harmonize energy efficiency-related study courses in partner countries as much as it is possible with EU ones. This goal should be achieved through sharing of the knowledge and experiences among partners, compilation of course books, provision of laboratory equipment and preparation of laboratory materials. It shown itself as a tricky and complicated task due to the size of the consortium and variety of different national educational legislation and practices.
Project goals set by FTS included the following:

- Development of new modernized curriculum in the area of energy efficiency
- Accreditation of newly introduced courses developed in the course of the project
- Compilation of several course books with the participation of project partners
- Purchase of laboratory equipment
- Installation of equipment and development of laboratory instructions
- Participation of staff and students in workshops, teacher and student trainings
- Testing of results

The main challenges in the case of UPKM included specific political situation in the North of Kosovo, differences between national and EU legislations in the area of public procurement and the level of language skills of students and staff. It influenced the purchase of the project equipment and translation of course books into Serbian language.
FTS introduced and accredited the following new courses:

- Distributed generation
- Grid integration of renewable energy sources
- Energy in general

FTS participated in compilation of the following course books:

- Distribution of power energy
- Wind energy
- Power electronics

FTS staff and students actively participated in events organized within the project framework.
Despites all of problems and obstacles, results of the project are more than satisfactory. The rate of enrolment and testing implemented among staff and student showed significant level of satisfaction with new courses and materials developed within the project framework.
Flexible approach in relation with the development of course books and selection of equipment, enabled participants to adopt what is the most suitable for them and to tailor programmes and courses according to their needs, taking into account different educational and legislative environments, in order to implement project goals in the best possible way.
Bilateral agreements with project partners will enable the future cooperation and joint participation in different projects.
Remaining tasks include completion of laboratory equipment and development of laboratory materials, as well as translation of course books into Serbian language.
The present situation in the labour market as well as future developments will ensure the high rate of employability of graduate students in this study programme. This will have as a consequence significant level of interest of future students to choose this study programme.
All abovementioned will assure long-term sustainability of results achieved during the project. Priceless experiences gained during the project implementation will enable future improvements.
Future challenges and remaining tasks for next projects include development and accreditation of new study programme, accreditation of new study programme in English language, development and introduction of new courses and textbooks, purchase and installation of new equipment.
Completely new study programme which is under accreditation will include the following courses:

- Renewable Energy Power Plants
- Renewable Energy Project Analysis
- Energy Effective Materials
- Effective Lightening
- Power Plant Heat Exchangers
- Solar Photovoltaic Electricity Systems
- Principles of Power Electronic Converters
- Wind Power Generation
- Grid Integration of Renewable Energy Sources
- Distributed Generation
- Master thesis

5. IMPACT AND SUSTAINABILITY OF THE PROJECT RESULTS

The successful collaboration between EU and EU partner's universities encouraged project participants to observe further steps beyond the project and to utilise lessons learned.

5.1. EU partner's countries – Belorussian universities

Striving to reform Belarussian high education system according to the Bologna process, the Ministry of Education of Belarus set the target to reform curricula from the existing system "5 plus 1" to the system "4 plus 2", which should comply with the Bologna system principles, in the area of physical sciences.

However, decreasing a training period from 5 to 4 years for physics and engineering specialists causes a certain risk providing an impact on the labour market. First of all, it is a challenge for research institution and enterprises due to supply of specialists with a qualification different from that of the previous graduates. Before Ministry of Education planned proportion of 5 and 6 year specialists in physics specialities as 90% and 10% that conformed labour market tendencies. By now, 5-years trained specialist qualification meets industry requirements, but specialists with 6-years training cycle were requested mostly by universities and small part of research institutions. However, in EU countries a proportion between professional bachelors and professional masters significantly differs, for example in Baltic countries it is about 70% and 30% (depending on the industry), therefore, the labour market in EU countries is focusing on professional masters graduates in much higher degree than in Belarus, which maintains former Soviet education system.

That is why Belorussian partners came to conclusion to initiate a new project in order to reform curricula in sphere of applied physics. The project will focus on a curricula modernisation in the field of functional nanomaterials production and nanotechnology, including photonics.

Furthermore, a new project aims to deepen and strengthen the curricula reform. Unlike the previous project it should address new training programs for practice-oriented master-level students complying with Bologna system principles and labour market requirements. Based on the acquired experience, the new project would broaden the number of beneficiary-universities, involving industry, professional associations and Ministries representatives working in the sphere of Education of Belarus.

5.2. EU countries – positive experience from cooperation and new ideas

Situation analysis related the status RTU among other |Latvian and neighboring universities revealed the weaknesses and the strength of the university:

- Unfavorable demographic factors cause low competition for bachelor's studies programs.
- RTU is an insufficient number of students graduate, the number of graduates diminishes each year.
- There are a large number of dropouts in the 1-2nd year study.
- RTU devotes too little efforts to develop new study programs (the most recent study program "Intelligent Robotic Systems" accredited in 2013).
- Without additional measures the situation deteriorates: the market segment of RTU is shrinking.
- Fortunately, RTU has competent staff, who are able to develop new programs and directions and to attract new students and to promote RTU's image and to compete with the other Baltic universities.

One of the decisions made before the end of the project is to develop 4 new courses for foreign students in 2015-16, namely: Energy saving technologies, Hydrogen energy, Power electronics, and Effective lighting. Based on the course materials created in cooperation with the project partners RTU elaborated 5 course books in English, which will be used as learning material for planned courses. This is a result of the efforts of the majority of the project partners including all EU partners' universities.

The other decision derived from project results is to develop two new academic programs: a program "Adaptronics" for professional bachelor and master students and a program "Electrical Engineering and Transport Information Systems" also for professional bachelor and master students.

ACKNOWLEDGMENTS

This article was developed to disseminate Tempus project experience. Project title: Development of Training Network for Improving Education in Energy Saving, acronym: ENERGY. Project number: 530379-TEMPUS-1-2012-1-LV-TEMPUS-JP.

REFERENCES

Ferreira J.C., Filipe P., 2009. Academic Ontology to Support the Bologna Mobility Process, 2nd International Conference on Adaptive Science & Technology, 2009. ICAST 2009. Page(s): 308-331

Grigorjevs, J., Ņikiforova, O., 2009. Several Outlines on Model-Driven Approach for Testing of Embedded Systems. Technologies of Computer Control. Vol.38, 2009, pp.96-107.

Haslam M.B., 2010. Teacher Professional Development Evaluation Guide. National Staff Development Council. Maryland State Department of Education. Pages: 1-71.

Kirkpatrick D.L., Kirkpatrick J.D., 2009. Evaluating Training Programs The Fours Levels, Published by Berrett-Koehler Publishers. Pages: 1-373.

Zabašta, A., Casaliccio, E., Kuņicina, N., Ribickis, L., 2014. A numerical model for evaluation power outages impact on water infrastructure services sustainability. Proceeding of EPE 2014 ECCE Europe, Finland, Lappeenranta, 25.-28th August 2014. Lappeenranta, Finland: Lappeenranta University of Technology, 1.-10 pp.

Zabasta A., Kunicina N., Zhiravecka A., Patlins A., Ribickis L., 2013. Establishing Regional Competence Centre for Life Long Learning in Electrical Engineering. 21st Mediterranean Conference on Control & Automation (MED) Platanias-Chania, Crete, Greece, June 25-28, 2013. Pages: 578-583.

Zabasta A., Nikiforova O., Kunicina N., 2012. Application of UML for Risk Based Interdependencies Modelling in Critical Infrastructures, The 6th International Conference on Integrated Modelling and Analysis in Applied Control and Automation" IMAACA 2012 - DHSS 2012 workshop, pp.1-6. Proceedings of the International Defense and Homeland Security Simulation Workshop.

AUTHORS BIOGRAPHY

Anatolijs Zabasta, Dr. Sc. ing. He is working at RTU as a senior researcher. The fields of scientific interests are electrical engineering, embedded systems, critical infrastructure. He is a project manager of Tempus 2012 V call project Development of Training Network for Improving Education in Energy Saving. He is a researcher in EU projects: FP7 ARTEMIS, INTERREG, COST Actions and in Latvian State Research project "The next generation of information and communication technologies (NexIT) project.
Contacts: +371-29232872, anatolijs.zabasta@rtu.lv

Nadezhda Kunicina, Dr. Sc. ing. Professor, is working in RTU from 2005. The fields of scientific interests are electrical engineering, embedded systems, sustainable transport systems. The research interest is related to the improvement of electric energy effectiveness in industrial electronics and electric transport. She is an author and coordinator of Tempus 2012 V call project Development of Training Network for Improving Education in Energy Saving. She is a project manager of RTU team "The next generation of information and communication technologies (NexIT) project, a scientific project manager of FP7 – ARTEMIS – 2012 call Arrowhead project.
Contacts: +371-67089052, nadezda.kunicina@rtu.lv

Nebojsa Arsic, Dr. Sc. ing. Full Professor and Dean of the Faculty of Technical Sciences in Kosovska Mitrovica, Serbia. His main fields of interest interests include high voltage measurements, renewable energy sources and energy efficiency. He is an author and coauthor of number of university books and scientific and professional papers published in international and national journals and conferences. He also participates in several national and international projects.
Contacts: Nebojsa.arsic@pr.ac.rs

Oskars Krievs, Dr. Sc. ing. Professor. He has been working in RTU since 2001. He is a Dean of the Faculty of Power and Electrical Engineering (FPEE). The fields of scientific interests are electrical engineering, embedded systems, DC/DC Converters, Fuel Cell Applications, and Frequency Selective Control of a Parallel Active Filter with Resonance Filter Regulators etc. O. Krievs is an author more than 42 scientific publication and monographies.
Contacts: +371 67089919, Oskars.krievs@rtu.lv

Leonids Ribickis, Professor, Dr. habil. sc. ing. Professor of Power and Electrical Engineering, Academician of the Latvian Academy of Sciences Member of EU Universities of Small States Association. He is a head of the Riga Technical University Institute of Industrial Electronics and Electrical Engineering and Head of the Department of Industrial Electronics and Electrical Technologies. He is a scientific project manager of Tempus 2012 V call project Development of Training Network for Improving Education in Energy Saving. He is a head of undergraduate, master and PhD study program Computer control of electrical technologies
Contacts: +371-67089300, Leonids.Ribickis@rtu.lv