

Evaluation and improvement of the credit transfer models in the student exchange process

Student
exchange
process

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Abstract

Purpose – Increasing flexibility and student mobility are among the most important objectives of today's universities. The purpose of this paper is to discuss the effects of student exchange process (SEP) on a campus management system (CMS), compare different models and recommend an improvement handling transfer process.

Design/methodology/approach – A comprehensive literature review of how credit transfer is handled in today's CMS was conducted to understand the information management methods used in the student transfer process. On this basis, a flexible task-based system design is recommended to facilitate the transfer of educational gains between universities. For evaluating the effectiveness of different system designs in the SEP, the duration of information processing process steps was measured quantitatively via on-site observations and user interview in a university's horizontal, vertical and the Erasmus student exchange (SE) data.

Findings – Building a flexible system design based on a loosely coupled mapping between curriculum and educational activities, and increasing the self-management capabilities of a student will facilitate managing SE data in an integrated environment and reduce the university staff's workload considerably.

Originality/value – To the author's knowledge, this is the first study making quantitatively measurement and comparison of different credit transfer methods of CMSs. Based on this result, the authors have recommended a new flexible method that supports increasing a student's self-administration capabilities, reducing the workload of university staff, and contributes academic mobility.

Keywords Campus management system, Credit transfer, Student exchange process

Paper type Research paper

1. Introduction

The success of educational services provided to students and the degree of satisfaction of students significantly depend on the success of software programs, which is called CMS or student management system (SMS) as the umbrella terms used to build educational information systems. The CMS advances both the efficiency and effectiveness of the entire study organization by improving the quality of teaching and learning (Alt and Auth, 2010). It is claimed that medium-sized and large universities are no longer able to handle the complexity of module combinations and the registrations or the calculations of credit points without any support of database application systems (Schilbach and Schönbrunn, 2009).

In recent years, student mobility became one of the most important drivers supporting higher education. It creates requirements of the transfer of the course and credit information of students between universities. The inability to transfer academic credit is an academic barrier to mobility. Even if credit transfer can often be tried, centrally encouraged and standardized, it is still very much a localized and *ad hoc* process, and credit transfer agreements are very specific: university to university, college to college and even course to course (Junor and Usher, 2008).

The credit transfer is mentioned rarely in the literature and is almost subsumed by the term, recognition of prior learning (RPL) (Bateman and Knight, 2001). The RPL assessment process includes some barriers, such as cost-intensive and time-consuming (Mulder, 2016), places considerable demands on the academic staff and requires additional resources (Council of Europe, 2008). If there is no standard credit transfer agreement including course-by-course



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mapping between the home and host university, both the RPL and credit transfer require detailed examining of the certificates and diplomas to map between curriculums. Because of a lack of standard agreements, we have accepted that these processes include similar operations.

The effect of student exchange (SE) on university information systems was investigated in the literature, including the transfer methodologies of educational information, the security of exchange network, defining a standard format for communication of information and managing an online database of agreements (Strack and Karich, 2007; Warfvinge, 2008), implementing identity management for mobility (Alves and Uhomoihi, 2014), correct and objective grades transfer from one grading scale to others (Lieponiene, 2011), and the student enrolment (Walasek, 2007). In this work, our focus is on the information transfer process and its effects on the home university's CMS. We have made an assessment based on the duration of the students and the university staff's activities. We have accepted all employees under the title of university staff.

We organize the rest of the paper as follows: Section 2 discusses the problem statement and gives information about the current methodologies and additional requirements of the SE process in CMSs. We compared different methodologies used to transfer and manage the course and grade information from outside. Section 3 introduces the proposed method and presents the advantages of the new approach, and also discusses the research method followed. Section 4 presents the quantitative and statistical results obtained using different methodologies and highlights the advantages of the proposed method. Section 5 reviews the conclusions of the proposed research and future works.

2. Modeling SE in CMS

Student mobility significantly affects both today's CMSs' data and information processing models in many aspects. This paper focuses on the student learning activity and credit transfer part of CMS. First, the basic capabilities of CMSs were reviewed and then, research portfolio has enlarged to the SE capabilities. We have researched vendors' solutions which support high market-share and wide functionality. The vendors' solutions include Oracle® (Oracle, 2013), SAP® (SAP AG., 2003), Campus Management® (Campus Management, 2018), Workday® (Zastrocky, 2012), Unit4® (Unit4, 2018), Jenzabar® (Jenzabar, 2018), Ellucian® (Ellucian, 2018) and ComSpec International® (Empowersis, 2018) using the Market Research Report of Gartner (Terri-Lynn and Thayer, 2016). Besides, our research includes non-profit community solutions supporting CMS integration such as Information System link network (University of Duisburg-Essen, 2018). Our main goal is to explain the current SE methods in CMSs and we do not want to endorse or criticize any vendor.

2.1 The basic structure of CMS

A CMS is considered one of the most important information systems that provide support to manage educational activities. It provides capabilities for creating complex course descriptions, establishing curriculum, assigning courses to students, grading the performance of a student and preparing a transcript of a student (Wu *et al.*, 2005), (Yakovlev and Anderson, 2001). A curriculum is a program of courses approved for a specific degree or certificate and represents a framework to meet institutional goals and missions. It is claimed that the success of any institution depends highly on the quality of its program curriculum (Hamam and Loucif, 2009). Curriculum design also plays a critical and central role in the structure of the CMS. A student is assigned to a curriculum just after his/her beginning of university and takes the responsibility to successfully complete it.

In the classical CMS system structure, the descriptions of the class, the course and the curriculum are mapped to each other strictly and one to one, as shown in Figure 1 (Zhang *et al.*, 2010; Williams, 2016). The CMS allows an instructor to create a grading object-based

on the curriculum for course-related assessments. Then the student assessment results are evaluated and entered in the CMS by the instructor. The assessments include the descriptions of the examinations, seminars, projects, practical work, self-study, the date of activities, the percentage, etc. The instructor gives a final mark and corresponding grade for each student in the course (Ong and Shepherd, 2002). In this study, for simplicity, we have intentionally ignored the effect of a student's registration on more than one curriculum.

2.2 The background processes of the SE in Europa

The infrastructure and the information structure of student exchange process (SEP) in Europa are developed and supported by two complementary processes: Bologna process (BP) and Erasmus student network (ESN). The ESN aims to work for the creation of a more mobile and flexible education environment by supporting and developing the SE from different levels (ESN, 2016). The BP aims to implement a shared course credit system for all of the universities which accept to meet Bologna criteria (CDE, 1999). Some of the main objectives of the BP have been described as follows (Europa.eu, 2015b):

- (1) A system of academic degrees that is easy to recognize and compare, including a shared diploma supplement (DS) to improve transparency.
- (2) The adoption of a common framework of readable and comparable degrees also depends on the DS.
- (3) A system of accumulation and transfer of credits of the European Credit Transfer and Accumulation System (ECTS). It allows for the transfer of learning experiences between different institutions and aids curriculum design and quality assurance.

The steps of the SEP are the following (Strack and Karich, 2007):

- (1) Modularization of study programs: preparing a credit point system compatible with ECTS, specifying for each module of the study program and the specific workload of the student.
- (2) Supporting ECTS: specifying the extent of the workload of the student, which is required to study the respective module successfully in examination certificates. Describing how the examination grade of the student can be classified relatively within his class – independent from the national grading system.

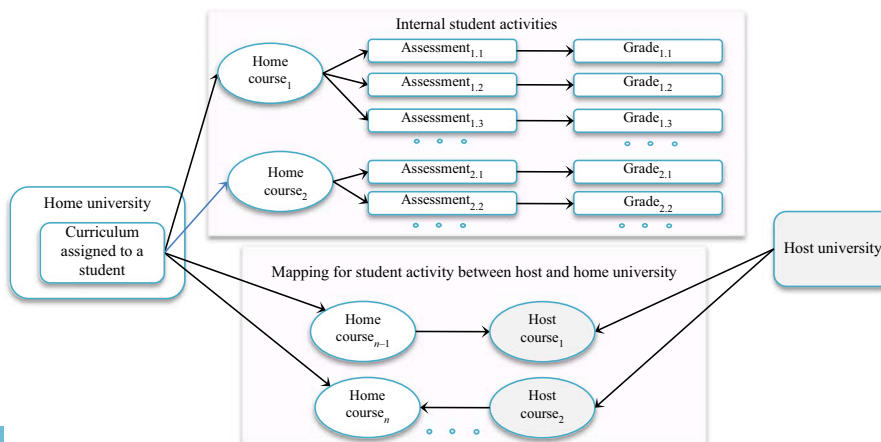


Figure 1.
Course evaluation
model in the CMS

- (3) Acceptance of examination results of study programs in the host university: a DS is given to the students an improved international acceptance of their achievements in exams and study programs during abroad studies.

2.3 Information flow between universities

The first step of the SE process is to build a general exchange contract between universities. Then, the home and host universities sign a student-specific exchange contract. The student submits the courses that he wants to take from a host university for pre-approval. After the end of the education period in the host university, the student gets a transcript or DS, which includes all of his/her the educational information. The DS accompanies a higher education diploma, providing a standardized description of nature, level, context, content, and status of the studies completed by its holder (European Commission, 2013). Also, the DS addresses the additional information requirements in the BP. The information in the DS is as follows (Europa.eu, 2015a):

- the data of university including university name, web address, contact person, etc.;
- the general structure of the national education system;
- dates, enrollment date, graduation date, etc.;
- student identification information: name, surname, birth date, etc.;
- main fields of study for the qualification, the course code, description, and content;
- the course learning outcomes;
- mapping of the learning outcomes of the courses to program outcome;
- grade system including exam types, ratio, homework;
- student achievement including the grades and earned ECTS credits; and
- the signatures of the host universities authorities.

The most suitable information exchange environment uses an electronic form. There were studies about the definition of electronic form standards (Strack and Karich, 2007) and the credit transformations (Warfvinge, 2008). Another research recommended the use of home university campus cards to access facilities at host institutions (Piotr and Andrzej, 2015). It requires changing the student connectivity module (SCM) of CMS to implement SCM-to-SCM integration, sharing a student card's unique identifier between universities, authentication based on certificate authorities, and all the students' personal data are stored and processed in their home universities. However, the integration of SCM module causes lots of change in the CMS structure, requires international standards and depends on difficult-to-implement agreements between universities.

Different from previous research, this study focuses on the effect of changes in the information storing and processing methods in the home university CMS caused by transferring educational information from the host university. In all exchange types such as Bologna, horizontal or vertical student transfer, the student educational activities, which are created in the host university, should be mapped to the home university curriculum. The main question is to build and store the student's activity map, as well as minimizing the changes to the infrastructure of the home university's CMS.

2.4 Additional requirements arising from SEP

The essential features of a modern system of study, which make it attractive for prospective students, are flexibility and adaptability. Flexibility means, in this case, that each student has a lot of freedom in the design of his/her education path (Krasniewski and Woznicki,

1998). As a software application in the education area, a CMS also needs to be more flexible and the integration capabilities should be increased. The integration with other systems requires numerous modifications of the application programs itself (Bolchini *et al.*, 2013). Traditional CMSs have a lot of facilities when a student takes all of the courses in his/her universities. However, if a student goes abroad and brings in educational gains from the other universities, the classical CMSs have a lot of drawbacks. The main reason behind these drawbacks is that the course description and the curriculum tight coupled, as a student should complete the courses previously defined in the university curriculum to complete the graduation requirements. The requirements can be summarized as follows:

- (1) Storing the new information: the course descriptions of the host university and the student's grades should be stored in the CMS of the home university.
- (2) Mapping the information: the data structure of the home and the host university may be different, such as in their course name and the learning outcome descriptions. Besides, a course in the home university curriculum can be mapped more than one course in the host universities.
- (3) Deciding who will be responsible for mapping the exchange data: in the classical approach, all of the student educational activities are inserted by university staff. When a student has done educational activities at the host, the university staff's role should be reinvestigated.

The other requirement in the mapping process of the courses is the changes of the enrolled course after the exchange process begins (Bijnens and Petegem, 2008). Many students are unable to follow the courses selected prior to their departure: courses simply do not exist any longer; courses appear to be only available in the local language; and it is not possible to attend courses because of overlapping timetables, inadequate or outdated information about courses on university websites. Therefore, the remapping of the courses is often necessary.

2.5 Current methodologies for information exchange

There exist many solutions to transfer and map the educational activities between home and host universities as follows:

- (1) General mapping standards: there are state-wide co-operative agreements between institutions. However, these transfer arrangements are laborious and often formulated on a course-by-course, department-to-department or institution-to-institution basis (Junor and Usher, 2008). Another answer to the mapping problem could be a kind of cross-repository of available courses. General higher education information portals try to support SE with providing the mapping tables. For example, the IS:link is a network of renowned information systems schools at universities from all around the world (University of Duisburg-Essen, 2018). The network's primary purpose is to promote international SE in information systems by establishing a university network, process improvement, standardization, and guaranteed credit acknowledgment. At the same time, the IS:link concept promises to significantly reduce the administrative effort and costs associated with SE programs at universities. However, just 15 universities are registered to the IS:link system in Europa and 3 universities in North America by January 2016. This number is too small compared to the number of universities in the world as 47 countries and more than 4,000 higher education institutions registered to ESN.
- (2) Agreement between universities: the two universities can sign a general SE contract and accept the equality of their specific department's education programs. Rarely,

the agreement includes the course-by-course mapping and provides students with insights into how they can choose courses from the host university.

- (3) Students enter course mapping for pre-evaluation: some CMS system supports a student suggests a specific course mapping for his/her external education activities. The students create an individual map, making a comparison between learning outcomes and ECTS of the courses in the home and host university. Then this mapping is evaluated by the faculty staff. Besides, in some CMSs, course definitions can be gathered in a pool for utilizing in the future SEP.
- (4) Paper-based student-specific maps: there are many CMSs which do not have a direct mapping solution. It can be called the worst case because academic staffs should handle all processes manually and their workload increases significantly.

The first two approaches can be called top-down because they need to map every course before they have been taken by students. However, building a map between all courses of universities at once generally required excessive work and not preferred. Besides, keeping the course map synchronized against changes in the curriculums is also difficult. The third approach that can be called bottom-up is the most preferred solution by the universities. In this approach, a university incrementally builds a mapping pool by using course transfer information of each student. There is no need to keep two university curriculum synchronized.

According to product documentation, a few CMS system including SAP CM supports exchange contract and course-by-course mapping (SAP AG, 2003). The equivalency determination features of SAP CM support transfer agreements with other higher education institutions. Once defined, the application will assess the student's external achievements and suggest internal equivalencies, transfer credits and grades. Besides, some CMS systems including Oracle (2013) provide an integrated self-service option for the students to enter their external courses for transfer modeling with administrative access to review, capture and evaluate those same courses. The university staff evaluates and approves the information that the student has entered into the system about host university activities. There are lots of in-house developed solutions to support this functionality also (ASU, 2016; Franklin University, 2016). The current student-specific pre-map solutions prove that students can build their own course map from scratch by handling risks such as every student might not be able to prepare the course map without any support. As an example, Franklin University points to a 13 percent increase in new undergraduate student enrollment specifically tied to their pre-map system (Schaffhauser, 2015).

In the CMS system supporting the students enter course mapping for pre-evaluation, international coursework can be evaluated as long as the courses show on an official paper transcript that has been processed by international admissions. Once transcripts have been processed, courses should be submitted for evaluation (ASU, 2016). The student's entrances reflect an unofficial evaluation of transfer credits, transfer value, and completion date, and it may differ from the official evaluation which will be completed via official transcripts. Some systems may have additional restrictions about the evaluation process,' for example, international courses cannot be submitted for pre-evaluation in some CMS (ASU, 2016). Even in the CMSs which support creating course mapping by the student are just able to support a one-by-one relation, as shown in Figure 1. It remains unclear how one-to-many course relations handle in the home university.

Moreover, the information exchange causes changes in the internal information processing methodologies of the CMS. In the paper-based student-specific maps approach, university staffs enter the student's course grade into the CMS as shown in Figure 2 and it increases the workload of the university staff considerably. Even in the systems supporting the students' entrance of their external courses for transfer modeling, this information is used for preliminary evaluation and the university staff needs paper processing to enter

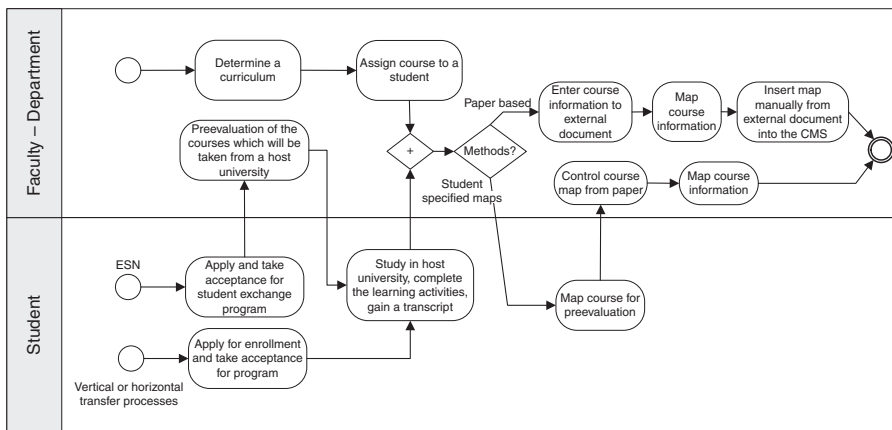


Figure 2. Information flow between universities in the CMS

final grades at the control course map from the paper step. Additional control is required to check whether the student’s course records in the paper and electronic environment are the same, and it limits time-saving for the university staff.

The new methodologies are required to manage the data of SEP and to decrease the workload of the university staff.

3. Method

We have analyzed several international and two commercial CMS used in Turkey’s nearly 30 universities to build the model of SEP in CMS. The analyzing process has been conducted on using product documentation, on-site measurements, CMS user interfaces, manuals, the data structures in the relational database, and interviews with students and university staffs (Zhang *et al.*, 2010; Williams, 2016).

3.1 Process improvements

The main idea of this paper is that SEP needs a loosely coupled mapping between students’ education gains and the curriculum of the home university. This idea is based on the importance of interoperability between information systems. Interoperability is the ability of two or more systems or components to exchange data and use information (IEEE, 1990). It equates to loosely-coupled enterprise integration which supplies that component of the system continue to work on their own or as components of the integrated systems (Nof, 2009). Also, we recommended to increase the self-administration capabilities of the student as master data maintenance, status display, progress checks increase efficiency due to manual processing and repetitive tasks in the exchange process (Sprenger *et al.*, 2010).

In the proposed method, the course definitions in the curriculum are considered as a task of a student should achieve. All of the educational studies are traced related to this task. The course grade of the host university is mapped to the student’s task in order to complete the home university’s curriculum as shown in Figure 3. A student can enter more than one activity to complete the task. So, the proposed system can handle the one-to-many course relationship. In this way, a student can enter different activities including open university course records and the business experience into the CMS; so, the recommended method helps to bring business experience to the university. However, it requires a different evaluation process and excluded from our research.

In a classical CMS, the course mapping activity generally restricted at the beginning or the end of the transfer process. However, the loose coupling allows integrating transfer

functions into the system wherever it is required and increases flexibility. Besides, we have recommended that a student should enter all courses in the host transcript to with the same order instead of just entering the mapped course. It makes easy to add the missing course to the CMS and the control course map from paper (with order) step's duration decreases.

3.2 Information storage improvement

Creating a new additional layer to separate partially the student's course records from the home university curriculum supports to store and to manage all of the information about student's educational work at the host university, as shown in Figure 4.

The mapping system contains entities to build a relationship between the home university curriculum's course and the external educational activities. The Task entity holds the descriptions of course and the other assignments which the student should complete in order to graduate. The SubTask entity contains information about the student's assignments. The activity is used to store the educational activity description a student has done. It is a supertype to handle the different type of educational works because a student can meet curriculum expectations in different ways. Subtype entities include the host university activity and the home exam results.

4. Results

We quantitatively evaluated the current and proposed systems' effectiveness using the duration of the basic steps in the transfer process. The workload of university staff have been chosen as the most important variable and called it the total time cost. This term does not include the elapsed time for manual processes such as the finding and organization of student transcript documents. The calculation formulas are as follows:

- The paper-based student-specific map approach: the total time cost composed of entering course information to external document + map course information + insert map manually from the external document into the CMS steps.

Figure 3.
The proposed information flow between universities in the CMS

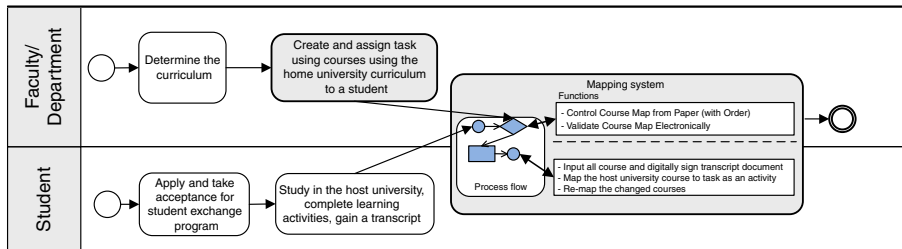
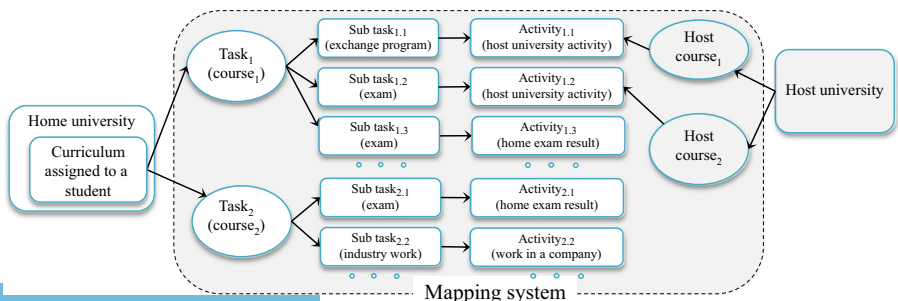


Figure 4.
The model of the course description for the recommended approach



- a CMS supporting students enter course mapping for pre-evaluation: the total time cost composed of the control course map from paper + validate course map electronically. Even if the calculation formula is different, controlling each course on the paper transcript limits the cost gain. When a university staff found a course which needed to be added to the map, the course insertion process is similar to the paper-based approach.
- The recommended approach: the course information entry and matching are done by the student so the total time cost is composed of the duration of the control course map from paper with order + validate course map electronically stages.

We used the ESN, horizontal and vertical student transfer process measures of Fatih Sultan Mehmet Vakif University (FSMVÜ) Computer Engineering Department. The CMS in FSMVÜ supports paper-based maps. The Microsoft® Excel tool has been used to manage the information required to simulate other methods and the proposed system. In six transfer seasons, over 35 student transcripts were investigated and matched to the FSMVÜ curriculum. For deciding the relationship between courses, we used course name, content, course theoretical duration, laboratory duration and ACTS values. First, for a few seasons, we built a university standard, and the mapping duration included the development time of the standard, so we ignored these statistics. For the simulation purpose, the student role was carried on by university staff. For simulating the paper-based map method, we calculated the duration of each step in the paper processing by measuring directly or interviewing the staff of the student office. The average durations are summarized in Table I.

We used a similar validation technique as the students enter course mapping for pre-evaluation in the several academic year's vertical and horizontal transfer processes. In sum, 11 students from 11 different universities applied for registration of course transfer and 199 courses were mapped by entering into Excel as a table. All course maps were considered valid and entered into the CMS. The insert map manually from an external document to the CMS was ignored because all processes were considered to be executed in the CMS. The student's workload did not count because we focused on the workload of the faculty staff. The student's pre-mapping activities have been carried out by faculty staffs and selected student and the durations were not directly measured. To use the same standard in comparison, we utilized the university staff course mapping durations for the student's actions. The control course map from the paper step took 48 percent and the validate map electronically step took 52 percent of the whole process time.

Systems	Student			University staff			The percentage of cost saving in the university staff's workload
	Course entered	Course pre-mapped	Enter course information to external document	Map course information	Control course map from paper (with order) + validate the course map electronically	Insert map manually from an external document to the CMS	
Paper-based student-specific maps	-	-	200	120	-	30	(350)
Students enter course mapping for pre-evaluation	200	120	-	-	36	-	%90 (1-36/350)
Recommended improvements	200	120	-	-	29	-	%92 (1-29/350)

Note: All times in seconds

Table I.
The basic data operation results in the exchange process for a student

In the 2016–2017 academic year's vertical and horizontal transfer processes, we have conducted a similar validation technique as the proposed system. In sum, 19 students from 6 different universities applied for registration of course transfer and 352 courses were mapped using Excel tool. Only 11 of them were registered, and 248 courses were considered valid and entered into the CMS.

The results based on the basic process steps are summarized in Table I. The percentage of cost saving in the university staff's workload was calculated by dividing the total workload of university staff in a specific method by the total workload of the paper-based process and extracting this value from 100 percent. The results reflect FSMVU courses transfer durations and each university's statistics may be different. However, we think that the implication of these results is generally acceptable to explain different methods on the performance.

Another important finding is that there were seven (~3.5 percent of the whole map) of the clerical errors in course name, code or ECTS information in students enter course mapping for pre-evaluation. The error corrections took additional time, nearly as the investigation time. If course information would be taken electronically from the host university, it is possible to completely get rid of this kind of errors caused by paper processing.

The cost analysis shows that paper processing takes more time than course evaluation and mapping processes. Besides, it is possible to decrease further the evaluation cost of a new transcript using similarity to the previous transcripts such as the students that came from the same university, while the time saving of paper-based documentation is limited even in these situations.

The structure of the course transfer process is also affected by the transfer type. Nearly all of the vertical transfers from vocational schools to bachelor degree contain a many-to-one course relation which is not directly provided in any of the researched CMS solutions. However, just one horizontal student transfer includes a many-to-one mapping and none of the ESN requires this.

The total number of students using the ESN process demonstrates the importance of cost saving. The total number of Erasmus students has reached 3.3m (European Commission, 2015). The Erasmus study period is one academic semester on average and the average number of lessons in one semester is approximately 7 in the researched universities. As a result of this, the number of course transfers will exceed 20m and the workload of university staff will significantly increase in the coming years.

5. Summary and conclusions

The importance of the SE is rapidly increasing in nearly every educational institution and affecting inevitably the CMS structures and design. In this study, we have recommended adding an extra layer to the CMS and changing information processing methodology to facilitate tracing, storing and managing SE data. We have measured the step durations of models to compare quantitatively their effectiveness in the horizontal and vertical student transfer processes, ESN and BP.

A direction for future research would be the effect of adding a digital signature to the transfer process. With the increase in the number of digital networks and the usage of the digital signature, there is a window of opportunities to decrease paper processing a step forward and the control course map from paper with paper stages can be shortened or removed. Students to scan and upload the transcript document to the CMS with own or home university supplied a digital signature. The digital signature prevents the changes in the paper so the university staffs do not need to revalidate transcript using the paper document. It is enough to check whether the course in the mapping list is the same as the course in the digitally signed transcript. If the host university can send the digitally

signed transcript to the home university. it will become unnecessary to use a paper transcript completely.

Another further research topic is the other advantages of integration of the task-based systems into the CMS to support the transfer process. The business process management and collaborative software features such as a task list, task scheduling, the completion of task and reporting can be integrated into the CMS to enhance the capability and usability.

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Further reading

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