PROCON
A Tool for Curricula Accreditation

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Abstract: Compliance with the set requirements is controlled by curricula accreditation. Though curricula is managed and prepared to meet the accreditation requirements, problems with control over accreditation requirements and demonstrating the performers of accreditation compliance to those are quite common. This article describes a system developed by the author – PROCON, which provides control over curricula content, study result and other curricula indicators for accreditation purposes by utilizing a compliance matrix.

1 INTRODUCTION

The role of curricula accreditation varies throughout the world. There are countries with mandatory curricula accreditation and countries where accreditation is optional and higher education institutions may chose their way. There are areas where the role of State accreditation becomes less important while the role of international accreditation increases, for instance, information and communication technologies (ICT). International accreditation is required to be able to compare curricula in different countries and even different regions, and considering the student mobility tendencies as well. Such allegation is supported by the fact that various accreditation organizations strive to harmonize the accreditation criteria, and had signed the Seoul Accord (Reif and Mathieu, 2009).

The higher education institutions must use their efforts to analyze curricula content and demonstrate its compliance with requirements of the industry. For instance, in ICT field, compliance of curricula with ACM Computing Curricula (ACM CC, 2006) or SWEBOK (2004) is assessed.

The achieved learning outcomes are analyzed during curricula accreditation, too. The issues of learning outcome analysis and meeting the ABET accreditation requirements have been analyzed by Booth (2006) and Booth, Preston and Qu (2007). The issues of learning outcomes control have been researched by Abunawass, Lloyd and Rudolph (2004).

This article describes research made by the author on control of accreditation requirements by analyzing curricula content from concept classification standpoint and analyzing correspondence of learning outcomes achieved to accreditation requirements by developing requirement matrix. The article describes a tool developed by the author, PROCON, which includes the above three activities for curricula analysis and practical application of which is planned for 2011 during reaccreditation of ICT curricula according to state requirements as well as during curricula accreditation for EQANIE label.

2 ACCREDITATION REQUIREMENTS

The importance of accreditation is different in different countries and regions. When curricula accreditation is mandatory, it is seen as measure of curricula quality, a quality threshold, a tool for attracting the best students, an assistant to students for choosing quality curricula, an assistant to employers for choosing next employees (Reif and Mathieu, 2009).

Parallel to state mandatory curricula accreditation the higher education institutions may opt to accredit the curricula according to various accreditation systems popular throughout the world to assess the quality of such curricula as well as raise its prestige. To achieve this, it is necessary to meet

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the different accreditation requirements. For instance, it is possible to accredit ICT curricula according to requirements of EQANIE, ABET.

2.1 EQANIE Accreditation Requirements

European Quality Assurance Network for Informatics Education (EQANIE) organization was established in Europe some years ago. One of the aims of this organization is to develop a unified standard and accreditation requirements for informatics program accreditation (EQANIE, 2009). Accreditation requirements include separate listing of learning outcomes for First and Second Cycle degree programs as well as guidelines for program assessment.

Curricula assessment guidelines include program educational objectives, academic and support stuff, facilities, financial resources, agreements with industry, management system. During preparing curricula to accreditation for EQANIE label it is necessary to ensure both analysis of learning outcomes in the program and get ready for inspection of assessment criteria.

2.2 ABET Accreditation Requirements

Curricula accreditation is optional in United States of America. Applied Science, Computing, Engineering and Technology curricula use Accreditation Board for Engineering and Technology (ABET) curricula accreditation in their battle for students, and to demonstrate the quality of programs. ABET accreditation requirements involve the following subjects: Objectives and Assessment; Student Support; Faculty Curriculum; Laboratories and Computing Facilities; Institutional Support and Financial Resources; Institutional Facilities (ABET, 2009).

ABET requires that program objectives must be measurable. That is, for any objective written for a program, there must exist some practical way to examine whether it is achieved over the graduates of the program. (ABET, 2004)

ABET requirements may be divided into three groups:

- General requirements.
- Requirements for learning outcomes.
- Requirements for topics reviewed within the curricula.

3 REQUIREMENTS FOR CURRICULA CONTENT

The experts, during curricula accreditation, are controlling the extent to which the curricula follow the requirements of the industry. Such requirements may vary between the industries. In ICT industry, significant role is played by requirements for IT curricula content summarized by leading organizations of the industry – ACM, AIS and IEEE-CS, the ACM Computing Curricula (ACM CC, 2006). Particular disciplines may have their own requirements developed, for instance, the Guide to the Software Engineering Body of Knowledge (SWEBOK) developed by IEEE-CS discusses one particular ICT discipline – software engineering.

In due course of developing and managing the curricula content, attention should be paid to the extent to which the curricula meets the requirements of external curricula content. At the moment of curricula accreditation the experts may aim at examination of review of particular topics within the curricula.

3.1 ACM Computing Curricula Requirements

As there is a very large number of IT curricula around, it is important to understand the IT specifics and its relation to study directions. Thus, the Computing Curricula proposed by ICT industry organizations ACM, AIS and IEEE-CS summarizes the information on advisable curricula content in directions of Computer Engineering, Computer Science, Information Systems, Information Technology and Software Engineering (ACM CC, 2006).

Computing Curricula describes the computing topics to be reviewed within five kinds of degree programs by indicating minimum and maximum review volume for each topic. Non-computing topics are described in a similar way. A sample of topic listing is provided further in Table 1.

Degree outcomes are another thing described in Computing Curricula. The report lists approximately 60 various performance capabilities and sets an expectation indicator for each of them (values from no expectation to the highest relative expectation). Sample of such requirements is provided in Table 2.

When curricula content is controlled, it is necessary to identify the extent to which the curri cula content meets the ACM CC computing topics and performance capabilities.

Table 1: Comparative weight of computing topics across the five kinds of degree programs (ACM CC, 2006).

Knowledge area	CE		CS		IS		IT		SE	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Programming Fundamentals	4	4	4	5	2	4	2	4	5	5
Integrative Programming	0	2	1	3	2	4	3	5	1	3
Algorithms and Complexity	2	4	4	5	1	2	1	2	3	4
Computer Architecture and Organization	5	5	2	4	1	2	1	2	2	4
… … …										

Table 2: Relative performance capabilities of computing graduates by discipline (ACM CC, 2006).

Area	Performance capability	CE	CS	IS	IT	SE
Algorithms	Prove theoretical results	3	5	1	0	3
	Develop solutions to programming problems	3	5	1	1	3
	Develop proof-of-concept programs	3	5	3	1	3
	Determine if faster solutions possible	3	5	1	1	3
Application programs	Design a word processor program	3	4	1	0	4
	… … …					

3.2 SWEBOK Requirements

Individual disciplines may have their own standards or guidelines developed. Thus, for instance, there is a guidebook developed for Software Engineering which is one of the IT disciplines, describing the boundaries of Software Engineering discipline – Guide to the Software Engineering Body of Knowledge. (SWEBOK, 2004) The Body of Knowledge is subdivided into ten software engineering Knowledge Areas: Requirements, Design, Construction, Testing, Maintenance, Configuration Management, Engineering Management, Engineering Process, Engineering Tools and Methods, Quality. Each of the areas is detailed further, even reaching the fourth detailing level in some areas.

When correspondence of curricula content to requirements of the industry is demonstrated during curricula accreditation, it is necessary to demonstrate the correspondence of curricula content to requirements of SWEBOK.

4 PROCON

A relevant tool of support is needed to ensure control over accreditation requirements discussed in previous paragraphs above as well as to provide control over curricula content. Performance of control activities is much easier by using such support tool, thus ensuring obtaining the results of curricula analysis quicker. The PROCON tool developed by the author is described in this chapter.

The tool is intended to be used both in everyday work and during curricula accreditation. This tool provides for input of curricula information, input of various accreditation requirements for analysis of curricula content, learning outcomes and other curricula indicators, analyzing functions for control over meeting the accreditation requirements.

4.1 Requirements for Curricula Content

Analysis of curricula content is important for curricula analysis as well as for comparing various curricula. Research performed by DeLorenzo, Kohun and Wood (2006) revealed that not all of IS2002 study courses were included in US TOP 19 IT curricula, as well as different study courses not mentioned in IS2002 were present. During curricula accreditation, the experts need to obtain confirmation that curricula cover particular concepts.

In PROCON tool, the analysis of curricula content requirements is granted by utilizing the concept classification described in research of Dosbergs and Borzovs (2010). Concept classification helps to 1) describe the concepts of the respective science field, 2) identify the topics covered by curricula study courses, 3) list the external curricula content requirements, for instance, ACM Computing Curricula computing topics, SWEBOK topics or requirements for curricula content analysis brought forward by accreditation commission experts.

Figures 1 and 2 present a screenshots of the PROCON tool, showing an example of control of

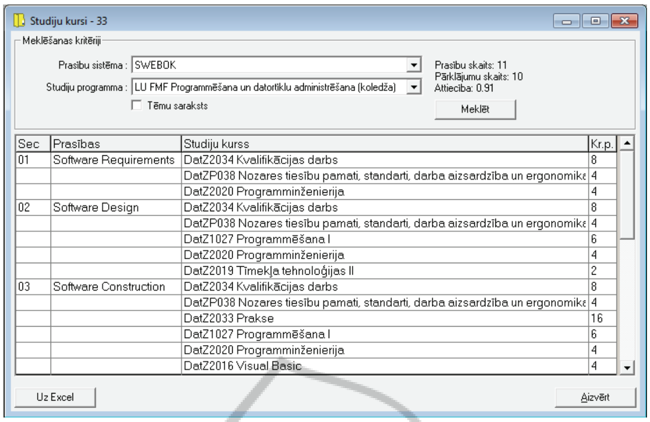

Figure 1: SWEBOK knowledge areas covered by study courses.

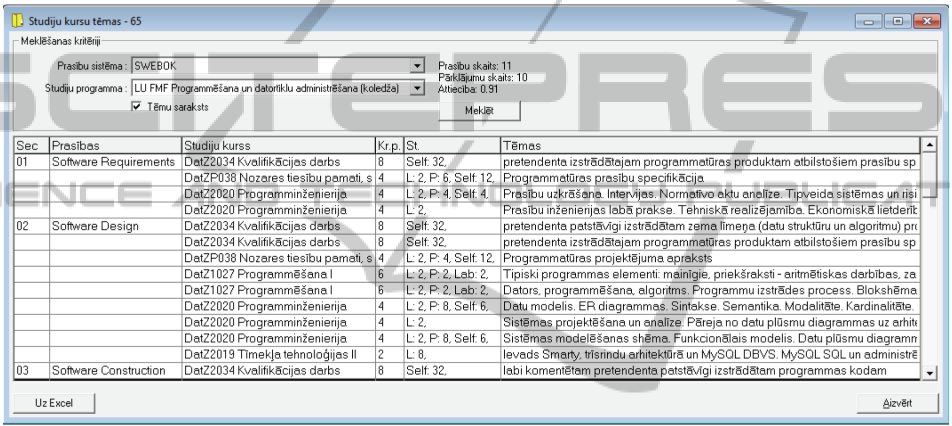

Figure 2: SWEBOK knowledge areas covered by topics of study courses.

requirements for curricula content: figure 1 illustrates report at the study course level, figure 2 – at the level of the study course topics. In the left two columns SWEBOK knowledge areas are included. In the 3rd and 4th column are included appropriate study course code, name and amount of credit points of evaluated study program. The last two columns in figure 2 show study course topics description and amount of contact and individual work hours planed for each topic.

4.2 Requirements for Curricula Learning Outcomes

Accreditation requirements demand achieving particular learning outcomes in study courses. It is necessary to demonstrate those during accreditation. Indication of what results demanded by accreditation requirements are achieved within each study course is needed for such demonstration. This kind of approach, with compliance matrix, is used also by Yao, Liu, Grubb and Williams (2007) to describe correspondence between study course learning outcomes, program objectives, CC2001 standards and CAC ABET criteria.

Requirements for achieving learning outcomes are imposed by EQANIE also, requiring indication of how program outcomes are met within curricula and how the Relative performance capabilities of computing graduates by discipline described in ACM Computing Curricula are imposed.

For the sake of ensuring compliance with accreditation requirements, PROCON provides for listing the curricula study courses with a possibility to indicate learning outcomes to achieve for each study course. It is possible to define various accreditation requirements with respect to learning outcomes within the tool and connect the outcomes to be achieved by study courses to accreditation requirements towards learning outcomes. Also, it is possible to generate reports on how accreditation requirements are met by the audited curricula to perform the accreditation requirement control, or on the contrary, assist the curricula responsible ones in preparations for the audits by reviewing study courses that do not achieve the accreditation requirements.

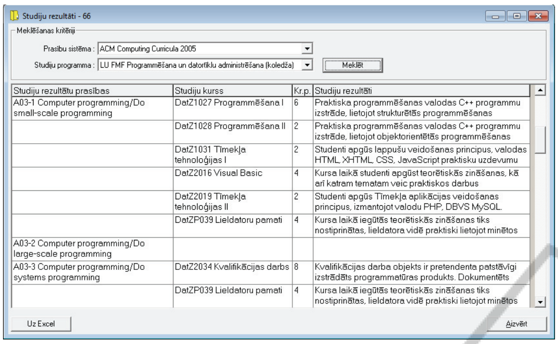

Figure 3: Control of learning outcomes in the PROCON tool.

Figure 3 presents a screenshot of the PROCON tool, showing an example of curricula learning outcome control. In the left column are included ACM Computing Curricula requirements for curricula learning outcomes. In the 2nd and 3th column are included appropriate study course code, name and amount of credit points of evaluated study program. The last column shows study course learning outcomes of evaluated study program.

4.3 General Requirements

PROCON is intended not only for analysis of curricula content and learning outcomes, but also for accumulation and processing of general curricula information that is required for curricula control and accreditation purposes. The tool allows accumulating different types of information in a universal data structure and ensures processing of these data and their connection to external requirements. The tool provides the option of generating various voluntary reports from curricula data accumulated by the system as well, for instance, professor number ratio, number of students to one professor ratio, number of students to one lecturer ratio.

Universal data structure used for the tool provides the option of defining new values to be accumulated within the tool and indicate the data type for such values. The tool allows accumulating data with number, text, date and similar values as well as employing classification or data selection SQL request values definable within the tool. The data selection SQL values provide for broader opportunities to apply the tool because the user familiar with data structure of the tool may generate various reports on accumulated data without changing the tool functionality.

4.4 Technical Implementation

This chapter describes the part of PROCON technical implementation related to curricula content, learning outcome and curricula information control discussed in this article. Data structure is illustrated in Figure 4. Implemented curriculum architecture corresponds to a simplified model where the course has several topics attached (Study_Course_Topic), but each topic has a knowledge unit attached, to be discussed within the topic (Study_Course_Topic_Concept).

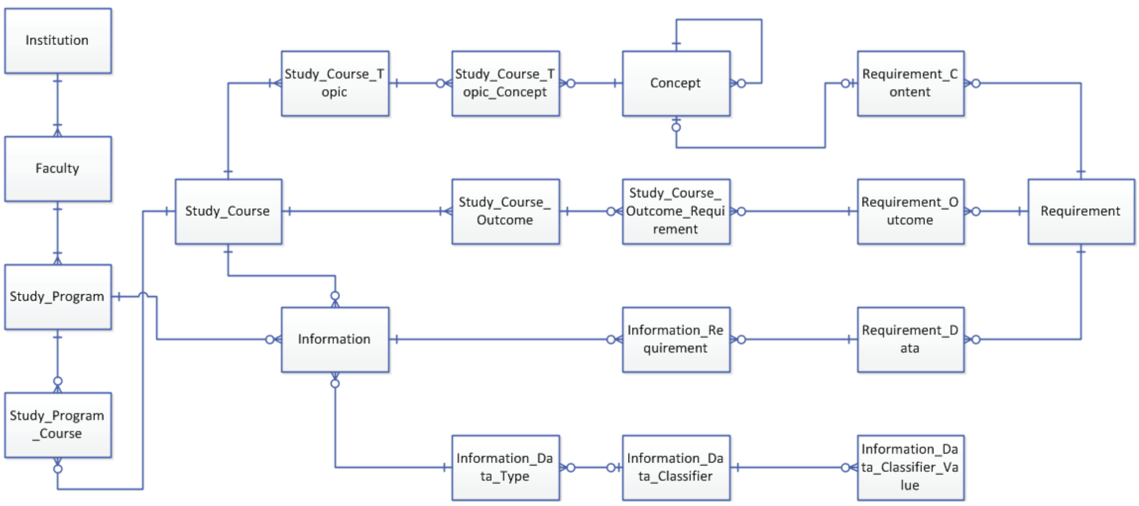

Figure 4: Data structure of PROCON tool.

Several learning outcomes have been adjusted to the course (Study_Course_Outcome). Recording of voluntary information (Information) on a curricula or particular study course is possible also.

Universal data structure of information accumulation is developed in a way that various curricula or study course data types are defined (Information_Data_Type), it is possible to define voluntary classifiers applicable within the tool (Information_Data_Classifier) and fill in these classifiers with classifier values (Information_Data_Classifier_Value).

The tool provides for listing of various accreditation requirements and connection to curricula indicators. Accreditation requirements are defined (Requirement) and accreditation content requirements (Requirement_Content), accreditation requirements towards achievement of learning outcomes (Requirement_Outcome) and accreditation requirements for revealing information on curricula or study course (Requirement_Data) are listed.

Compliance with accreditation requirements within particular curricula is ensured by filling in adequacies between curricula study course learning outcomes and accreditation requirements for learning outcomes to be achieved (Study_Course_Outcome_Requirement) and filling in correspondence of curricula information to accreditation requirements (Information_Requirement).

5 FUTURE WORK

Continuation of research foresees practical application of the developed PROCON tool in state accreditation and EQANIE accreditation for IT curricula.

6 CONCLUSIONS

Maintaining curricula information for accreditation requirement purposes is a time consuming process. It is not always possible to simply obtain acknowledgements required for accreditation from curricula data. Gathering of such data sometimes requires analysis of curricula information. The situation in curricula content analysis is made complicated by the fact that it is possible to accredit the curricula according to requirements of various external accreditation systems.

The article describes a tool developed by the author, PROCON, that is intended for accumulating and analysis of curricula information during preparation of curricula to various accreditations as well as for supporting the curricula responsible ones during accreditation. The tool supports control over curricula content requirements, learning outcome control and listing and control of curricula information indicators.

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