Development of an ePortfolio System Success Mode

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DEVELOPMENT OF AN EPORTFOLIO SYSTEM SUCCESS MODEL: AN INFORMATION SYSTEM APPROACH (RAZVOJ MODELA USPJEŠNOSTI EPORTFOLIO SUSTAVA)

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To my parents
(Mojim roditeljima)

PREFACE

This thesis represents a culmination of research that has been conducted since 2007. I decided to pursue this research topic due to the fact that ePortfolio had been insufficiently explored. Moreover, showing that ePortfolio is an information system provided me with the opportunity to apply the IS success measures to the emerging field of ePortfolio implementation and application. As a result, I developed an instrument to evaluate ePortfolio success, based on the DeLone&McLean updated IS success model as the assessment framework. Drawing on the results of the developed instrument and the D&M model, I proposed a model of ePortfolio success. It is worthwhile mentioning that during the research I gained immensely valuable international experience through cooperating with ePortfolio and IS experts in Europe and USA.

The first two chapters describe the problem, motivation for research and give insight into the current state in the field of ePortfolio. Chapter 3 describes preliminary research conducted at the Faculty of Organization and Informatics in Varaždin that resulted in implementation of the ePortfolio system in several hybrid courses. Chapter 4 introduces the rationale for using IS success measures on ePortfolio that provides a solid ground for instrument development. Chapter 5 describes the research methodology, instrument development process as well as the data collection procedure. In Chapter 6 the ePortfolio success instrument validation process is described in detail. The development and testing of the ePortfolio success model are presented in Chapter 7. The results are discussed in Chapter 8. Finally, the scientific contribution of this research, limitations of the study as well as implications for further research are given in Chapter 9.

I would like to express my sincere gratitude to my research supervisors, Dr. Blaženka Divjak from FOI and Dr. Enrique Mu from Carlow University. Their guidance, persistence, expertise and support were invaluable and remain highly appreciated.

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Finally, I wish to express my gratitude to my beloved family for their encouragement and to my friends and colleagues who would support me and show sincere understanding while I was occupied with my research.

Igor Balaban, January 2011.

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1 Introduction

Along with the development of LMS (Learning Management Systems) and Web technologies, it is learning support that has recently evolved in unprecedented ways (Zemsky&Massy, 2004). In light of these developments the idea of having a user oriented learning environment that would enable students to showcase their work and skills has finally been made possible through the Portfolio concept. Moreover, beside for presentation purposes, Portfolio is also used as an assessment tool thus changing the perspective of learning and teaching (Buzzeto-More&Alade, 2006; Fernández, 2008; Stevenson, 2006).

Electronic Portfolio, or ePortfolio, constitutes an extension to e-learning and has therefore been very strongly popularized in the last few years. An extensive ePortfolio literature review made for the purpose of this dissertation revealed that ePortfolio is widely used but still not properly explored and a model that would describe its successful implementation in the academic environment still does not exist. Prior to developing such a model, it is important to stress that all the processes supported by ePortfolio need to be thoroughly analyzed to ensure its successful implementation. Similarly, it is necessary to analyze both the pedagogical and technological potential of ePortfolio since it is becoming widely utilized by students, educators and academic institutions in general. In addition, an increased usage of such a system points to the conclusion that ePortfolio is likely to become an inevitable part of the education process. Academic institutions, along with students and teachers, will therefore become dependent on the ePortfolio use both for pedagogical and (self)presentation purposes. Consequently, it is obvious that successful implementation and usage of ePortfolio will have a key role in education and personal presentation in the future. However, so far no assessment frameworks for ePortfolio success have been developed, so in terms of evaluation of ePortfolio success there is a research gap which was established by the comprehensive literature review made by the author of this dissertation.

Regarding the fact that ePortfolio is an Information System, a whole set of Information System techniques and methods can be applied in order to analyze ePortfolio success, such as the EUCS instrument by Torkzadeh&Doll (1999), Updated DeLone&McLean

Information System Success Model (2003), Sedera *et al.*'s Measures for IS Success (2004), and IS Impact Measurement Model by Gable, Sedera&Chan (2008). One of those methods is the DeLone&McLean Information System Success Model (DeLone&McLean, 1992), initially developed in 1992, which is designed as a framework to assess successful implementation of an IS.

With respect to the fact that ePortfolio is still not properly explored and a model of its successful implementation does not exist, in this dissertation an ePortfolio success evaluation framework applicable at the individual level of analysis will be proposed based on the Updated D&M IS Success Model (DeLone&McLean, 2003), introduced in 2002, and the research on ePortfolio conducted by the author of the dissertation.

1.1 *Definitions and terminology*

This research will focus on two key terms: 1. Portfolio, and 2. Information System success. Since numerous definitions for both of these contexts currently exist it is essential to first agree on the terms and definitions that will be used in this doctoral dissertation. In the following sections the clarification of the contexts will therefore be provided for the purpose of their accurate interpretation within this particular research.

1.1.1 Portfolio context

Since Portfolio is mainly related to learning and was developed to support the learning process, there are numerous definitions of student learning portfolios proposed by educators. Literature review has revealed a dozen possible definitions of the term Portfolio, three of which are presented in this section, each of them sheding light on a different aspect of the term.

An excellent definition was offered by Paulson *et al*. (1991), who described Portfolio as "a meaningful collection of student work that demonstrates progress and/or mastery guided by standards and includes evidence of student self-reflection".

Abrenica (1996) defined Portfolio as "a collection of student achievement artefacts created during a period of time that serve as authentic assessment tools used to evaluate student learning".

Barret (1998) defined Portfolio as "a purposeful collection of student's work that illustrates efforts, progress and achievement".

All these definitions describe Portfolio as a concept or a set of procedures and data that result in the demonstration of a student's capabilities. However, to fully utilize Portfolio potential, the procedures and data identified in the aforementioned definitions need to be supported by Information and Communication Technology (ICT). As nowadays it is common for Portfolio systems to be supported by ICT, this research will refer to Portfolio systems that are Web-based. In order to differentiate a paper Portfolio from its electronic counterpart, the letter 'e' will be added to the word 'Portfolio'. Therefore, the

term ***ePortfolio*** will be used hereafter to denote the currently most popular type of electronic Portfolio, i.e. the Web-based Portfolio.

Although the analysis of the aforementioned definitions may suggest that they mainly focus on the student, other entities (e.g. administration, potential employers) can use ePortfolio as well. Drawing on previous definitions and taking into consideration that none of them specifically included the IT component, new definitions of ePortfolio were coined, some of which are presented in this paragraph. According to Barker (2003), ePortfolio is considered to be "an electronic learning record which enables an individual to store, organize and present their work and accomplishments". The European Institute for E-learning (EIfEL), which leads the Europortfolio consortium and is a founding member of the European Foundation for Quality in E-Learning (EFQUEL), defines ePortfolio as "a personal digital collection of information describing and illustrating a person's learning, career, experience and achievements". Furthermore, the definition proposed by EIfEL emphasizes that ePortfolios are privately owned and the owner has a complete control over who has access to what and when. The Inter/National Coalition for Electronic Portfolio Research that mostly deals with ePortfolios across the USA, defines ePortfolio as a "collection of diverse evidence created in authentic activity that is brought together and recontextualized to say something about what I know and can do (how I have grown or changed) … and with an added interpretation intended for one or more specific audiences" (Cambridge *et al*., 2009, p. 145).

In the three ePortfolio definitions above certain shortcomings of the previous ones have been overcome. They focus on the IT aspect of ePortfolio and generalize the ePortfolio owner. On the other hand, it seems that another very important aspect of ePortfolio is still overlooked, i.e. the learning component, which does not only embrace the storage and presentation of past work and experience, but also encompasses reflection and feedback. It is the two latter features that represent the biggest potential of ePortfolio with respect to Lifelong Learning it supports, and should therefore not be neglected.

Table 1. Analysis of existing Portfolio definitions

1st group of definitions	**Shortcomings:**
Meaningful collection of student work that demonstrates progress and/or mastery guided by standards and includes evidence of student self-reflection. *(Paulson, Paulson&Meyer, 1991)*	• Student-oriented (does not include other possible types of owners such as organization or teacher) • IT component missing • Ownership issues such as copyright not considered
Collection of student achievement artefacts created during a period of time that serve as authentic assessment tools used to evaluate student learning. (Abrenica, 1996)	
Purposeful collection of student's work that illustrates efforts, progress and achievement. (Barret, 1998)	
2nd group of definitions	**Shortcomings:**
An electronic learning record which enables an individual to store, organize and present their work and accomplishments. (Barker, 2003)	• Ownership issues not considered • Does not include all possible types of entities (such as organization) • Does not imply the most important type of support in learning ((self)reflection, feedback, etc.) that makes the process of learning far more advanced than before
A personal digital collection of information describing and illustrating a person's learning, career, experience and achievements. (EIfEL, 2009)	

Considering the various definitions referred to in this section, one general definition will be coined to overcome the shortcomings of the previous ones (see Table 1). Consequently, the ePortfolio purpose, type of information, entities involved and IT will be taken into account. Therefore for the purpose of this dissertation ePortfolio will be defined as ***a personal digital record that supports Lifelong Learning and contains evidence about one's accomplishments in the form of artefacts which can be provided to whomever the owner has chosen to grant permission***.

Lifelong Learning (LLL) represents a user-centered learning environment used throughout one's entire life encompassing all three learning forms: formal, non-formal and informal learning. Its extensive description can be found in Section 2.3.

The term artefact stands for a representative collection of an individual's work which best shows one's skills, competencies, achievements and talents (Abrenica, 1996; Barret,

1998; Barker, 2003, EIfEL, 2009). Artefacts can appear in the form of information, links, tools or other personal or non-personal records that can be selectively provided by the ePortfolio owner. A more detailed explanation of artefacts can be found in Section 2.4.

1.1.2 Information System context

According to Laudon&Laudon (2002), organizations tend to make large investments in information systems assuming that they will have a positive impact, most notably on performance. The same authors report that after the investment is implemented, the biggest concern is that of measuring the impact of IS in the organization. In other words, the question *'What makes an IS successful?'* needs to be addressed.

Researchers have derived a number of models to explain what IS success relies on. However, success has been interpreted in different ways by different researchers. In 1989, Davis devised the Technology Acceptance Model (TAM) to explain why an IS is not equally accepted by users and explore the factors that drive user acceptance of IS. Sabherwal *et al*. (2006) noticed that despite considerable empirical research the determinants of IS success are often inconsistent. Following that, DeLone and McLean, who are among the first and most successful contributors in the field of IS success, argued that acceptance "... is not equivalent to success, although acceptance of information system is a necessary precondition to success" (Petter et al., 2008, p. 237). Although many authors have dealt with IS success in the last two decades, the scope and approach of the evaluation studies has varied, so there is little consensus on the appropriate measures of IS success.

To date, the D&M IS Success Model (1992) has been one of the most cited models (as shown in Petter *et al*., 2008) and has served as a reference point for many other models that tried to encompass IS success. The model was so well accepted that the authors proceeded to update it in 2003 (DeLone&McLean, 2003) taking into consideration the results of research that had been based on the D&M Model. The updated model was even more successful than its predecessor. This was confirmed by Petter *et al*. (2008) as well as the very authors of the model in their research in which they analyzed over 80

scientific papers[1] in which the D&M Model was used to assess IS success (DeLone&McLean, 2008).

Based on their research results, DeLone and McLean (1992) suggested that IS success should be defined as a complex variable composed of several interdependent constructs based on the multi-dimensional nature of IS. In accordance with that, they identified six variables they called components of IS success. In their Updated IS Success Model they classified those variables as: System Quality, Information Quality, Service Quality, Use, User Satisfaction and Net Benefits. They also suggested that in order to develop a comprehensive measurement model and instrument for a particular context, the constructs and measures should be systematically selected considering contextual contingencies, such as the organization's size or structure, or the technology and the individual characteristics of the system. Hereafter, the Updated D&M IS Success Model will be referred to as the D&M Model and will be used to assess ePortfolio success in this dissertation. The model is explained in detail in Section 4.3.3.

[1]Most of the papers were published in *MIS Quarterly, Journal of Management Information Systems, Information&Management,* and *Information Systems Research*.

1.2 *Research problem*

When educational institutions embraced e-learning for the first time, they realized they needed to adjust their business (i.e. teaching and learning) processes to fully utilize the new concept. EPortfolio, as an extension of e-learning, aims to remove obstacles between the learner's 'inner world' and the 'outside world'. A learner's 'inner world' includes a Learning Management System (LMS), which used to be considered an environment closed to an audience and was limited to the learner and the learning organization. The 'outside world' includes procedures, events, systems, people and other entities that do not have permission to view an individual's personal or private learning data from their 'inner world'. EPortfolio, on the contrary, offers a new approach, a new philosophy of teaching and learning, giving the learner an opportunity to express oneself, to show one's past work and experience to all the interested parties ranging from teachers to potential employers (see Paulson *et al*., 1991; Abrenica, 1996; Barret, 1998; Barker, 2003; Gray, 2008). As far as an academic organization is concerned, this calls for new adjustments in both the system and the process because ePortfolio is not merely a technology. It is a whole new set of educational rules and approaches that should be incorporated into academic organizations curricula (see Tosh, 2004; O'Brien, 2006; Emmett *et al*., 2006; Stefani *et al*., 2007). By eliminating a strict division between the learner's 'inner world' and the 'outside world', both 'worlds' have gained something valuable. Moreover, a new entity has appeared in the process of lifelong learning, i.e. the employer. With ePortfolio, the learner has the ability to show their work to the educator as well as to the potential employer. As a result, ePortfolio implementation in an academic institution is by no means simple because it involves several entities (Hartnell-Young *et al*., 2007; Gray, 2008). Consequently, an extended study is required to enable all the parties involved, i.e. the learner, educator, organization and potential employer, to benefit most from its implementation (for examples, see Gray, 2008). Since ePortfolio is mainly used by students in the academic environment that presents a starting point for individual's further personal development, it is natural for successful implementation of ePortfolio to be investigated in that specific context.

In order to successfully implement ePortfolio in an academic institution, a new approach is needed that will take into account several different aspects: ePortfolio as an

educational innovation, ePortfolio as a software platform that needs to be incorporated into the existing ICT structure and organization's curriculum; and ePortfolio as a new phenomenon that will bring the learner closer to the potential employer. Such a complex study that would take all the previously mentioned aspects into consideration requires an Information System approach. EPortfolio needs to be represented as an Information System since it fulfils all the required characteristics. The success of ePortfolio can therefore be interpreted as equivalent to the success of a particular IS. The motivation for studying ePortfolio success based on IS success comes from Briggs *et al*. (2003), which further justifies its importance. Namely, according to Briggs *et al*. (2003), in a study comprising 8,000 projects in 352 companies, the Standish Group found that more than half of software projects undertaken in the United States fail after deployment. In other words, systems get deployed but eventually do not meet the expectations. The issue of IS success should therefore be of great importance to researchers as well as to organizations and the society. With respect to problems identified in other studies, the D&M Model will be used to assess the success of ePortfolio, as it is the most appropriate model for this purpose. Since the D&M Model was not previously used in this context, a whole new set of criteria needs to be developed to match ePortfolio requirements. According to the D&M Model, IS success consists of six constructs that are interconnected. The existence or absence of 'inner connections' between the six categories need to be established to comprehend the exact structure and dependencies between the constructs that constitute successful ePortfolio implementation. In addition, critical factors of success should be determined and incorporated into the model to show their relationship with the six constructs within the model.

By following the Model of ePortfolio success that describes relationships between the components of ePortfolio success as well as critical success factors needed for successful implementation of ePortfolio, an academic institution will ensure that ePortfolio implementation is successful. In other words, it will not only embrace the requirements of all the interested parties but also give certain consideration to critical success factors. This is the only way to ensure that information technology serves the people and not the other way around.

To conclude, the research problem addressed in this dissertation is to develop an instrument to measure the ePortfolio success from the student's perspective following the D&M IS Success Model and propose the ePortfolio Success Model based on empirical results. The ePortfolio Success Model and the corresponding instrument will both enable the assessment of ePortfolio success in an academic institution. In addition, a group of factors that moderate relationships between the categories in the ePortfolio Success Model are to be identified for a complete insight into components that constitute ePortfolio success.

1.3 *Complementary research*

Within its E-learning strategy devised in July 2007, the University of Zagreb defined that it will "establish and maintain an ePortfolio system at the University and/or at the faculties within the University" (Kučina-Softić, 2007; E-learning strategy, 2007, p.14). The report (Bekić&Kučina-Softić, 2008) from the Centre for e-learning at the University of Zagreb states that its 11 constituents have announced the planning of conducting other activities defined by the E-learning strategy, among which is ePortfolio. Several studies presently exist within the Centre for e-learning that deal with certain professional aspects of ePortfolio, such as the possibilities of tools that support ePortfolio. However, neither any more complex research nor an integral strategy for ePortfolio implementation currently exists. A similar state of affairs applies to other universities in Croatia as well. On the other hand, universities all around Europe and globally have started to use ePortfolio and stress the importance of its use, e.g. the University of Porto (Martins *et al*., 2008), Carlow University[2], Penn State University[3], etc.

An integral model for ePortfolio implementation in academic institutions that would take into account three different levels of stakeholders: 1. Individual (student and teacher); 2. Institution; and 3. Employer, has not been developed. A lot of research on ePortfolio (see Batson, 2002; Gathercoal *et al*., 2002; Love *et al*. 2004; Stevenson, 2006; Ring&Foti, 2006; Stefani *et al.*, 2007) mainly focuses on the process of its development within an institution, defining ePortfolio requirements and case studies of institutions that have implemented ePortfolio on the course level. However, "... ePortfolio system implementation is in general a comprehensive educational innovation and therefore support has to be provided in both pedagogical and technical sense" (Ring&Foti, 2006, p.353). Furthermore, for the relevance and validity of ePortfolio implementation in academic institutions to be increased, an entire set of factors that affect its implementation has to be taken into account. It is very important to determine the value in terms of benefits that all the stakeholders using ePortfolio gain. Moreover, the

[2] Carlow University started to introduce an experiential learning portfolio based on their ongoing research about ePortfolio importance. Details about ePortfolio at Carlow University can be found at http://caa.carlow.edu/experiential.html

[3] Penn State University has quite a long tradition in using ePortfolio, which can bee seen at http://portfolio.psu.edu/.

promising strands of ePortfolio research include identifying the impact ePortfolio has on job quality (Stevenson, 2006), taking into account all the possible future users, potential benefits and its universality (Jafari, 2004).

By approaching the ePortfolio as an Information System, the D&M Model (Petter *et al*., 2008) can be used to measure the success of ePortfolio system implementation. The authors themselves suggest possible methods that can be used to measure the constructs within the model, although so far none of the suggested methods has been applied in the ePortfolio context. Since no specific methods exist for measuring a specific construct, they need to be compiled for the needs of a specific research. Petter *et al*. (2008) restated that problem as well in their latest research where they identified several different approaches to measuring each construct in the model. They also noted that other authors either used some generic, i.e. general, instruments (such as TAM or SERVQUAL) or created their own indices for measuring constructs. An example of the latter approach is found in Gable *et al*. (2003), where the authors analyzed gaps in the existing IS success studies and proposed their own IS success model. Similarly, Alberto&Gianluca (2007) considered several IS success research streams, one of which was the D&M IS Success Model, and proposed their own theoretical framework to assess IS success combining technology acceptance, task-technology fit and IS success streams.

An example of applying the D&M Model for measuring online learning systems success can be found in Lin (2007). Having slightly modified the D&M Model, he tested it in the learning systems context. Significant correlations between all the constructs of the model were established, which means that all the constructs and their interrelationships are important for the success of online learning systems.

Katerattankul&Siau (2008) went one step further by analyzing information quality, as one of the constructs from the D&M Model, in the ePortfolio context. They tried to validate the instrument for measuring information quality of ePortfolios. However, regarding the D&M Model, the factors identified in that study do not refer only to the information quality construct. For example, Web page length, visual settings, Web page layout and other similar elements analyzed in the mentioned study are related to system quality rather than information quality, if the D&M Model is considered as a whole.

Therefore for the purpose of this doctoral dissertation, none of the existing aforementioned approaches is appropriate for the following reasons:

1. Existing instruments are either to general or inadequate as they encompass more than one construct or just a part of the construct.
2. Assessment methods created by others are applicable only in a specific context for which the measure was created. Since the ePortfolio context as a whole was not included in any of the previous studies, neither of those measures is appropriate for this doctoral dissertation.

With respect to the absence of suitable measures, in this doctoral dissertation an individual specific for the ePortfolio context will be given to each construct and corresponding measures will be developed.

In their latest paper (Petter *et al*., 2008), the authors of the D&M Model reviewed and analyzed over 90 empirical studies in which the model was tested in different contexts, but none of them was in the ePortfolio context. Based on study results, the same authors suggest that future researchers should test the model on different IS as well as explore the type and strengths of relationships between the constructs in a specific context. "Empirical research is also needed to establish the strength of interrelationships across different contextual boundaries. Researchers must take a step further and apply rigorous success measurement methods to create a comprehensive, replicable, and informative measure of IS success" (Petter *et al*., 2008, p. 258). Moreover, the same authors suggested two possible levels of analysis: individual and organizational. Having all this in mind, an ePortfolio success instrument will be developed to assess ePortfolio success at the individual level of analysis encompassing all the measures specified in the previous step. Based on the results obtained from the ePortfolio success instrument the ePortfolio Success Model that will show relationships between the constructs of ePortfolio success will be developed.

Another stand of research in the ePortfolio literature, apart from the ePortfolio model, are the criteria that affect the maturity of ePortfolio (Gathercoal *et al*., 2002) and ePortfolio critical success factors (Love *et al*., 2004). By reviewing these criteria and factors as well as several dozen other sources and ePortfolio project reports, in this

dissertation a new set of critical success factors for ePortfolio implementation will be proposed. In addition, the ePortfolio Success Model will be updated with those factors as moderating factors between constructs for successful implementation of an ePortfolio system.

Critical factors for successful implementation of enterprise systems are extensively discussed in literature (see Fiona *et al*., 2001). However, in case of ePortfolio, the available critical factors are insufficient on the account that:

1. Identified critical success factors are rather outdated as they were identified by Love *et al*. in 2004. They need to be re-examined since, although observing the ePortfolio in its entirety, some of them are not critical any more, and some of those that should be proclaimed critical due to the technological and pedagogical development are missing.
2. Several attempts have been made to identify factors that are important for using ePortfolio (Gibson&Barret, 2003; Challis, 2005; Brant, 2006). Some of them were rendered only in a narrative manner without any support of quantitative research methods. All the studies mainly observed ePortfolio solely from the learner's perspective, while neglecting other perspectives.

With regard to arguments brought up in this paragraph, all the identified factors that have an effect on ePortfolio implementation and usage will be taken into consideration and included in the process of critical success factors identification.

Finally, the ePortfolio success instrument will be used to measure the ePortfolio success, while the ePortfolio Success Model will show the structure of ePortfolio success, providing insight into relationships between constructs and the impact of moderating factors on the constructs of ePortfolio success at the individual level of analysis.

1.4 *The purpose of the research*

The purpose of the research in this dissertation is reflected in research goals. Two wider goals that underlie the entire research can be identified:

1. Development of an instrument to assess ePortfolio success that leans on the very well accepted DeLone&McLean Updated IS Success Model.
2. Further development and testing of the ePortfolio Success Model in the academic environment.

Both the ePortfolio success instrument and the ePortfolio Success Model will be considered at the individual unit of analysis in order to make them applicable to student population.

Neither of the two aforementioned goals is simple or trivial. On the contrary, they are fairly complex and therefore a whole set of activities and pre-research are needed in order to fulfill them.

Bearing this in mind, the first goal will be decomposed into two sub-goals that will present milestones in achieving the wider goal. Prior to the development of the ePortfolio success instrument that will be based on the D&M Model it is necessary (**1a**) to determine whether the D&M model is an adequate model to assess ePortfolio success. Explanation and argumentation regarding this problem is given in Chapter 4. In that chapter the connection between ePortfolio and IS is established and explained along with the appropriateness of the D&M Model to be used in this context. After the interrelationship has been determined and the use of the D&M Model found to be legitimate, I will proceed (**1b**) to develop an instrument for measuring ePortfolio success. In doing so, I will observe the recommendations of authors of the D&M IS Success Model that the instrument is based on. Moreover, it needs to be mentioned that an initial set of items will be developed for the all three levels of stakeholders: individual, institution and employer, although due to sample restriction, the initial set of items will be reduced to only one that can be perceived by students. In other words, instrument validation will be performed at the individual level of analysis. The process of instrument development will be covered in detail in Section 5.4.

The second wider goal needs to be decomposed and achieved by defining milestones. After the ePortfolio success instrument has been developed and its validity tested, it is necessary (**2a**) to identify a new set of Critical Success Factors (CSFs) based on the existing factors found in literature and the ones based on experience of international ePortfolio experts that will participate in the research process. Critical Success Factors will be interpreted as Moderating Factors (MF) because they will either affect the constructs or will moderate the relationships between constructs. A significant difference between CSFs and the ePortfolio success instrument is that the former can be detected only at the institution level, i.e., they are institution specific, while the latter is applied to students and reflects students' attitudes towards ePortfolio. A detailed description of Critical Success Factors (CSF) and Moderating Factors (MF) important for ePortfolio success is given in Sections 4.3.4 and 5.3. After the factors are identified and ePortfolio success instrument is tested, it is possible (**2b**) to develop the ePortfolio Success Model that will consist of:

a) Constructs from the D&M IS Success Model (supported by the ePortfolio success instrument); and

b) Relationships between constructs derived from results of the developed instrument.

In addition, CSFs for ePortfolio implementation will also be identified and the implications for their inclusion in the ePortfolio Success Model will be given.

As a result, the ePortfolio Success Model will be developed with all its constructs, relationships and the associated instrument.

1.5 *The original scientific contribution of the research*

In the previous section research goals that show the purpose of this research were presented. The original scientific contribution this research will make is contained in the hypotheses.

H1. Considering ePortfolio as an Information System, it is possible to develop a measurement instrument to assess ePortfolio success.

Explanation for H1:

For this purpose, the ePortfolio system will be approached as an IS and the existing literature on IS (for example, the D&M Model) and ePortfolio will be used to develop the measurement model.

When the first wider goal and its sub-goals are considered, their correlation with this hypothesis is obvious. The selection of the research methodology and instrument development is described in Chapter 5. Chapter 6 deals with instrument validation. In addition, Structural Equation Modeling (SEM) will be used to determine whether the measurement instrument fits the data. The hypothesis is supported if the measurement model (instrument) is valid and if it indicates a good fit.

H2: Based on the developed instrument, D&M IS Success Model and ePortfolio literature, it is possible to develop an ePortfolio Success Model.

Explanation for H2:

For this purpose, paths between different ePortfolio success constructs (based on DeLone&McLean) will be tested using multivariate data analysis. Critical success factors from ePortfolio will be included in the model.

The identification of CSFs is presented in Section 5.3. If the first hypothesis is supported, which would mean that the instrument is valid and fits the data, the Partial Least

Squares SEM (PLS SEM) will be used to explore the existence of paths between the constructs in the structural model. The hypothesis is supported if the structural model shows a good fit and if significant paths exist between the constructs. The whole process is described in Chapter 7.

Results from both hypotheses testing are discussed in detail in Chapter 8.

The original scientific contribution of this research can be summarized as follows:

1. By combining different scientific approaches and emerging findings in the field of ePortfolio it will be shown that ePortfolio is an Information System.
2. The instrument to assess ePortfolio success will be developed following the Updated D&M IS Success Model.
3. Factors critical for the success of ePortfolio will be identified.
4. Based on the results obtained by administration of the instrument, an ePortfolio Success Model will be proposed.

2 Portfolio: historical and learning context

Generally speaking, a Portfolio presents a personal record containing artefacts which can be provided to the faculty, peers, friends, prospective employers, or the general public. Owing to the ePortfolio concept, the user has finally been brought to the centre of learning. The main purpose of e-learning is to bring the content to the learner in a most suitable form thus enabling the learner to be more effective. This can be achieved by embracing the ePortfolio technology.

However, Portfolio has not always been considered as powerful a tool as it is today. To better understand its current role, an overview of the historical development of Portfolio will be given in this chapter. Furthermore, since an artefact represents a central and most important entity in a Portfolio, a comprehensive explanation of this concept is also needed. The purpose and the structure of artefacts grouped together and presented in a meaningful way determine the Portfolio type. According to the literature, there are many types of Portfolio and therefore it is necessary to present and summarize them into a few most cited and widely used ones. At the end of this chapter theoretical assumptions and instructions for Portfolio implementation in teaching and learning will also be presented.

2.1 *From paper to electronic media*

According to Love *et al*. (2004, p. 24) Portfolios offer "… a viable alternative to current, high-stakes testing, which focuses education on test-taking rather that teaching and learning". Numerous authors (see Batson, 2003; Love *et al*., 2004; Stefani *et al*., 2007) agree that Portfolios have had the most significant effect on education since the introduction of formal schooling. Of course, when Portfolio was just a set of data stored on paper, its potential was not fully exploited and therefore not so meaningful. Along with the development of the media which store information (artefacts), Portfolio has become increasingly more interesting to the end-user. Several levels of Portfolio maturity considering Portfolio's physical and theoretical qualities have been identified. For example, Love *et al*. (2004) distinguish 5 levels of maturity in academic surroundings, with each level presenting a stepping stone for the next one. Each of the levels is briefly described below.

- **Level 1 – Scrapbook**

  Students develop portfolios on their own initiative. It is not mandatory to have a personal Portfolio and students are unaware of each other's activities. There is no template or official Portfolio system. Student work can be presented either on paper or some electronic media (hard-drive, CD-ROM, Web etc.).

- **Level 2 – Curriculum Vitae**

  The institution identifies a template which helps students to organize their work. Their work can be guided by the educator, department or institution. No formal feedback from the educator exists, but students can see each other's work. Data can be on paper or stored on electronic media.

- **Level 3 – Curriculum Collaboration Between Student and Faculty**

  From this stage and above, paper and standalone electronic media such as CD-ROMs, hard drives etc. do not provide the needed functionality to satisfy all the requirements that can only be met by a Web-based Portfolio or a Webfolio. In a Webfolio, students can nominate who can view which items in their Portfolios.

Furthermore, it is possible to leave comments on other persons' work. This level is enriched with input from educators, student and the institution itself. Employers can also easily view a student's Portfolio.

- **Level 4 – Mentoring Leading to Mastery**

Portfolios allow students to receive feedback from mentors and educators. The system is advanced so the educator can 'lock out' students from making further iterations on a certain work assignment. Portfolio is used by students and educators as well. Educators are given the opportunity to copy course syllabi and assignments from one semester to the next. Employers can see student's assignments along with course syllabi, assessment criteria and a lot of other information. The advanced usage of Portfolio can be clearly seen in this stage.

- **Level 5 – Authentic Evidence as Authoritative Evidence for Assessment, Evaluation, and Reporting**

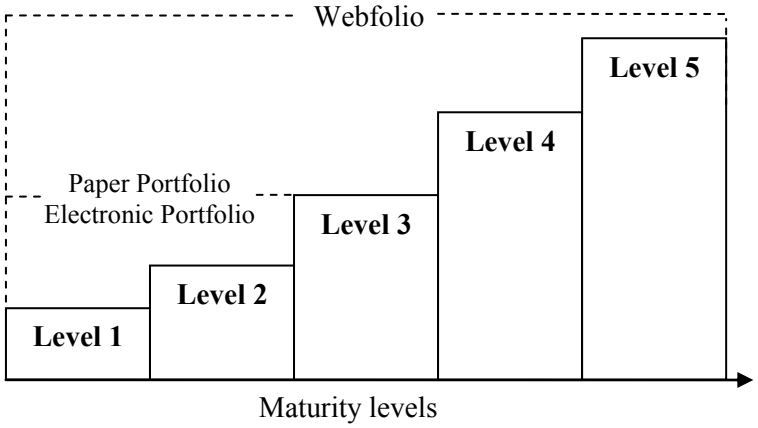
Portfolios are very structured and organized according to institution standards. Students and educators have the finest possibilities for managing their Portfolio. Portfolio is of the highest value for students, educators, institution and employers. Student work along with feedbacks, summative and formative assessment, syllabi, links to standards, goals and other taxonomies can be presented. At this stage, Portfolio can be used to assist with program assessment and revision.

At the first three levels, the Portfolio maturity model actually captures the utilization of features of ICT for use in the Portfolio context, the number of which increases with each level. On the other hand, at higher levels it is more oriented towards the academic institution's acceptance and readiness. By looking at the explanation of each maturity stage, two conclusions can be drawn:

1. EPortfolio is of the highest value for the individual at Level 3. This is the level at which an individual uses a Web-based Portfolio and has all its artefacts in the digital form. A Web platform enables a lightweight presentation of artefacts as well as collaboration with other peers and instructors.

2. Level 5 is of the highest value for the institution. The initial value for the institution starts with Level 3. While at Level 4 ePortfolio is mostly used as an advanced pedagogical tool, at Level 5 a tight integration between the institution's standards, programmes, syllabi and student work has been established.

Figure 1. Appropriateness of technology at different levels of maturity



To accomplish multimedia capabilities, possibilities for instant feedback, enriched context, highest value for student, educator, institution and employer as well as digital equity, both paper and independent standalone electronic media have become insufficient. Therefore, as shown inFigure 1, the most appropriate Portfolio nowadays is the one based on Web technologies.

Three different types of Portfolio regarding the type of media that hold the information are presented below:

Paper Portfolio is a hard-copy Portfolio: paper holds the information. Limited lifetime, decreasing print quality, hard time with managing and storing the data makes this type of Portfolio fairly inappropriate and its opportunity for usage very limited.

Electronic Portfolio indicates that information is held on some kind of electronic media such as a CD-ROM, hard drive, USB storage etc. The main characteristic of this kind of information is that its quality does not decrease over time since it is in the digital form. The opportunity for multimedia presentation also exists. Nevertheless, the information

remains isolated, being stored on a single electronic medium without enough possibilities for sharing it with others.

Webfolio, or a Web-based Portfolio, represents the ultimate stage in the Portfolio development. Information is kept on a Web server which can be easily accessed by many users simultaneously. Since server storage is also an electronic medium, all features from Electronic Portfolios remained the same, while additional functionalities and flexibility were added making it possible to share the information and gain instant access to that information.

There are three main differences between a Webfolio and a paper based Portfolio (Stefani, 2007):

- **With a digital portfolio, it is easy to rearrange, edit and combine materials.** The student manages their own storage; content can be searched and accessed in a non-linear fashion. Modifications can be made more frequently and more easily than on paper.
- **The Webfolio is a 'connected document'.** Hyperlinks allow a student to connect documents together thus forming a network of documents which can be stored internally or on some external source.
- **It is not possible to retain portability without the electronic form.** All documents are stored and maintained as a set of digital files that can be easily transported and transferred in accordance with needs. Therefore, a Webfolio can be accessed and used in a variety of locations.

According to Buzzetto-More (2006), electronic portfolios have a number of advantages over those that are paper-based as they support a greater variety of artefacts and allow for increased learner expression; are dynamic and multimedia driven; accessible by a large audience; contain meta-documentation; easy to store; and may serve to promote a student academically or professionally.

Upon analyzing the main characteristics of different types of Portfolio it can be concluded that a Webfolio as the cutting edge technology brings the most benefits to all interested parties – from a student to a potential employer. In addition, a Webfolio can

be considered an extension of electronic types of Portfolio because the information is also in the electronic form. In case of a Webfolio, however, a Web application that utilizes Portfolio processes is also present. Therefore in this dissertation the term ePortfolio will be used to denote a Webfolio as a special instance of an electronic Portfolio.

2.2 *The role of Portfolio in teaching and learning*

Nowadays most universities tend to enhance learning by adding the online component, which results in a new way of learning called e-learning that is increasingly being enriched by ePortfolios. According to Stefani *et al*. (2007), ePortfolios can be used in distributed, blended and totally online learning programmes and institutions. Lorenzo and Ittelson (2005) depicted electronic portfolios as the biggest innovation in educational technology since the introduction of course management systems showing promise across disciplines, institutions, and applications. Moreover, they are changing the perspective of learning, transferring it from the behaviorist theory towards constructivist principles. For this reason, the underlying pedagogy of the ePortfolio is probably one of the biggest contributions of this new phenomenon.

According to the ePortConsortium's White Paper (2003), the benefits of electronic portfolios in education are numerous, serving a number of purposes and stakeholders, including: helping the student to develop organizational skills; recognize skills, abilities, and shortcomings; assess their progress; demonstrate how skills are developed over time; make career decisions; and promote themselves professionally. In addition, the cited document refers to innovations in assessment: while traditional assessment is 'one-dimensional', ePortfolios offer an alternative approach that is more authentic and user-centered. As a result, it is asserted that ePortfolios enable an expression of a broad range of student knowledge and learning experience that may not be considered with traditional assessment.

The constructivist theory places the emphasis on the learner instead of on the teacher. The learner becomes the 'centre of learning', interacts with the content and gains understanding and new ideas about the presented topic. Instead of the content, the focus is on the learner and their way of understanding. The learner becomes autonomous, feels encouraged and takes initiative.

According to Batson (2002), ePortfolio integrates three trends:

- Student work is now mostly in the electronic form, or based on a canonical electronic file even if it is printed out: papers, reports, proposals, simulations, solutions, experiments, renditions, graphics, or just about any other kind of student work.

- The Web is everywhere: We assume that our students have ready access to the Web (which is not always true, of course). The work is 'out there' on the Internet, and therefore the first step for transferring work to a Web site has already been taken.

- Databases are available through Web sites, allowing students to manage large volumes of their work. The 'dynamic' Web site that is database-driven, instead of HTML link-driven, has become the norm for Web developers.

These characteristics enable ePortfolio to become a central supporting system to some of the 21st century phenomena. Among them is Lifelong Learning (LLL), the characteristics of which will be described in the next section. Furthermore, Personal Development Plan (PDP), Personal Learning Environment (PLE) and reflective learning will be extracted and explained as the most interesting trends and processes in LLL.

2.3 *Lifelong Learning*

The European Qualifications Framework (EQF)[4], a common European reference framework that enables European countries to interlink their qualifications systems, distinguishes three forms of learning. According to Schugurensky (2000), these forms can be defined as follows:

- **Formal learning** goes from preschool to graduate studies. It comprises the following features:
    - it is highly institutionalized;
    - it includes a period called 'basic education', which is compulsory and implements a prescribed curriculum;
    - each level prepares learners for the next one, and to enter into a certain level it is prerequisite to satisfactorily complete the previous level;
    - it is a hierarchical system;
    - at the end of each level and grade, graduates are granted a diploma or a certificate.
- **Non-formal learning** refers to all organized educational programs that take place outside the formal schooling system, and are usually short term or voluntary. These programs usually do not require prerequisites in terms of previous schooling. Teachers and curriculum exist, but with much more flexibility than in formal education. An example of non-formal learning is driving lessons.
- **Informal learning** takes place outside the curricula provided by formal and non-formal educational institutions and programs. In the process of informal learning there are no educational institutions, instructions or prescribed curricula. Three forms of informal learning exist:
    - **Self-directed,** in which learning is undertaken by individuals without the assistance of an educator. It is intentional because the learner has defined

[4] EQF issued the Recommendations of the European Parliament and of the Council on establishment of the European Qualifications Framework for LifeLong Learning. The recommendations should contribute to modernising education and building bridges between formal, non-formal and informal learning. For detailed information, see http://www.qcda.gov.uk/libraryAssets/media/EQF_Recommendations%281%29.pdf.

the goal of learning something new even before the learning process begins.

- **Incidental**, which occurs when the learner did not have any previous intention of learning something out of that experience, but after the experience one becomes aware that some learning has taken place.
- **Socialization** or **tacit learning**, which refers to the internalization of values, attitudes, behaviors, skills, etc. in everyday life that learner has no a priori intention of acquiring. They are not aware that they learned something either when acquisition occurs.

Most formal learning ends at some point of human life, usually after formal schooling. Unlike formal learning, informal learning starts almost from the birth, occurring in parallel with formal learning and lasts throughout one's entire life. Regardless of its type, we can say that 'modern' learning continues throughout the entire lifespan of an individual and combines all the aforementioned learning forms. Such a new way of understanding learning is referred to as Lifelong Learning (LLL). Therefore ePortfolios, except for providing an inventory of acquired knowledge and skills, should "have a richer purpose: to facilitate lifelong learning" (Hartnell-Young, 2006, p. 126). Lifelong learners should actively use PLEs and PDPs and should be reflective learners. If we consider ePortfolio functionalities, it is therefore obvious that it could appropriately support LLL.

Hargreaves (2004) suggests that lifelong learners know what they know, what they have to learn, and what they can do for an employer. According to the same author, there is increasing evidence that LLL does not start after schooling ends. EPortfolio provides an environment for an individual to store and manage their artefacts throughout one's entire life. By facilitating reflections and feedbacks, ePortfolio supports both individual and collaborative learning that makes for a very important component in LLL. In other words, by supporting the processes in LLL, ePortfolio exceeds the boundaries of formal education and takes place throughout one's life.

PDP and PLE both represent 'virtual processes and environments' within LLL and occur in formal, non-formal and informal learning.

2.3.1 Personal Development Plan

One of the features that ePortfolio shares with e-learning is that it enables individuals to set their learning goals or develop action plans for the future. By setting one's own learning goals, an individual can track their progress toward the achievement of each goal. In such a way, ePortfolio helps an individual to plan and track their personal development. In the United Kingdom, a PDP encompasses a number of activities such as (Grant&Richardson, 2006):

- Discussing a learner's personal situation/experiences;
- Compiling a list of experiences or past activities, including employment;
- Reviewing and reflecting on logs;
- Reviewing past written goals and action plans against more recent past experience;
- Listing achievements/qualifications (with documentation if available);
- Relating experiences to skills (or vice versa);
- Reviewing progress in/development of skills;
- Reviewing personal interests;
- Setting goals for skills development;
- Setting goals related to subject development;
- Originating action plan for the achievement of academic goals;
- Revising CV/personal statement/other compilation;
- Originating action plan for personal/skills development/goals;
- Revising action plan for personal goals in the context of feedback/discussion, etc.

Identifying the key components of a PDP is essential for creating Web-based IT systems that would support all the needed activities. In brief, a PDP can be described as a process of supporting an individual's theory of oneself as a learner. According to Grant *et al*. (2006, p. 148) "this happens as part of a reflective cycle which we characterize as having seven steps: noticing, documenting, recollecting, theorizing, goal setting, action planning, and acting". All these steps can be seen through the activities mentioned above. Today's ePortfolio systems can support most of these activities.

Embedding ePortfolio into a curriculum also contributes to integration of PDP into the curriculum, many examples of which can be found in current literature, especially in the United Kingdom, where a very high concern for quality in e-learning exists. PDP is supported by reflection and (self)assessment processes. These two kinds of processes enable the learner to plan their own development and actions that will lead them to fulfill their goals.

2.3.2 Personal Learning Environment

Learning management systems have enabled the creation of the so-called Virtual Learning Environment (VLE) in which a learner can enroll. In a VLE, all the tools and materials needed in a course can be found in one place. Since the learner is virtually present in a virtual class, the environment created in such a way was named a VLE. Such an environment represented an organization-centered environment in which an individual was enrolled. By introducing ePortfolio, the centre was shifted from the organization and from VLEs towards another concept in which an individual plays the central role by using information from different sources. As a result, a new environment was created around the individual, called a Personal Learning Environment (PLE). That environment enables the learner to learn in different contexts thus combining formal and informal learning. According to Attwell (2007, p. 1), "the idea of a Personal Learning Environment recognizes that learning is ongoing and seeks to provide tools to support that learning". Consequently, PLE is actually a set of tools that an individual uses in their everyday life for learning. It can vary from a word processor, instant messaging tools, e-mail, LMS, to a wide range of Web 2.0 tools.

A number of different forms of learning, new approaches to assessment and fast-changing technologies exist nowadays. The purpose of contemporary and emerging technologies should be their adaptability to end-user needs (especially their learning styles) and simplicity or ease of use. It is not the user who should adapt to technology, but vice versa.

It can be clearly seen that in a PLE individuals can choose which tools they will use. Since an individual is the one who will 'fetch' all the necessary information from many different systems, ePortfolio should be the central system in a PLE to enable the individual to store, maintain and present the information obtained from various sources.

2.3.3 Reflective learning

In the constructivist theory of learning the emphasis should be put on the learners' previous knowledge, their personal impression and personal field of interest regarding the new content. In such a form of learning, learners need to be given a chance to express themselves and connect their pre-existing knowledge with new facts or things being learned. Such critical thinking about the matter that is being learned is called reflection. 'Reflection' is often used to refer to activity individuals engage in concerning things or events. According to Stefani *et al*. (2007), reflection seems to be part of the forms of learning in which learners try to understand the material that they encounter and relate it to what they already know.

In the ePortfolio context reflection means "contemplation on the meaning of artefacts, ideas, expressions, and the processes that supported their creation, including a consideration of intent" (Gibson, 2006, p. 145).

To become a reflective learner, one needs to develop certain skills such as critical thinking. As a critical thinker, an individual is capable of thinking in a purposeful, reasoned and goal-directed way, i.e. "the thinker is using skills that are thoughtful and effective for the particular context and type of thinking task" (Blackburn&Hakel, 2006, p. 89).

Reflection is a very important process in modern schooling. Owing to its features, ePortfolio offers support for reflection process, which is one of its main advantages over other systems that support modern schooling. Despite all its potential benefits, there are a few issues that should be taken into consideration regarding reflection. According to Riedinger (2006), in an academic institution there should be a unique definition of reflection along with instructions about what is expected from the reflection process.

Furthermore, students should be taught how to reflect in a purposeful way. Resistance to reflection and clichéd responses is something that can be expected since the process is relatively new to students so steps should be taken to prevent that from happening.

EPortfolios offer a great potential in enhancing dimensions for reflection. An academic institution needs to nourish the culture of reflection in all organizational aspects. According to Riedinger (2006, p. 100), effective reflection will depend "... on the willingness of all to take risks, think outside of their disciplines, and learn childhood curiosity – the art of asking why".

2.4 *Artefacts*

Among other things, an ePortfolio is intended to act as a file repository. By adding certain business logic it becomes a system for managing a user's PLE and LLL environment. "Documents, projects, and video that students felt represented their best works and abilities were collected as artefacts for the portfolios" (Flanigan&Amirian, 2006, p. 105). An artefact is created for presentation purposes and can appear in the form of text, presentation or a spreadsheet document, Web page, video, image or some other multimedia content. The concept of artefact "captures the physical nature of those items" (Gibson, 2006, p. 141). In other words, not every piece of data in a file repository is an artefact and, when it becomes an artifact, it can have more than one meaning. Gibson (2006) states the example of an artefact that represents a person and at the same time, although maybe not intentionally, also captures the essence of a culture. By taking all this into consideration, we can conclude that artefacts refer to a representative collection of someone's work that best shows their skills, competencies, and talents. In educational assessment, "artefacts provide evidence of what the person or group knows and can do" (Gibson, 2006, p. 145).

One of the fundamental purposes of ePortfolio is to present one's work through artefacts. Therefore it is very important that these artefacts are authentic and valid. However, not all artefacts can be verified for validity and authenticity. Since ePortfolio is widely used in academic organizations for assessment purposes, one of the best ways to start ensuring artefact validity is in an academic environment. Within an ePortfolio, artefacts can be presented in different ways or views, depending on its purpose. Actually, any electronic data becomes an artefact when it is published within the ePortfolio and acts as evidence of one's accomplishments.

2.5 *Types of Portfolio*

During the maturation process, ePortfolio has undergone many changes and different perspectives of its perception. Numerous definitions of ePortfolio exist corresponding to the phases of its development over time. Some of them were presented in the first chapter of this dissertation.

Nowadays the term ePortfolio can be used to express several different aspects of Portfolio such as the software; a particular representation of material (Portfolio view); or all of the content (set of materials) from which a particular presentation will be selected. In terms of the context in which ePortfolio is applied several types of ePortfolio can be distinguished.

Depending on the level of institution, according to the scope of ePortfolio, three main types exist (Stefani *et al*., 2007):

- ***Course*** portfolio, where ePortfolio is assembled by students of one course;
- ***Programme*** portfolio, which is related to a specific university programme and used by students to document skills and outcomes they have learned and/or gained in the academic programme; and
- ***Institutional*** portfolio, which belongs to an institution and in which employees record their achievements, future plans etc.

According to the same authors, if we use ePortfolio as e-learning tool, different ePortfolio types can be recognized:

- ***Assessment*** Portfolio for demonstrating achievements;
- ***Presentation*** Portfolio used to evidence learning;
- ***Learning*** Portfolio, in which a student documents and advances their learning over time;
- ***Personal development,*** which is related to professional development;
- ***Multiple owner*** Portfolio, which allows more than one person to participate in content development; and
- ***Working*** Portfolio, which combines previous types of ePortfolios.

The European Portfolio Initiatives Co-ordination Committee (EPICC), which is part of the European Institute for E-learning, classifies ePortfolios in terms of their purpose as:

- ***Assessment Portfolios*** – used for assessment; however, they differ from other assessment tools in that they are not based on testing. Portfolio owners are instead required to provide evidence of their competencies.
- ***Showcase Portfolios*** – showcase portfolios perhaps most closely resemble the traditional notion of what a Portfolio is. Typically, they contain examples of the portfolio owner's best or most relevant work.
- ***Development Portfolios*** – these portfolios are used to create personal development plans and are best used in situations where learning is tailored to the individual.
- ***Reflective Portfolios*** – individuals use these portfolios to monitor their own progress and development.

Joint Information Systems Committee (JISC), which is the leading organization in UK that manages and funds over 200 projects related to innovative use of ICT in education and research, has undertaken many projects concerning the development and implementation of ePortfolio. JISC provides a different classification of ePortfolios regarding their purpose:

- ***Presentation*** – selected material for application for admission to study, job, induction, appraisal or assessment;
- ***Transition*** – supporting learners as they move between and across institutions and sectors; and
- ***Learning*** – personal and reflective, to guide and develop learning over time (both formal and informal) in education, training and employment.

Another classification offered by Stevenson (2006) distinguishes three types of ePortfolio according to their purpose:

- **Showcase ePortfolio** – used to display work to prospective employers or clients. It can be also used for peer assessment.

- **Structured ePortfolio** – designed to meet preset requirements by an accrediting agency or institution of higher education. Criteria or requirements should be given as a template.
- **Learning ePortfolio** – exhibit what students have learned, but are more student-directed and less rigid in their makeup. It is a sort of a working ePortfolio in which students develop reflective and learning skills.

With respect to numerous classifications presented above, several conclusions will be drawn for the purpose of this dissertation:

1. Most ePortfolio classifications are based on one common criterion: its purpose. By considering its purpose and role in Lifelong Learning it will be concluded here that such a classification is the only one that is acceptable and applicable in the context of ePortfolio. An institution that has reached Level 5 according to ePortfolio maturity levels can define different classification types for its purpose, although they will not be an object of this dissertation.
2. Considering the purpose of ePortfolio as a classification criterion and the diversity of existing classifications (McGrath *et al*., 2004; IMS GLC, 2005; JISC, 2006; Stevenson, 2006; Stefani *et al*., 2007), three main types of ePortfolios will be coined here and used in this dissertation hereafter:

   1. **Assessment ePortfolio**: Demonstrates individuals' competences and skills for well-defined areas. The purpose is to evaluate individual's competency as defined by program standards and/or outcomes in case of an educational institution. An individual can publish their work and educators as well as peers can leave their feedback.

   2. **Development ePortfolio**: Demonstrates the advancement and development of skills over a period of time. It is a direct support to Personal Development Planning.

   3. **Showcase ePortfolio**: Demonstrates exemplary work and skills. Individuals typically show this portfolio to potential employers, peers or educators. For example, it can be one's CV.

In addition, a **Hybrid ePortfolio** can be drawn by combining all the three types of ePortfolio. As a matter of fact, this is the most widely used ePortfolio today. For example, a job application ePortfolio is a type of Hybrid ePortfolio because it contains a CV as a Showcase ePortfolio and a set of artefacts by which some work is demonstrated or proven and according to which an individual will be assessed by the employer, which is a characteristic of an Assessment ePortfolio.

It has to be noted, however, that these types are not to be taken for granted. In most cases individuals will create an ePortfolio without being aware of the type they are creating. Even if someone intends to create a Showcase ePortfolio, that same ePortfolio can be used to assess that individual. In that particular case it will become an Assessment ePortfolio.

2.6 *Experiences with implementation in an academic institution*

For users to effectively use an ePortfolio it is of great importance to introduce it into the organization in a strategic way. It is also essential to select the system that will support ePortfolio features according to users' specific needs. In literature there are numerous descriptions of different experiences with ePortfolio implementation at different levels of education, from curriculum to course implementation. Key findings from the current research will be presented in this chapter and used as a theoretical background for the pre-pilot research of introducing ePortfolio at the course level at the Faculty of Organization and Informatics (FOI) in Varaždin described in Chapter 3.

When implementing ePortfolio, three major management levels in organization are to be taken into consideration (see Table 2). This is consistent with traditional organization management as well as with levels of IS support (for example see Laudon&Laudon, 2002). The implementation process should be introduced at all the three levels to ensure that this phenomenon is fully embraced by an academic institution. Of course, step-by-step implementation is also possible and may be the one most often used, especially with pilot projects. The three levels identified are common in every business environment. They correspond to (1) **strategic level**; (2) **tactical level**; and (3) **operating level** in organization management.

Table 2. Overview of different management levels

Level	Strategic	Tactical	Operating
Description	Identified by institution's Mission, Vision and Strategy.	Characterized by teaching and learning processes.	Includes infrastructure components and user acceptance (the use of ePortfolio and user satisfaction).
Basic characteristics	- EPortfolio integrated into curriculum - Assist in organization's development - Used for revision of study programmes - Align ePortfolio with employability frameworks	- Improves student learning (by enabling reflections) - Assist faculty to extend learning terrain - Assessment tool - Improves self-presentation	- All faculty staff should be involved in choosing and implementing ePortfolio - Implementation should be a step-by-step process - Education on use of ePortfolio (workshops, helpdesk etc.)
Implementation examples	- Alverno College Faculty (O'Brien, 2006) - Queensland University of Technology (QUT) (Emmett *et al*., 2006) - University of Strathclyde (Stefani *et al*., 2007)	- Alverno College Faculty (O'Brien, 2006) - Montclair State University (Flanigan&Amirian, 2006) - East Stroudsburg University (Flanigan&Amirian, 2006) - University of Strathclyde (Stefani *et al*., 2007)	- University of Dundee (Doig *et al*., 2006) - Montclair State University (Flanigan&Amirian, 2006) - East Stroudsburg University (Flanigan&Amirian, 2006) - Virginia Tech's Department of Communication (Hickerson&Preston, 2006) - Queensland University of Technology (Emmett *et al*., 2006)

The **strategic level** of implementation can be identified by the institution's **Mission, Vision and Strategy**. Starting from the top of the academic organization's structure and having in mind its mission, vision and strategy, it is considered that ePortfolios should be integrated into the curriculum because they are shifting the control towards the learner enabling student-centeredness and adoption of new learning models. In that way they are inevitably affecting curriculum design and development. EPortfolio will become a societal need in near future, and if they are not implemented into the

curriculum "they may never fulfill their potential and become a tool that alters learning pedagogy" (Tosh, 2004). EPortfolio requires changes in the curriculum that was based on traditional pedagogic methods. A learner will have the opportunity to show their accomplishments to the society, to learn from the populace and to share resources with the global community.

Alverno College Faculty (O'Brien, 2006) has implemented ePortfolio and stresses its power to assist in the organization's development. According to their experience, ePortfolio allows faculties to explore and evaluate their own assessment practice over time by specific courses and outcomes. This valuable feedback can be used to modify the curriculum, and to positively influence the faculty's development.

According to Emmett *et al*. (2006), Queensland University of Technology (QUT) aligned ePortfolio implementation with the University's key policies. Before the actual implementation within the entire university, they did a series of extensive piloting and testing. This enabled the institution to establish what modifications were needed in the curriculum to align it with ePortfolio and vice versa. The project staff attained support from senior management so the university did not only embed ePortfolio into the curriculum, strategy and other teaching and learning structures but also opened up the possibility to align ePortfolio to the Employability Skills Framework.

A few other examples of embedding ePortfolio into the curriculum can be found in Stefani *et al*. (2007). The University of Strathclyde in Glasgow, Scotland and Alverno College in Milwaukee embraced the idea of embedding personal development planning into the curriculum. As a result, the institutions' strategies as well as teaching and learning processes were changed accordingly, thus enabling personal development planning supported by ePortfolio to be implemented.

Teaching and learning correspond to the **tactical level**. Both teaching and learning processes should be carefully designed bearing in mind the new pedagogical approach, ICT development and students' capabilities. It has been proven in several occasions that ePortfolio improves student learning. The case of ePortfolio implementation at Alverno College Faculty (O'Brien, 2006) is just one of the examples where ePortfolio served as a pedagogical tool and helped students to connect learning across courses, assisting the

faculty to extend the learning terrain of their majors. It helped them to discover their learning patterns. Stefani *et al*. (2007) stress the proper use of ePortfolio in the assessment of knowledge as a key to successful ePortfolio implementation. The authors extensively describe issues related to the assessment process such as improving assessment reliability and authenticity, advantages of self and peer assessments, etc. Some of those issues need to be solved at the lower level within the ePortfolio system and need to be considered when choosing the ePortfolio system.

To fully utilize the ePortfolio potential, students and teachers should be prepared to act reflectively. Reflection and self-regulated learning are one of the most interesting and most important benefits ePortfolio brings to formal schooling. A brief overview of reflection and reflective learning can be found in Section 2.3.3. Based on his experience, Riedinger (2006) described how to teach students to reflect and underlined a few challenges in reflection such as: (**a**) defining reflection in the most accurate way; (**b**) teaching students how to reflect; (**c**) resolving issues in resistance to reflection; and (**d**) recognizing and dealing with clichéd responses. Doig *et al*. (2006) also stressed the importance of reflection and proper preparation of students and teachers for the process.

An exemplary case of ePortfolio implementation in two courses (Flanigan&Amirian, 2006) shows how two university teachers, although teaching at separate universities and in very different programmes, collaborated on the ePortfolio strategy, processes, and results over a two-year period. As a result of their cooperation, they developed an outline of the ePortfolio development process with concrete suggestions on the steps to follow, design process, and modes of distribution.

Infrastructure (both hardware and software) and user acceptance are the essential components at the **operating level**. Each of the two higher levels ultimately depends on this basic level of implementation. In order for all ePortfolio functionalities and benefits to find their application in an academic institution, two basic assumptions are: (**a**) to find the most appropriate ePortfolio system; and (**b**) to prepare (i.e. train) all the potential users to embrace the system. Research shows that students are by far the most satisfied users of the system with some exceptions (for examples, see O'Brien, 2006;

Doig *et al*., 2006; Hickerson&Preston, 2006; Stefani *et al*., 2007). Most of the previously mentioned research indicates that all faculty members including the management, teachers, students and IT administration staff were involved in the process of choosing and implementing the ePortfolio system. In case of the two courses at Montclair State University in New Jersey and East Stroudsburg University in Pennsylvania (Flanigan&Amirian, 2006), ePortfolio implementation was performed step-by-step, from introducing the process, following the pre-designed templates for structure, to introducing the artefacts, tutorials and reflection. Choosing the adequate software that would support desired functionalities and requirements presented a challenge.

The University of Dundee (Doig *et al*., 2006) has also recognized the importance of professional education in the process of using ePortfolios. Students were introduced to the university's ICT and VLE in order to develop appropriate skills needed for ePortfolio. As a result of the project a long checklist was devised concerning processes that were required to achieve an acceptable quality of reflections using ePortfolios. This university has also embraced ePortfolio because of it's "... huge potential as a vehicle for helping students to collect, record and evidence their achievements" (Doig *et al*., 2006, p. 165). The implementation at QUT (Emmett *et al*., 2006) included workshops and an e-mail help desk in order to help students with issues that may occur. Workshops addressed faculty needs, using ePortfolio for assessment purposes, reflective practices for workplace learning, and integration into the curriculum.

Another example of ePortfolio implementation at the course level can be found at the Virginia Tech's Department of Communication (Hickerson&Preston, 2006). Their portfolio team selected a course first and then identified the Department's needs. Along with implementation in the classroom they made a checklist with transition to Portfolio items that related to program, expense, assessment, implementation and refinement planning. The ePortfolio team also made a survey analysis and confirmed once again the usefulness of ePortfolios, but also identified some gaps in the process. In addition, the consistency of ePortfolio use during both semesters as well as its ease of use were confirmed.

Taking into consideration the experiences with ePortfolio implementation described in this section, we can conclude that the needs of learners in higher education are rapidly changing so it is very important to identify the existing requirements and anticipate some of those likely to emerge in near future. An appropriate mechanism can be embedded in all the three levels of organization's management to ensure that ePortfolio is well-accepted and judiciously used.

3 Preliminary research

This chapter describes preliminary research that had to be carried out prior to choosing a research methodology and developing an ePortfolio success instrument in order to fulfill all the necessary prerequisites for the main research. It should be noted that preliminary research started two years before the ePortfolio instrument was developed to allow full insight into the process of ePortfolio implementation and usage to be gained.

Since ePortfolio implementation and usage had neither been reported in Croatia's universities nor at the Faculty of Organization and Informatics (FOI) in Varaždin before the beginning of this research (Kučina-Softić, 2008) it was necessary to first implement ePortfolio in teaching and learning at FOI. Three main goals to be achieved in that respect were:

1. Intensive ePortfolio usage at FOI would be carried out for at least one academic year that would enable FOI students to become potential respondents for the ePortfolio success instrument.
2. The results of ePortfolio success instrument based on the results obtained from Croatian students would be combined with those obtained from other universities in Europe and USA.
3. The author of this dissertation would get fully acquainted with ePortfolio, its implementation and usage, as well as with possible issues arising from those processes.

It was fairly convenient that this institution was one of the pioneers in e-learning in Croatia, so e-learning had already been established there. Moreover, a number of Croatian faculties had adopted FOI's e-learning strategy that was evaluated as one of the most comprehensive e-learning strategies in Croatia, in the development of which the author of this dissertation also participated. E-learning at FOI is based on the Moodle platform and currently more than 190 courses from the undergraduate to the doctoral level of study are implemented in the system. All of the courses have already reached Level 2 (out of three prescribed levels) of e-learning maturity, which includes basic

course information, learning outcomes, forums, literature, selected educational materials organized by units, calendar of important events, online exams, online dictionary, homework upload and grading. So far only a few courses have reached Level 3, which includes online questionnaires, systematic grading of all online student activities (discussions, exams, and access to materials) as well as audio and video educational materials organized by units.

The research environment was prepared in two phases: 1. Introducing and selecting the ePortfolio system; and 2. Using the ePortfolio in hybrid courses. In the first phase (2008) students and several teachers were introduced to ePortfolio, its functionalities and its purpose in teaching and learning. Moreover, two ePortfolio systems were presented, both of which had to be used and evaluated by students. Based on their evaluation, one ePortfolio system was chosen to be used in all the courses at FOI. In the second phase (2009) the chosen ePortfolio system was used as a pedagogical tool and as a tool for self-presentation in three blended courses, which enabled the students and educators to actively use the system for teaching and learning as well as for self-presentation purposes.

3.1 *Introducing and selecting the ePortfolio system*

During the winter semester of the 2008/2009 academic year the implementation of the ePortfolio system in a hybrid (blended) course Security of Information Systems was initiated at FOI. Instruction for the fifty-four students enrolled in the course included conventional face-to-face lectures and practical sessions in a computer lab. Supplementary teaching materials and discussion forums were placed in the Moodle Learning Management System (LMS). Most of the students were in their third year of undergraduate study.

This first implementation phase was motivated by two main goals:

1. Introducing the ePortfolio concept to students and educators. Here a common strategy found in literature was followed, in which starting with small-scale pilots aimed at exploring the ePortfolio in a specific context and training the key players is preferred to introducing the system to all students at once.
2. Choosing which ePortfolio system would be most suitable for use at FOI regarding the course structure, since most courses at the Faculty are organized in a similar manner.

Since this was the first case of ePortfolio implementation at FOI and within the University of Zagreb as well, three main aspects were taken into consideration:

1. Recommendations for ePortfolio specification by IMS/GLC;
2. Organizational/course requirements and possibilities, and
3. Available ePortfolio systems.

As suggested in the IMS ePortfolio specification, types of information that an ePortfolio can contain include those related to (IMS, 2005):

- digital and non-digital works created or part-created by the subject;
- subject of the ePortfolio;
- activities in which the subject has participated, is participating or plans to participate;

- competencies of the subject;
- subject's preferences, goals, plans, interests and values;
- any notes, reflections or assessments relevant to any other part;
- results of any test or examination of the subject;
- creation and ownership of the parts of the ePortfolio, etc.

Organizational and course requirements were not so strict since this was the first case of ePortfolio implementation and it was not possible to predefine them entirely. Previous research findings (like Richardson&Ward, 2005; Stefani *et al*., 2007; Bisovsky&Schaffert, 2009; Himpsl&Baumgartner, 2009) therefore served as guidelines. Most constraints were related to organizational and technical requirements. Given that in Croatia there is a growing tendency towards working with open standards and interoperability, commercial ePortfolio systems were parsed out from further considerations.

Three ePortfolio systems that were free of charge and available for installation at FOI were the Exabis ePortfolio block within the Moodle LMS (the official LMS at FOI); ELGG – open source social networking and social publishing platform; and Mahara – open source ePortfolio and social networking software. Since Exabis was still in its early phase of development and "showed serious weaknesses concerning the support of portfolio processes, especially in regard to the design of a presentation portfolio" (Himpsl&Baumgartner, 2009, p. 20), the decision was made to introduce only Mahara and ELGG ePortfolio system to students.

Mahara is entirely built as an ePortfolio application, while ELGG is primarily a social networking platform that supports ePortfolio functionalities. Since both of them are open source systems, they are being continuously improved by the Community, so new functionalities are added rather frequently.

According to literature and users' experience, Mahara has a much simpler user interface. In addition, it is impressive how quickly its developers fix bugs that have been reported. ELGG, on the other hand, has a richer set of functionalities and therefore provides better support in terms of community/social networking. Mahara has been entirely built as an ePortfolio system in accordance with its definitions. Although we primarily sought to find a system which would support ePortfolio features, we offered ELGG and its social

networking functionalities to students to see if they would use them too. Moreover, Mahara supports single-sign-on (SSO) from Moodle so that when users log in Moodle they are automatically logged in Mahara as well. However, no such connection was activated in order to preserve the independence of the systems and avoid giving any advantage to Mahara, considering that our students were using Moodle LMS and would perhaps prefer to use a system that is interoperable with it.

3.1.1 Introducing the ePortfolio concept

Since ePortfolio had previously not been introduced in any of the courses at FOI, this was the students' first encounter with such a system. In order to avoid possible issues and provide students with necessary information, a lecture was given as an introduction to the concept of ePortfolio and also to ePortfolio as a tool to be used in the course. In addition, an agenda with ePortfolio implementation stages and its usage was developed and presented to students. Thus the students had a full insight into the entire process; they knew what their assignments were and what would be expected from them at any moment. In the same week in their laboratory sessions they were given a quick tutorial on the use of ePortfolio systems Mahara and ELGG (see Table 3). All the students used both systems and had to upload their artefacts in both of them.

Table 3. Stages of ePortfolio implementation

Stage	Title and description:
1	**Introduction to ePortfolio** 1. Introduction to the ePortfolio concept and systems; The need for an ePortfolio; Power of reflection 2. Logging into the systems and artefact upload: a. Upload course related artefacts: seminar, presentation, practical work b. Personal artefact upload (4-5 artefacts) -> 'Best of me' section c. Tag the artefacts as follows: i. All course related artefacts are to be tagged with SIS08 ii. Tag all personal related artefacts arbitrarily 3. Fill in your personal profile (including the resume) and review at least 5 profiles of your peers
2	**Reflecting on ePortfolio** 1. Monitor progress, problem solving ... 2. Reflect by answering the questions according to the template: a. What have I learned about the ePortfolio? b. What was the most interesting thing about using the ePortfolio so far? Explain why. c. What in the ePortfolio was less interesting? Why? d. Where can I apply the ePortfolio in the process of my Lifelong Learning? 3. Split in groups. Make a view available only to peers from your group in which you will include the reflection made in Step 2. Use the ePortfolio systems to give feedback on reflections made by other peers within your group.
3	**Using ePortfolio to make course related reflections** 1. Monitor progress, problem solving ... 2. Now the set of tasks has been created. Reflect on all 4 major units learned in laboratory exercises. For each of them, answer the following questions by using the given template: a. What have I learned in this unit? b. What was the most interesting part of this unit? Why? c. What was less interesting? Why? d. Where can I apply it in future?
4	**Analyzing the results and evaluating the systems** 1. Final conversation about students' experience and impressions. 2. Analyzing and scoring students' work in ePortfolio. 3. Evaluating the ePortfolio systems used during classes.

The basic idea was to assign the students certain tasks for which they would have to use the ePortfolio. As can be seen from Stage 1 in Table 3, apart from being introduced to ePortfolio, the students were also given exercises like artefacts upload and tagging in order to get used to the new concept. First they had to create a showcase Portfolio and once they had become familiar with the systems they had to create an assessment Portfolio by placing their assignments and reflections in the ePortfolio systems for assessment (Stage 3).

Types of ePortfolio (showcase, assessment etc.) are usually represented as ePortfolio views. To illustrate this, an example of the ePortfolio creation process is presented:

1. Person creates his/her ePortfolio account and logs in.

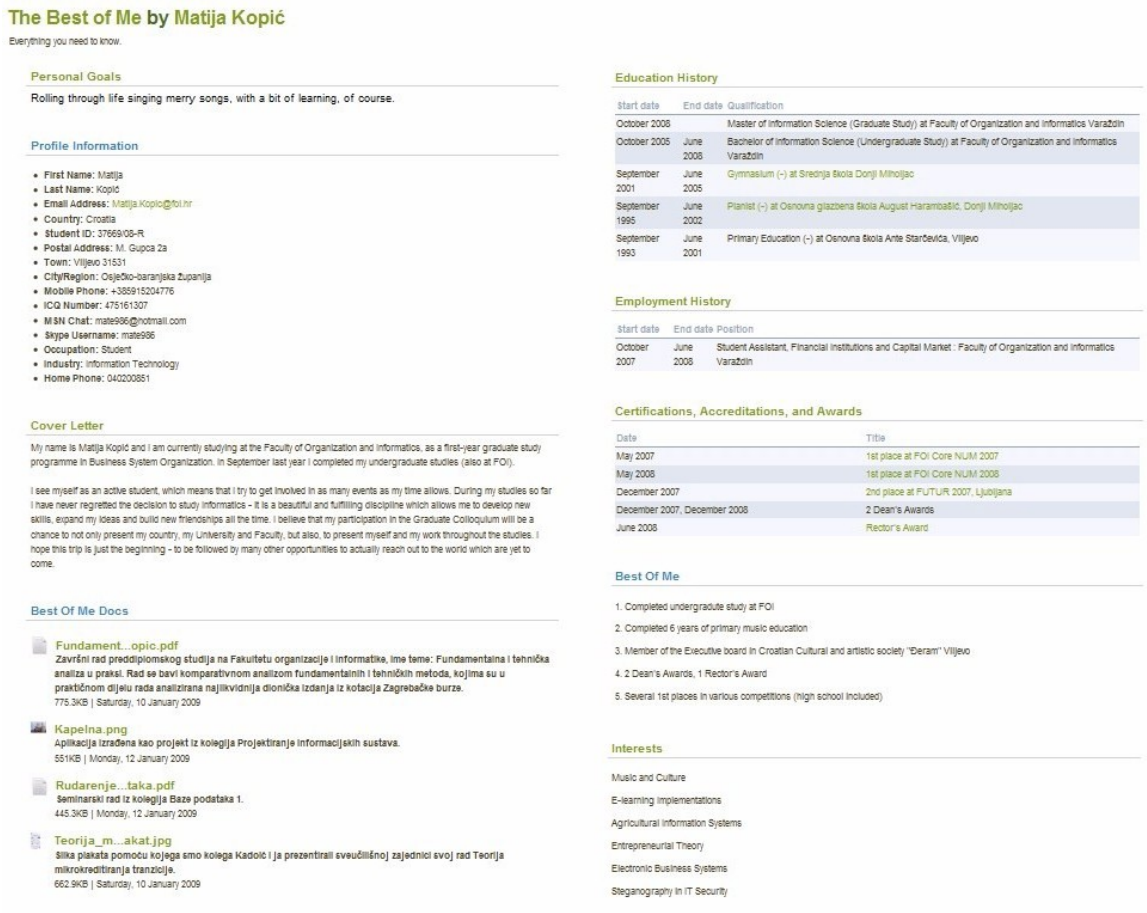
2. If Personal Profile or Resume fields are included in the ePortfolio, the owner fills them with information about himself or herself. If not, the owner creates a document in which he/she will store personal information.

3. The ePortfolio owner starts uploading artefacts into the system. An artefact can be any document, multimedia file, link, blog or another type of a digital record. The owner can also write reflections on stored artefacts. Until this moment, not a single artefact has been revealed to the audience – they are still inaccessible to others.

4. The ePortfolio owner creates view(s). A view is a collection of artefacts targeted at a certain audience. The owner selects artefacts to be included in the view as well as the view layout. The owner can nominate persons who will have access to the created view. Based on the type of artefacts within the view the ePortfolio type can be determined. In an Assessment Portfolio, the view is created for assessment purposes and contains seminar or practical work to be assessed by the educator. Since in this first stage students had to show their best work, skills and personal information, this was the case of a Showcase ePortfolio. An example of a Showcase ePortfolio can be seen in Figure 7.

5. After the view has been created and published, other peers can browse it and add their feedback. The potential of reflection and feedback is considered to be the most valuable characteristic of ePortfolio.

Figure 2. Example of student's Showcase ePortfolio



The Best of Me by Matija Kopić

Everything you need to know.

Personal Goals

Rolling through life singing merry songs, with a bit of learning, of course.

Profile Information

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Cover Letter

My name is Matija Kopić and I am currently studying at the Faculty of Organization and Informatics, as a first-year graduate study programme in Business System Organization. In September last year I completed my undergraduate studies (also at FOI).

I see myself as an active student, which means that I try to get involved in as many events as my time allows. During my studies so far I have never regretted the decision to study Informatics - it is a beautiful and fulfilling discipline which allows me to develop new skills, expand my ideas and build new friendships all the time. I believe that my participation in the Graduate Colloquium will be a chance to not only present my country, my University and Faculty, but also, to present myself and my work throughout the studies. I hope this trip is just the beginning - to be followed by many other opportunities to actually reach out to the world which are yet to come.

Best Of Me Docs

Fundament...opic.pdf
Završni rad preddiplomskog studija na Fakultetu organizacije i informatike, ime teme: Fundamentalna i tehnička analiza u praksi. Rad se bavi komparativnom analizom fundamentalnih i tehničkih metoda, kojima su u praktičnom dijelu rada analizirana najlikvidnija dionička izdanja iz kotacija Zagrebačke burze.
775.3KB | Saturday, 10 January 2009

Kapelna.png
Aplikacija izrađena kao projekt iz kolegija Projektiranje informacijskih sustava.
551KB | Monday, 12 January 2009

Rudarenje...taka.pdf
Seminarski rad iz kolegija Baze podataka 1.
445.3KB | Monday, 12 January 2009

Teorija_m...akat.jpg
Slika plakata pomoću kojega smo kolega Kadoić i ja prezentirali sveučilišnoj zajednici svoj rad Teorija mikrokreditiranja tranzicije.
662.9KB | Saturday, 10 January 2009

Education History

Start date	End date	Qualification
October 2008		Master of Information Science (Graduate Study) at Faculty of Organization and Informatics Varaždin
October 2005	June 2008	Bachelor of Information Science (Undergraduate Study) at Faculty of Organization and Informatics Varaždin
September 2001	June 2005	Gymnasium (-) at Srednja škola Donji Miholjac
September 1995	June 2002	Pianist (-) at Osnovna glazbena škola August Harambašić, Donji Miholjac
September 1993	June 2001	Primary Education (-) at Osnovna škola Ante Starčevića, Viljevo

Employment History

Start date	End date	Position
October 2007	June 2008	Student Assistant, Financial Institutions and Capital Market : Faculty of Organization and Informatics Varaždin

Certifications, Accreditations, and Awards

Date	Title
May 2007	1st place at FOI Core NUM 2007
May 2008	1st place at FOI Core NUM 2008
December 2007	2nd place at FUTUR 2007, Ljubljana
December 2007, December 2008	2 Dean's Awards
June 2008	Rector's Award

Best Of Me

1. Completed undergradute study at FOI
2. Completed 6 years of primary music education
3. Member of the Executive board in Croatian Cultural and artistic society "Đeram" Viljevo
4. 2 Dean's Awards, 1 Rector's Award
5. Several 1st places in various competitions (high school included)

Interests

Music and Culture
E-learning implementations
Agricultural Information Systems
Entrepreneurial Theory
Electronic Business Systems
Steganography in IT Security

3.1.1.1 Working with ePortfolio: educators' perspective

Since the implementation involved a hybrid (blended) course it was much easier to introduce ePortfolio to students than it would have been in a completely online course. Laboratory exercises showed that students did not have any problems with either of the ePortfolio systems since they were familiar with Web 2.0 technologies and e-learning in general. At this point it has to be mentioned that, since the subject of the course was information systems security, it was also expected that the students enrolled in the course would be comfortable using (new) information technologies.

In Stage 1, the main goal was to get students interested in the ePortfolio. Previous experience and literature review showed that students were likely to be more interested in the type of work during which they could both create something for themselves and show their competencies. This was the reason the students' assignment consisted of

uploading their personal information as well as the information they found relevant for showing 'the best of them'. Another reason was the research (Fernández, 2008) which showed that the information of the contents of ePortfolio must be selected by the owner of the digital portfolio "to be able to show his or her educative achievement and reflections about his or her own learning, in such a way that it reflects to himself or herself and to the others (teachers or 'peers'), the knowledge acquired in a certain period" (Fernández, 2008, p. 56). That proved to be a complete success, because students were very enthusiastic about this new idea of using ePortfolio. In fact, some of them completed Stage 2 ahead of schedule.

The scope of Stage 2 was threefold. Firstly, the students needed to learn how to reflect, which is in line with the user-centered constructivist approach and represents a crucial step in using ePortfolio. The tendency of new ePortfolios in Web-based environments needs to be more oriented towards the modern theories of learning, typically including aspects like social learning with a constructivist perspective while taking into consideration its individualization aspect (Fernández, 2008). Secondly, by dividing the students into groups within which they were supposed to browse and comment on views of their peers, they had to realize the potential of using ePortfolio views for presentation and feedback from others. Thirdly, it was important to get feedback from students about ePortfolio to find out their opinion about the ePortfolio and its usage in teaching and learning.

Stage 3 had a single purpose: to create an Assessment ePortfolio. When assessment is concerned, it has to be noted that certain types of work are suitable for assessment using ePortfolio, whereas others are better assessed with an LMS. For example, ePortfolio can be used for peer to peer assessment and as a reflection-based assessment tool, while LMS is more suitable for traditional assessment types such as tests and quizzes. The feedback received from the students at this stage was of great value for this research and it could even be considered as an added value. A detailed insight into the parts of the course that the students found either less appealing or too comprehensive was also obtained. It was also indicated which aspects of the course should be changed and why, as seen from the students' perspective. As a result, improvements in the course were made for the next generation of students, using the participants' suggestions.

3.1.1.2 Students' experience

The initial part of Stage 4 included a face-to-face discussion with the students about the ePortfolio concept, which was an opportunity for students to update their reflections and feedback from the previous stages. In addition, their impressions about ePortfolio in the form of reflections were analyzed. Judging by students' reactions, there is a huge potential for ePortfolio implementation at FOI to be exploited in the future. Selected parts of students' feedback are presented below:

"So far I didn't know there were systems as good as ePortfolio. The famous Facebook and similar systems are used for creating a personal profile and communication, but they do not provide what is important, what ePortfolio systems do provide, especially Mahara. Those systems offer a possibility to find a job much faster and more easily, to work on projects and maintain relationships with other peers that use the same system. By all means, I fully support educators in introducing ePortfolio to students. It is most likely those systems will replace a job interview in the future."

"EPortfolio has enabled me to record my qualifications and experience in course of education. My own ePortfolio could assist me in student mobility, in finding a right job and starting my career. EPortfolio enables me to introduce myself, my competencies, skills and work to potential employers."

"EPortfolio has a special purpose in fulfilling personal goals. Namely, when you have your life goals written out in a single place like an ePortfolio, you tend to look at them more often and therefore ask yourself whether they are being fulfilled. If one of those goals is lifelong learning, it can be assumed that some of the activities in your life would be directed towards fulfilling that goal."

"I see ePortfolio application in lifelong learning primarily as an opportunity to express our soft skills we didn't acquire in formal education but rather through working on projects or teams or while doing some other job (...). Furthermore I like the possibilities the ePortfolio offers, such as the ability to benchmark with other peers. In that way we can perceive our weaknesses and strengths to work on in order to improve our own capabilities."

3.1.2 Choosing the ePortfolio system

In the final step of Stage 4 students had to complete a comprehensive questionnaire aimed at the evaluation and comparison of the two ePortfolio systems used in the course. Statements in the questionnaire were mostly focused on (a) application features such as the ePortfolio application in general, organization of artefacts, file management, communication, security and privacy, as well as (b) technical features. Furthermore, in order to find out more about the students' impressions regarding the use of ePortfolio as a new way of learning, several statements were included in the questionnaire for that purpose only. It is important to mention that the questionnaire was based on an extensive overview of ePortfolio literature, as well as on a questionnaire developed for online course evaluation in the previous research (Bubaš *et al.*, 2007).

By analyzing the students' responses in the questionnaire, some interesting results were obtained. In the process of selecting the ePortfolio system, Mahara outperformed ELGG in all the categories. Therefore Mahara was the system introduced to students in several other courses during the summer semester 2008/2009. More than 500 students are currently using Mahara as an ePortfolio system at the Faculty. The second goal of introducing the ePortfolio as a new concept and teaching and learning methodology has also been fully realized. Namely, based on students' reflections presented in the previous section and the results of the first part of the questionnaire, in which the students expressed their opinion about the ePortfolio in general, we can conclude that they were impressed with this new tool. Most of them (76%) intend to use Mahara and ePortfolio in general in the future to show their competencies, work results, goals and reflections. The students did not only find the ePortfolio very useful, but also reported that learning how to build a personal ePortfolio was fairly easy for them. Detailed data about the questionnaire items and validation as well as the results obtained can be found in Balaban&Bubaš (2009).

3.2 *Using ePortfolio in hybrid courses*

Based on the results from the pilot project, a second phase was initiated. For this phase a twofold goal was defined: 1. To install and provide support for the needed ICT functionalities; and 2. To prepare students to work with ePortfolio. Concerning the ICT-related issues, it was necessary to decide on hardware and software requirements, study the possibilities of Moodle and Mahara integration and determine whether changes in the application interface would be needed.

The process of introducing the ePortfolio concept to students through training tasks was conducted within the course Informatics 2 (approximately 200 students). This blended course is taught in the summer semester and is enrolled by most of the undergraduate students at FOI. Since it was used to introduce ePortfolio to students, several lectures were delivered to students accompanied by ePortfolio materials explaining ePortfolio and its purpose in lifelong learning. These introductory actions were almost identical to Stages 1 and 2 in the pilot project. In addition, laboratory sessions were held to make students familiar with Mahara as an ePortfolio application and its functionalities. After that, students had two weeks to try out the application, explore the reflections segment and do their first task in ePortfolio. It consisted of making their own reflections about the ePortfolio following the questions provided in the template. The questions were the same as those in Stage 2 of the pilot project (see Table 3, Stage 2, task 2). Other reflections were related to the remaining three main topics of the laboratory exercises: Linux OS, Open Office and Python programming. Students were asked to reflect on those topics according to the instructions provided in the template. The template for reflection was provided at the end of each topic. At the end of the semester the students stated that they had found the reflections very interesting. On the other hand, the teachers were given feedback about the topics and the attractiveness of the content, which enabled them to make slight modifications accordingly. In the course of the semester the students got familiar with ePortfolio and learned how to use the system. They also learned how to use ePortfolio as a pedagogical tool since their reflections were evaluated. Moreover, they were prepared to show their CV or to create a showcase ePortfolio to present themselves in different contexts. With all this, prerequisites were met for a comprehensive usage of ePortfolio in other courses.

The full scale use of ePortfolio at FOI is conducted in the fourth semester of the undergraduate study, where students enroll in Selected Chapters of Mathematics (SCM), which is quite a complex course consisting of six chapters. In addition to monthly tests, students have to work on many problem-solving exercises that imply using mathematical theory and ICT tools that support problem solving. The ePortfolio was therefore introduced in order to fulfill two goals: 1. To enable students to reflect on their progress in the course; and 2. To provide a tool for the assessment of learning outcomes to be used both by students and teachers. Students continuously had to reflect on the issues they had learned, referring to the learning outcomes for each particular chapter. Students' reflections in ePortfolio needed to be written within two weeks after the lectures on a certain chapter had finished. The students' work done in ePortfolio was not an obligatory condition for fulfilling their course requirements and getting the professor's signature in their student's transcript. However, by participating in it students were able to collect 6% of the total amount of points awarded for coursework in SCM (i.e., 6 points, or one for each chapter). In awarding these points, teachers used the following criteria: student understanding of the basic course concepts presented in the reflection, student achievement evidenced by the attached artefacts and creativity of their choice. The teachers' motivation for introducing this new kind of assessment was to gather reflections and evaluation of learning outcomes in working with a large group of students (approximately 250 students in SCM and only 3 teachers – 1 professor and 2 teaching assistants). In such an instructional environment there is a significant number of students who do not have the opportunity to express their opinion and the teachers can hardly manage to monitor their individual achievements. The intention of using ePortfolio was thus to obtain better insight into the progress and work of individual students. Detailed analysis of this process can be found in Balaban *et al*. (2010b).

The whole process of ePortfolio implementation described in this section lasted for almost 18 months, starting from the pilot project and ending with its full scale implementation. Such thorough planning and implementation of ePortfolio presented a solid ground for further research. Today more than 500 students are using ePortfolio at the Faculty of Organization and Informatics, some of whom will be used as respondents in this research.

4 Information System approach to ePortfolio

From the description of ePortfolio, its main characteristics and possibilities for its implementation it is obvious that ePortfolio is a system that supports LLL (Richardson&Ward, 2005; Hartnell-Young, 2006). To determine whether ePortfolio fulfils its purpose (by, for instance, supporting required educational processes in a corresponding manner) or whether it is successfully implemented and applied within an academic institution, a method for measuring ePortfolio performance should be developed. From the current ePortfolio literature review mostly contained in Chapter 2 and Section 4.3 it can be noted that so far very little attention has been given to ePortfolio success, while successful ePortfolio implementation has been reduced to case studies only. Moreover, the research results related to popular IS Success Models (such as the D&M Model and Gable *et al.*'s Model) do not mention the usage of such models in the ePortfolio context (see Seddon *et al.*, 1999; Petter *et al.*, 2008; and Gable *et al.*, 2008).

In this chapter, a comparison between ePortfolio and IS will be made to show that an ePortfolio is in fact an IS. In order to reveal and comprehend the processes that an ePortfolio system should support, the ePortfolio meta-model that describes data/information flows, processes and entities will also be presented. By perceiving ePortfolio as an IS it is possible to apply IS success methods for measuring ePortfolio success. While some of the methods for IS success will only be briefly presented, the D&M IS Success Model to be used in this research to assess ePortfolio success will be explained thoroughly along with reasons for choosing that model. Beside the D&M Model constructs that determine ePortfolio success, Moderating Factors (MF) of ePortfolio success to be embedded into the D&M Model will be revealed and argued for.

4.1 *EPortfolio as Information System*

Several examples that indicate the interrelationship between ePortfolio and IS can be found in literature (see Jafari, 2004; Richardson&Ward, 2005; Mu *et al*., 2010). In his description of ePortfolio, Jafari (2004) approached its development using the IS framework. Mu *et al*. (2010) attempted to conceptualize the functional requirements for ePortfolio systems referring to ePortfolio as a concept which consists of people and technology. Although ePortfolio is frequently considered merely as an IT tool, its very concept actually comprises a lot more than that. As with any other IS, when ePortfolio is concerned, it is not sufficient to merely embrace the technology; it has to be adopted and used by people supporting all the required business processes in a proper way. An ePortfolio is a set of interrelated or 'meshed' components and functionalities, which also applies to IS. Therefore, ePortfolio applications should be put in a wider organizational context. Such an approach was taken in the research by Mu *et al*. (2010) in order to understand ePortfolio functionalities and their prioritization criteria. In the same paper, the authors discussed the challenges associated with the adoption of ePortfolios drawing on the literature about IS adoption and assimilation. Furthermore, in their survey conducted in the UK, Richardson&Ward (2005) argued that ePortfolios should support LLL. They also reported a significant discrepancy between ePortfolio applications and the requirements of a LLL environment as an organizational system to be supported with ePortfolio. In their study, the authors interpreted ePortfolio as an electronic system that supports LLL.

These examples justify the attempt to view ePortfolio as IS, suggesting that it should also be treated as such during deployment, while paying particular attention to its organizational context. In this dissertation two different approaches are used to provide evidence that ePortfolio is IS:

1. **Descriptive method** describes a phenomenon as such and is opposed to the genetic method. In addition, Johnson (1953) argues that this method is in contrast with exemplifying the causes of a phenomenon or ascertaining its value or significance. Since this approach is not adequate for understanding a life-cycle

of a phenomenon it cannot be used in the process of the IS development. However, it can be used to show the functions and goals of an IS to the end-user.

2. **Genetic taxonomy** (Brumec, 1997) provides a rationale for the existence of an IS, its development, source and origin. It is derived from a philosophical approach named the 'genetic method' (see Jensen, 1939; Žugaj, 2007) that tries to analyze and understand a phenomenon in terms of its genesis or origin. In case of IS, it explains why a particular IS exists and how it operates to support business system processes[5].

It is important to emphasize that these two approaches are not mutually exclusive. On the contrary, they observe the same phenomenon from two different aspects. The genetic taxonomy is used to define and explain an IS from the perspective of an IS analyst and is therefore much more comprehensive than the other method. On the other hand, the descriptive method describes an IS to the end-user and therefore does not need to be as exhaustive as the genetic one. In this research more attention will be given to the genetic taxonomy bearing in mind its complexity and the potential of using it in IS design.

4.1.1 Descriptive methods

In this section comparison between IS and ePortfolio definitions will be made. The resemblance between the definitions will be highlighted that can be attributed to similarities between the systems themselves. In Table 4 common attributes (3) extracted from IS definitions (1) and ePortfolio definitions (2) are grouped. It is assumed that similarities in definitions reflect similarities between objects.

[5] According to Brumec (1997) and Alter (2002), a business process is a set of mutually connected activities and decisions undertaken to achieve some specific parts of a common goal of the organizational system, for performance of which some resources and time are necessary. Different participants perform the same activities differently due to differences in their skills and knowledge.

Table 4. Comparison between definitions of IS and ePortfolio

(1) IS definition	(2) EPortfolio definition	(3) Common attributes of IS and ePortfolio
A set of interrelated components working together to collect, process, store, and disseminate information. (Laudon&Laudon, 2004)	A personal digital collection of information describing and illustrating a person's learning, career, experience and achievements. (European Institute for E-learning, 2009)	a. An individual uses several components (other people, institutions, network, IT technology) to create a personal digital collection. b. Within the digital collection, information is collected, processed and stored. c. Illustrating one's career and achievements implies dissemination in the IS context.
Work (organizational) system whose business process is devoted to capturing, transmitting, storing, retrieving, manipulating, and displaying information. (Alter, 2002)	A meaningful collection of student work that demonstrates progress and/or mastery guided by standards and includes evidence of student self-reflection. (Paulson *et al*., 1991)	a. Again, a meaningful collection implies the use of technology by people or organizations to gather, process and disseminate information. b. To demonstrate progress, mastery or to provide evidence of reflection, the information gathered in a. should be processed and disseminated accordingly using technology.
A set of interconnected components that involve hardware, software, people and procedures and work together to achieve some objective. (Lawlor, 1994)	An electronic learning record which enables an individual to store, organize and present their work and accomplishments. (Barret, 2003)	a. An electronic learning record is a combination of hardware and software that enables creation, storage and presentation of information. b. In an IS, individuals represent people who use procedures (presenting their accomplishments) to achieve an objective, like getting a better job.

Considering the common attributes (3) between IS definitions and ePortfolio definitions above (Table 4), the following conclusions can be drawn:

- An ePortfolio is a set of interrelated components at the technical level: it comprises a Web application, hardware and software support as well as a network infrastructure. These features qualify ePortfolio as IS from the technical perspective.

- An electronic learning record established at the technical level supports processes from a business system. It enables to collect, store, manage, process and disseminate information in the form of an artefact, which occurs at the data level. From the point of view of its purpose, ePortfolio is equivalent to IS.
- Providing support to data and having ICT features is not sufficient for an entity to qualify as an IS. EPortfolio fulfils its purpose the moment an individual interacts with others by giving and receiving feedback in different forms. In other words, ePortfolio fulfils its purpose when it is used within a community. Therefore, another important aspect of ePortfolio are people and organizations that use it (either as users or/and as the audience). These are also the most important elements of almost every IS. By recognizing those elements in the ePortfolio context, we can conclude that ePortfolio is equivalent to IS in terms of people, community and organization involvement.

To sum up, considering the results of the descriptive analysis, ePortfolio can indeed be perceived as IS since it meets all the IS requirements. Correspondence between the two is evident at all levels and in all aspects, thus providing sufficient evidence to classify ePortfolio as IS.

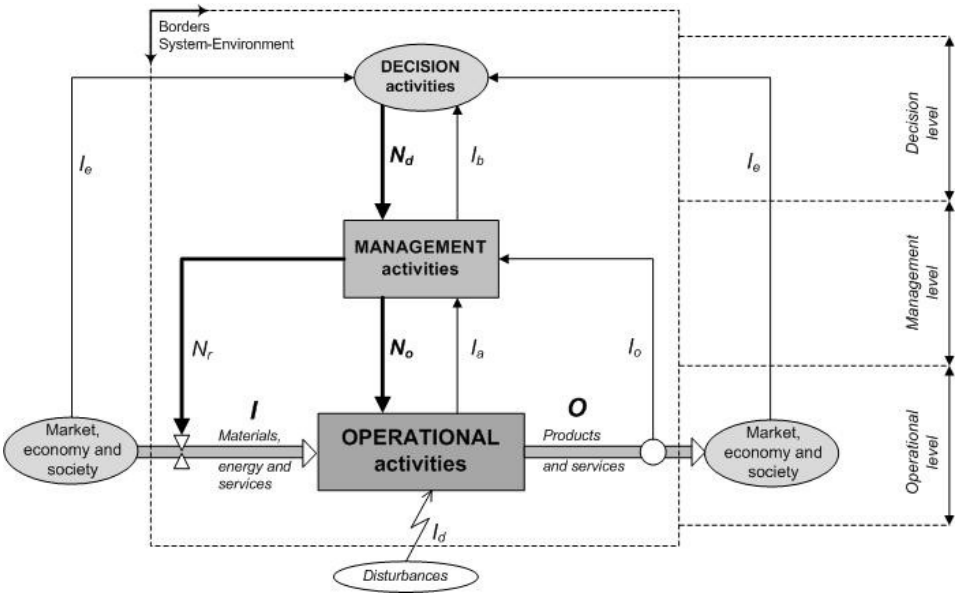
4.1.2 Genetic taxonomy method

Every organizational system has corresponding Information (sub)System, without which it could not properly perform its functions. Interdependence between the two systems (see Brumec, 1997) is shown in Figure 3. Organizational system and its information subsystem (cf. Brumec, 1997)Each organizational system involves people, business processes and certain resources to achieve some specific goals (see Lawlor, 1994; Alter, 2002; Laudon&Laudon, 2004). A user-centered LLL environment can be interpreted as a complex organizational system that includes people; the processes of learning, reflecting, development, planning and presenting as business processes; certain technical equipment such as computers and networks; and operates within some unstable environment in order to achieve specific goals (long-term and short-term goals like increasing personal competences; finding a job, successful course completion, etc.). The unstable character of such an environment can be explained in terms of upcoming

new trends in education (i.e. more complex learning requirements), new technologies and emerging global trends in general, including those in the environments that a LLL environment can be in direct contradiction/confrontation with.

Many authors, including Lawlor (1994), Alter (2002), Laudon&Laudon (2004) and others, argue that IS is not formless, but has a recognizable internal structure that is mostly hierarchical and enables optimum performance of its activities. Therefore each part of this complex system carries out a single set of activities, although their interaction is coordinated.

Figure 3. Organizational system and its information subsystem (cf. Brumec, 1997)



According to the relationships shown in Figure 2, all the processes that constitute the business technology of any kind of organizational systems can be categorized into the following three levels or main subsystems (for examples, see Licker, 1997; Brumec, 1997; Laudon&Laudon, 1998; Alter, 2002; Laudon&Laudon, 2004): Operational Information Subsystem (OIS), Management Information Subsystem (MIS), and Decision-Making Information Subsystem (DIS).

In the research in this dissertation the approach shown in Figure 2 will be applied to ePortfolio as IS and to the user-centered LLL (UCLLL) environment as an organizational environment. It must be noted that the IS structure is shown in the centre of Figure 2 with activities that support the processes carried out at different organizational levels shown on the right. The arrows in the chart represent information flows.

4.1.2.1 Interpreting ePortfolio in terms of Genetic taxonomy

Based on an extensive ePortfolio literature overview (Barker, 2003; Barret, 1998; Bisovsky&Schaffert, 2009; Blackburn&Hakel, 2006; Brant, 2006; Challis, 2005; Doig *et al*., 2006; Emmet *et al*., 2006; Flanigan&Amirian, 2006; Gibson&Barret, 2003; Hartnell-Young, 2006; Hickerson&Preston, 2006; Himpsl&Baumgartner, 2009; Jafari, 2004; Fernández, 2008; Martins *et al*., 2008; Paulson, 1991; Riedinger, 2006; Stefani *et al*., 2007; Stevenson, 2006; Zhang *et al*., 2009, etc.) and on the research by the author (Balaban&Bubaš, 2009; Balaban, 2010) an explanation will be given for each level independently in accordance with the original model shown in Figure 2:

At the **operational level** all the basic processes of an organizational system are carried out. Those are the processes whereby a system can be easily identified by an independent observer. At the operational level, input factors (**I**) are transformed into output values (**O**) that the system delivers to its environment. In case of ePortfolio, inputs (I) include learning methods, personal data, prior work and experience, certificates, exams, reflections and other types of previous learning as well as evidence of it. **Operational activities** include all types of manipulation with input factors which result in artefacts and ePortfolio views available to a wider audience (O). The transformation of input factors into artefacts and views presents an **added value** to an individual and a wider community. Every system tends to improve the efficiency of this transformation.

At the **management level** work is planned and organized. Furthermore, the needs for resources are identified, the success of the organizational system is monitored, and actions for eliminating disturbances from the environment or processes from the lower level are run. In case of ePortfolio it includes managing learning activities, PLE, ePortfolio artefacts and views, etc. To successfully manage the activities, information about activities at the operational level ($\mathbf{I_a}$), information about outgoing effects of the system ($\mathbf{I_o}$), and information about disturbances ($\mathbf{I_d}$) is needed. In case of ePortfolio, those three categories of information are represented as follows:

- $\mathbf{I_a}$ **=** created artefacts and views in the ePortfolio;

- $\mathbf{I_o}$ = feedback from the audience delivered in multiple ways (inside the ePortfolio, by e-mail, verbally etc.); and
- $\mathbf{I_d}$ **=** all the different types of disturbances such as failed expectations, artefacts in a certain view not matching the requirements set by the audience, wrong items processed at the level of transformation, etc.

Disturbances ($\mathbf{I_d}$) should be defined in the general sense as any disturbance coming from the environment, not necessarily a negative one. Moreover, in case of ePortfolio they can be in the form of upcoming new technologies that can eventually lead to enhanced self-presentation possibilities.

Based on the three categories of information presented above and goals set at the decision level ($\mathbf{N_d}$), orders about carrying out transformation processes ($\mathbf{N_o}$) and input resources usage ($\mathbf{N_r}$) are set at the management level. In the ePortfolio context, orders about carrying out transformation processes ($\mathbf{N_o}$) include the ways of constructing the view and designing and formatting artefacts. Using input resources ($\mathbf{N_r}$) refers to different means of gathering and preparing the data to become Input factors (I). The efficiency of a user-centered LLL environment as a whole depends on the management level quality.

At the **decision level** goals are proposed in the form of decisions ($\mathbf{N_d}$) that represent instructions for management activities. In case of ePortfolio, one's own mission and vision are set or re-examined. At this level an individual plans and develops one's own career. Information about the influence of the environment ($\mathbf{I_e}$) and information on business status ($\mathbf{I_b}$) obtained from the management level is needed in order to carry out decision activities. In the ePortfolio context, those terms can be explained as follows:

- $\mathbf{N_d}$ = decisions about view templates for different uses, such as job finding or further education; view and artefact tagging strategy, decisions about PDP activities;
- $\mathbf{I_b}$ = usability, view completeness, tagging usefulness; and
- $\mathbf{I_e}$ = new multimedia and ePortfolio capabilities, feedbacks, number of visits and comments for each view, information obtained from other persons' ePortfolios.

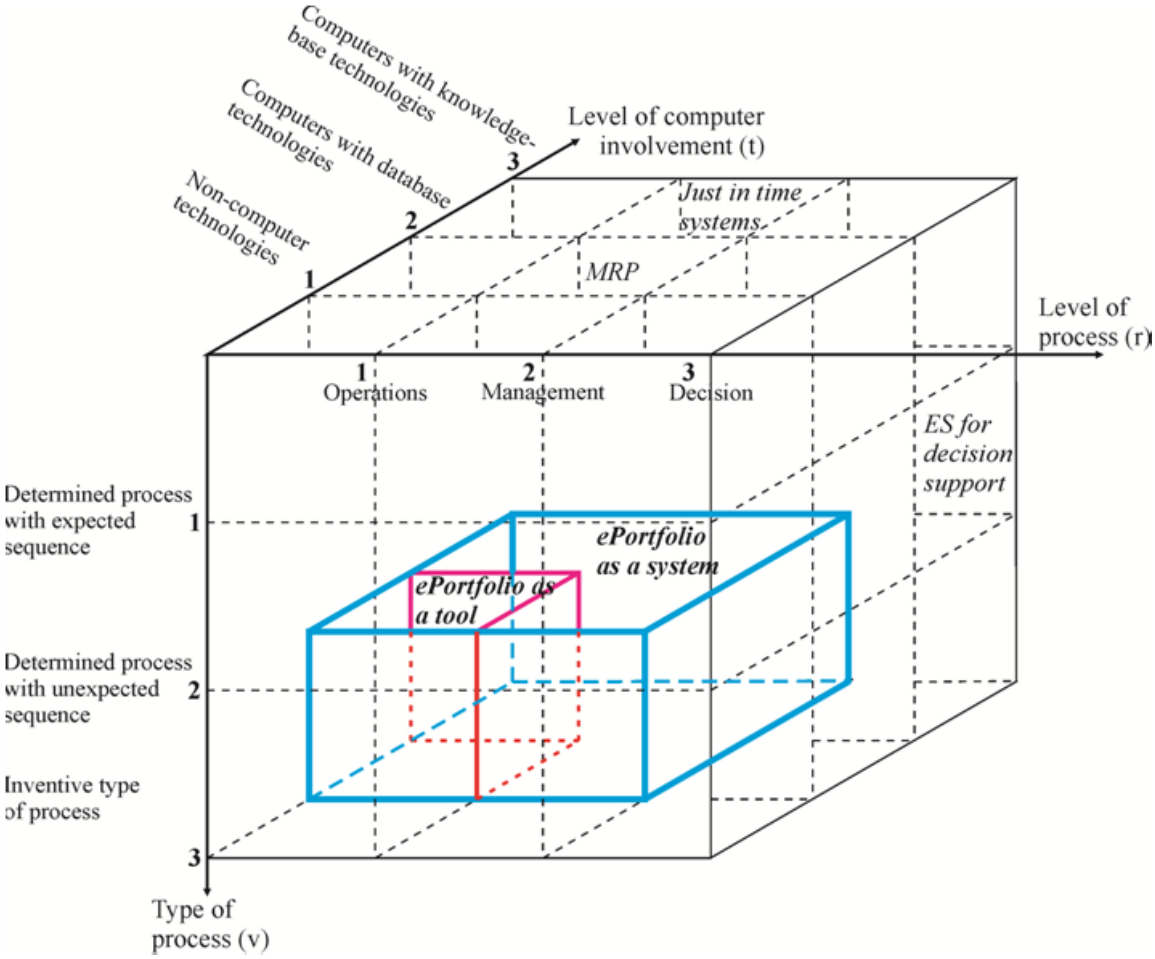
The stability of the user-centered LLL environment as well as one's personal growth and development depend on the quality of decisions made at this level.

4.1.2.2 Genetic Taxonomy Space (GTS)

Since all IS do not have the same goals and do not support similar processes in the same manner, they do not have the same internal structure. A Genetic Taxonomy Cube shown in Figure 3 comprises three different levels described as the taxonomy criteria. The criteria shown in that way constitute a 'Genetic Taxonomy Space' (GTS) allowing for 27 partial subspaces to be identified. Each of them corresponds to one group (type) of IS. Brumec (1997) and Brumec&Dušak (1999) indicated its openness and applicability in IS strategic planning as basic characteristics of GTS.

By considering GTS and ePortfolio from the perspective of GTS dimensions, two different terms can be distinguished: ePortfolio as an IT tool, and ePortfolio as a system. The GTS dimensions will be used in drawing a solid line between the two concepts.

Figure 4. EPortfolio in Genetic Taxonomy Cube



With respect to GTS and its dimensions, ***ePortfolio as a system*** shall be classified as follows (parameters for ePortfolio as an IT tool are given in parentheses):

- Type of process (v) = **3(3)**

  EPortfolio, both as a system and an IT tool, supports inventive type processes which are not determined in advance and whose structure cannot be completely known until completion. Feedback and (self)reflection are examples of inventive processes.

- Level of process (r) = **2(1)**

  If ePortfolio as a system is used as a pedagogical tool, the teacher uses it to partially manage teaching but it can also be used by the learner to manage one's learning. EPortfolio as a system enables managing teaching and learning by using artefacts and feedbacks received from others as well as inputs from the environment. Therefore parameter 2 can be designated to ePortfolio as a system. On the other hand, ePortfolio as an IT tool provides support only at the operations level while management activities are not directly supported. Therefore parameter 1 is designated to ePortfolio as an IT tool.

- Level of computer involvement (t) = **3(2)**

  EPortfolio as an IT tool presents a computer- or ICT-supported portfolio which consists of a Web application with a database. With respect to this taxonomy and the level of computer involvement, parameter 2 is designated to ePortfolio. On the other hand, ePortfolio as a system uses ePortfolio as an IT tool and other available Web 2.0 tools as well as all the information available within the IT tools and outside them. These are used as a knowledge base for making decisions about personal growth and development and to manage teaching and learning. Owing to that, an IT tool becomes an instrument merely used for achieving higher goals. In that sense, parameter 3 is designated to ePortfolio as a system.

This classification can also be presented in another way with respect to the Genetic-Taxonomical Order (GTO), in other words, as parameter: $\mathbf{R_{v,r,t}=[3,2,3]}$ for ePortfolio as a system and $\mathbf{R_{v,r,t}=[3,1,2]}$ for ePortfolio as an IT tool. It has to be noted that, when GTS is concerned, ePortfolio as a system takes up four times more space than ePortfolio as a

tool (see Fig. 3). This means that ePortfolio as a tool is entirely contained within ePortfolio as a system.

To summarize, considering the results of the genetic approach to ePortfolio it can be concluded that ePortfolio can be explained and interpreted as IS. It was previously shown that conceiving of ePortfolio only as an IT tool and restricting its usage to such a narrow interpretation implies that all ePortfolio functionalities are not entirely used. In other words, ePortfolio as an IT tool captures only certain aspects of ePortfolio as a system, which results in a significant misinterpretation of this phenomenon. Namely, by viewing ePortfolio only as an IT tool some of its crucial characteristics are clearly disregarded, such as the learning management support or support to decisions concerning personal growth and development. Using the genetic approach to ePortfolio, on the other hand, enables a broader insight into the ePortfolio concept.

4.1.3 Conclusion

In this chapter, departing from two contrary methods, ePortfolio was approached as IS. Both of them yielded the same result in proving that ePortfolio can be conceived as IS. Between the two methods, more attention was given to the genetic taxonomy, in the context of which the user-centered LLL environment was considered as an organizational system, while ePortfolio was considered as IS that provides support to the organizational system.

Consequently, a new definition of ePortfolio has been proposed with respect to the genetic taxonomy. EPortfolio can thus be defined as ***a subsystem of a user-centered lifelong learning organization, whose task is to link processes on the operational, management and decision-making level and the goal of which is to improve personal competencies, support learning management and increase decision-making reliability regarding personal growth and development***.

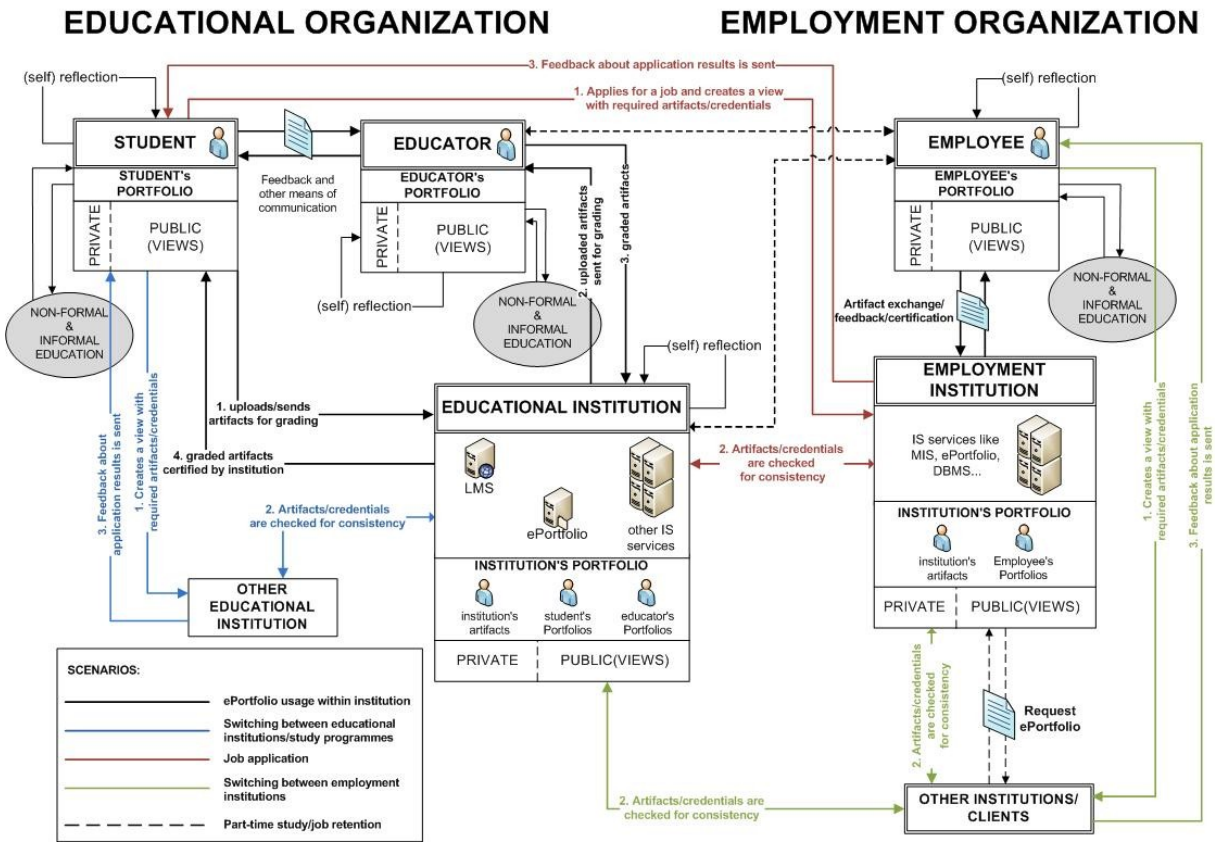
Moreover, distinction between ePortfolio as an IT tool and ePortfolio as a system was established. It was stated that ePortfolio as an IT tool represents a subsystem of ePortfolio as IS. With respect to GTS the smaller cube representing ePortfolio as an IT

tool can be expanded by two dimensions: Process level and Computer involvement level. A perfect alignment or match between the two cubes indicates that the IT tool fully supports all IS functionalities. Therefore, the aim of ePortfolio applications developers should be to enrich the applications' functionalities in a way that the application (IT) cube is expanded as much as possible towards the bigger cube pertaining to the ePortfolio system. In the ePortfolio literature numerous examples can be found of researchers and users conceiving and using ePortfolio only as an IT tool. Its possibilities, use and importance in LLL are therefore often misinterpreted. The findings presented here are intended to clarify the difference between the two terms so as to enable future users and researchers to approach and comprehend ePortfolio as a system rather than only as an IT tool.

4.2 *The ePortfolio meta-model*

In order to adequately comprehend ePortfolio functionalities it is necessary to understand the organizational environment in which ePortfolio operates, i.e. the User-Centered Lifelong Learning environment (UCLLL) with all its characteristics and subspaces (such as PLE). Based on the extensive ePortfolio literature overview (Abrenica, 1996; Barker, 2003; Barret, 1998; Batson, 2002; Bisovsky&Schaffert, 2009; Blackburn&Hakel, 2006; Brant, 2006; Challis, 2005; Doig *et al*., 2006; Emmet *et al*., 2006; Flanigan&Amirian, 2006; Gibson&Barret, 2003; Gibson, 2006; Hartnell-Young, 2006; Hickerson&Preston, 2006; Himpsl&Baumgartner, 2009; Jafari, 2004; Fernández, 2008; Lorenzo&Ittelson, 2005; Martins *et al*., 2008; Paulson, 1991; Riedinger, 2006; Ring&Foti, 2006; Stefani *et al*., 2007; Stevenson, 2007; Tosh&Werdmuller, 2004; Zhang *et al*., 2009, etc.) as well as the author's own experience with ePortfolio, a meta-model shown in Figure 5 was developed to represent a possible usage of ePortfolio as a central system in Lifelong Learning. Moreover, it represents ePortfolio in the way it is comprehended in the context of this dissertation. In the following sections it will be shown that the success of ePortfolio greatly depends on how well it supports all the possible processes in LLL. Five basic scenarios can be identified regarding ePortfolio usage in LLL that will be briefly described in the following part of this section.

Figure 5. The ePortfolio meta-model



Scenario I: **ePortfolio usage within an educational institution**

Three entities are present in this case: Student, Educator and Educational Institution. Since the primary function of ePortfolio is to support the learning process it is obvious that formal education is the point of departure. In this case Student collects, organizes and presents their data through ePortfolio. Educator can use the ePortfolio system in two ways: 1. To present their data and to contribute to the Institution's ePortfolio; and 2. To communicate with Students and support their learning process. Concerning its internal structure, every ePortfolio consists of two main parts: 1. Private: set of data in ePortfolio available only to the owner; and 2. Public: set of data grouped and published as an ePortfolio view to the wider audience.

Most ePortfolio views developed in the context of formal education are intended for assessment. The process will be simplified and described as follows:

1. Student creates a view that holds artefacts to be graded by Educator. Although in formal education it is common for Institution to host the ePortfolio system, in this case it is not relevant. An artefact can be sent for grading through the Institution's services, or it can be uploaded on the Institution's LMS.
2. Educator receives/downloads a Student's artefact, grades it and makes some comments and recommendations for improvement if needed.
3. The graded artefact is uploaded to LMS or some other service. During that procedure the artefact with its metadata (grade, comments, date, author, etc.) is certified by Institution to preserve its integrity and validity.
4. Student downloads/receives the certified artefact and stores it in ePortfolio for later usage.
5. By repeating steps 1 to 4, Student enriches their own ePortfolio with certified artefacts that will be used in the second step, i.e. the job application or job retention process.

Modern schooling offers students an opportunity to be mobile during the study period and spend it on different institutions (universities). EPortfolio can assist in this process and enable a quicker, easier and more transparent process of switching between institutions or study programmes in a way that competences and prior learning are documented and proven in an easy and transparent manner.

Scenario II: **Switching between educational institutions/study programmes**

Three entities included in the previous scenario remain present in this one as well, with the possible addition of another entity, i.e. another educational institution, which can basically be perceived as an Educational Institution entity.

1. Student creates a view and includes artefacts needed to apply for a study programme, change Educational Institution or simply spend one semester or year in a mobility scheme (for example, Erasmus). The view is published and a potential institution has access to it.

2. During education artefacts are certified by Educational Institution. This enables the Institution to check the consistency and validity of artefacts in a Student's ePortfolio.
3. Based on the results of audit from step 2 and the quality of the given credentials/artefacts, feedback is sent back to Student.
4. If Student returns to their home institution after a certain study period spent in mobility at a host institution, the home institution can find proofs of Student's achievements in ePortfolio.

After the student completes the formal education process it is time to apply for a job.

Scenario III: **Job application**

In this scenario, the student evolves into an employee. Different types of entities appear in this case: Student, Educational Institution and Employment Institution.

1. Student creates a view and includes artefacts needed for a job application. The view is published and a potential employer has access to it.
2. During education artefacts are certified by Educational Institution. This enables the potential employer to check the consistency and validity of artefacts in a Student's ePortfolio as well as to assess their quality and appropriateness.
3. Based on the results of audit from step 2 and the quality of the given credentials/artefacts, feedback is sent back to Student.

The artefact verification/certification process presents a very serious issue today and should therefore be addressed properly. To support this claim, a recent research should be mentioned which showed that in 91 ePortfolio systems not a single artefact could be verified for its consistency or validity (Balaban *et al*., 2010a). The author of this dissertation has attempted to address the artefact certification problem and suggested a lightweight protocol as a possible solution (Balaban&Kišasondi, 2010).

On a different note, it has to be mentioned that the meta-model in this section shows general processes in a real (business) system that ePortfolio should support. It

represents a basic view or a starting point in approaching ePortfolio as a concept. For every scenario described in the meta-model, more detailed decomposition can be made along with the corresponding model. In addition, the success of the ePortfolio system will be seen as a percentage in which ePortfolio can support all the required processes in a real system.

Scenario IV: **Switching between employment institutions**

This scenario is very similar to Case II scenario. Moreover, Case V scenario can be comprehended as Case II applied in an employment organization. Three main entities can be identified: Employee, Employer and Educational Institution. In addition, another employer to which an employee wants to apply for a job can also be identified, although technically this is still an instance of an entity named Employer.

1. Employee creates a view and includes artefacts needed to apply for a study programme or to change the institution. The view is published and a potential institution has access to it.
2. During education artefacts are certified by Educational Institution. This enables the Institution to check the consistency and validity of artefacts in an Employee's ePortfolio.
3. Based on the results of audit from step 2 and the quality of the given credentials/artefacts, feedback is sent back to Employee.

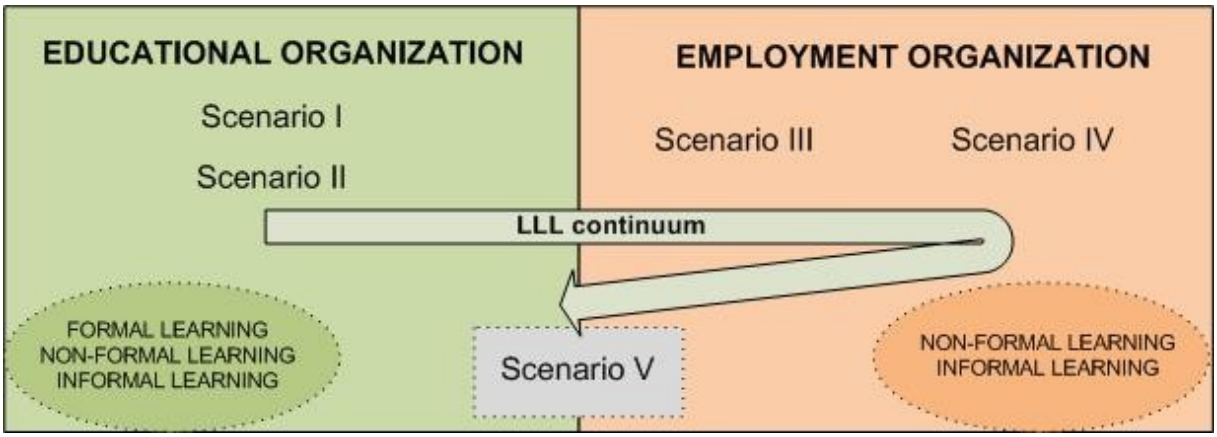
Scenario V: **Part-time study/job retention**

This is a combination of several scenarios presented so far. An individual is an employee but at the same time wants to continue their education. In most cases it is related to non-formal education, although in some countries it is organized as a part-time study in which an individual enrolls a university or a polytechnic. This scenario enables an individual to study and work at the same time using on-line or blended education. As in Case I, all the achievements in the form of artefacts can be signed and verified by the educational institution. Moreover, an individual can interact directly with the educator if

needed. The results of an individual's working experience and education are stored in ePortfolio.

In addition to scenarios, it is important to mention processes which occur in the life of every individual often considered as 'the background processes' that refer to non-formal and informal learning. Those are presented as ovals and also result in artefacts stored in ePortfolio.

Figure 6. LLL continuum



It is important to notice that the scenario sequence follows the LLL concept shown in Figure 5. In Scenarios I and II the student acquires knowledge mainly during formal education. In addition to knowledge, they learn how to think and reflect. After formal schooling the student becomes an employee, as described in Scenarios III and IV. To stay competitive, they must enrich their knowledge throughout life. Therefore Scenario V shows the employee who acquires new knowledge through different education mechanisms and uses an ePortfolio to document their knowledge and accomplishments, show their competencies, and manage their own personal growth and development.

Scenarios I to V represent foundations of this dissertation. The meta-model and extensive literature overview helped in understanding ePortfolio as a concept, including its mission and purpose. In addition, the five scenarios show how IS should work or how it should provide support for an employment organization. In this case, the LLL concept is perceived as an employment organization while ePortfolio is seen as its IS supported by ICT.

4.3 *EPortfolio success*

The previous sections (4.1 and 4.2) provided grounds for the discussion of ePortfolio as IS. Consequently, it is justifiable to apply theoretical findings from IS success literature to measure ePortfolio success. However, a specific environmental context, the UCLLL environment (described as a meta-model in section 4.2) in which ePortfolios operate, has to be taken into account in the process.

Since the function of IS is to support business processes entirely or partially (that is, supporting only some of their subunits), the functionality of the supported business processes depends on the underlying IS (Laudon&Laudon, 2002). Therefore, IS performance and business performance are causally related (Gable *et al*., 2008). Until the 1990s there had not been many serious attempts to measure IS success, mostly because researchers did not approach this complex phenomenon in an adequate way. Sabherwal *et al*. (2006, p. 1849) analyzed previous work in the field of IS success and noticed that "despite considerable empirical research, results on the relationships among constructs related to information systems (IS) success, as well as the determinants of IS success, are often inconsistent."

The first serious attempt to measure IS success was in 1992, when DeLone and McLean developed a multidimensional IS success model that comprehended the complexity of IS success. After that many researchers were encouraged to try to develop their own models or to adapt the D&M Model in terms of developing new measures or adapting the existing ones to measure the constructs in the D&M Model. Some of the researchers that developed their own models, like Mirani&Lederer (1998); Seddon *et al*. (1999); Gable *et al*. (2003); and Sedera *et al*. (2004) are worthwhile mentioning here. However, most of them derived their models from the D&M Model, while others used the D&M Model to assess IS success as a whole. A brief and systematic overview of some alternative models of IS success are presented in the next section.

4.3.1 Different approaches to measuring IS success

A number of measures dealing with IS success has been developed over the last decade. However, a commonly accepted index or a unique set of measures that would enable a comparison of results does not exist because of the difficulty of having generic measures for each construct. For example, Gable *et al*. (2003) developed specific measures for Enterprise System (ES) success although they used the D&M Model as the theoretical framework for their measures. DeLone and McLean based their model on an e-commerce system and therefore developed measures for the e-commerce context. By analyzing previous work of Smithson&Hirchheim (1998), Mirani&Lederer (1998), Seddon *et al*. (1999), Torkzadeh&Doll (1999), Gable *et al*. (2003), Sedera *et al*. (2004) as well as DeLone&McLean's work between 1992 and 2008, it is evident that a unique index will be difficult to establish for following reasons:

1. Numerous models and measures of IS success exist.
2. Existing measures do not measure the same constructs and/or do not use the same scales.
3. Although some common constructs between measures exist, too many deviations can still be found within constructs and in relationships between constructs.

Seddon (1997) started his work relying on the first version of the D&M Model developed in 1992. His research resulted in a re-specification and extension of the D&M Model. Some of his findings were found to be interesting and valuable by the authors of the D&M Model themselves so they were integrated into the update of the D&M Model in 2003. Seddon *et al*. (1999) continued to study IS success and the D&M Model, leading to a proposal of an IS effectiveness matrix based on data warehouse systems. The basic message of their research was that different measures are needed to assess the impact and effectiveness of IS.

Gable *et al*. (2008) analyzed issues with current IS success models and measurement. They suggested that IS success should be multi-dimensional, basing most of their analyses on empirical studies of DeLone&McLean from 1992 to 2005. In fact, Gable *et al*. (2008) wanted to separate IS impact from IT function to enable organizations to track their IT performance. To accomplish that, they reconciled the D&M IS Success Model

with IS-Net from Benbasat&Zmud (2003) and performed their research on the newly suggested model. Gable *et al*. (2008) thus obtained 4 constructs that determine IS impact: System Quality, Information Quality, Individual Impact and Organizational Impact. It is very interesting that they parsed out, i.e. eliminated User Satisfaction because it added little explanatory power to the model on the whole. Use was also eliminated because the system use was mandatory and therefore constant practice influenced satisfaction. Their model has not been widely tested yet and the authors themselves have raised the questions of "whether the initial list of impact citations used in the development of the a-priori model was complete and representative of contemporary IS in general" and "whether the final list of measures and dimensions can, indeed, be generalized" (Gable *et al.,* 2008, p. 397). It is important to mention that the model was developed for enterprise systems and so far it has not been proven that it is applicable to other types of IS.

Many authors decided to focus on a single aspect of measuring IS effectiveness or success. Rivard *et al*. (1997) developed a comprehensive instrument to capture system quality. The instrument is widely used today and DeLone and McLean recommend it to be used along with their model. Gable *et al*. (2003) developed their own index of system quality. Coombs *et al*. (2001) and Wixom&Watson (2001) developed their own scales for measuring information quality using literature review. On the other hand, Venkatesh *et al*. (2003) developed a very well accepted and commonly used Unified Theory of Acceptance and Use of Technology (UTAUT) method for assessing use and user satisfaction. Torkzadeh&Doll (1999) developed an instrument that specifically measures the individual impact of IS.

For the purpose of this doctoral dissertation, only a model that has the ability to be applied on a variety of IS types and that has been proved to be widely accepted can be taken into consideration.

4.3.2 Choosing an appropriate approach

Instead of trying to develop a common measure for IS success, researches are still struggling to prove that their model or measure is the best under certain circumstances while criticizing other models (e.g. Seddon, 1997; Sedera *et al*., 2004; Gable *et al*., 2008). However, if researchers engaged themselves in analyzing several models that measure IS success, they would perceive that all models share certain constructs, although different interpretations of each construct are used. Therefore, when such common constructs are considered, it is obvious for each construct different factors are measured and different measure scales are used. Furthermore, different interpretation of constructs between models and construct diversity are also caused by different contexts in which a model/measure was developed.

Bearing all this in mind, three possible solutions should be considered:

1. Developing common model/measures for IS success that could be used in all contexts.
2. Developing a unique model for IS success that will measure success in a specific context.
3. Adopting one of the most widely used models for IS success and using it in a specific context.

Developing a common model can be very demanding in terms of complexity and time. A detailed analysis of a very large number of IS success models and measures in all possible contexts is needed in order to comprehend the nature of IS success and to form constructs that could be universally applied. It can be assumed that the resulting model would not be analogous to any of the existing models. This could happen since many researchers tried to develop a common model. Also, a very large number of tests are needed in order to prove that the model could be applied in different contexts.

The awareness of the aforementioned issues has led some researchers to try to develop a unique model for a specific context rather than generalize and prove that their model can be applied in several contexts. Most of them used the existing models as a starting point, while others started from scratch and ended up developing their own scales and

indices. As a result, new models were built but without any possibilities for result comparison between them. DeLone&McLean (1992) started developing a unique model for measuring IS success in e-commerce and proposed a common model which had a potential to be applied in general (that is, in different contexts). After several iterations the model became well-known and was used and cited in more than hundred papers in the academic literature (Petter *et al*., 2008).

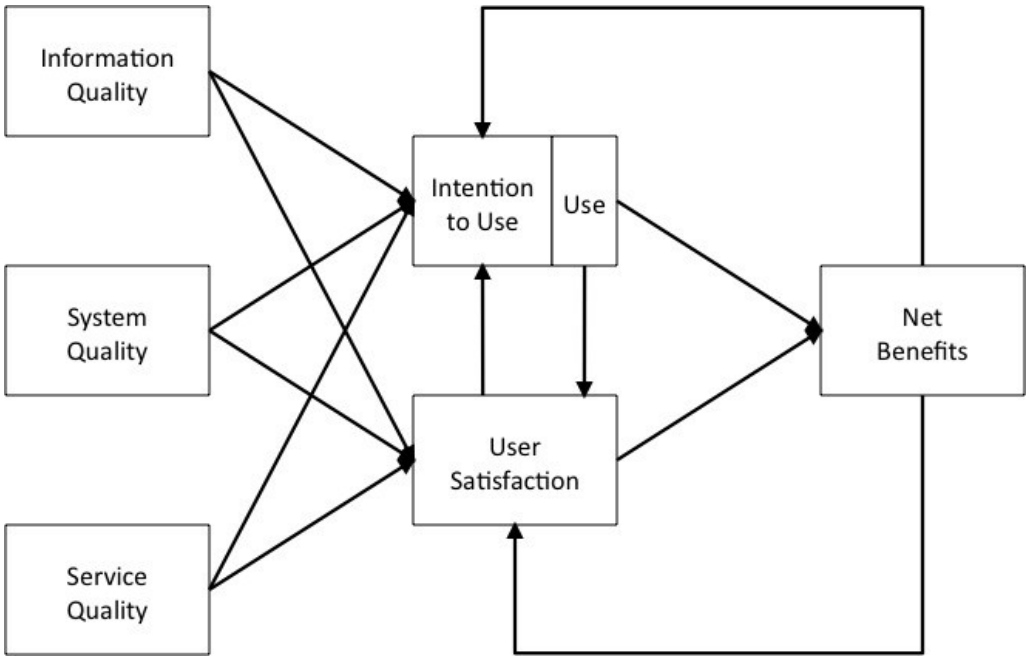
Therefore it can be claimed that the D&M Model (DeLone&McLean, 2003) is a very widely accepted model for measuring IS success. Many researchers have adopted the D&M Model and measured the success of a particular IS. Since many researchers used the same model, it is possible to compare results and to obtain some valuable information about IS success in different contexts. Moreover, Petter *et al*. (2008) analyzed over 90 empirical studies and gave suggestions for further research in which they further encouraged the use of the D&M Model in a variety of contexts. Such a wide adoption of the D&M Model has prompted researchers to adopt the model rather than try to develop their own. In this dissertation, the D&M Model will also be used to assess the success of ePortfolio. However, it will be enhanced with Moderating Factors (MF) in order to provide a more profound insight into the nature of relationships between the constructs in the D&M Model.

4.3.3 Using the D&M Model to assess ePortfolio success

The original D&M Model for measuring IS success was developed in 1992. Its primary purpose was synthesizing previous research involving IS success and providing guidelines to future researches. The multidimensional model was proposed considering "communications research of Shannon and Weaver and the information 'influence' theory of Mason, as well as empirical management information systems (MIS) research studies from 1981-87" (DeLone&McLean, 2003, p. 70). As a result, both process and causal model based on six dimensions (constructs) of success were developed. These two features, causality and processing, embedded into a single model would raise major issues concerning the model and eventually lead to confusing interpretations. However, DeLone and McLean did a citation research in 2002 and yielded 285 refereed papers in

journals and proceedings that referenced the original model. Taking into consideration the criticism expressed in some papers regarding model validation, as well as suggestions and implications from other researchers who had tested the model, the original D&M Model was updated and published in the Journal of Management Information Systems (DeLone&McLean, 2003). The Updated D&M IS Success Model will be used in this dissertation, hereafter referred to as the D&M Model.

Figure 7. Updated D&M IS Success Model



All the process and causal elements from the original model were transferred to the Updated version of the original D&M Model shown in Figure 6 since its authors argued that "in order to understand fully the dimensions of IS success, a variance model is also needed" (DeLone&McLean, 2003, p. 76). In other words, the process model states that B *follows* A. In this example we can say that some benefits occur due to system use (i.e. Net Benefits follow Use). A variance or causal model postulates that A *causes* B; in other words, by increasing A we will cause B to increase (or decrease) as well. Following the same example, if we assume that an increased or even extensive system use will occur,

which can be inappropriate in some cases, there may also be no benefits. Therefore, both aspects (process and causal) should be encompassed and considered when assessing IS success.

Since this model presents the backbone of this dissertation, each of its six dimensions of success will be explained separately along with indications for measuring each dimension. Construct descriptions are mostly based on literature review (DeLone&McLean, 1992; DeLone&McLean, 2002; DeLone&McLean, 2003; Petter *et al*., 2008) and the author's personal experience gained during the development of measures for each category. DeLone and McLean distinguish and explain in detail two possible levels of analysis: individual and organizational. Regarding the fact that most of the institutions contacted for the purpose of this dissertation reported a very low level of ePortfolio maturity as well as early stages of implementation (see section 5.6), which leads to specific sample limitations in terms of academic institutions, the ePortfolio success will be analyzed at the individual level, i.e. from a student's perspective. Accordingly, the constructs will be operationalized and described having in mind the individual level of application.

CONSTRUCTS:

(1) **System Quality:** *Measures of the Information Processing System Itself*

This dimension measures the desirable characteristics of IS. Since this dimension captures the system itself it is oriented towards technical specifications like data processing capabilities, response time, ease of use, system reliability, sophistication etc. According to DeLone and McLean (2003), the System Quality construct should measure *technical success* that Shannon and Weaver (1942) defined as the accuracy and efficiency of the communication system that produces information. The most common measure of System Quality is the *perceived ease of use* related to the Technology Acceptance Model (TAM). However, many researchers, including DeLone and McLean, believe that the perceived ease of use does not capture the construct as a whole (Petter *et al*., 2008). Therefore researchers have created their own indices of System Quality based on literature review or DeLone and McLean's recommendations.

In the ePortfolio context: The system for processing information is the ePortfolio (Web) application itself. Today's ePortfolios are Internet applications, so this construct measures the desired characteristics of an ePortfolio application (tool) in the Internet environment. Usability, functionality, user interface and security are examples of qualities that are valued by users of ePortfolio application from the users' point of view. More specifically, the ePortfolio system quality is reflected in the ease of use, availability of help functions, ability of the ePortfolio system to continuously be up and running, its ability to provide sufficiently quick response, its integration with other on-line tools, etc.

(2) **Information Quality:** *Measures of Information System Output*

This construct includes the desirable characteristics of system outputs. The quality of information the system produces, primarily in the form of a report or a Web page, is measured. Since DeLone and McLean developed their IS Success Model considering the Shanon&Weaver's (1942) framework, this construct measures Shanon&Weaver's *semantic success*, which is the success of the information in conveying the intended meaning. According to Petter *et al*. (2008) the Information Quality construct has proven to be problematic to capture and measure as it is not often distinguished as a unique construct. While some researchers used the existing generic scales of Information Quality, others developed their own scales. Some categories of Information Quality that can be measured are relevance, understandability, accuracy, completeness, usability, importance etc.

In the ePortfolio context: Information is processed by the ePortfolio application. Outputs present added value to the society and to individuals themselves. Outputs should be valid, relevant, well formatted, easy to understand and up to date if we expect students, teachers or employers to use ePortfolio. Two main types of information are produced in the ePortfolio in conjunction with the user: artefacts and views. It needs to be mentioned, however that views can also be interpreted as artefacts. Therefore this construct measures the quality of views and artefacts produced by the ePortfolio application and the user. The quality is reflected in terms of whether the artefacts can be verified, whether the artefacts or views are concise, readable, up-to-dated, etc.

(3) **Service Quality:** *Measures of Support Provided to the End-User*

Except for quality software and satisfactory information, the nature and the extent to which end-users receive support in working with the system plays a very important role in IS success. Therefore in this construct the quality of support that system users receive from the IS department and IT support personnel is measured. This construct was added to the Updated D&M Model on grounds of previous research based on the original D&M Model that identified the need for this construct. The importance of this construct is determined by the context, since Service Quality can be of great importance when measuring the success of an IS department, as opposed to that of individual systems. The most widely used method for measuring Service Quality is SERVQUAL. Possible characteristics of this construct are responsiveness, accuracy, reliability, technical competence etc.

In the ePortfolio context: All the means of support in using ePortfolio that differ depending on the context and range from online help, manuals and help-desk service to the ability of using the ICT equipment in institutions. Its importance is great since inadequate user support can actually lead to poor use of ePortfolio. Therefore this construct measures end-users assurance, empathy and clarity. In the ePortfolio-specific environment, service quality measures the individual attention paid to the user by the institution, the available means of end-user support, how well the ePortfolio assessment and usage criteria are described in course requirements, etc.

(4) **System Use:** *Recipient Consumption of the System's Capabilities*

Indicates the degree and manner to which staff and customers utilize the capabilities of IS. Intention to Use and Use are strongly interconnected and the authors suggest using Intention to Use as an alternative to Use in some contexts. Although Intention to Use describes an attitude and Use relates to behavior, either of them can be used depending on the context. Some authors suggested the removal of this construct as a success variable because in most research the construct was too trivially defined. Since this is a complex variable it is crucial to consider the nature of use and not only the frequency of use. Wrongfully, some researchers assumed that System Use was the most objective and the easiest to quantify and therefore tried to interpret the concept by measuring only the frequency of use. Therefore, when updating the D&M

Model, its authors stressed the importance of this construct and suggested that researchers "consider the nature, extent, quality, and appropriateness of the system use" (DeLone&McLean, 2003, p. 76). There was also a debate about appropriate measures. Namely, in empirical studies a lot of measures of use were adopted, but in most cases those measures led to mixed results between use and other constructs. Therefore considerable attention needs to be given to choosing appropriate measures in a specific context.

In the ePortfolio context: The purpose of ePortfolio is to support LLL. This construct assesses the degree and manner in which an individual uses the ePortfolio application and realizes its potential and usage for LLL. In terms of ePortfolio it measures the system's functionalities being used by the user such as features for organizing the ePortfolio content, joining groups, artefacts tagging as well as facilitating conditions that are present during the use of ePortfolio.

(5) **User Satisfaction:** *Recipient Response to the Use of the Output of an Information System*

Users' level of satisfaction with reports, Web sites, and support services is measured with this construct. The main difference between this concept and the previous one can be noted when system use is mandatory. In that case, User Satisfaction becomes a very useful construct because satisfaction will eventually lead to greater efficiency. Use and User Satisfaction are interrelated in both process and causal sense. Use precedes User Satisfaction, while greater Satisfaction will lead to greater Use. As in case of System Use, the most popular measures for this construct also contain items related to other constructs. This is due to the fact that these measures were originally designed to measure different categories but many researchers simply adopted them and applied them to the D&M Model. Therefore some researchers parsed out elements that do not measure this construct or used their own scales.

In the ePortfolio context: This construct assesses user satisfaction with the ePortfolio application and the information produced by that application. User's satisfaction with views, artefacts and feedback received will probably lead to a greater use of the ePortfolio as an application and a concept. The attitude toward using the system and its usefulness are considered to be two of the most important

elements of User Satisfaction in the ePortfolio context. Therefore this construct measures whether the ePortfolio system makes work more interesting, whether all necessary resources are met in order to use ePortfolio, whether an individual has the knowledge to work with the ePortfolio, etc.

(6) **Net Benefits:** *The Effect of Information System on Specific Contextual Levels*

The extent to which IS contribute to the success of individuals, groups and other stakeholders is represented as Net Benefits. In the original model the term 'impact' was used to describe the effect of IS on individuals and/or groups. Over the years, in the course of implementation of the D&M Model it has become clear that individual and group impacts are not sufficient to measure success. In the light of those findings, rather than complicate the model with more 'impact' categories and measures, its authors decided to group all the measures into a single category – Net Benefits. Depending on the level of study and the context, a finer granularity may be needed in order to distinguish and address sub-categories of benefits specific to the level of analysis and the observed context. This is the only construct that is 'case specific' and entirely depends on the type of IS. This means that characteristics of e-commerce systems such as improved decision-making, improved productivity, market efficiency, cost reductions, etc. that DeLone and McLean analyzed with the D&M Model (DeLone&McLean, 2003) may not be applicable to other IS domain such as ePortfolio. On the contrary, it is a rather complex construct that requires a whole new set of measures and characteristics to be developed for a specific type of the IS domain.

In the ePortfolio context: This is the most comprehensive and delicate construct because it is specific for every context. It needs to be developed separately for each type of IS because it captures the contribution of a specific type of IS to different target groups. This construct measures the extent to which ePortfolio enhances LLL. One of the key aspects of Net Benefits concerning the individual is enhanced learning through developing a positive attitude to LLL, fulfilling learning outcomes, increased transparency in evaluation, enhanced communication between student and teacher etc. The other important aspect of Net Benefits for an individual can be seen through personal growth and development in terms of evaluating one's progress towards the

achievement of personal goals, the ability to choose co-workers, benchmarking, etc. At the same time, based on the information from ePortfolio, institutions can show their particular strengths and advantages or re-group employees into project teams based on their interests, skills and work experience and advance work efficiency. Moreover, employers can benefit from ePortfolio in the recruitment process by, for instance, narrowing the list of potential employees based on the information provided in their ePortfolios. Students can also benefit in that respect by enhancing their learning and managing their own growth and development.

RELATIONSHIPS:

As can be seen in Figure 5, the first three constructs (System Quality, Information Quality and Service Quality) are independent and present a starting point in assessing the success of each IS in the D&M Model. In a process sense, those three constructs precede Use and User Satisfaction. In a causal sense, as an example it can be stated that a higher System Quality will lead to a greater Use of the system. So, generally speaking, relations between all the first three constructs on the one hand and Use and User Satisfaction on the other are possible.

Use precedes User Satisfaction in a process sense, but greater satisfaction will lead to an increased Use. Those two constructs are mutually tightly related and depend on the first three constructs as well as on Net Benefits.

Net Benefits is also a dependent construct. It directly depends on Use and User Satisfaction, and indirectly on System Quality, Information Quality and Service Quality. In addition, the construct is related to its immediate predecessors, which means that every change in Net Benefits will be reflected on Use and User Satisfaction.

Since a variance model exists based on causal relationships between constructs, the 'strength of relationships' can be determined and measured. Moreover, the cause of change in the strengths of relationships should be identified in order to fully explain the variance model. Therefore, besides explaining the nature of changes related only to the constructs, an additional set of Critical Success Factors (CSFs) will be introduced that

also influences the nature of interconnections. It is important to stress that those interrelationships can be investigated at two levels: individual and organizational. As already mentioned, in this dissertation the support for interrelationships between the D&M Model constructs will be researched at the individual level of analysis.

4.3.4 Critical Success Factors of ePortfolio success

Besides the six basic groups of factors presented as constructs in the D&M Model that determine the success of ePortfolio, a set of other factors can be identified independently that are essential for ePortfolio implementation. In this dissertation these factors are referred to as Critical Success Factors (CSF) and according to Gathercoal *et al*. (2002, p. 34) they "must be present and active" in order to implement an ePortfolio system. Those factors are reflected in a particular institution's strategy and approach towards ePortfolio implementation and usage, grading system for educators and students, training opportunities, financial and other material resources, etc. Therefore, a set of identified CSFs can only be applied to the institutional level of ePortfolio usage.

Since CSFs are vital for ePortfolio implementation and their importance should not be neglected when ePortfolio success is concerned, it is very important to identify them. Regarding the nature of CSFs, they do not fit into any of the constructs of the D&M Model because they are related to a particular institution's strategy and organization in using ePortfolio, while constructs in the D&M Model are measured at the level of an individual. Moreover, considering the constructs description, CSFs do not capture any one of them. Therefore they could be treated as contextual factors primarily related to the organizational rather than the individual level of study. However, since the D&M Model assesses the ePortfolio success, and CSFs are vital for that success, their influence on the ePortfolio success should be considered. In this research it will be assumed that some CSFs moderate the relationships between the constructs in the D&M Model. According to Jaccard *et al*. (1990) moderation occurs when the relationship between X and Y depends on Z. For the purpose of this dissertation, **Moderating Factors (MF)** shall be defined as "Critical Success Factors that moderate relationship(s) between constructs in the D&M

Model". In other words, MFs influence on the 'strength of relationships' between the constructs.

Bearing all this in mind, a set of updated CSFs needs to be defined parallel to instrument development. To support this claim, it has to be noted that CSFs identified by Gathercoal *et al*. (2002) are fairly outdated and some of them, such as the requirement that all classes have an Internet access with computer display projection units, are nowadays fulfilled by default so there is no need for them to be categorized as critical. Consequently, apart from revising the existing CSFs, current literature, experts opinion and self-experience in using ePortfolio will be used in order to update the list of CSFs. Moreover, it is important to mention that not all CSFs necessarily moderate relationships in the D&M Model, which can also be perceived from the definition of MFs. This research will therefore also determine which CSFs can effectively be perceived as MFs and which relationships they moderate.

5 Research methodology

In previous chapters all the prerequisites for carrying out the main research were described. All aspects of the ePortfolio concept were taken into account, studied and elaborated in detail in Chapter 2 to ensure its thorough comprehension. The author of this dissertation gained profound insight into the process of ePortfolio implementation (see Chapter 3), which provided a solid ground for claiming that ePortfolio can be comprehended as an IS and that a whole set of techniques to assess IS success can be applied to ePortfolio (see Chapter 4). This section describes the selection of the research methodology, operationalization of research constructs, development of measurement instruments, and data collection procedures. Each of these steps is reported in the following sections, along with the details of the pre-pilot and pilot tests.

5.1 *Choice of research methodology*

Considering there are three main objectives to be identified in this doctoral dissertation, the research methodology will be presented with regard to these goals, with the choice of a respective research methodology justified accordingly.

The main objectives of this dissertation are identified as follows:

1. Development of a measurement instrument to assess ePortfolio success at the individual level based on the D&M IS Success Model.

In order to ensure instrument validity, in this dissertation the instrument will be developed in accordance with the steps typical for instrument development in IS (Straub *et al*., 2004). Since the unit of analysis is individual, the whole instrument will be designed to be applied to student population. In the process of instrument development, the extant ePortfolio **literature overview** and **Delphi method** that will include more than 20 ePortfolio experts and researchers from Croatia, Slovenia, Austria, Germany, Poland, Estonia, Great Britain and USA will be used. The result will be the **content validity** of the instrument.

In the second step the **card sorting method** will be used with experts to card sort instrument statements within the proposed constructs (constructs are a part of the D&M Model). After obtaining all the remaining statements within the constructs, another round of card sorting will be conducted, but this time the respondents will be from FOI. The aim will be to card sort statements into subcategories within constructs according to the D&M Model's implications for researchers. The result of this step will be the **construct validity** of the instrument.

After both content and construct validity have been established, respondents will be used for **instrument reliability** verification. Concerning the sample restrictions, instrument reliability will be verified at the individual level of analysis. Therefore students and educators involved in different years of study at FOI will be potential respondents.

The reliability of measure scales will be determined by means of **Cronbach Alpha coefficient**, and instrument reliability by means of **Structural Equation Modeling (SEM)**. **Factor analysis** will be used to determine instrument reliability only if the number of statements in the instrument is reduced to an acceptable level after the first two steps considering the number of possible respondents.

2. Identification of critical success factors groups that will moderate relationships within the model.

Beside instrument evaluation, the extant literature overview will be conducted to identify ePortfolio critical success factors. Furthermore, the **Delphi method** will be used for critical success factors evaluation by experts and researchers. The identified critical success factors will first be included in the instrument developed in the previous step. After the results of the instrument have been obtained, they will also be included in the ePortfolio Success Model as moderating factors. Here it is important to mention that not all critical success factors will be moderating factors.

By analyzing results from the **multiple regression analysis** it will be shown which group of critical success factors moderate which relationships between the constructs in the D&M Model (Armstrong&Sambamurthy, 1999). The ePortfolio Success Model to be developed in the third step will be updated with moderating factors. It needs to be noted that common errors in identifying moderating factors will be taken into account (Carte&Russell, 2003) in the process.

As already mentioned, concerning the sample limitations, both the instrument and the model will be verified at the individual level of analysis. Since the initial version of the instrument contains statements related to both the academic institution and the employer, it should be fairly easy to verify the instrument at the organizational level of analysis in future research. Despite that, testing and verifying the results at the organization level of analysis exceeds the limits of this doctoral dissertation.

3. Development of an ePortfolio Success Model based on D&M Model.

The instrument developed in the first step and the D&M Model will serve as the basis for ePortfolio Success Model development. In order to show that the instrument fits the D&M Model, the SEM method or **Partial Least Squares (PLS)** as a subset of SEM will be used (Kline, 1998; Schumacker&Lomax, 2004). Using SEM or PLS SEM is justified in this research because it implies the existence of a model which needs to be verified by means of certain analysis. The instrument will enable to test relationships between constructs in the D&M Model and these relationships will be shown in the ePortfolio Success Model along with moderating factors.

5.2 *Operationalization of research constructs*

In respect to the D&M Model, six constructs were operationalized in this study: Information Quality, System Quality, Service Quality, Use, User Satisfaction and Net Benefits. All the constructs were measured with multiple items. Besides, it should be emphasized that the statements from the D&M Model could not be entirely applied to ePortfolio since DeLone&McLean developed their model based on generic information systems. Therefore, besides adopting the statements from the original D&M Model, a whole new set of items needed to be developed to capture the ePortfolio concept. Consequently, the existing items from other related instruments that were empirically tested were adopted and used in this research to enhance the validity and reliability of the instrument. In addition, new measures were developed based on the extensive ePortfolio literature overview and experience in ePortfolio implementation at FOI. In the following sections each construct is operationalized. It should be mentioned that the result of operationalization was the initial pool of items that captured their prospective constructs, some of which might be redundant, not relevant for ePortfolio or might capture another construct better than the one in which they were initially placed. In the following step, content and construct validities were carried out to ensure that all statements were relevant to ePortfolio and captured their prospective construct. Moreover, subcategories within constructs were created and named in order to get a clearer picture of all the possible subdimensions comprised within each construct. Subcategories also enabled to get a better view of the initial pool of statements since the number of statements in each construct was very large. In all the other steps of the instrument validation process those subcategories were not shown. The only exception was the pilot phase where those subcategories were determined again based on the 3rd round of Q-sorting since a large number of statements was omitted during the Q-sorting procedure.

Although one of the aims of this dissertation was to develop an ePortfolio success instrument applicable at the individual level of analysis, the initial pool of statements was designed for a wider range of possible stakeholders, such as teachers, institutions and employers. However, having in mind that the final instrument is targeted for students, the initial pool of statements needed to be refined through a series of

procedures to be applicable only to students. Accordingly, the subsequent construct descriptions will focus on the individual level of analysis.

5.2.1 System Quality

This construct defines the characteristics of a system that utilizes ePortfolio. According to the original D&M Model, the measures of the information processing system itself are defined in this construct. Since ePortfolio is a Web-based application, it was possible to use statements related to the quality of Web applications such as those in Alberto&Gianluca (2007) or Wang&Wang (2009) to assess the quality of an ePortfolio system. Apart from DeLone&McLean's measures developed for this construct, several new items from other instruments were added. Therefore the statements from the instrument in Gable *et al*. (2008) were used since the instrument itself was developed as an alternative to the D&M Model. In addition, the instrument from Rivard *et al*. (1997) was used following the recommendations for its usage in Peter *et al*. (2008). Some statements from the latter were omitted since they were not relevant to ePortfolio.

5.2.2 Information Quality

The main purpose of ePortfolio is to process information. In Chapter 4, the genetic taxonomy was used to show that the purpose of information produced as an output is to add value to the society. Therefore this construct captures a vital part of ePortfolio. In the previous chapter it was also explained that information in ePortfolio appears in the form of an artefact and a view, and stated that the quality of information can be measured by various means. In this research, beside the statements from the D&M Model, some items concerning the information as a whole were adopted from Gable *et al*. (2008). Some other characteristics like validity, completeness, consistency, correctness etc. were adopted from Fraser *et al*. (1995) and Wixom&Watson (2001), in accordance with DeLone and McLean's suggestions (Petter *et al*., 2008). The research by Roldán&Leal (2003) was used to reflect conciseness and clarity of information.

5.2.3 Service Quality

This construct originally refers to measures of support provided to the end user. It includes all kinds of support (online help, manuals toward help-desk service, the ability to use the ICT equipment in institutions, etc.) that a user receives from the official support desk, instructor (teacher) and in the online form. Besides the statements from the D&M Model, the statements from the SERVQUAL method were also used. Although the latter is considered to be the most common method for measuring service quality, it does not contain some key components considering the ePortfolio context. Most of its statements are related to the so called offline components such as employees in the aforementioned services. Mekovec *et al*. (2007) reviewed an entire set of service quality measures that are oriented towards online services or Web services. Since ePortfolio is utilized as a Web application, it is very important to measure the quality of e-service. Therefore a set of statements from E-S-QUAL (Kim *et al*., 2006) and WebQual/eQual (Barnes&Vidgen, 2005) were used to encompass the online service components such as efficiency, interaction, availability, privacy, virtual community and contacts.

5.2.4 Use

Following DeLone and McLean's recommendations (Petter *et al*., 2008) several instruments were reviewed. Some of them were from Burton-Jones&Straub (2006), Torkzadeh&Doll (1999), Venkatesh *et al*. (2003) as well as from the D&M Model itself. Considering the essence of this construct, which is to capture the recipient's consumption of the system's capabilities, the Unified Theory of Acceptance and Use of Technology (UTAUT) instrument developed by Venkatesh *et al*. (2003) was found to be the best choice. Moreover, one part of the instrument assesses all the necessary characteristics of the ePortfolio system regarding its use, so no additional statements were needed. Instead, the part of the UTAUT instrument concerning performance expectancy, effort expectancy, social influence, self-efficacy and behavioral intention to use the system was used to capture this construct.

5.2.5 User Satisfaction

Petter *et al*. (2008) suggested the End-User Computing Support (EUCS) or User Information Satisfaction (UIS) instruments as a means of measuring user satisfaction. However, by analyzing both instruments it was noted that in respect to the D&M Model those instruments include statements related to almost all the constructs of the mentioned model. The authors of the D&M Model also reported this by stating that both models "contain items related to system quality, information quality, and service quality, rather than only measuring overall user satisfaction with the system" (Petter *et al*., 2008, p. 242). Therefore, following the description of the User Satisfaction construct, according to which it captures the recipient's response to the use of the output of an ePortfolio system, the other part of the UTAUT instrument was used in this research. In other words, the previously unused part of the UTAUT instrument concerning the attitude towards using technology, facilitating conditions and anxiety was used in this context. In addition, it was possible to use statements from the same instrument for both Use and User Satisfaction constructs since DeLone&McLean confirmed a very tight relationship between those constructs. In addition, UTAUT also captures the essence of Use and User Satisfaction: the intention to use the system and subsequent usage behavior that results in different satisfaction modalities.

5.2.6 Net Benefits

The effect of an ePortfolio system on specific contextual levels is captured in this construct. According to DeLone&McLean (2003), the measures for this construct should be domain specific since different types of information systems cause different benefits in different contexts. Although DeLone and McLean differentiate between measures developed at the individual and organizational level, for the purpose of this research net benefits were captured on both levels simultaneously. As a result, the instrument would be applicable on different levels, although for the purpose of this dissertation it would be verified only at the individual level of analysis.

Several statements from Gable *et al*. (2008) were adopted in this study. Moreover, EUCS instrument (Doll *et al*., 1994) and the instrument for measuring perceived impact (Torkzadeh&Doll, 1999) were considered. However, most of the statements did not fit this construct or had already been covered by the instrument from Gable *et al*. (2008). In addition, the characteristics of ePortfolio maturity levels from Love *et al*. (2004) were used to reflect net benefits. Researches from Gathercoal *et al*. (2002), Blackburn&Hakel (2006), Kim (2006), Marcoul-Burlinson (2006), Hickerson&Preston (2006) and Helen Barrett[6] that describe benefits from ePortfolio were also considered in designing the statements.

[6] Dr. Helen Barrett has been researching strategies and technologies for electronic portfolios since 1991, publishing a Website (http://electronicportfolios.org), chapters in several books on electronic portfolios, and numerous articles. She has been providing training and technical assistance on electronic portfolios for teacher education programs throughout the U.S. under a federal PT3 grant for many years. At the European ePortfolio Conference in Maastricht, October 2007, Dr. Barrett received the first EIFEL Lifetime Achievement Award for her contribution to ePortfolio research and development. More information can be found at http://electronicportfolios.org/.

5.3 *Operationalization of Critical Success Factors*

In their research on implementing Web-based Portfolios, Gathercoal *et al*. (2002) identified Critical Success Factors (CSFs) for ePortfolio implementation. According to their definition, CSFs "must be present and active in order to implement a Webfolio system" Gathercoal *et al*. (2002, p. 34). The authors also stressed that the order of factors is not relevant because all of them are equally important and required for ePortfolio success. In other words, they can be termed 'necessary conditions'.

For the purpose of this research those factors were used as the initial factors for ePortfolio success. Since they were identified several years ago, it was to be expected that with the development of ICT some of those factors would be fulfilled by default and would therefore not need to be interpreted as critical any more. On the other hand, there was a possibility that some other factors appear as critical in respect to changes in teaching and learning as well as in the maturity of academic institutions. It should be mentioned that none of the CSFs was contained in any of instrument constructs. Moreover, concerning their nature, they did not fit into any of research constructs either.

To ensure the comprehensiveness of CSFs, the initial list of CSFs was sent to experts for review. Their task was to mark the factors they believed to be the critical and if needed, to add the ones that they found to be critical for the success of ePortfolio. The initial list of CSFs based on the work of Gathercoal *et al*. (2002) sent to 12 international ePortfolio experts[7] was as follows:

1. Students and educators are encouraged to use ePortfolio (rewards for educators, extra scores for students within the course).
2. Faculty participants are not punished for negative feedback on student evaluations of teaching.
3. All participants have equitable access to the ePortfolio services.
4. All classrooms have Internet access with computer display projection units.
5. Students complete Portfolios as a program requirement.
6. Students complete Portfolios as requirements in courses.

[7] EPortfolio experts involved in CSFs analysis were drawn from the pool of experts that participated in the ePortfolio success instrument development. More information about experts can be found in Appendix A.

7. The student's work in the ePortfolio strongly contributes to define the student to faculty and recruiters.
8. Multiple faculty/supervisors/mentors read and comment on students' portfolio work.
9. Faculty members routinely give students assignments in written form.
10. Students routinely address unstructured problems.
11. Faculty grade and provide feedback on students' work.
12. The push for adoption and implementation of ePortfolios comes from faculty management, students and educators.
13. A group of faculty members has the commitment and stamina to make the ePortfolio system work.
14. An implementation plan exists, with reasonable milestones that are measurable and that collectively lead to full implementation (adoption).
15. Open computer lab assistance is available for students and faculty.
16. Opportunities exist for student/faculty/mentor training (multiple times and places).
17. Documentation about using the ePortfolio as a pedagogical tool is available for faculty/mentors and students.
18. Faculty commit to casting course assignments into a uniform format, such as Statement of Standard; Student Assignment; Detail/Help/Internet Resources; Assessment Description.
19. Teams of faculty agree to cast program standards into a uniform format to adopt ePortfolio as an assessment tool.
20. Faculty teams periodically review and revise the content of the curriculum and are aware of the content of courses making up the entire program.
21. Courses and/or program requirements are designed and sequenced to build student mastery of standards.

The experts were sent an Excel spreadsheet with CSFs definition and instructions for completing the sheet (see Appendix B). They needed to check only those statements they found to be critical for ePortfolio success and explain why they think the statement is critical (or not) for ePortfolio success. In addition, it was possible to suggest CSF they

considered to be critical for ePortfolio success. After each round, Content Validity Ratio (CVR) slightly adapted for the needs of this research was calculated for each CSF. Based on the table in Lawsche (1975) the CVR for each item was evaluated for statistical significance (.05 alpha level). Statistical significance meant that more than 50% of the panelists rated the item as critical for ePortfolio success. Items that were not significant at the level of 0.05 were excluded. Based on the experts' responses, six statements were excluded (No. 4, 5, 8, 9, 15, and 17) and five statements added to the list. The modified list was once again sent to the same pool of experts for another review of CSFs. After the 2nd round four statements were excluded, while some of the remaining ones were modified in accordance with the experts' remarks. This resulted in a final set of 16 CSFs that were retained as critical ones for ePortfolio success:

1. Students and educators are encouraged to use ePortfolio (rewards for educators, extra scores for students within the course).
2. All participants have equitable access to the ePortfolio services.
3. Students complete ePortfolios as requirements in courses.
4. The student's work in the ePortfolio strongly contributes to define the student to faculty and recruiters.
5. Faculty grade and provide feedback on students' work.
6. The push for adoption and implementation of ePortfolios comes from faculty management, students and educators.
7. A group of faculty members has the commitment and stamina to make the ePortfolio system work.
8. An implementation plan exists, with reasonable milestones that are measurable and that collectively lead to full implementation (adoption).
9. Opportunities exist for student/faculty/mentor training (multiple times and places).
10. Faculty commit to casting course assignments into a uniform format to adopt ePortfolio as an assessment tool.
11. Financial and other material and technical resources are committed to the implementation and evaluation of ePortfolio.

12. Faculty teams periodically review and revise the content of the curriculum and are aware of the content of courses making up the entire program.

Newly added CSFs:

13. The ePortfolio initiative is part of the strategic IT vision of the institution.
14. The ePortfolio is approached as a process, not a product.
15. The long-term adoption (assimilation) of the ePortfolio system is approached as an organizational change management initiative.
16. There is a permanent ePortfolio adoption (post-implementation) group monitoring and searching for mutual technology-organization adaptation.

The identified CSFs would be given to the institution representatives as a separate survey following the main ePortfolio success instrument based on the D&M Model, since CSFs represent contextual factors and are therefore institution specific. Only an institutional representative such as the director, dean, vice-dean, ePortfolio project manager or a person familiar with the ePortfolio strategy and the institution's mission and vision can identify CSFs that are present in their institution. Students cannot be used as respondents in this case because they simply do not have the insight into the existence or absence of factors such as 'The ePortfolio initiative is part of the strategic IT vision of the institution' or 'Financial and other material and technical resources are committed to the implementation and evaluation of ePortfolio'. In addition to CSFs, certain questions to collect general background information about the institution were also included in the survey. Since this instrument was to be sent to institutions worldwide and Croatian institution representatives are proficient in English it was not necessary to translate it to Croatian language, which was not the case with the main ePortfolio success instrument. For the final version of the online CSFs survey, see Appendix G.

5.4 *Instrument development*

In order to develop a measurement instrument with good psychometric properties, the instrument creation process suggested by Moore&Benbasat (1991) was followed in this research. They proposed three main stages of instrument development: item creation, scale development and instrument testing. The purpose of **item creation** was to create pools of items for each construct. For this purpose operationalization of research constructs described in the previous section that included items from the existing scales as well as additional items was performed. The second stage, **scale development**, included several rounds of card sorting (henceforth, Q-sort) with different sets of judges in order to card sort the items within constructs and to eliminate any inappropriately worded or ambiguous items. In the **instrument testing** stage, the validity of instrument was assessed in three steps: 1. Pre-pilot test with a few respondents to get an initial indication of the scales' reliability; 2. Pilot test with a larger number of respondents; and 3. Final field test of the instrument. In addition to following the traditional instrument development paradigm, some other guidelines **and** examples of instrument development typical for IS research (Lewis *et al*., 1995; Armstrong&Sambamurthy, 1999; Straub *et al*., 2004) were also followed. The subsequent sections describe each step in detail.

5.4.1 Item creation

The objective of this phase was to ensure the **content validity** of the instrument. According to Straub *et al*. (2004) several different techniques can be used in this step. For the purpose of operationalization of research constructs, literature review, existing scales and expert panels were used. This resulted in 175 statements categorized into six dimensions of the D&M Model that they were originally intended to address (see Table 5). As a result, an initial pool of items for each construct was created. Since the target instrument would be developed at the individual level of analysis, that is, from the students' perspective, it should be mentioned that the initial pool of statements involved all the statements related to the ePortfolio, regardless of the perspective (student,

employer, organization, etc.). Subsequently, Q-sort process and the pilot-test would ensure that only the statements related to students remain in the pool.

Table 5. The initial pool of items in the ePortfolio success instrument

SYSTEM QUALITY
USABILITY
1. The system is easy to use.
2. The system is easy to learn.
3. It is not difficult to get access to information that is in the ePortfolio.
4. The views (selected collections of artefacts for self-presentation) are easy to create and understand.
5. The terms used in data-entry screens and menus are familiar to users.
6. Menus have a maximum of three to four sub-menus.
7. The documentation is easy to access and use.
8. Help functions provide sufficient information for using the application.
9. Help functions are available/accessible throughout the application.
10. The users can be easily trained to access and operate the system – build their own portfolios.
11. Users are able to quickly search and retrieve portfolio materials partly or fully.
12. Users can collaborate (work together) on creating and organizing portfolios from scratch to completion.
13. Users can create views in flexible styles and formats so that the overall presentation is not confined in a linear or a hierarchical structure.
14. Sitemap of the portfolio system clearly shows site construction and organization of materials.
15. To achieve a task with a portfolio system, a minimal number of screens, tasks and actions are required.
DATA ACCESS
16. Only authorized users can access and change the data files or their part.
17. Each user owns a unique password.
18. The system performs an automatic backup of data.
19. Data recovery and retrieval procedures are available in case of an application malfunction.
20. The system includes controls to detect unauthorized access.
21. The system provides reports showing all unauthorized accesses and errors within a given period.
DATA PROTECTION
22. The system does not delete/destroy any information without asking for confirmation and getting a positive response.
23. The system never modifies a field without asking for confirmation and getting a positive response.
24. In case of an artefact update, the view that contains that artefact can also be automatically updated.

Table 5. The initial pool of items in the ePortfolio success instrument (continued)

SYSTEM FUNCTIONALITY
25. The system does not require increasing resources over time to maintain the daily operation and minor refinements.
26. The system features should always perform consistently and provide services under the stated normal condition for a defined time.
27. The system is broken up into separate and independent modules.
28. The system is able to easily scale up as more contents are stored and more concurrent sessions with an increasing number of users access the system.
29. The system is always up-and-running as necessary.
30. The system responds quickly enough.
UNDERSTANDABILITY OF THE USER INTERFACE
31. All headings (screens, menus, reports) are always at the same place.
32. The same terminology is used throughout the application.
33. Data entry screens clearly show spaces reserved to record the data.
34. Message presentation is always the same (position, terminology, style ...).
35. Data entry screens are organized in such a way that the data elements are logically grouped together.
36. Menus are hierarchical, that is, they go from general to detailed choices.
37. Error messages adequately describe the nature of the problem.
38. Error messages clearly indicate the actions to be taken to rectify errors.
INTEROPERABILITY
39. The system provides the capability to import data from other applications.
40. It is possible to export data into other applications.
41. The system can work with other systems such as a CMS or connect to an LDAP server for authentication.
ADAPTABILITY
42. The system meets (the organization's) requirements.
43. The system includes necessary features and functions.
44. The systems' user interface can be easily adapted to one's personal approach.
45. Users are to access the system with a simple conventional Web browser without much preparation.
46. The system could be used in other organizational environments, similar to the one in which it is presently used, without any major modification.
47. The system can be easily modified, corrected or improved.

Table 5. The initial pool of items in the ePortfolio success instrument (continued)

INFORMATION QUALITY
VALIDITY
1. Information available from the ePortfolio is important.
2. Information provided by the ePortfolio is complete.
3. The ePortfolio provides output that seems to be exactly what is needed/required.
4. Information produced by the ePortfolio is valid (i.e. presents real evidence of accomplishments).
5. Information provided by the ePortfolio is verifiable (i.e. can be checked by some other means).
FORMAT
6. Information from the ePortfolio is concise (i.e. contains only necessary data).
7. Information from the ePortfolio is in a form that is readily usable.
8. Information from the ePortfolio is easy to understand.
9. Information from the ePortfolio appears readable, clear and well formatted.
AVAILABILITY
10. Users can easily access exclusive/unique information available only through the ePortfolio system.
11. Information needed from the ePortfolio is always available.
12. The ePortfolio provides up to date information.
13. Information from the ePortfolio is always timely.

Table 5. The initial pool of items in the ePortfolio success instrument (continued)

SERVICE QUALITY
ASSURANCE FOR END-USERS
1. Users find the organization (University) which provides the portfolio service to have good credibility.
2. It feels safe to work with the ePortfolio.
3. Your personal information feels secure.
4. E-mail and telephone contacts are available in case of problems while using ePortfolio.
5. FAQ page is included and covers all relevant questions.
6. The behavior of teachers instills confidence in you.
7. Teachers/instructors/ePortfolio staff has the knowledge to answer your questions.
8. On-line help is available.
TANGIBLES
9. The organization has modern looking equipment available for accessing ePortfolio services.
10. The organization's facilities from which the user can access its Portfolio are visually appealing.
11. The organization's ePortfolio office staff is neat appearing.
EMPATHY
12. When you have a problem regarding ePortfolio, the organization shows a sincere interest in solving it.
13. The faculty/institution gives you individual attention.
14. The teacher/instructor understands your specific needs.
15. A certain degree of freedom for you to express your own individuality and personal strengths is allowed.
16. Teachers/instructors give you a prompt service/response.
17. Teachers/instructors are always willing to help you.
CLARITY
18. EPortfolio completion is well described within program requirements.
19. Evaluation criteria for selecting and assessing the e-Portfolio contents, as well as the overall ePortfolio goal, are clear and very well explained prior to developing the ePortfolio.
20. Privacy policy exists and clearly states all related privacy issues.
21. Security policy exists and clearly states all related security issues.
22. Terms of use as well as ethics regulations are clearly shown.

Table 5. The initial pool of items in the ePortfolio success instrument (continued)

USE
PERFORMANCE EXPECTANCY
1. I would find the system useful in teaching and learning.
2. Using the system enables me to present my accomplishments more quickly.
3. Using the system increases my learning capacities.
4. If I use the system, I will increase my chances of being awarded.
EFFORT EXPECTANCY
5. My interaction with the system would be clear and understandable.
6. It would be easy for me to become skillful in using the system.
7. I would find the system easy to use.
8. Learning to operate the system is easy for me.
SOCIAL INFLUENCE
9. People who influence my behavior think that I should use the system.
10. People who are important to me think that I should use the system.
11. The ePortfolio staff has been helpful in the use of the system.
12. In general, the organization has supported the use of the system.
SELF-EFFICACY
13. I could complete a job or task using the system…
14. …if there was no one around to tell me what to do as I go.
15. …if I could call someone for help if I got stuck.
16. …if I had a lot of time to complete the job for which the software was provided.
17. …if I had just the built-in help facility for assistance.
BEHAVIORAL INTENTION TO USE THE SYSTEM
18. I intend to use the system in the next <n> months.
19. I predict I would use the system in the next <n> months.
20. I plan to use the system in the next <n> months.
COGNITIVE ABSORPTION
21. When I was using ePortfolio, I was able to block out all other distractions.
22. When I was using ePortfolio, I felt totally immersed in what I was doing.
23. When I was using ePortfolio, I got distracted very easily.
24. When I was using ePortfolio, I felt completely absorbed in what I was doing.
25. When I was using ePortfolio, my attention did not get diverted very easily.
DEEP STRUCTURE USAGE
26. When I was using ePortfolio, I did not use features that would help me present my artefacts.
27. When I was using ePortfolio, I used features that helped me tag my artefacts.
28. When I was using ePortfolio, I used features that helped me test different views.
29. When I was using ePortfolio, I used features that helped me join the groups.
30. When I was using ePortfolio, I used features that helped me organize my artefacts.

Table 5. The initial pool of items in the ePortfolio success instrument (continued)

USER SATISFACTION
ATTITUDE TOWARD USING TECHNOLOGY
1. Using the system is a good idea.
2. The system makes work more interesting.
3. Working with the system is fun.
4. I like working with the system.
FACILITATING CONDITIONS
5. I have the resources necessary to use the system.
6. I have the knowledge necessary to use the system.
7. The system is compatible with other systems I use.
8. A specific person (or group) is available for assistance with system difficulties.
ANXIETY
9. I feel apprehensive about using the system.
10. It scares me to think that I could lose a lot of information using the system by hitting the wrong key.
11. I hesitate to use the system for fear of making mistakes I cannot correct.
12. The system is somewhat intimidating to me.

Table 5. The initial pool of items in the ePortfolio success instrument (continued)

NET BENEFITS
SELF-PRESENTATION
1. I can show my comprehensive profile through ePortfolio.
2. I have the ability to generate my own views for displaying work samples and achievements.
3. I can generate portals for displaying work samples and achievements within the same curricular structure.
4. I can generate portals for displaying work samples and achievements within the institutional standard.
5. I can nominate who can view my Portfolio.
6. I can nominate who can provide feedback for each item in my ePortfolio.
7. Potential employers can view the Showcase Portfolio with the benefit of contextual clues from the institution, assessment criteria, and student-generated descriptions of achievements.
ENHANCED LEARNING
8. Using ePortfolio helped me to become a more effective, independent and confident self-directed learner.
9. EPortfolio helped me to understand how I learn.
10. EPortfolio helped me to relate my learning to a wider context.
11. EPortfolio helped me to make connections among my formal (structured learning within the school or faculty) and informal (unstructured learning occurring in everyday life) learning experiences.
12. My ePortfolio enables me to learn more effectively through interaction with other students including the feedback received from them.
13. The use of ePortfolio enabled me to receive important comments and suggestions from my teacher.
14. EPortfolio enabled me to have multiple opportunities to better evaluate the products of my work based on the feedback received from educators.
15. EPortfolio encouraged me to develop a positive attitude to lifelong learning.
16. The enhanced communication between students and educators enhances the chances for student success.
17. The potential for enhanced communication between peers stimulates my motivation to work and learn through the ePortfolio system.
18. The mean and frequency of students' work can be easily monitored.
19. The educator can give summative assessment to students' work based on stored artefacts and feedback.
20. EPortfolio provides evidence of students' understanding of course-specific knowledge and skills.
21. Using ePortfolio has led to increased transparency for evaluation and benchmarking.
22. I can choose my co-workers according to various criteria presented in ePortfolio.
23. EPortfolio has resulted in improved learning outcomes or outputs.

Table 5. The initial pool of items in the ePortfolio success instrument (continued)

IMPROVED STANDARDS AND CURRICULUM
24. EPortfolio clearly reflects learning objectives as identified in the course curriculum.
25. Standards, department goals and other descriptors can be linked to specific ePortfolio items.
26. EPortfolios are organized by curricular requirements and electives or by standards established by the cadre of educators or the institution.
27. There is a possibility to repeat instructional implementation by copying the course content as well as goals and standards from one instructor to others, each time enriching the content through additional resources and new curricular initiatives.
28. The assessment data generated from the ePortfolio system can be used each semester to assist with program assessment and revision.
29. There is a possibility to copy course syllabi and assignments along with complete links to standards and department goals from one semester to the next, each time enriching the content through additional resources and new curricular initiatives.
30. I can use the assessment data generated within the ePortfolio system each semester to assist with course revision.
31. It can be ascertained which students met or exceeded standards linked to specific work samples and achievements.
32. EPortfolio has resulted in improved quality assurance process.
PERSONAL GROWTH AND DEVELOPMENT
33. I can monitor my own improvement.
34. I can monitor changes in my ideas, criteria and attitudes.
35. I am able to compare myself with others.
36. I can show my personal growth and development over time.
37. I have improved my general skills for education/learning.
38. I have improved my general skills for career management.
39. I can articulate personal goals.
40. I am able to evaluate progress towards the achievement of my personal goals.
41. I can reflect on artefacts
42. I can enrich the course content based on received feedback in ePortfolio.
43. EPortfolio enabled me to track the efficiency of teaching (changes in attitudes, increased interest for some part of the content, interpretation clarity …)
44. I can monitor the efficiency of strategies I use in teaching.
45. I can show how artefacts match my goals and standards.
46. Reflections enable me to get insight into individual thinking processes, introspection, and thoughts on problem-solving.
47. Reflections enable me to observe intellectual strengths and weaknesses.
48. Reflections enable me to develop decision-making skills.
49. I can solve problems much more easily by using ePortfolio with all its features.
50. EPortfolio has resulted in my own better positioning among others.
51. EPortfolio brings about benefits that are more important than its costs (e.g. time and money).

To ensure the content validity of the instrument, a survey was constructed along with detailed instructions for evaluation (see Appendix C) and sent to ePortfolio experts by e-mail in the form of an MS Excel spreadsheet. The spreadsheet form was chosen as the most appropriate for this type of research for several reasons:

1. It can be sent by e-mail worldwide thus presenting the fastest way for data collection and processing.
2. It enables very easy manipulation with a large number of statements (horizontal and vertical scrolling).
3. Certain cells can be locked out from making any changes. Only the cells that require data input can be left unlocked thus enabling experts to input the data only to the required cells.

Before the spreadsheet was sent to the experts it was pre-tested at FOI for: 1. possible issues with the spreadsheet itself such as compatibility, visibility and formatting; 2. clarity of instructions, 3. spelling and grammar; and 4. time needed for completion. One graduate and two doctoral students were used in this process. After they filled in the spreadsheet an interview/meeting was held to reconcile their notes and comments. Once the spreadsheet was modified according to the suggestions it was sent by e-mail to 23 ePortfolio experts. Some of the experts were persons the author of the dissertation had previously cooperated with, while others were contacted through recommendations.

Eighteen experts from 9 different countries (Austria, Croatia, New Zealand, Poland, Russia Slovenia, Spain, United Kingdom and USA) returned the completed sheet. Their level of expertise could be divided into three categories: institution representatives (experts in implementing ePortfolio at the institution level), educators (experts in using ePortfolio in teaching) and students (primarily experienced in using ePortfolio in learning and for self-presentation). More detailed information about their expertise is provided in Appendix A. Their task was to score the 175 items using the scale '0 – Cannot answer, 1 – Not relevant, 2 – Important (but not essential), and 3 – Essential'. From the data obtained, the content validity ratio (CVR) was computed for each item using the Lawsche's formulation (1975):

$$CVR = (n-N/2) / (N/2),$$

where *n* is the frequency count of the number of panelists that rated the item as either '2 – Important' or '3 – Essential' and *N* is the total number of respondents. From the explanation of the formula it can be noted that a less stringent criterion was used in comparison to the original Lawsche's (1975) approach. The work of Lewis *et al*. (1995) was followed here since they utilized responses of both 'important (but not essential)' and 'essential', with the explanation that both of them were positive indicators of the items' relevance to ePortfolio.

Based on the table in Lawsche (1975) the CVR for each item was evaluated for statistical significance (0.05 alpha level). Statistical significance meant that more than 50% of the panelists rated the item as either 'important' or 'essential'. Items that were not significant at the level of 0.05 were dropped. In addition, the mean CVR across the items was calculated as an indicator of the overall test content validity. The minimum value provided in Lawshe (1975) for 16 panelists is 0.48. In this research, the calculated mean CVR was 0.78, which indicated that the agreement among panelists was unlikely to have occurred accidentally.

In the next step all evaluation sheets were thoroughly analyzed again, but this time qualitatively. Based on the panelists' comments, redundant and ambiguous statements were excluded and some statements were modified according to panelists' suggestions. Since the number of statements was quite comprehensive, the panelists did not suggest any additional statements that might have been missing from the instrument. However, they suggested that, for consistency sake, all the statements should be written in the 1st person, so some of the statements were modified accordingly.

As a result of content validity calculation, the number of items was reduced to 132. The distribution of items within constructs is shown in Table 6.

Table 6. Number of items in the constructs after CVR

Constructs	Number of items	
	Initial	After CVR
System Quality	47	42
Information Quality	13	12
Service Quality	22	19
Use	30	9
User Satisfaction	12	9
Net Benefits	51	40
Total	**175**	**132**

5.4.2 Scale development

In order to ensure that the items represented the six constructs from the D&M Model, **construct validation** was conducted. According to Straub *et al*. (2004, p. 388) construct validity "raises the basic question of whether the measures chosen by researcher fit together in such way to capture the essence of the construct". The research by Davis (1986, 1989), Moore&Benbasat (1991), Segars&Groover (1998), Chang&King (2005) as well as examples from Straub *et al*. (2004) were followed in this research and the Q-sort technique was used to validate the constructs and sub-constructs in the instrument. Straub *et al*. (2004) and Moore&Benbasat (1991) recommend the usage of Q-sort to ensure both **discriminant (divergent)** and **convergent validity** of the construct. According to Moore&Benbasat (1991), if the item is consistently placed within a particular construct, it is considered to demonstrate **convergent validity** with a related construct and **discriminant validity** with other constructs.

To assess the **reliability** of the sorting procedure, two different measures were used. First, Cohen's Kappa was used to measure the level of agreement between the judges as a part of **inter-rater reliability** that according to Straub *et al*. (2004) should be mandatorily performed in IS research. Therefore the Kappa score was calculated for each pair of judges. Moore&Benbasat (1991) claim that no general authority exists with respect to required scores, but suggest that, according to literature, scores greater than 0.65 are acceptable. On the other hand, following extensive literature overview, Straub

et al. (2004), suggest 0.70 for minimum inter-rater reliability score, so it would be used as a minimum value in this research too. Moreover, the items placement procedure described in Moore&Benbasat (1991) was also used as the second measure of reliability.

In the **first round of Q-sort** the survey constructed for ensuring content validity was used since it also included the ability of categorizing each item into one of the six dimensions from the D&M Model (see Appendix C). Therefore, the judges in the first round of Q-sort were the ePortfolio experts used in the process of establishing content validity. Besides evaluating each item's importance for CVR they were also asked to sort each item into one of the construct categories. Since the instrument is based on the D&M Model, the six main constructs had already been defined and their definitions provided to the experts (judges), as shown in Appendix C. A random list of all statements was also provided to judges, whose task was to sort each item into one of the six constructs of the D&M Model. They were supposed to place the item into a separate 'Other' category if they believed it did not belong to any of the six dimensions.

The items that were excluded after the CVR were not taken into consideration when the results of Q-sort were analyzed although the judges had sorted those as well since they had to do the CVR and Q-sort in one go (see Appendix C).

As already mentioned, the judges were representatives of three different categories of ePortfolio users: institutions, educators and students. The structure of experts was as follows: institution representatives (6), educator representatives (7) and student representatives (3). Owing to the large number of judges and for the purpose of data processing, three Virtual experts (judges) were created, each one representing one category of experts. In the explanation, for each statement in the instrument the most frequent value based on the institution representatives' evaluations in Q-sort was calculated thus representing the Virtual expert's evaluation for the institution representative category. It should be mentioned that the most frequent value was actually the most frequent construct under which the experts sorted the item. Therefore the 'answer' from the Virtual expert actually represented the most frequent answer from all the experts within one category (in this example, institution representatives). The most frequent values were calculated for two other categories of experts accordingly.

Table 7. Item placement ratios and Cohen's Kappa for the 1st round of Q-sort*

	Actual Categories								
Target Categories	SYSQ	INFQ	SERVQ	USE	USAT	NETB	N/A	Total	Target
System Quality (SYSQ)	**127**	0	0	0	2	3	0	132	96%
Information Quality (INFQ)	0	**36**	0	0	0	0	0	36	100%
Service Quality (SERVQ)	6	3	**34**	2	6	0	0	51	67%
Use (USE)	3	1	3	**16**	1	3	0	27	59%
User Satisfaction (USAT)	0	0	0	0	**27**	0	0	27	100%
Net Benefits (NETB)	11	12	0	22	6	**63**	3	117	54%
Total Item Placements: **390**	Hits: **303**			Overall Hit Ratio: **79%**					
Cohen's Kappa: **0.76**									

* results are based on Virtual experts' responses

The items placement procedure (see Table 7) showed the overall hit ratio of 79%, which is acceptable. Moreover, Cohen's Kappa test showed the average value of 0.76, which is also considered acceptable. As the result of Q-sort, items with no agreements between the judges were dropped. In dropping the items, attention was paid to ensure that comprehensiveness was not sacrificed in the process. Since the number of items in the first round was quite large, it may have been too much for experts to handle since both CVR and Q-sort needed to be done at once. Therefore, those items with no agreements between the judges that still scored as 'essential' for ePortfolio in CVR were retained for the second round of Q-sort. Table 8 shows the end of the first round, where the number of statements was reduced to 107, with 43 items for System Quality, 12 for Information Quality, 14 for Service Quality, 7 for Use, 9 for User Satisfaction, and 22 for Net Benefits.

Table 8. Number of items in the constructs after the 1st round of Q-sort

Constructs	Number of items		
	Initial	After CVR	After Q-sort (1st round)
System Quality	47	43	43
Information Quality	13	12	12
Service Quality	22	19	14
Use	30	9	7
User Satisfaction	12	9	9
Net Benefits	51	40	22
Total	**175**	**132**	**107**

The second round of Q-sorting was performed at two universities: Carlow University in Pittsburgh and University of Zagreb, Faculty of Organization and Informatics Varaždin (FOI). The rationale for the second round was twofold: 1. Straub *et al*. (2004) recommend two rounds of Q-sorting process, which is the approach also followed by Chang&King (2005); and 2. In the first round of Q-sorting the experts needed to validate the item's importance for ePortfolio and card-sort all the items, both of which had to be done in only one go. Since it was rather comprehensive and difficult to card sort and evaluate 175 statements at the same time, an additional round of Q-sorting was needed in which the experts would be able to focus only on card-sorting. Therefore this set of Q-sorting included two system administrators, two educators and two students (one graduate and one post-graduate). Such a range of backgrounds was chosen to ensure the variety of perceptions in analysis. Judges were sent an Excel spreadsheet containing instructions by e-mail. The spreadsheet was very similar to the one used in the first round, the only difference being that it contained fewer statements and no columns for indicating the importance for ePortfolio (Importance for EPortfolio and Pre-test comment). The spreadsheet contained all the statements and constructs. The judges needed to assign each statement to only one construct by marking the corresponding field with 'x'. A moderator at Carlow University ensured that all the judges understood the procedure by showing a few examples of the sorting procedure and answering any potential questions by the judges. The moderator at FOI was the author of this

dissertation. As in the first round of Q-sort, the judges were introduced to the constructs and their definitions. Again, items with no agreement between the judges were dropped (see Table 9). As a result of the second round, the number of statements was reduced to 85 (see Table 10). The Cohen's Kappa test was not calculated in this particular round since the Item Placement Ratio is adequate for showing the reliability of the raters (judges) (Chang&King, 2005; Moore&Benbasat, 2001; Straub *et al.*, 2004).

Table 9. Item placement ratios after the 2nd round of Q-sort

	Actual Categories								
Target Categories	SYSQ	INFQ	SERVQ	USE	USAT	NETB	N/A	Total	Target
System Quality (SYSQ)	**181**	29	9	17	9	3	4	252	72%
Information Quality (INFQ)	8	**47**	4	3	6	4	0	72	65%
Service Quality (SERVQ)	5	3	**53**	12	5	3	3	84	63%
Use (USE)	6	0	1	**29**	7	5	0	48	60%
User Satisfaction (USAT)	6	0	2	12	**47**	4	1	72	65%
Net Benefits (NETB)	4	3	3	19	15	**69**	1	114	61%
Total Item Placements: **642**	Hits: **426**			Overall Hit Ratio: **66%**					

Table 10. Number of items in the constructs after the 2nd round of Q-sort

Constructs	**Number of items**			
	Initial	**After CVR**	**After Q-sort (1st round)**	**After Q-sort (2nd round)**
System Quality	47	43	43	39
Information Quality	13	12	12	9
Service Quality	22	19	14	9
Use	30	9	7	6
User Satisfaction	12	9	9	9
Net Benefits	51	40	22	13
Total	**175**	**132**	**107**	**85**

Exploring subcategories within constructs

Having firmly established that the items in each dimension did represent the desired dimension, **the third round** of Q-sorting was conducted at the Faculty of Organization and Informatics in Varaždin. This round was aimed at gaining insight into possible subcategories within the constructs and further refinement of the statements. Here it should be mentioned that the identified sub-categories would still need empirical testing. For this factor analysis would be used after the field-test results are obtained (see Section 6.2).

This time each item was printed on one 3x5 cm index card and cards were separated by dimension. Therefore the maximum amount of cards to sort was 39 for System Quality, while for other categories the number was much smaller. Three different judges (doctoral students) were read a standard set of instructions prior to sorting the cards and were demonstrated the card-sorting process. In addition, they were allowed to ask as many questions as necessary to ensure they understood the procedure. Their task was to sort the cards one dimension at a time into as few categories as possible and to name the categories. After all the judges had completed their sorting, a meeting/interview was conducted to reconcile the differences among their results. This resulted in a number of sub-categories with multiple items for each dimension, which matched well with sub-constructs suggested by the literature:

- System Quality – usability, functionality, user interface, and security;
- Information Quality – validity and format;
- Service Quality – assurance for end users, empathy, and clarity;
- Use – deep structure usage, and facilitating conditions;
- User Satisfaction – attitude towards using the system, and usefulness; and
- Net Benefits – enhanced learning, and personal growth and development.

Beside indications of the existence of subcategories within the constructs, two statements with no agreements between judges were dropped. It is worth mentioning that those statements had the lowest level of agreement between the judges in the first two rounds of the card-sorting process. Moreover, the judges noted that several statements in the System Quality construct were very similar, while some measured the

same functionality. Therefore some statements were joined and modified accordingly, wheareas some were excluded. Furthermore, some statements were noted as ambiguous so they were modified and made more precise and clear. The process of refining and reducing the number of statements was very useful since System Quality was the biggest construct and, in the end, the number of statements would have to be reduced anyway. It was somehow expected since the initial number of statements in the first two sorting rounds was too large for similarities between the specific statements to be perceived. As a result of this round of Q-sort (shown in Table 11) the number of statements was reduced to 60, with 19 items for System Quality, 9 for Information Quality, 9 for Service Quality, 6 for Use, 6 for User Satisfaction, and 11 for Net Benefits. It should be mentioned that none of the statements marked as 'essential' by the experts was dropped.

Table 11. Number of items in the constructs after the 3rd round of Q-sort

Constructs	Number of items				
	Initial	After CVR	After Q-sort (1st round)	After Q-sort (2nd round)	After inner construct Q-sort (3rd round)
System Quality	47	43	43	39	19
Information Quality	13	12	12	9	9
Service Quality	22	19	14	9	9
Use	30	9	7	6	6
User Satisfaction	12	9	9	9	6
Net Benefits	51	40	22	13	11
Total	**175**	**132**	**107**	**85**	**60**

The remaining statements represented the version of the instrument ready for the pilot test (see Appendix D). All items were measured using a five point Likert-type scale from 1 (I don't agree/totally incorrect) to 5 (I totally agree/totally correct). In addition to the items that measure ePortfolio success, some questions to collect general background information were also included in the instrument.

After the first version of the instrument was developed, a pretest was made with ten undergraduate students in order to get feedback about the visibility, clarity, readability and time needed for completion. After incorporating the comments from the pretest, a localized version of the instrument was also created since most respondents were from Croatia. The process of translation was conducted as follows:

1. Statements from English were translated to Croatian by three independent persons. There were certain slight differences in translations but those were reconciled during the meeting with translators after they did the translation.
2. The translated statements were given to a teacher of English, who translated those statements back to English.
3. The initial English statements and the ones obtained after the translation from Croatian were compared to ensure that the core meaning had not been lost in translation.

After ensuring that both instruments were equivalent, online versions of the instruments were created. In that way they it was possible to send them to national and international students, making the data analysis faster. The same process of translation was conducted for the CSFs survey as well.

5.4.3 Pilot test

The aim of the pilot-test was twofold: ***The first aim*** was to become aware of the typical and possible anomalous responses from potential respondents, as well as of potential problems with statistical analyses. For that purpose at the end of the questionnaire the respondents were able to comment on its length, wording and instructions in the last field of the online survey reserved for comments. Moreover, technical reliability and usability of the online survey system was also tested. The online instruments were created in the Unit Command Climate Assessment and Survey System (UCCASS)[8] hosted at FOI.

[8] UCCASS ver 1.8.1, available at: http://www.bigredspark.com/survey.html

The second aim of this test was to perform an initial reliability assessment of the scales. Here the Moore&Benbasat's (2001) approach was followed, in which they used the six measures of reliability discussed by Guttman (1945). He argued that the measure with the "highest rating establishes the lower bound of the true reliability of the instrument" (Moore&Benbasat, 2001, p. 204), to be referred to as the Guttman's lower bound or GLB in this research. Cronbach's Alpha (Cronbach, 1970), one of the Guttman's six measures, would be used in this research to assess reliability since it is often used in the instrument creation process (Moore&Benbasat, 2001; Straub *et al*., 2004). Furthermore, according to Moore&Benbasat (2001), the accepted level of reliability depends on the purpose of research. They also argue that in the early stages of research reliabilities of 0.50 to 0.60 would be adequate while for basic research increasing Alpha beyond 0.80 is often wasteful. For this research, the cut-off value was set to 0.7

Several students from the first, second and third year of undergraduate study at the Faculty of Organization and Informatics were chosen for the pilot test, while the other half of respondents (also undergraduate students) joined the study on a voluntary basis. In total, 52 students were involved in the pilot test. They were e-mailed the link to the online instrument along with the explanation of importance of the pilot test and their own role in that process. In addition, they were asked to leave their comments at the end of the instrument. Based on their responses, reliability analysis was conducted. The summary of results is presented in Table 12.

Table 12. Summary of reliability analysis (N=52)

CONSTRUCTS	# ITEMS	ALPHA	GLB
System Quality	19	0.82	0.90
Information Quality	9	0.86	0.87
Service Quality	9	0.86	0.89
Use	6	0.56	0.60
User Satisfaction	6	0.88	0.91
Net Benefits	11	0.89	0.92

Notes: ALPHA: Cronbach's Alpha reliability coefficient,
GLB: Guttman's Lower Bound to reliability

All the constructs except for Use showed good reliability. It was decided to attempt to improve the reliability of the Use construct by slightly rewording some of the items and restoring two statements that had been excluded during previous culling. Moreover, the correlation of items within the scale (henceforth item-item correlation), the corrected item-to-total correlations (henceforth item-scale correlation) and the effects on Alpha if the item was deleted were used to determine which item has negative effects on reliability. Two items slightly raised Alpha if deleted, but since the difference was not so significant, it was decided to keep those items. Since two statements were restored in the Use construct, at the end of this process the ePortfolio success instrument contained 62 items and their final arrangement across the six constructs was as follows (numbers in brackets show the number of items in the construct): System Quality (19), Information Quality (9), Service Quality (9), Use (8), User Satisfaction (6), and Net Benefits (11). A detailed overview of the instrument ready for the field test is provided in Appendix D.

Subcategories within the constructs were named according to suggestions from the 3rd round of inner construct Q-sorting. Once again, those subcategories would need to be empirically tested. The final online instruments that were used in the main data collection (i.e. English and Croatian versions of the instrument) are presented in Appendices E and F.

5.5 *Data collection*

The pilot test ensured that no major flaws in the instrument existed and that the online survey software was adequate for this type of research. The instrument was once again carefully examined to ensure it was easily readable and to reduce the effort needed by the respondents. To avoid possible problems with skipping a question or overseeing an item, all the answers in the instrument were marked as mandatory so the system would not let the respondent proceed to the next page unless all the items on the current page were previously answered. In addition, short and friendly links to the surveys were created with tinyurl.com, since the existing links to the surveys were rather comprehensive, which may prevent potential respondents from participating.

Since ePortfolio implementation is relatively new in Croatia, a research has been conducted in order to determine which educational institutions use ePortfolio in Croatia. The results were not as good as expected. Only the Faculty of Organization and Informatics (FOI) (domestic institution) actively uses ePortfolio with more than 350 students. Three other institutions in Croatia use ePortfolio but with a smaller number of students. Therefore it was decided to contact institutions in Europe and USA to obtain the number of respondents required for a stable factor analysis and SEM. In addition, a cross-national sample was needed for the results to be generally applicable. It was necessary to obtain about 300 responses in total to achieve the 5:1 ratio between students and instrument items. In case of a smaller sample, PLS would be used for factor analysis since it is more robust for smaller samples. Since the ePortfolio is mostly in the pilot phase it was rather difficult to find institutions/universities that actively use ePortfolio. The following strategy of collecting participants outside Croatia was used:

1. An online research was conducted to collect as many institutions as possible in Europe and USA that might have experience in implementing and using ePortfolio. Based on the results, 72 institutions that reported any kind of experience with ePortfolio were targeted.
2. An invitation letter presented in Appendix H was mailed to an institution representative such as the dean, director or manager to find out whether they were willing to participate in research, how many respondents they would be

able to provide, and if there were any additional requirements for their participation (for example, some institutions required a special form to be submitted and approved by the board in order to conduct any kind of research involving students). The letter also stated that, in return, after the analysis, a full report of the institution's score would be sent to the institution representative if the institution provided a sufficient number of respondents.

3. If the institution decided to participate, another mail (see Appendix I) was sent to students in agreement with the institution representative. Prior to this mail, the students were e-mailed by the institution and informed that they would get the invitation letter to join the survey. The e-mails sent to students in different institutions were not identical in their structure because it depended on the institution's regulations and requirements.

If no reply was received from the institution representative, a gentle reminder was sent two weeks after the first e-mail. The same procedure was used for students if the response rate was low. At FOI, students were e-mailed in the same way as those outside FOI, but their teachers were also asked to remind them to complete the survey.

Two instruments for analysis were administered in this research. The first one, which measured ePortfolio success, was intended for students since the unit of analysis was individual. The second one, which assessed CSFs, was intended for institutions in order to collect some general data and information about maturity level and CSFs that were present in a respective institution. Since one of the aims of this research was to establish the connection between CSFs and ePortfolio success, it was important that an institution whose students participated in the ePortfolio success survey also participated in the CSF survey.

The data collection process started in June 2010 and ended in November 2010. At the end of the process, 28 different institutions worldwide completed the CSFs survey (see Appendix J), while 248 students completed the ePortfolio success survey. Careful screening of the responses in the latter survey showed that 62 user responses were not usable since 54 users reported the ePortfolio usage in only one course and 8 answers were not valid (for example, students provided identical answers to all the questions).

Therefore, 186 valid students' responses were left for further analysis. The response rate for institutions that participated in the CSFs survey was calculated by taking into account the number of targeted institutions and the Dillman's formula (Dillman, 1987) for calculating the responses rate adapted for this research as:

$$Response\ rate^{9} = \frac{No\ of\ Usable\ reponses}{Invitation\ e{-}mails\ sent - Unusable\ Responses - Undeliverable\ e{-}mails}.$$

The response rate for the institutions was 42%. However, calculating student responses to the ePortfolio success survey was much more difficult because almost none of the institutions that agreed to participate in this research and complete the CSFs survey reported the exact number of targeted students. Therefore this research ended when it was determined that there were enough data points in the ePortfolio success survey to perform the analysis and no institutions were left in the pool of potential participants.

Prior to a detailed sample analysis, it should be determined whether the sample is adequate for further statistical analysis. First, the universities' responses to the CSFs survey were analyzed in conjunction with students' responses to the ePortfolio success survey to check how many students from each institution had completed the survey and whether the sample for further CSF analysis was valid. Table 13 shows the geographical dispersion of the institutions together with their students as well as the number of institutions' responses and the corresponding students' responses. Since some universities wanted to remain anonymous, only general data is displayed. In Croatia, the Faculty of Organization and Informatics participated with 81 students, while the other faculty participated with 20 students. Other respondents outside Croatia were located in countries ranging from Russia to USA. Owing to such geographical dispersion, based on the survey data, the ePortfolio success instrument would be generally applicable and the ePortfolio Success Model would reflect ePortfolio success in general.

[9] Response rate = $\frac{28}{72-0-6}$=0,42

Table 13. Demographic structure of respondents

	Country	No. of universities	Frequency	Total	Percentage
Croatia	Croatia	2	101	101	54.3
Outside Croatia	Slovenia	2	19	85	45.7
	Russia	1	19		
	UK	2	12		
	Spain	1	11		
	USA	2	24		
Total		**10**	**186**	**186**	**100**

However, the fact that students from only 10 universities (compared to 28 universities that completed the CSF survey) filled the ePortfolio success survey presented a problem. Therefore, despite the respectably high response rate by institutions (42%), too few institutions providing student responses (only 10 universities) were usable to analyze the influence of CSFs on the ePortfolio success, so the results would have no statistical meaning. In respect to this finding, it was decided that further analysis of CSFs would be omitted from this research and recommendations for further research would be given in the final chapter of this dissertation.

5.6 *Sample characteristics*

The student population that represents respondents for the ePortfolio success survey is analyzed in terms of age, number of courses in which they used ePortfolio, frequency of use, and number of artefacts in ePortfolio. It should be mentioned that concerning the gender in the student population there were 55.4% female and 44.6% male respondents, which in terms of gender is a balanced sample.

Table 14 shows the age of students who completed the ePortfolio success survey. Generally, most students (80.6%) fall into category aged 18–23, which actually corresponds to most of the university student population. Namely, in Croatia, as well as in other European countries, students tend to enroll university at the age of 18 and, according to the Bologna Process, should be finishing their study at the age of 23.

Table 14. Respondents' age

Age	Frequency	Percentage	Cumulative Percentage
18-20	78	41.9	41.9
21-23	72	38.7	80.6
24-26	12	6.5	87.1
27-31	8	4.3	91.4
Over 31	16	8.6	100.0
Total	**186**	**100.0**	

The targeted population comprised students that had used ePortfolio in at least two courses or for a period of at least six months. According to Balaban *et al*. (2010), students participating in research need to have used ePortfolio in at least one subject or course and it is only when they have finished the course that they can start perceiving the benefits of ePortfolio. Table 15 shows the number of courses in which the respondents had the opportunity to use ePortfolio. Most of them had used ePortfolio in

two courses (69.4%), which can be explained with the fact that ePortfolio is still in its early stages of development and usage. This finding is also supported by the fact that most of the targeted institutions who responded to the invitation mail reported they could not participate in the research because ePortfolio was still in its early stages of usage at their institutions.

Table 15. Number of courses in which respondents used ePortfolio

No. of courses	Frequency	Percentage	Cumulative Percentage
2	129	69.4	69.4
3	24	12.9	82.3
4	11	5.9	88.2
5	8	4.3	92.5
more than 5	14	7.5	100.0
Total	**186**	**100.0**	

The frequency of ePortfolio usage is reported in Table 16. Most students used ePortfolio on monthly basis (59.2%), and a respectable number used ePortfolio at least once a week (35.5%). This is understandable because producing artefacts is not an everyday activity. An average ePortfolio user therefore tends to use the system at least once a week and in respect to the data obtained in this research, most respondents fall into that category.

Table 16. Frequency of ePortfolio usage

Usage	Frequency	Percentage	Cumulative Percentage
Daily	10	5.3	5.3
Weekly	66	35.5	40.8
Monthly	110	59.2	100.0
Total	**186**	**100.0**	

The number of artefacts in students' ePortfolio is provided in Table 17. A very large number of respondents (94.6%) reported having a few up to 20 artefacts in their ePortfolios. Most respondents (38.7%) had between 5 and 10 artefacts stored in ePortfolio. Most of them had their CVs in the form of a single artefact.

Table 17. Number of artefacts in ePortfolio

Number of artefacts	Frequency	Percentage	Cumulative Percentage
fewer than 5	64	34.4	34.4
5 - 10	72	38.7	73.1
11-20	40	21.5	94.6
21-30	2	1.1	95.7
more than 30	8	4.3	100.0
Total	**186**	**100.0**	

Having in mind all the arguments related to categories analyzed in this section, it can be concluded that the sample population is very similar to the average student population in higher education. The respondents as a whole were therefore considered representative of the higher education student population who are using ePortfolio in their education process.

At the end of this section, descriptive statistics for each of the constructs is presented in Table 18. It is evident that in all the categories the mean values are greater than 3, which indicates that the respondents lean towards favorable perceptions of the three IS oriented features (System Quality, Information Quality and Service Quality). They reported confidence in their own abilities to use the ePortfolio and were mostly satisfied with the usage of such a system. In addition, the perceived impact in terms of benefits had a tendency to be recognized in a positive manner.

Table 18. Descriptive statistics of research constructs (N=186)

Constructs	Mean*	Standard deviation
System Quality	3.51	0.67
Information Quality	3.26	0.69
Service Quality	3.43	0.83
Use	3.39	0.79
User Satisfaction	3.24	0.99
Net Benefits	3.10	0.83

* Answers on 1 to 5 point Likert type scale (1 – I disagree/Completely untrue; 3 – Can't decide/ Neither true nor untrue; 5 – I completely agree/Completely true).

5.7 *Reliability of scales*

Prior to further analysis of instrument validity, the **reliability of the measures** will be assessed in order to gain insight into how the items behave as a group in representing their prospective constructs.

Cronbach's Alpha and **GLB** coefficients were calculated in order to test the instrument's reliability and to determine whether the scales could be further refined. As shown in Table 19, all Alpha coefficients were at 0.80 level or above. According to Moore&Benbasat (2001), Alpha score between 0.50 and 0.60 can be considered sufficient. Similarly, Rajh&Rajh (2006) accepted Alpha of 0.64 as valid in their research, while in the research by Chang&King (2005) Alpha of 0.60 was accepted as sufficient. Therefore Alpha scores in this research were evaluated as very good (0.80 or above) and were not further tested.

Table 19. Reliability coefficients

	Cronbach's Alpha	
CONSTRUCTS	**Pilot test (N=52)**	**Field test (N=186)**
System Quality	0.82	0.85
Information Quality	0.86	0.91
Service Quality	0.86	0.89
Use	0.56	0.90
User Satisfaction	0.88	0.80
Net Benefits	0.89	0.89

6 Instrument validation

In Structural Equation Modeling (henceforth SEM), a SEM model can be decomposed into two sub-models: measurement and structural model. According to Byrne (2010, p. 13), the measurement model defines relationships between the observed and unobserved variables, in this case items as indicators and their constructs. In other words, it shows the pattern by which each measurement item loads on a particular factor. On the other hand, the structural model shows relationships between unobserved variables or constructs. In this chapter, the measurement model is estimated using **Confirmatory Factor Analysis (CFA)** to examine overall fit, validity, and reliability of the model. This process is often referred to as the instrument validation process. In the next chapter, the hypotheses between constructs are examined using the structural model.

According to validation guidelines given by Straub *et al*. (2004), instrument validation requires evaluation of content validity, construct validity and reliability. Content validity was performed during the instrument creation process and was described in detail in Section 5.4.1. Therefore in this chapter only a summary of the content validity process is presented. The construct validity by using Q-sorting method was conducted afterwards to sort the items into the corresponding constructs and to make sure those items actually represent those constructs (as described in Section 5.4.2). That procedure ensured **convergent and divergent (discriminant) validity** of the constructs (Straub *et al*., 2004).

In this chapter, the construct validity is further explored. In addition to suggestions given by Straub *et al*. (2004) and Moore&Benbasat (2001), Segars' (1997) work is also followed. First, CFA is used to establish **convergent validity and unidimensionality** of the constructs. Gefen&Straub (2005) define unidimensionality as the property of the scale where each of its measurement items relates to it better than to any others. After it has been ensured that each item represents the desired dimension, **Exploratory Factor Analysis (henceforth EFA)** is used to determine the existence of subconstructs within each dimension. After that, CFA is used to eliminate items that loaded on multiple factors

within constructs as well as to establish unidimensionality of the factors**. Measurement model fit** for all the constructs as well as for the instrument as a whole is assessed.

Even though the instrument follows the D&M Model whose constructs are based on a substantial body of prior research, factor analysis is appropriate because 1) in this study several different instruments were combined, and 2) a whole new set of statements related to ePortfolio were introduced.

If the instrument (i.e. measurement model) proves to be valid considering all the terms explained this section, as well as reliable, the hypothesis H1 stating that **"Considering ePortfolio as an Information System, it is possible to develop a measurement instrument to assess ePortfolio success"** will be supported.

6.1 *Content validity*

Content validity is an issue of representation (Straub *et al*., 2004). According to Cronbach (1970), content validity is established when the instrument items are pulled in a representative manner from all the ways that could be used to measure the content of a given construct. Straub *et al*. (2004) suggest that literature review and expert judges or panels should be used in the process of establishing content validity. Those recommendations were followed in this research in the process described in detail in Section 5.4.1.

The instruments recommended by DeLone and McLean, which had already been developed for their instrument, were used in the item creation process together with the available ePortfolio literature. After that, expert judges (see Appendix A) were asked to coin the missing ePortfolio related items if needed.

In the end, the initial items were refined through a series of Q-sorting procedures (see Section 5.4.2). All those techniques ensured the content validity of the instrument.

6.2 *Construct validity*

According to Straub *et al*. (2004, p. 388), construct validity shows "whether the measures chosen by researcher 'fit' together in such as way as to capture the essence of the construct". In the instrument construction process, Q-sorting was conducted not only to eliminate unnecessary items and ensure content validity, but also to assess convergent and discriminant validity of the constructs (see Section 5.4.2). In the following subsections, the description of CFA used to **verify convergent validity** and to **establish the unidimensionality** of the instrument is provided. Once construct validity was confirmed, EFA would be conducted to determine the number of subconstructs for each of the dimension because the Q-sorting procedure indicated the existence of subconstructs within each dimension which needed to be empirically tested and verified. After that, another CFA would be performed to examine the **measurement model fit** for each of the subconstructs and constructs as a whole.

In respect to factor analysis, it should be mentioned that in general, it attempts to determine which set of observed variables share common variance-covariance characteristics that define theoretical constructs or factors. A researcher collects data and uses factor analysis either to confirm that a set of variables define a construct (factor) (CFA), or to explore which variables relate to which factors (EFA). Depending on the strength of factor loadings (or correlation coefficients) and elimination criteria set by the researcher, some items are dropped from further research. For that reason it is often considered that factor analysis enables to 'clean up' the construct.

EFA does not assume that an a priori model exists, but the researcher explores possible factors, whether the factors are correlated and which measurement items (observed variables) best measure which factor. The aim is to identify the smallest number of factors that explain most of the variance in the measurement items. The loading pattern is usually rotated with Varimax rotation to simplify the interpretation of the results (Gefen&Straub, 2005). In this research, EFA was run in statistical program R[10].

[10] R is a language and environment for statistical computing and graphics under the Linux operating system. In this research R ver 2.8.1 was used in Ubuntu 10.10 operating system.

On the other hand, in CFA the researcher specifies the measurement model by adding the measurement items to their prospective constructs. Factorial validity is established "when each item correlates with a much higher correlation coefficient on its proposed construct than on other constructs and when the square root of each construct's AVE is notably larger than its correlation with other constructs" (Straub et. al, 2004, p. 379). Furthermore, CFA enables to test "whether the sample data confirm the model" (Schumacker&Lomax, 2004, p. 169) through series of fit indices. For assessing construct validity via CFA, two basic methods were used: Structural Equation Modeling (SEM) and Partial Least Squares (PLS).

SEM is a covariance-based technique and attempts to minimize the difference between the sample covariance and that predicted by the theoretical model (Haenlein&Kaplan, 2004). According to Schumacker&Lomax (2004), it is used to determine how sets of variables define constructs (i.e. measurement model) and how these constructs are related to each other (i.e. structural model). It includes a large set of powerful statistical indices for testing measurement and structural models. Its goal is to determine to which extent the model fits the sample data. According to Schumacker&Lomax (2004), the minimum recommended sample size is 150 samples and/or 5 respondents per item. Same authors suggest the desirable sample size of 300, 400 or more and/or 10 respondents per item. LISREL[11], which is a synonym for covariance-based SEM, would be used to perform CFA and examine the model fit for each construct and subconstructs.

PLS is also a type of SEM, but it is a variance-based technique that "… focuses on maximizing the variance of the dependent variables explained by the independent ones instead of reproducing the empirical covariance matrix" (Haenlein&Kaplan, 2004, p. 290). It was developed as an alternative to SEM and likewise consists of a measurement model that is often called the outer model and the structural model often called the inner model. Besides those two models, PLS has a third component, the weight relations, which are used to estimate case values for latent variables (Haenlein&Kaplan, 2004). It is a very popular technique in IS research and in other areas as well (Henseler *et al*., 2009). Chin *et al*. (1996) reviewed over 80 articles that had used PLS and concluded that, although some authors reported an extremely small sample size amounting to 20,

[11] LISREL ver 8.80 Student Edition, obtained from www.ssicentral.com/lisrel/student.html

the desirable sample size for stable results is 100. These same authors also claim that, among complex models, PLS is virtually without competition (Chin *et al*., 1996). In this research SmartPLS[12] was used to run PLS.

According to Henseler *et al*. (2009), the main difference between the two methods is that SEM is more appropriate for theory testing due to its powerful statistical features, while PLS is much more appropriate for prediction. Of course, both of them can perform CFA, but in general SEM can generate many more statistical interpretations than PLS, especially for the measurement model. Research has showed that PLS is more robust for smaller samples than SEM and that CFA can be performed by any of those methods, only with a different set of fit indices (Straub *et al*, 2004; Henseler *et al*., 2009; Gefen *et al*., 2000).

Bearing in mind the advantages and constraints elaborated in previous sections, both SEM and PLS were used in this research. SEM was used to examine model fit for each construct and its subconstructs (to assess the measurement model) while PLS was used to test the relationships between the constructs (to test the hypotheses in the structural model). Such a selection of methods is justified by the fact that if we limit the analysis to only one construct at a time, we have a maximum of 10 measurement items per construct which, in respect to sample size (N=186), gives us the ratio >18:1 that is more than adequate for SEM (Haenlein&Kaplan, 2004; Schumacker&Lomax, 2004). On the other hand, if we want to analyze the structural model, we are confronted with all measurement items (62) in the model, which leaves us with a 3:1 ratio. In that case, SEM usage is not recommended due to its sensitivity to sample size and the number of items in the model. PLS combined with the bootstrap method was therefore used to obtain t-statistics to assess the statistical significance of the results. A similar approach was already used by Mahmood *et al*. (2004), where PLS was used for analyzing the relationships in the structural model, while AMOS (as a SEM tool) was used for fit statistics.

[12] Ringle, C.M.; Wende, S.; Will, S.: SmartPLS 2.0 (M3) Beta, Hamburg 2005, http://www.smartpls.de.

6.2.1 Establishing convergent validity and unidimensionality

The CFA process started following the guidelines by Segar (1997), Straub *et al*. (2004) and Gefen&Straub (2005) to eliminate items that had significant cross loading on more than one construct. Because of a relatively small sample (N=186) that yielded a subject to item ratio of 3:1, PLS rather than SEM would be used to determine whether all the items load on their prospective constructs. For all PLS calculations in SmartPLS, the following settings were selected:

1. Weighting Scheme: Path Weighting Scheme
2. Data Metric: Mean 0, Var 1
3. Maximum Iterations: 300
4. Abort criterion: 1.0E-5
5. Initial Weights: 1.0

The starting point was the construct structure obtained from the Q-sorting process. Since the strict rules on when to eliminate items in factor analysis do not exist or the process of dropping the items at least depends on the researcher and the case, a threshold needed to be defined in this research. In doing so, recommendations from Segar (1997), Straub *et al*. (2004) and Gefen&Straub (2005) were followed. The items that loaded over 0.6 into their prospective construct were retained. It was a slightly higher threshold than usual (0.5) but it is important to have only the items with high loadings in their latent constructs and not to leave any space for possible cross-loadings. This ensured convergent validity. According to Gefen&Straub (2005), convergent validity is shown when each of the measurement items loads with a significant t-value on its latent construct. In addition, the difference in loadings of one item between its prospective construct and all the other constructs needs to be greater than 0.1. For example, if an item loads on its latent construct with 0.60 coefficient, the loadings of all the measurement items on any latent construct but its own should be below 0.50. This ensured that an item did not load highly on any other construct and represented a first step in ensuring discriminant validity that would be tested in the next chapter. Finally, unidimensionality was established by eliminating the items that cross loaded on more than one construct (i.e. over 0.5 on at least two constructs).

Owing to a relatively small sample size (N=186) and low subject to item ratio (3:1), the bootstrap method was conducted to obtain t-statistics as estimates of significance of factor loadings. The usage of bootstrap is often found in literature in case of a smaller sample size to provide confidence intervals for all parameter estimates and also because PLS, if used, does not provide such information (Armstrong&Sambamurthy, 2000; Henseler *et al.*, 2009). Bootstrap provides the mean value and standard error for each item or path model coefficient and this information is adequate to calculate t-value using the following formula (Henseler *et al.*, 2009):

$$t_i = \frac{w_i}{se(w_i)},$$

where t_i represents t-value for i-th item or path coefficient, w_i the original PLS estimate of a certain item or path coefficient, and $se(w_i)$ the bootstrapping standard error. By using this method, 300 random samples of observations from the original data set by sampling through replacement were generated. Each sample size was kept similar to the size of the original data set (Armstrong&Sambamurthy, 2000; Henseler *et al.*, 2009). Factor loadings were re-estimated and t-values generated for each item loading (see Appendix K). T-statistics is significant at the 0.05 level if its value exceeds 1.96 and at the 0.01 level if its value exceeds 2.56 (Hoyle, 1999). The minimum t-value was 3.65 while all the other values were much higher. T-statistics tables revealed that the factor loadings were significant at p=0.001, so the results obtained from CFA can be interpreted with confidence. The construct structure is showed in Table 20.

Table 20. CFA factor structure for each construct

Items	Constructs					
	Information Quality	Net Benefits	Service Quality	System Quality	Use	User Satisfaction
IQ1	**0.561870***	0.355098	0.351565	0.471267	0.300571	0.243907
IQ2	**0.664136**	0.367241	0.325707	0.411204	0.111374	0.220117
IQ3	**0.682665**	0.452174	0.436260	0.455407	0.271837	0.347734
IQ4	**0.427042***	0.170434	0.249055	0.311775	0.117765	0.126308
IQ5	**0.660310**	0.433610	0.439306	0.410617	0.152077	0.380395
IQ6	**0.774088**	0.464365	0.539741	0.526521	0.390551	0.506003
IQ7	**0.827949**	0.518380	0.619878	0.606508	0.485866	0.486276
IQ8	**0.664386**	0.386339	0.399933	0.459301	0.245550	0.304088
IQ9	**0.696356**	0.490521	0.522550	0.506127	0.425922	0.421820
NB1	0.430672	**0.762500**	0.430933	0.347933	0.329339	0.696507
NB10	0.484396	**0.787869**	0.545523	0.474434	0.436266	0.629834
NB11	0.504047	**0.671806**	0.503258	0.485879	0.471711	0.522282
NB2	0.415232	**0.749175**	0.404843	0.410182	0.367378	0.618784
NB3	0.493210	**0.695852**	0.438566	0.329910	0.288642	0.576377
NB4	0.458601	**0.744093**	0.517773	0.386141	0.367052	0.631212
NB5	0.406418	**0.754515**	0.502735	0.345943	0.370253	0.609179
NB6	0.524526	**0.763810**	0.618498	0.528891	0.458119	0.634886
NB7	0.449066	**0.743244**	0.537314	0.541533	0.527507	0.548730
NB8	0.405629	**0.664250**	0.454763	0.521135	0.586975	0.494030
NB9	0.496954	**0.736109**	0.577436	0.444982	0.424207	0.567137
SERQ1	0.506799	0.515084	**0.737984**	0.497495	0.450284	0.438885
SERQ2	0.432754	0.477159	**0.718202**	0.563190	0.529478	0.452250
SERQ3	0.528813	0.510200	**0.705597**	0.353032	0.312128	0.550537
SERQ4	0.608448	0.590995	**0.802290**	0.534694	0.455531	0.649305
SERQ5	0.515984	0.565611	**0.783461**	0.501389	0.441018	0.563607
SERQ6	0.423809	0.519045	**0.791834**	0.489391	0.416833	0.530198
SERQ7	0.495365	0.491803	**0.782510**	0.539544	0.482009	0.487938
SERQ8	0.461977	0.401843	**0.609900****	0.602052	0.455553	0.374183
SERQ9	0.535032	0.475161	**0.725482**	0.525055	0.436172	0.513673
SYSQ1	0.448683	0.361571	0.474226	**0.722215**	0.501032	0.372632
SYSQ10	0.444445	0.440117	0.522805	**0.716277**	0.554186	0.438411
SYSQ11	0.456536	0.260003	0.271351	**0.567353***	0.305737	0.145426
SYSQ12	0.498061	0.352070	0.288551	**0.562248***	0.241808	0.340828

Table 20. CFA factor structure for each construct (continued)

Items	Constructs					
	Information Quality	Net Benefits	Service Quality	System Quality	Use	User Satisfaction
SYSQ13	0.326360	0.268218	0.314621	**0.528708***	0.335128	0.259251
SYSQ14	0.443709	0.291448	0.303357	**0.544002***	0.317838	0.240192
SYSQ15	0.455068	0.297776	0.382349	**0.547349***	0.273607	0.242639
SYSQ16	0.230155	0.125595	0.100626	**0.372191***	0.187006	0.026444
SYSQ17	0.405324	0.254186	0.251449	**0.487442***	0.257223	0.155072
SYSQ18	0.373048	0.243696	0.258596	**0.562065***	0.356467	0.168207
SYSQ19	0.418873	0.256347	0.263751	**0.491909***	0.239924	0.213215
SYSQ2	0.337227	0.300156	0.397630	**0.625441**	0.411857	0.278409
SYSQ3	0.425072	0.356171	0.521130	**0.620468**	0.459963	0.424427
SYSQ4	0.527325	0.490542	0.574719	**0.688099**	0.511523	0.516443
SYSQ5	0.395843	0.408364	0.439966	**0.636382**	0.516401	0.386130
SYSQ6	0.567475	0.551835	0.570347	**0.797783**	0.580292	0.507354
SYSQ7	0.408360	0.393171	0.494793	**0.622875**	0.447525	0.296627
SYSQ8	0.464537	0.432499	0.511048	**0.648238**	0.388742	0.336634
SYSQ9	0.444860	0.396707	0.478365	**0.582380***	0.449196	0.388645
U1	0.364745	0.430949	0.345476	0.409678	**0.694909**	0.382315
U2	0.298047	0.368418	0.287541	0.334812	**0.634885**	0.303213
U3	0.281904	0.344138	0.300681	0.285744	**0.502426***	0.301659
U4	0.281877	0.456807	0.398310	0.483186	**0.759051**	0.416377
U5	0.171023	0.399368	0.391461	0.442083	**0.710106**	0.312737
U6	0.414734	0.436329	0.502583	0.544955	**0.666169**	0.482106
U7	0.336610	0.273185	0.437269	0.501875	**0.642919**	0.341974
U8	0.224989	0.165512	0.383323	0.447446	**0.513086***	0.193458
US1	0.489399	0.653526	0.607079	0.463928	0.503283	**0.841349**
US2	0.373098	0.596644	0.456921	0.287643	0.406912	**0.786624**
US3	0.428053	0.647785	0.601322	0.428920	0.407988	**0.865341**
US4	0.386806	0.674058	0.484680	0.318057	0.303170	**0.800365**
US5	0.505334	0.739887	0.611114	0.565733	0.523379	**0.823800**
US6	0.450001	0.614986	0.562374	0.557623	0.477560	**0.737632**

Bolded values mark the loading of the item into its prospective construct

** Candidates for drop out due to loading values below threshold of 0.6*

*** Although the item has a higher loading on its prospective construct than required, it cross-loads on the other construct and should therefore be omitted*

It should be stressed that the System Quality construct experienced serious dropouts, which was expected since that construct contained too many items from the beginning. After a close examination of items that were dropped, it is evident that most of them are related to system security. Therefore it can be concluded that it is adequate for ePortfolio systems to have only standard (default) security mechanisms built in while some further and finer security features are not mandatory. In addition, it should be mentioned that items were dropped in a way that would not decrease the comprehensiveness of the instrument. To summarize, during the item reduction process 10 items were eliminated from System Use, 2 from Information Quality, 2 from Use, 1 from Service Quality, while User Satisfaction and Net Benefits did not suffer any eliminations.

After cleaning up the constructs, Cronbach's alpha was calculated again to ensure the reliability of the scales was not compromised. This was particularly important for System Quality, as it had suffered some serious dropouts. Table 21 shows that reliability of the constructs remained at a satisfactory level.

Table 21. Constructs' structure after CFA

Constructs	No. of items	Cronbach's Alpha
System Quality	9	0.88
Information Quality	7	0.84
Service Quality	8	0.90
Use	6	0.79
User Satisfaction	6	0.89
Net Benefits	11	0.91

As a result of this analysis, both **convergent validity and unidimensionality of the constructs were established**.

6.2.2 Extracting the subconstructs

After it had been ensured that the items indeed represented the constructs and all the constructs were "clean", following recommendations in Gefen *et al*. (2000), Straub *et al*. (2004) and Gefen&Straub (2005), an EFA was used to determine the number of subconstructs in each dimension. The method used for extracting the factors was Common Factor Analysis with Varimax rotation. Costello&Osborne (2005) reported that Varimax rotation is by far the most common choice of many researchers. Gefen&Straub (2005) also recommend using the Varimax method to rotate the loading pattern in order to simplify the interpretation of results. Varimax rotation creates orthogonal factors with minimized high loadings of the measurement items on other factors. In the explanation of the extracting method, Principal Component Analysis (PCA) is very often used in EFA. It seeks a linear combination of variables such that the maximum variance is extracted from the variables. After that, it removes that variance and seeks for another linear combination that explains most of the variance. On the other hand, Common Factor Analysis (CFA), also called Principal Factor Analysis (PFA) or Principal Axis Factoring (PAF), seeks the least number of factors that can account for a common variance of a set of variables. Costello&Osborne (2005) analyzed many cases of EFA usage and came to the conclusion that there is no optimal extraction procedure so the researcher must choose the most appropriate method in each specific case. Moreover, the authors stressed the importance of running CFA to confirm the obtained result due to the fact that EFA is exploratory.

The purpose of this stage of the research was to extract a minimum number of factors within each construct considering the initial number of items in individual constructs did not exceed 10. Therefore the more factors were extracted, the less chance there would be to run CFA because it works with a minimum of 4 items per factor. Following this rationale, Common Factor Analysis was used for extracting the factors.

The sample size (N=186) was adequate for this analysis because six separate exploratory factor analyses were conducted one construct at the time, which led to a substantially higher subject to item ratio. The lowest ratio was established for Net

Benefits (17:1), due to the highest number of items. This presented a respectable starting point for further analysis.

Prior to each analysis the Kaiser-Meyer-Olkin Measure of Sampling Adequacy and Barlett's test of sphericity were performed to check whether the data scales are suitable for further factor analysis (Gefen *et al*., 2000; Costello&Osborne, 2004). The Kaiser-Meyer-Olkin measure of sampling adequacy was greater than 0.7 for all the constructs and Barlett's test of sphericity was significant at 0.00 level. This implied that the factor model was appropriate and factor analysis could be conducted.

Since this was an exploratory factor analysis, it was run without specifying the number of factors to be extracted. Moreover, in determining the final number of the factors two different criteria were combined (Loehlin, 2004): Cattell's scree test (Cattell, 1966) and Guttman-Keiser criterion (Yeomans&Golder, 1982) with eigenvalue grater than 1.0. The results are two factors for System Quality, Information Quality, Use and Net Benefits, and only one factor for Service Quality and User Satisfaction.

Although the convention in EFA is to eliminate the items with factor loading below 0.5 (Chang&King, 2005; Gefen&Straub, 2005), numerous examples of different thresholds can be found in literature varying from 0.40 to 0.70 (Costello&Osborne, 2004). In this research, items with loadings below 0.50 were dropped. In general, all the items had high loadings mostly due to the prior Q-sorting and CFA. After a careful examination of all the constructs and factor loadings only two issues were detected. Firstly, there was one item that loaded below 0.5 on its prospective factor in the Information Quality construct but it was retained because otherwise it would result in one factor having fewer than 4 items, which is not sufficient for a confirmatory factor analysis. The second issue occurred in the Net Benefits construct, where one item cross loaded significantly (above 0.5) on two factors. It was decided to eliminate that item. Table 22 shows the factor structure for each construct.

Table 22. Factor pattern for each construct (N=186)

Construct	SYSTEM QUALITY			INFORMATION QUALITY			SERVICE QUALITY	
Factors		1	2		1	2		1
Items and loadings	SYSQ1	**0.609**	0.421	IQ2	0.190	**0.765**	SERQ1	0.704
	SYSQ2	**0.522**	0.360	IQ3	0.208	**0.770**	SERQ2	0.652
	SYSQ3	**0.723**	0.141	IQ5	0.262	**0.605**	SERQ3	0.677
	SYSQ4	**0.634**	0.318	IQ6	**0.850**	0.218	SERQ4	0.777
	SYSQ5	**0.649**	0.203	IQ7	**0.824**	0.297	SERQ5	0.769
	SYSQ6	**0.669**	0.416	IQ8*	0.368	**0.485**	SERQ6	0.771
	SYSQ7	0.187	**0.774**	IQ9	**0.604**	0.231	SERQ7	0.755
	SYSQ8	0.255	**0.638**				SERQ9	0.658
	SYSQ10	0.424	**0.592**					
	Total variance explained: **62.7%**			Total variance explained: **68.4%**			Total Variance explained: **58.0 %**	

Construct	USE			USER SATISFACTION		NET BENEFITS		
Factors		1	2		1		1	2
Items and loadings	U1	**0.556**	0.260	US1	0.817	NB1	0.249	**0.809**
	U2	**0.599**	0.136	US2	0.757	NB2	0.271	**0.762**
	U4	**0.865**	0.149	US3	0.856	NB3	0.322	**0.609**
	U5	**0.698**	0.208	US4	0.760	NB4	0.302	**0.712**
	U6	0.218	**0.708**	US5	0.759	NB5	0.419	**0.602**
	U7	0.169	**0.770**	US6	0.649	NB6	**0.701**	0.346
						NB7	**0.769**	0.262
						NB8	**0.694**	0.203
						NB9	**0.673**	0.330
						NB10**	**0.566**	0.509
						NB11	**0.577**	0.315
	Total variance explained: **68.1 %**			Total Variance explained: **65.7 %**		Total Variance explained: **65.1 %**		

Bolded values mark the highest loading of the item on its prospective factor
Method of extraction was Common Factor Analysis with Varimax rotation
* Item with a lower loading (below 0.5) that was retained
** Item that cross loaded on two factors was dropped

6.2.3 Adjusting the model fit

After identifying the subconstructs (factors) within each dimension, a confirmatory factor analysis was used again, but this time to examine the measurement model fit for each of the subconstructs and finally, for the constructs as a whole. The measured factors would first be modeled in isolation, then in pairs, and finally as a collective network, representing the whole construct, as suggested by Segars&Groover (1998). Even though at the beginning of this analysis PLS was used because of a small sample size, LISREL, which is a SEM tool, was be used here for several reasons: 1. PLS does not provide all the necessary information about measurement model fit; 2. Factors and constructs are modeled in isolation (i.e. only few items are analyzed at the same time) which gives us both a respectable sample size and a subject to item ratio for conducting SEM.

The process started by analyzing the items that loaded on the same factor with CFA in LISREL to verify the results obtained from EFA. Exceptions were factors with only 3 items. Those would only be identified for CFA and analyzed in conjunction with other factors in the same dimension. Each model went through an iterative modification process to improve its model fit. As was already mentioned, the model fit was analyzed and modified for each factor in isolation and then in pair.

Therefore, the modification process started with an individual factor by examining the individual item loadings. The equation for a single item is given as:

$$x_i = \lambda_i \xi + \delta \,,$$

where x_i is the ith indicator from a set of unidimensional factors, λ_i is the corresponding factor loading, ξ is the latent factor being measured, and δ is the corresponding error term assumed to be uncorrelated with any factors or other residuals (Chang&King, 2005). Since the Q-sorting process and first CFA ensured that all the items had a high loading on their prospective factor, and EFA showed high loadings for almost all factors, it was expected that this CFA would only confirm the results from previous methods. Again, since there is no consensus on the minimum standardized loading for retaining an item, a standardized loading of 0.5 was used in this dissertation. In factor analysis, an

item with a low standardized loading indicates that only a small portion of a factor score is measured by that indicator and therefore it should be dropped from the model. In this research, if the individual item loading λ_i was below the cut off value, the item was carefully examined to ensure that it was not eliminated except if it decreased the model fit.

After it was determined that all factors loaded highly on their latent constructs, the model was tested again to examine its fit. Since it is advised that several model fit indices are combined to estimate the model fit, in this research the following goodness-of-fit indicators were used:

Chi-square (χ^2): Widely used for making decisions about the model fit. However, it is sensitive to sample size so with very large samples it can lead to rejection of an otherwise highly satisfactory model (Loehlin, 2004). Therefore it should be used in combination with other fit indices. Three estimation methods are used to calculate χ^2 and in this research a maximum likelihood method was chosen as one of the widely used methods (Schumacker&Lomax, 2004).

Goodness-of-Fit Index (GFI): Compares the fit of a given model to that of no model at all (Loehlin, 2004). It measures the absolute fit because it is unadjusted for degrees of freedom. It is one of the most widely used fit indices and is usually combined with AGFI. Its values are in range from 0 to 1. Values greater than 0.9 indicate a good fit.

Adjusted Goodness-of-Fit Index (AGFI): Measures the model fit and takes into account the degrees of freedom. In other words, it is adjusted for the degrees of freedom of a model relative to the number of variables (Loehlin, 2004). Its values are in range from 0 to 1. Values greater than 0.9 indicate a good fit.

Comparative Fit Index (CFI): Derived from Normative Fit Index (NFI) that has been a strongly popularized in the last decade (Byrne, 2010). In comparison with NFI, CFI is adjusted for sample size, which makes it a better choice, especially for smaller samples. CFI ranges from 0 to 1, with a larger value indicating a better model fit. The acceptable model fit was indicated by a value greater than 0.90, which was also used in this research.

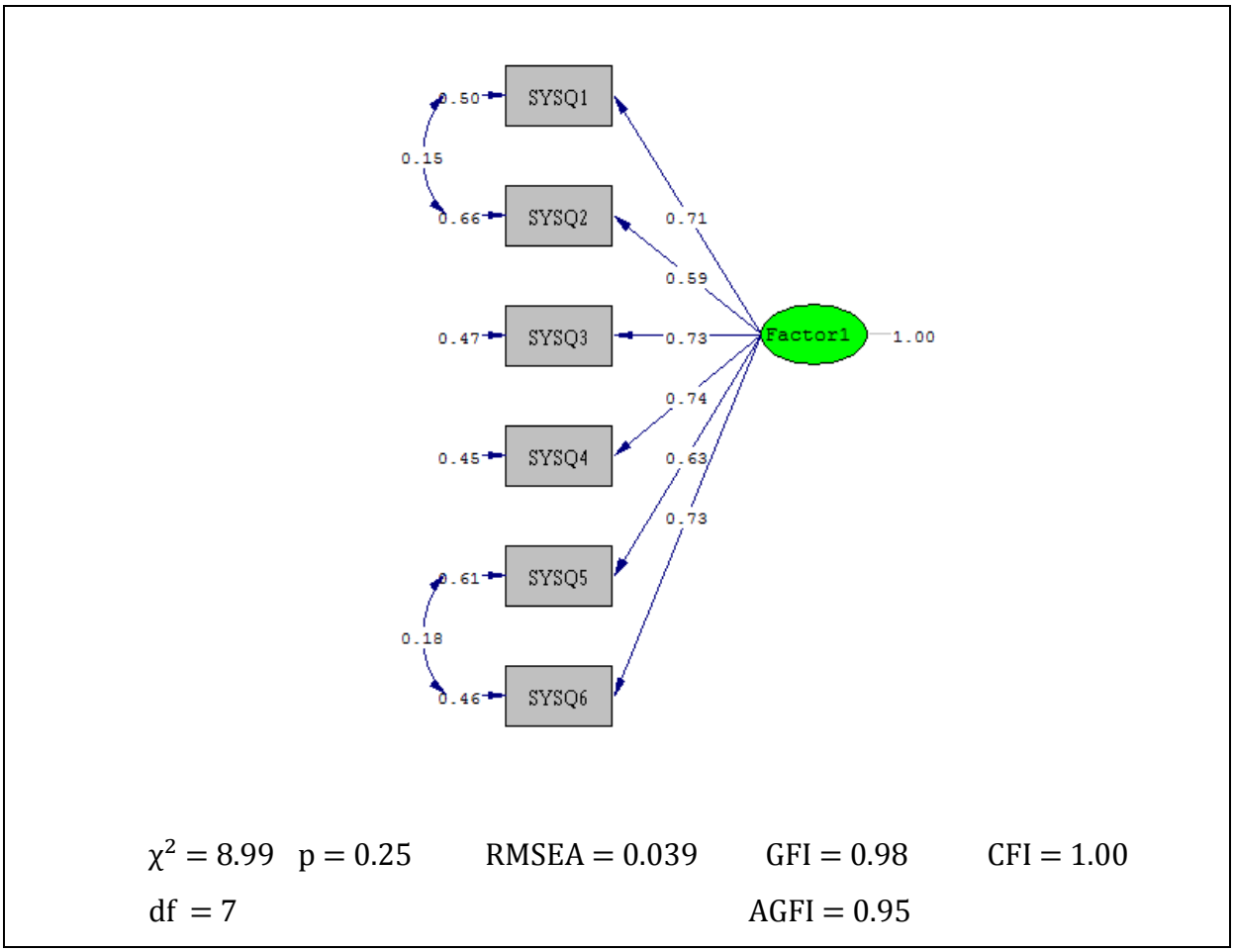
Root Mean Square Error of Approximation (RMSEA): A population-based index related to residual in the model. RMSEA values range from 0 to 1, with a smaller RMSEA value indicating a better model fit. Values below 0.05 are considered to show a very good fit.

In this research, in cases of an unsatisfactory model fit, the modification index of the model was examined. The modification index for a single factor measurement model indicated the possibility of error correlation, which suggested that items influenced each other. Consequently, by allowing the error terms to correlate, the model fit was improved. However, this modification is only feasible when there is a theoretical reason to suggest that the two items should be correlated. If the suggested modification is not rational, it will not be implemented. It is important to mention that the process of improving the model fit needs to be done iteratively, with one modification made at a time, until either a satisfactory model fit is achieved or no modification is suggested. The summary of the modification process for each construct and its subconstructs (factors) is presented in Tables 23-28, while the final measurement model is shown in Figures 8-12.

Table 23. Summary of modification process for System Quality construct

Factors	Modification process
Factor 1 Initial Model	Items: Sysq1, Sysq2, Sysq3, Sysq4, Sysq5 Fit indices: χ^2 = 34.16 p = 0.00 RMSEA = 0.120 GFI = 0.94 CFI = 0.96 df = 9 AGFI = 0.87
Final Model	Items: Sysq1, Sysq2, Sysq3, Sysq4, Sysq5 Fit indices: χ^2 = 8.99 p = 0.25 RMSEA = 0.039 GFI = 0.98 CFI = 1.00 df = 7 AGFI = 0.95 Modifications: 1. Using the system will be easier to learn if help functions are available and sufficient (Sysq1&Sysq2). 2. The system's sitemap clearly shows the organization of materials was suggested to correlate negatively with the process of easily managing the views (Sysq3&Sysq4). Since there is no rationale for such a relationship, this modification was not implemented. 3. It would be possible to quickly search (e.g. using a search engine) through ePortfolio content if the system included necessary features and functions (Sysq5&Sysq6).
Factor 2	Not analyzed in isolation because it consisted of only 3 items

Figure 8. Measurement Model for System Quality



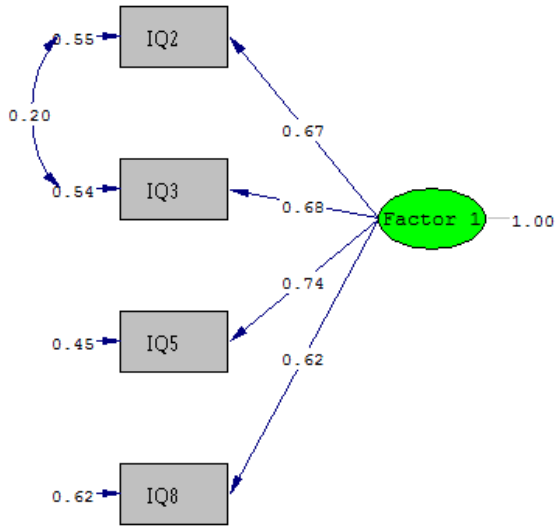
$\chi^2 = 8.99$ p = 0.25 RMSEA = 0.039 GFI = 0.98 CFI = 1.00

df = 7 AGFI = 0.95

Table 24. Summary of modification process for Information Quality construct

Factors	Modification process
Factor 1 Initial Model	Items: Iq2, Iq3, Iq5, Iq8 Fit indices: χ^2 = 6.78 p = 0.037 RMSEA = 0.114 GFI = 0.98 CFI = 0.98 df = 2 AGFI = 0.91 Modifications: 1. The more frequently updated information in ePortfolio will be more complete. (IQ2&IQ3)
Final Model	Items: Iq2, Iq3, Iq5, Iq8 Fit indices: χ^2 = 0.68 p = 0.41 RMSEA = 0.000 GFI = 1.00 CFI = 1.00 df = 1 AGFI = 0.98
Factor 2	Not analyzed in isolation because it consisted of only 3 items

Figure 9. Measurement Model for Information Quality



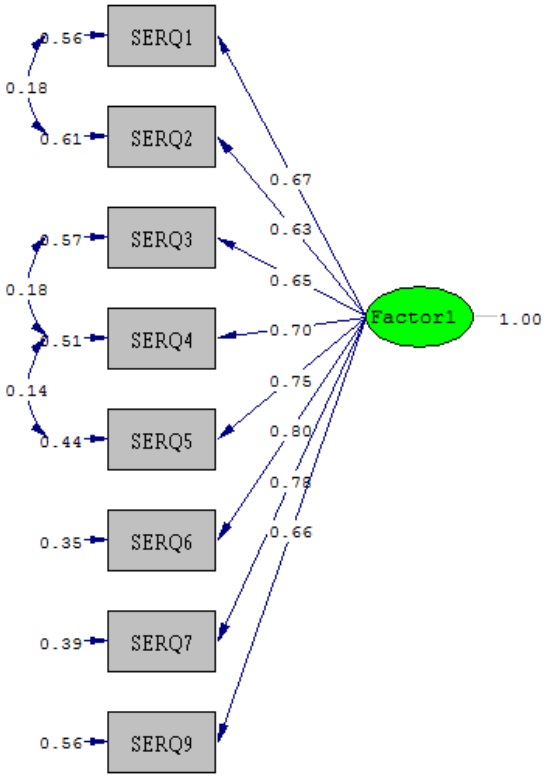
$\chi^2 = 0.68$ p = 0.41 RMSEA = 0.000 GFI = 1.00 CFI = 1.00

df = 1 AGFI = 0.98

Table 25. Summary of modification process for Service Quality construct

Factors	Modification process
Factor 1 Initial Model	Items: Serq1, Serq2, Serq3, Serq4, Serq5, Serq6, Serq7, Serq9 Fit indices: χ^2 = 66.49 p = 0.00 RMSEA = 0.110 GFI = 0.92 CFI = 0.97 df = 20 AGFI = 0.86
Final Model	Items: Serq1, Serq2, Serq3, Serq4, Serq5, Serq6, Serq7, Serq9 Fit indices: χ^2 = 25.16 p = 0.091 RMSEA = 0.051 GFI = 0.97 CFI = 0.99 df = 17 AGFI = 0.93 Modifications: 1. The existence of a specific person (or group) to assist with system difficulties leads to the existence of e-mail and other types of on-line help in case of problems and vice versa (Serq1&Serq2). 2. Teachers/ePortfolio support staff are more helpful for using the system if they have better competences in ePortfolio (Serq3&Serq4). 3. The more individual attention the institution gives to the user it needs to educate the ePortfolio staff/Teachers that will be competent to answer the user questions (Serq4&Serq5). 4. Teachers/ePortfolio support staff are helpful for using the system was suggested to correlate negatively with giving the institution giving the user individual attention (Serq3&Serq5). Since there is no rationale for such a relationship, this modification was not implemented.

Figure 10. Measurement Model for Service Quality



$\chi^2 = 25.16$ p $= 0.091$ RMSEA $= 0.051$ GFI $= 0.97$ CFI $= 0.99$

df $= 17$ AGFI $= 0.93$

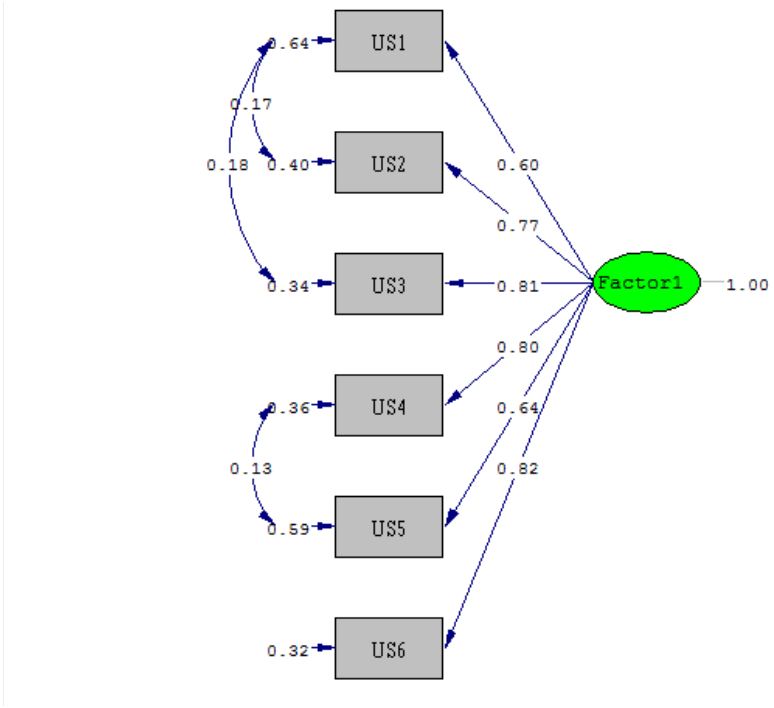
Table 26. Summary of modification process for Use construct

Factors	Modification process
Factor 1 Initial Model	Items: U1, U2, U4, U5 The factor was not further analyzed in isolation because CFA reported very low loading (0.25) of item U5 leading to the conclusion that the item should be dropped. However it was decided to try the modification process later with both factors in pairs. Therefore, this factor was parsed out from further individual analysis.
Factor 2	Not analyzed in isolation because it consisted of only 2 items. In factor analysis, factors with less than 3 items are considered weak (Costello&Osborne, 2005). Therefore U5 will be analyzed in this factor in the next iteration.

Table 27. Summary of modification process for User Satisfaction construct

Factors	Modification process
Factor 1 Initial Model	Items: Us1, Us2, Us3, Us4, Us5, Us6 Fit indices: χ^2 = 56.44 p = 0.00 RMSEA = 0.230 GFI = 0.84 CFI = 0.90 df = 9 AGFI = 0.63
Final Model	Items: Us1, Us2, Us3, Us4, Us5, Us6 Fit indices: χ^2 = 27.41 p = 0.000 RMSEA = 0.197 GFI = 0.91 CFI = 0.94 df = 6 AGFI = 0.68 Modifications: 1. Using the available features for organizing the content was suggested to correlate negatively with using the features to join the groups (U1&U4). Since there is no rationale for such a relationship, this modification was not implemented. 2. Using the available features for organizing the ePortfolio content leads to increased collaboration with peers in organizing the content (U1&U2). 3. Using the available features for organizing the content will lead to using features that help to tag artefacts (U1&U3). 4. Collaborating with peers in organizing the ePortfolio content was suggested to correlate negatively with the knowledge necessary to use the system (U2&U6). Since there is no rationale for such a relationship, this modification was not implemented. 5. Using the features that help to tag artefacts was suggested to correlate negatively with using the features that help to set view permissions for different views (ePortfolios)(U3&U5). Since there is no rationale for such a relationship, this modification was not implemented. 6. Using the features that help to join the groups positively affects using the features that help to set view permissions for different views (ePortfolios)(U4&U5).

Figure 11. Measurement Model for User Satisfaction



$\chi^2 = 27.41$ p $= 0.000$ RMSEA $= 0.197$ GFI $= 0.91$ CFI $= 0.94$

df $= 6$ AGFI $= 0.68$

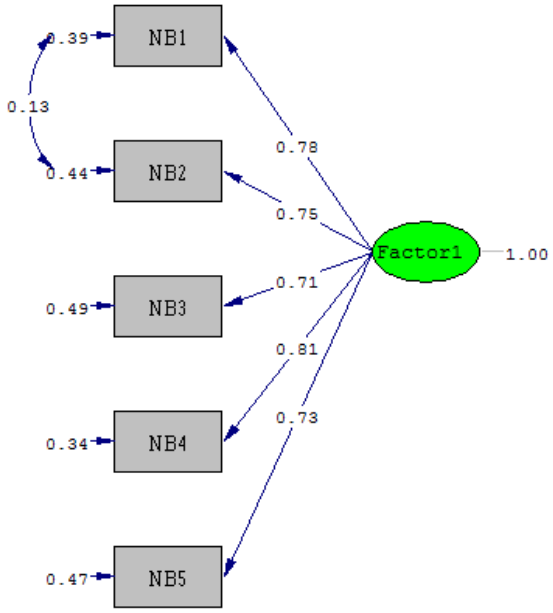
Table 28. Summary of modification process for Net Benefits construct

Factors	Modification process
Factor 1 Initial Model	Items: Nb1, Nb2, Nb3, Nb4, Nb5 Fit indices: χ^2 = 13.04 p = 0.023 RMSEA = 0.092 GFI = 0.97 CFI = 0.99 df = 5 AGFI = 0.92
Final Model	Items: Nb1, Nb2, Nb3, Nb4, Nb5 Fit indices: χ^2 = 4.63 p = 0.327 RMSEA = 0.029 GFI = 0.99 CFI = 1.00 df = 4 AGFI = 0.96 Modifications: 1. If ePortfolio encourages an individual to develop a positive attitude to lifelong learning, it will also help him/her to make connections between formal (i.e. structured learning within the school or faculty) and informal (i.e. unstructured learning occurring in everyday life) learning experiences (Nb1&Nb2).

Table 28. Summary of modification process for Net Benefits construct (continued)

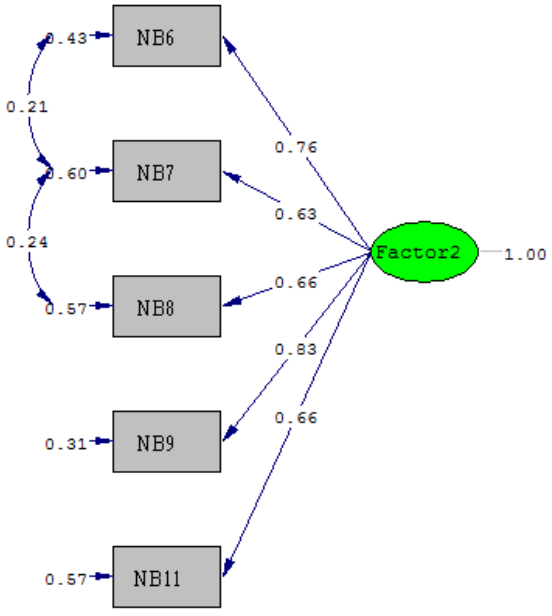
Factors	Modification process
Factor 2 Initial Model	Items: Nb6, Nb7, Nb8, Nb9, Nb10, Nb11 Fit indices: χ^2 = 38.86 p = 0.00 RMSEA = 0.170 GFI = 0.93 CFI = 0.94 df = 5 AGFI = 0.80
Final Model	Items: Nb6, Nb7, Nb8, Nb9, Nb11 Fit indices: χ^2 = 6.87 p = 0.076 RMSEA = 0.084 GFI = 0.99 CFI = 0.99 df = 3 AGFI = 0.93 Modifications: 1. Writing reflections enables the individual to develop decision-making skills was deleted since it cross loaded significantly on the first factor. (Nb10) 2. Being able to evaluate progress towards the achievement of personal goals positively affects the ability to choose co-workers among peers according to various criteria (interests) presented in ePortfolio (Nb6&Nb7). 3. Evaluating progress towards the achievement of personal goals was suggested to correlate negatively with the ability to compare oneself with others (Nb6&Nb8). Since there is no rationale for such a relationship, this modification was not implemented. 4. The ability to choose co-workers among peers according to various criteria (interests) presented in ePortfolio will lead to an increased ability to compare oneself with others (Nb7&Nb8). 5. The ability to choose co-workers among peers according to various criteria (interests) presented in ePortfolio was suggested to correlate negatively with the ability to show personal growth and development over time (Nb7&Nb9). Since there is no rationale for such a relationship, this modification was not implemented. 6. The ability to compare with others was suggested to correlate negatively with the ability to show personal growth and development over time (Nb8&Nb9). Since there is no rationale for such a relationship, this modification was not implemented.

Figure 12. Measurement Model for Net Benefits



χ^2 = 4.63 p = 0.327 RMSEA = 0.029 GFI = 0.99 CFI = 1.00

df = 4 AGFI = 0.96



χ^2 = 6.87 p = 0.076 RMSEA = 0.084 GFI = 0.99 CFI = 0.99

df = 3 AGFI = 0.93

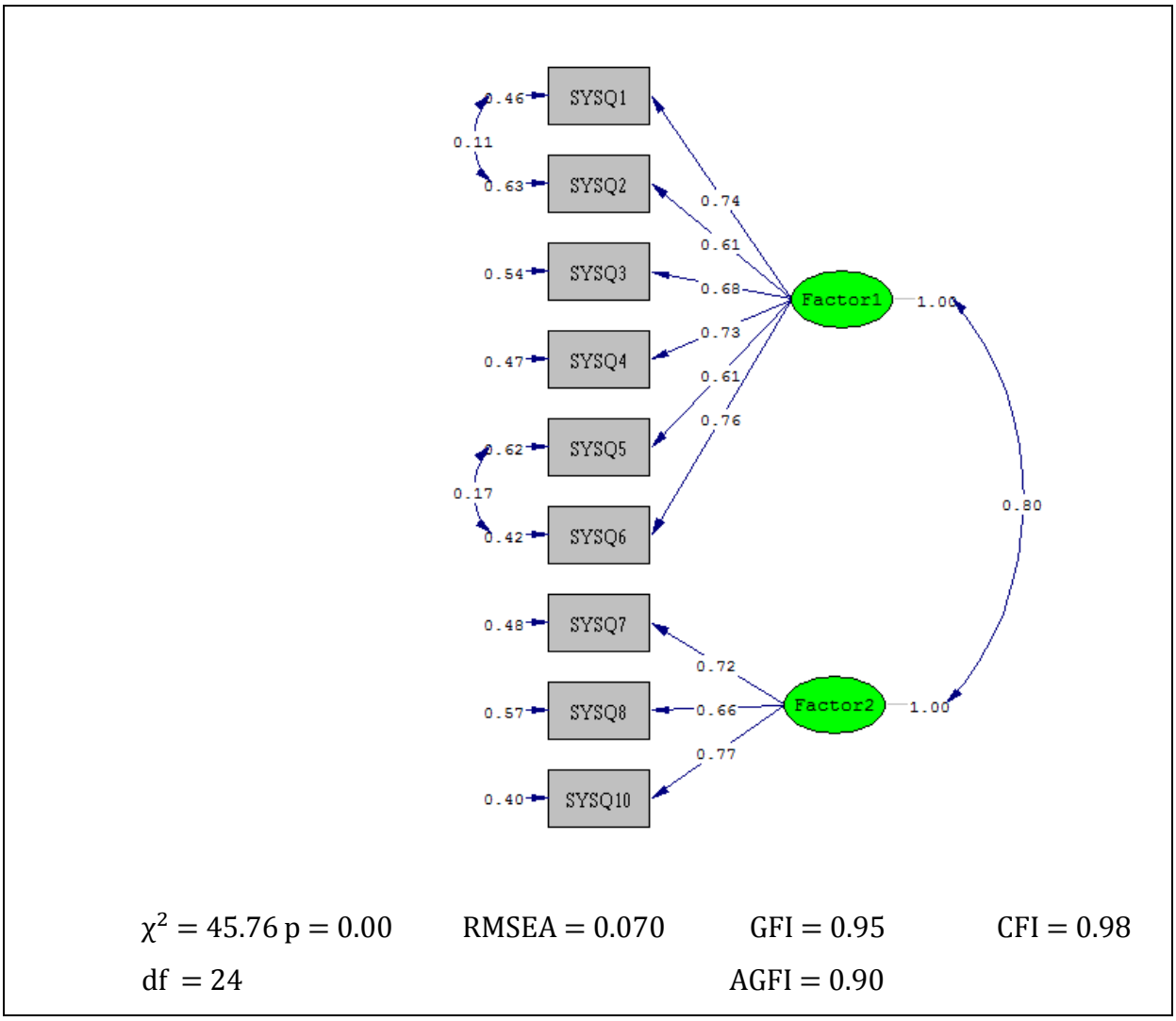
Following the procedure suggested by Segars&Groover (1998), after the factors were analyzed in isolation, they needed to be further analyzed in pairs and then as a collective network. Since all the constructs in this research consisted of at most two factors, pair analysis was equivalent to collective network analysis. The main aim of this analysis was to determine if any items with cross-loadings between factors in the construct still existed in order to eliminate them. That would ensure unidimensionality of factors within the construct.

There were also several exceptions to be taken into consideration:

1. Use construct, whose factors could not be modified in isolation due to a small number of items. It would be modified for the first time in this iteration.
2. Factor 2 in System Quality construct and Factor 2 in Information Quality construct that also consisted of only 3 items. They would be modified in pair with other factor within their respective construct.
3. Service Quality and User Satisfaction constructs would be excluded from this analysis since those were single factor constructs and as such were analyzed in the previous step.

After the careful examination of all the constructs and their factors, no items remained that cross-loaded on two factors. It means **all factors are unidimensional**. In addition, CFA performed on all constructs (see Section 6.2.1) also ensured that all constructs were unidimensional. Full measurement models for each construct are represented in Figures 13-18.

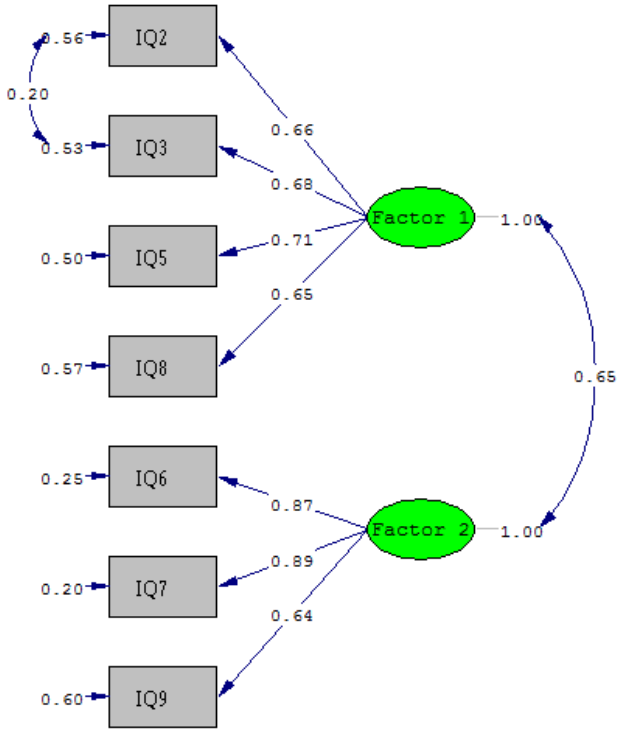
Figure 13. Full Measurement Model for System Quality construct



$\chi^2 = 45.76$ p $= 0.00$ RMSEA $= 0.070$ GFI $= 0.95$ CFI $= 0.98$

df $= 24$ AGFI $= 0.90$

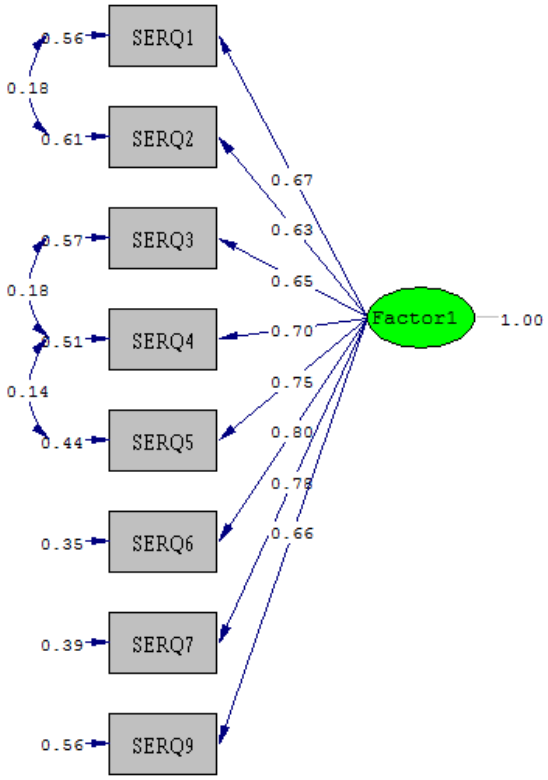
Figure 14. Full Measurement Model for Information Quality construct



$\chi^2 = 15.64$ p $= 0.21$ RMSEA $= 0.040$ GFI $= 0.96$ CFI $= 0.98$

df $= 12$ AGFI $= 0.91$

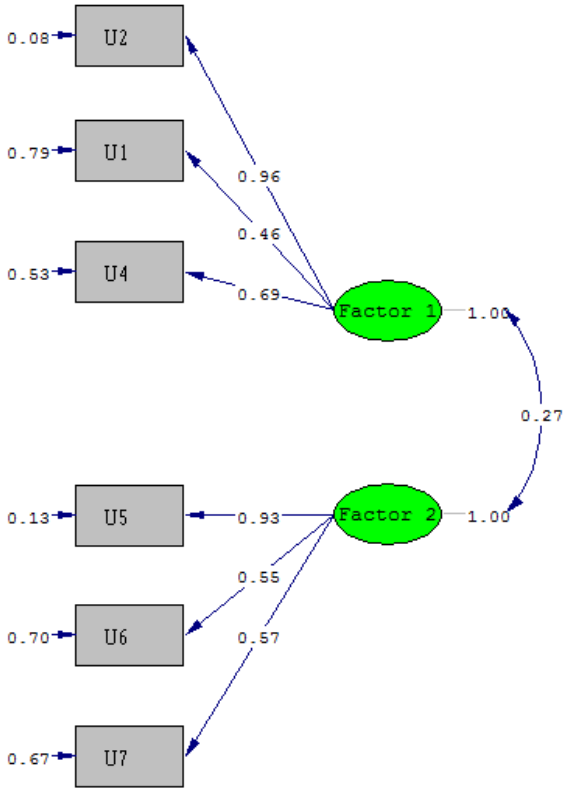
Figure 15. Full Measurement Model for Service Quality construct



$\chi^2 = 25.16$ p $= 0.09$ RMSEA $= 0.051$ GFI $= 0.97$ CFI $= 0.99$

df $= 17$ AGFI $= 0.93$

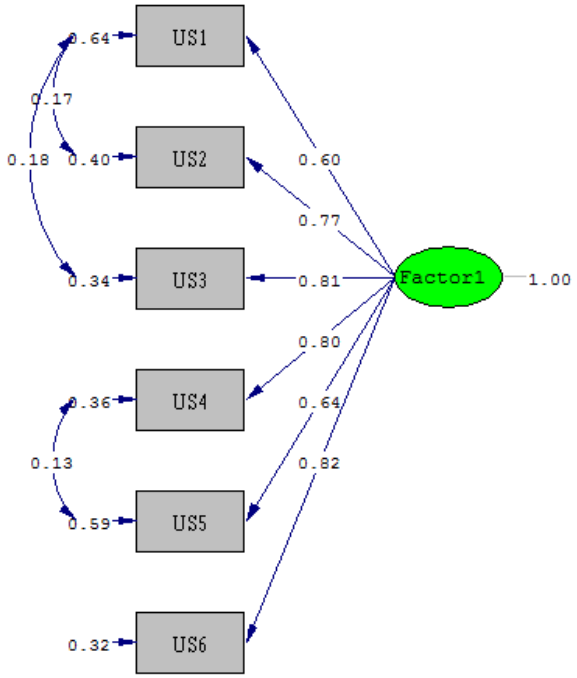
Figure 16. Full Measurement Model for Use construct



$\chi^2 = 10.08$ p $= 0.26$ RMSEA $= 0.053$ GFI $= 0.96$ CFI $= 0.98$

df $= 8$ AGFI $= 0.91$

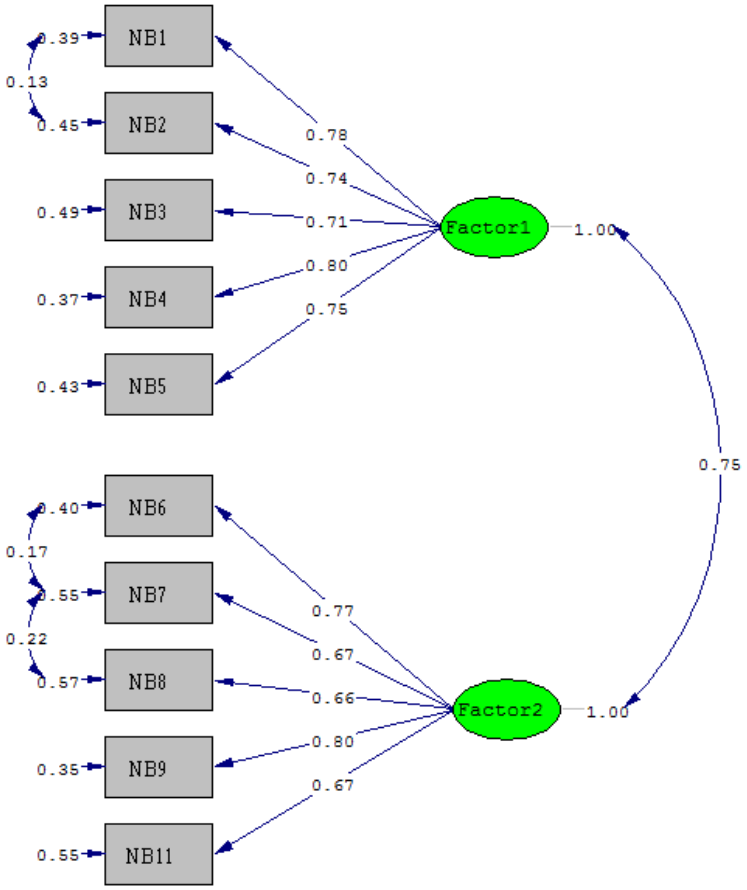
Figure 17. Full Measurement Model for User Satisfaction construct



$\chi^2 = 27.41$ p $= 0.00$ RMSEA $= 0.197$ GFI $= 0.91$ CFI $= 0.94$

df $= 6$ AGFI $= 0.68$

Figure 18. Full Measurement Model for Net Benefits construct



$\chi^2 = 41.88$ p $= 0.09$ RMSEA $= 0.044$ GFI $= 0.96$ CFI $= 0.99$

df $= 31$ AGFI $= 0.92$

In reviewing the model fit indices, it can be noted that all the measurement models had very satisfactory model fit indices, except the User Satisfaction construct. This could have been noticed even earlier, during the single factor modification process since User Satisfaction is a one factor construct. By reviewing the modifications indices for this construct, the following was established:

1. $\chi^2(27.41)$ and its degrees of freedom (6), according to Gefen *et al*. (2003), showed a little higher ratio (1:3.57) than recommended (df : χ^2 < 1:3). Considering the χ^2 limitations, mostly due to the sample size and recommendations that it should be interpreted in terms of model adjustments (or model improvement) rather than its fit, no clear judgments could be made based on this result.
2. Henseler (2009) reported that GFI and AGFI can be very sensitive to the sample size, but in this case one index (GFI) reported a satisfactory fit (0.91), while the other reported the opposite (0.68).
3. RMSEA reported an unsatisfactory measurement model fit (0.197).
4. CFI reported a good model fit (0.94).

Since it was not possible to interpret the model fit results with confidence having in mind the results obtained from fit indices, two additional model fit indices were calculated for this construct: NFI (Normed Fit Index), which is used to compare a restricted model with a full model using a baseline null model; and SRMR (Standardized Root Mean Square Residual), which is a standardized difference between the observed covariance and predicted covariance. Both of those measures are also frequently used in literature for assessing model fit. For NFI, values greater than 0.90 present a good fit, while for SRMR values smaller than 0.05 indicate a good fit. For User Satisfaction construct NFI = 0.93 and SRMR = 0.049, which indicated a good model fit.

Therefore the User Satisfaction construct showed an acceptable fit, and since no further modifications were possible to improve it, it was retained as such.

After the unidimensionality and convergence had been achieved for all the factors, factor names were assigned, as shown in Table 29.

Table 29. Factors in each construct

Constructs and Factor Names	Factor Number
System Quality	
Usability	Factor 1
Functionality	Factor 2
Information Quality	
Validity	Factor 1
Format	Factor 2
Service Quality*	
Use**	
Deep Structure Usage	Factor 1
Facilitating Conditions	Factor 2
User Satisfaction*	
Net Benefits	
Enhanced Learning	Factor 1
Personal Growth and Development	Factor 2

** A single factor construct*

*** This construct was entirely derived from the UTAUT[13] instrument and therefore the categories were named in respect to the UTAUT instrument*

6.2.4 Assessment of discriminant validity

Discriminant or divergent validity is established when a set of items that measure a specific construct differ from those measuring the other constructs. Straub *et al*. (2004) suggest several techniques to assess discriminant validity. One of them is the Q-sorting method used earlier in this research. According to Straub *et al*. (2004), Q-sorting combines the validation of the content and construct through experts who group items according to their similarity. This process allows experts to eliminate the items that do not match the posited constructs and to ensure discriminant validity. Therefore, discriminant validity for all the constructs was established as the result of the Q-sorting process. However, the EFA extracted additional factors within some constructs and it

[13] Developed by Venkatesh *et al*. (2003)

needs be ensured those factors are discriminant as well. During the second CFA, convergent validity for those factors was established as well as their unidimensionality.

In SEM, discriminant validity can be established by comparing the model fit of an unconstrained model that estimates the correlation between a pair of constructs and a constrained model that fixes the correlation between the constructs to unity (Segars, 1997; Chang&King, 2005; Gefen *et al*., 2003; Straub *et al*., 2004). If the unconstrained model has a significantly better fit than the constrained model, discriminant validity is achieved. On the other hand, Gefen *et al*. (2000) give recommendations on how to ensure discriminant validity using PLS. According to those authors, discriminant validity is assessed in the following two cases:

1. Each item has a higher loading on its prospective construct than on the other constructs. To illustrate this, the authors mention that if an item loads at 0.70 on its prospective construct, its loadings on other constructs should not be higher than 0.60.
2. The Square Root of Average Variance Extracted (AVE) of each construct is larger than its correlation with the other constructs.

Since all model fit indices were calculated in LISREL, the discriminant validity was also assessed with this tool using the χ^2 difference between the models. Gefen *et al*. (2003) and Straub *et al*. (2004) suggest testing discriminant validity by comparing two models, one which constrains the item correlations to 1 and another which frees the items, i.e. permits them to be estimated. A significant difference in χ^2 between the two models indicates that the posited items are significantly different from other construct items thus showing discriminant validity. In this research, only a two factor construct appeared, so Segars' (1997) recommendations were also followed. According to Segars (1997, p. 110), "discriminant validity of the two factor model can be inferred by fixing the correlation parameter between the two factors at 1.0 and then performing a χ^2 difference test on the values obtained for the constrained and unconstrained model". A significance of the χ^2 difference is a χ^2 variate with one degree of freedom. Table 30 represents χ^2 differences in all the constructs except for Service Quality and User Satisfaction, since those were single factor constructs and their

discriminant validity was already determined during the Q-sorting and first round of CFA.

Table 30. Chi-Square differences between factors in the constructs

Constructs	χ^2 differences
System Quality	
Usability	55.24*
Functionality	
Information Quality	
Validity	107.53*
Format	
Use	
Deep Structure Usage	51.2*
Facilitating Conditions	
Net Benefits	
Enhanced Learning	63.75*
Personal Growth and Development	

* significant at p<0.001 level

All χ^2 differences were with one degree of freedom and were significant at p<0.001, indicating that each scale seemed to capture the construct that was unique and independent of other constructs in the model. This **provided evidence of discriminant validity** between the factors corresponding to each construct.

6.3 *Reliability*

Straub *et al*. (2004, p. 400) define reliability as the statement about measurement accuracy or as "the extent to which the respondent can answer the same questions or close approximations the same way each time". In previous cases, the internal consistency (Cronbach Alpha coefficient), as one of the measures of reliability, was used to assess the reliability for each construct prior to comprehensive analysis of its validity. Since EFA extracted subcategories (factors) within several constructs the reliability of those factors needed to be assessed as well. Beside internal consistency, several other techniques for assessing reliability exist.

Schumacker&Lomax (2004) reported that a Composite Reliability (CR) is a better indicator of a single common factor model than the Cronbach Alpha internal consistency coefficient. Composite Reliability is "a measure of internal consistency of the construct indicators, depicting the degree to which they 'indicate' the common latent (unobserved) construct" (Hair *et al*., 1998). It is calculated as:

$$CR = \frac{(\sum_i \lambda_i)^2}{(\sum_i \lambda_i)^2 + (\sum_i (1 - \lambda_i^2))},$$

where λ_i is the i-th standardized loading of indicator x on factor ξ. Its value should exceed 0.7 to indicate good reliability (Segars, 1997).

Segars (1997) reports Average Variance Extracted (AVE) that reflects the overall amount of variance due to the measurement error, as another measure of reliability. It is defined by the following formula:

$$AVE = \frac{(\sum_i \lambda_i^2)}{(\sum_i \lambda_i^2) + (\sum_i (1 - \lambda_i^2))},$$

where λ_i is the i-th standardized loading of indicator x on factor ξ. The AVE value should exceed 0.5 to indicate that the variance captured by the construct is larger than the measurement error.

In performing CFA, both CR and AVE can be calculated for each factor (Schumacker&Lomax, 2004; Gefen&Straub, 2005). In this research, SmartPLS was used for calculations, the results of which are presented in Table 31.

Table 31. Reliability of measurement factors

Constructs and Factor Names	Composite reliability	AVE
System Quality		
Usability	0.89	0.58
Functionality	0.86	0.68
Information Quality		
Validity	0.88	0.70
Format	0.88	0.64
Service Quality	0.92	0.58
Use		
Deep Structure Usage	0.85	0.65
Facilitating Conditions	0.79	0.57
User Satisfaction	0.92	0.65
Net Benefits		
Enhanced Learning	0.91	0.67
Personal Growth and Development	0.90	0.64

By reviewing the data in Table 31 it was concluded that all the factors showed good reliability. CR for all the factors was much greater than 0.7 and all AVEs were above 0.5.

On the whole, the measurement model was **valid and reliable**. Therefore, the hypothesis H1 stating that **"Considering ePortfolio as an Information System, it is possible to develop a measurement instrument to assess ePortfolio success"** is supported.

7 Assessing the structural model

Every structural equation model can be demarcated into a measurement and structural part. The measurement model was tested in the previous chapter indicating a good fit. In this chapter, the test of the structural part of the model is described.

According to Loehlin (2004), the structural part of a model specifies the relationships among the latent variables, while the measurement model specifies the relationship of the latent to the observed variables. As was already mentioned in Chapter 6, PLS was used to test the structural model and relationships among its variables concerning the sample size. Compared to LISREL, PLS does not provide such exhaustive data about the model fit and so different fit indices need to be used to demonstrate model fit.

Henseler *et al*. (2009) suggest using the **coefficient of determination (R^2)** of the endogenous latent variables as the essential criterion for structural model assessment. In PLS, endogenous latent variables are caused by one or other latent variables in the model while exogenous latent variables are only caused by the indicators (measurement items). Whereas AVE captures the amount of variance explained by the latent exogenous variable, R^2 captures the amount of variance explained by endogenous variables. Chin (1998) describes R^2 values above the cutoffs of 0.67, 0.33, and 0.19 as "substantial", "moderate", and "weak", respectively. In addition, Henseler *et al*. (2009) explain that if an endogenous variable is explained by only one or two exogenous latent variables, "moderate" R^2 is acceptable. However, in case of several exogenous variables explaining one endogenous variable, R^2 should exhibit a substantial level.

Another measure for assessing a structural model is **prediction relevance (Q^2)** that explains the model's predictive capability. It is calculated based on the blindfolding procedure as:

$$Q^2 = 1 - (\sum_D SSE_D)/(\sum_D SSO_D),$$

where D is the omission distance, SSE is the sum of squares of prediction errors, and SSO is the sum of squares of observations. According to Henseler *et al*. (2009), Q^2 values above zero indicate that the model has predictive relevance, while values below zero

indicate the model lacks predictive relevance. This technique represents a synthesis of function fitting and cross-validation. Chin (1998, p. 320) also points out the importance of the technique by saying that "the prediction of observables or potential observables is of much greater relevance than the estimator of what are often artificial construct parameters". In PLS, two kinds of Q^2 statistics are estimated, that is, cross-validated communality (H^2_j) and cross-validated redundancy (F^2_j).

A cross-validated communality (H^2_j) is obtained if the prediction of the omitted data points in the manifest variables (or indicators) block is made by the underlying latent variable (Chin, 1998). In other words, the cross-validated communality measures the capacity of the path model to predict the manifest variables directly from their own latent variable by cross-validation. It uses only the measurement model (Karim, 2009). On the other hand, a **cross-validated redundancy (F^2_j)** predicts the omitted data points by constructs that are predictors of the blindfolded construct in the PLS model (Chin, 1998). In other words, the cross-validated redundancy F^2_j measures the capacity of the path model to predict the endogenous manifest variables indirectly from a prediction of their own latent variable using the related structural relation, by cross-validation (Karim, 2009). Henseler *et al*. (2009) also indicate that the blindfolding procedure to obtain the cross-validated redundancy F^2_j instead of cross-validated communality H^2_j fits the PLS very well. Therefore, this index was used for measuring the quality of the path model in this research. According to Chin (1998), the blindfolding procedure omits a part of the data matrix for the construct being examined and then estimates the model parameters. This is done a number of times based on the blindfold omission distance. Chin (1998) argues that the omission distance parameter should be a prime integer between the number of indicators and the number of cases to ensure proper execution of the algorithm. It should be mentioned that the blindfolding procedure is only applied to reflective endogenous latent variables.

Tenenhaus *et al*. (2005) suggest a global **Goodness-of-fit index (GoF)** to be used in PLS as an alternative to a series of fit indices used in SEM. It is employed to judge the overall fit of the model. GoF, which is the geometric mean of the average communality (outer measurement model) and the average R^2 of endogenous latent variables, represents an index for validating the PLS model globally, as a compromise between the performance

of the measurement and the structural model (Karim, 2009). Therefore it is calculated as:

$$GoF = \sqrt{averageR^2 * averageCommunality}\,.$$

Its values range between 0 and 1, where a higher value represents better path model estimations.

The fourth criterion for the structural model assessment used in this research is estimates for path coefficients or regression weights, known as **standard beta coefficient**($\boldsymbol{\beta}$). The path relationships would be evaluated in terms of sign, magnitude, and significance (via bootstrap). Structural paths, whose sign is in keeping with the a priori proposed algebraic signs, provide partial empirical validation of the theoretically assumed relationships between the latent variables (Henseler *et al.*, 2009). Paths possessing the sign contrary to expectations did not support the hypothesis. In order to determine the significance of path magnitude, the bootstrapping technique would be used. Henseler *et al*. (2009) also suggest that direct effects proposed by hypotheses should be analyzed first, followed by additional analyses for mediating and moderating effects.

In this chapter series of techniques used to test the hypothesis H2 that states "**Based on the developed instrument, D&M IS Success Model and ePortfolio literature, it is possible to develop an ePortfolio Success Model"** are shown. First, Coefficient of determination (R^2) and Prediction relevance (Q^2) are examined to determine whether all the constructs are well explained and can be used for prediction. Afterwards, path coefficients are analyzed to determine causal relationships in the structural model. Bootstrapping is used to show the statistical significance of the path coefficients. Indirect effects are also identified to obtain additional information about possible spurious or suppressor effects of individual variables in the model.

7.1 *Defining relationships in the model*

Prior to testing the structural model, relationships between latent variables need to be proposed. In this section, the rationale for each proposed connection between the latent variables is brought up and argued. Here it must be mentioned that over 50 ePortfolio papers were analyzed for any relationships between the constructs that might be reported. However, in almost all cases only case studies of ePortfolio usage, implementation and development were reported without any in-depth analysis of possible causal relationships between factors that can be identified in the process of ePortfolio usage. This is also supported by the fact that out of 25 institutions targeted for this research and that reported the usage of ePortfolio in an ongoing ePortfolio pilot project, 17 of them replied that they either did not use it any more or that they were still in the early stages of adoption and not ready for any deeper analysis of its usage.

Owing to a serious lack of information on relationships between factors in the process of ePortfolio usage, a more general approach is used to propose the relationships in the structural model. This is possible since it was previously shown that ePortfolio can be perceived and interpreted in terms of Information System (see Chapter 4) so a priori relationships determined for IS are applicable to ePortfolios. Evidently, an ePortfolio is also a Web-based information system, so relationships determined for Web-based systems and online information systems in general can be applied to ePortfolio as well.Since the D&M IS Success Model also serves as a framework in this research, several presumptions from that model are used for justifying relations in the structural model. Taking all of the above into consideration, hypotheses about relationships in the model along with corresponding discussions are presented:

H2.1: System quality has a positive effect on Use of ePortfolio.

Wang&Wang (2009) analyzed the effects of System Quality on Use and reported that the former construct influenced the latter through the perceived ease of use. Petter *et al*. (2008) also reported possible positive influence of System Quality on Use. In the meta-analysis of their own research model, Sabherwal *et al*. (2006) showed a significant positive relationship between the two constructs.

H2.2: System Quality has a positive effect on User Satisfaction with ePortfolio.

Wang&Wang (2009) reported that System Quality positively affects User Satisfaction. Lin (2007) also reported the existence of a positive relationship between System Quality and User Satisfaction. Peter *et al*. (2008) analyzed 21 papers in IS studies that dealt with the relationship between System Quality and User Satisfaction, all of which confirmed the existence of such a relationship. In the meta-analysis of their own research model, Sabherwal *et al*. (2006) showed a significant relationship between the two constructs.

H2.3: Information Quality has a positive effect on Use of ePortfolio.

Wang&Wang (2009) reported an indirect positive influence of Information Quality construct on the Intention to Use and, eventually, System Use constructs, which in the D&M IS Success Model are contained in the Use construct. Lin (2007) also established that Information Quality directly influences intention to use an online learning system, and indirectly affects its actual use.

H2.4: Information Quality has a positive effect on User Satisfaction with ePortfolio.

Wang&Wang (2009) argued that Information Quality has a direct positive effect on Perceived Usefulness, which is a part of the User Satisfaction construct. Lin (2007) supported the relationship between Information Quality and User Satisfaction in the context of learning systems. Petter *et al*. (2008) agreed that a strong support for Information Quality influencing User Satisfaction exists based on the fact that 15 of 16 papers in IS research reported the existence of such a relationship.

H2.5: Information Quality has a positive effect on Net Benefits.

Katerattanakul&Siau (2008) conducted a research about factors that influence the Information Quality of ePortfolios. They established that Information Quality has a significantly positive importance for the final benefits. Doig *et al*. (2006) also reported the importance of use of the information generated in ePortfolio for further growth and development as one of the Net Benefits. The positive influence of Information Quality on Net Benefits was also confirmed by Petter *et al*. (2008).

H2.6: Service Quality has a positive effect on the Use of ePortfolio.

Lin (2007) argued that Service Quality positively influences intention to use and indirectly leads to the actual use of online learning systems. Wang&Wang (2009) also reported a direct influence of Service Quality on perceived ease of use that is a part of the Use construct.

H2.7: Service Quality has a positive effect on User Satisfaction with ePortfolio.

Wang&Wang (2009) reported a direct positive influence of Service Quality on Perceived Usefulness of the system that is part of the User Satisfaction construct. Furthermore, Alberto&Gianluca (2006) showed a similar effect indicating that training and support directly positively influence User Satisfaction. Lin (2007) also reported a significant relationship between Service Quality and User Satisfaction.

H2.8: The Use of ePortfolio has a positive effect on User Satisfaction.

Wang&Wang (2009) found out that self-efficacy as part of the Use construct in this case has positive effects on User Satisfaction. Fernández&Rodriguez-Illera (2008) reported a high positive influence of the use of a digital course ePortfolio on their attitudes and satisfaction, both of which are included in User Satisfaction construct in this research. In measuring IS success, Peter *et al*. (2008) identified that 4 of 5 papers reported that Use directly influences User Satisfaction.

H2.9: User Satisfaction has a positive effect on Use of ePortfolio.

Wang&Wang (2009) established that greater User Satisfaction will lead to greater Intention to Use and, eventually, greater Use. Alberto&Gianluca (2006) also supported this by proving that facilitating conditions as part of User Satisfaction influence Use. Lin (2007) reported the influence of User Satisfaction on Use in the online learning systems context as one of the strongest relationships in his model. In measuring IS success, Peter *et al*. (2008) identified that 17 out of 21 papers provided evidence for the effect of User Satisfaction on Use.

H2.10: Use of ePortfolio has a positive effect on User satisfaction.

Lopez-Fernández&Rodriguez-Illera (2008) investigated student learning ePortfolios and reported a strong positive impact of Use on students' opinions and on enhancing their learning as part of Net Benefits. Petter *et al*. (2008) and Burton-Jones&Straub (2006) indicated the existence of a relationship between Use and Net Benefits.

H2.11: User Satisfaction has a positive effect on Net Benefits.

In measuring Web-based IS success, Alberto&Gianluca (2006) showed that User Satisfaction directly positively influences Net Benefits. Petter *et al*. (2008) found a very strong positive relationship between User Satisfaction and Net Benefits. In their analysis, all the 14 papers reported a positive relationship between the two constructs.

H2.12: Net Benefits have a positive effect on User Satisfaction with ePortfolio.

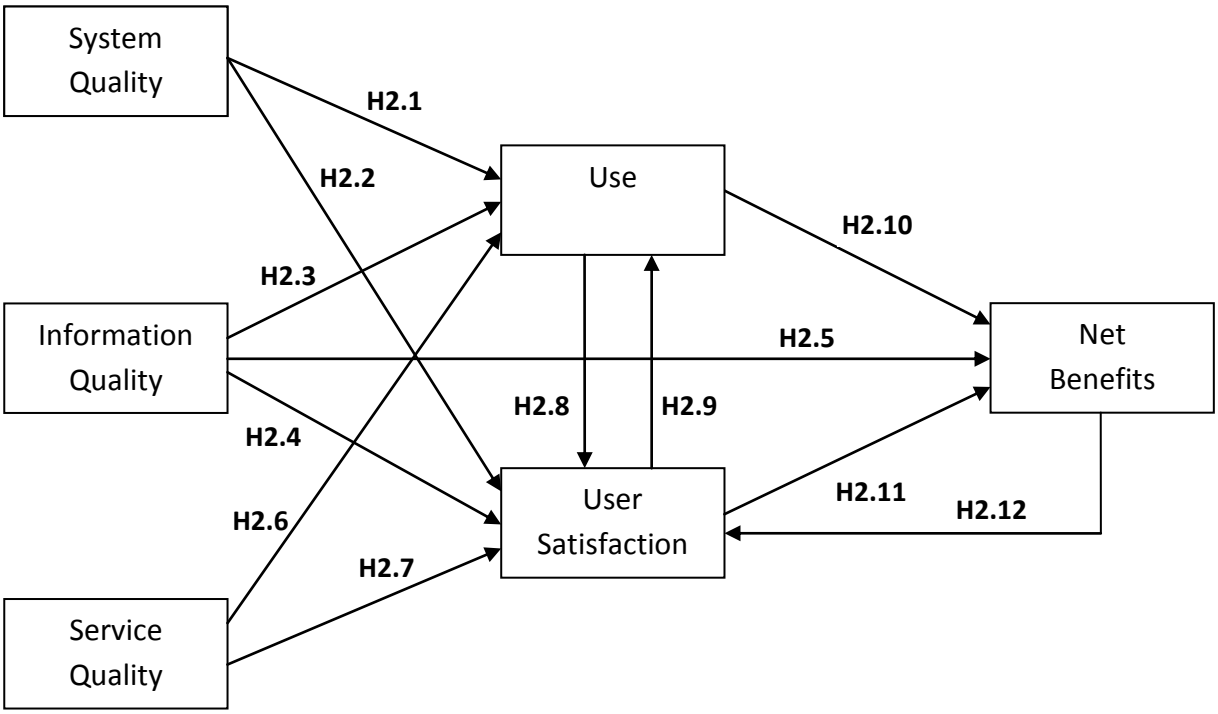
Petter *et al*. (2008) provided evidence for the existence of a very strong positive relationship between Net Benefits and User Satisfaction. All the 11 papers encompassed by their analysis confirmed the existence of such a relationship.

The summary of the proposed hypotheses is shown in Table 32, while the structural model with hypothesized relationships among latent variables (constructs) is shown in Figure 19. During the extensive literature review no cases that would refute or oppose the relationships proposed in the aforementioned hypotheses were found. Only in a few cases it was reported that some relationships were evaluated as non-significant.

Table 32. Overview of hypothesized relationships and relevant literature

Hypothesis	Relationship	Literature
H2.1	System Quality -> Use	Wang&Wang (2009), Petter *et al*. (2008), Sabherwal *et al*. (2006)
H2.2	System Quality -> User Satisfaction	Wang&Wang (2009), Lin (2007), Petter *et al*. (2008), Sabherwal *et al*. (2006)
H2.3	Information Quality -> Use	Wang&Wang (2009), Lin (2007)
H2.4	Information Quality -> User Satisfaction	Wang&Wang (2009), Lin (2007), Petter *et al*. (2008)
H2.5	Information Quality -> Net Benefits	Katerattanakul&Siau (2008), Doig *et al*. (2006), Petter *et al*. (2008)
H2.6	Service Quality -> Use	Lin (2007), Wang&Wang (2009)
H2.7	Service Quality -> User Satisfaction	Wang&Wang (2009), Alberto&Gianluca (2006), Lin (2007)
H2.8	Use -> User Satisfaction	Wang&Wang (2009), Peter *et al*. (2008), Fernandez&Rodriguez-I.(2008)
H2.9	User Satisfaction-> Use	Wang&Wang (2009), Alberto&Gianluca (2006), Lin (2007), Peter *et al*. (2008)
H2.10	Use -> Net Benefits	Fernandez&Rodriguez-I.(2008), Peter *et al*. (2008), Burton-Jones&Straub (2006)
H2.11	User Satisfaction -> Net Benefits	Alberto&Gianluca (2006), Peter *et al*. (2008)
H2.12	Net Benefits -> User Satisfaction	Peter *et al*. (2008)

Figure 19. Proposed research model for ePortfolio success



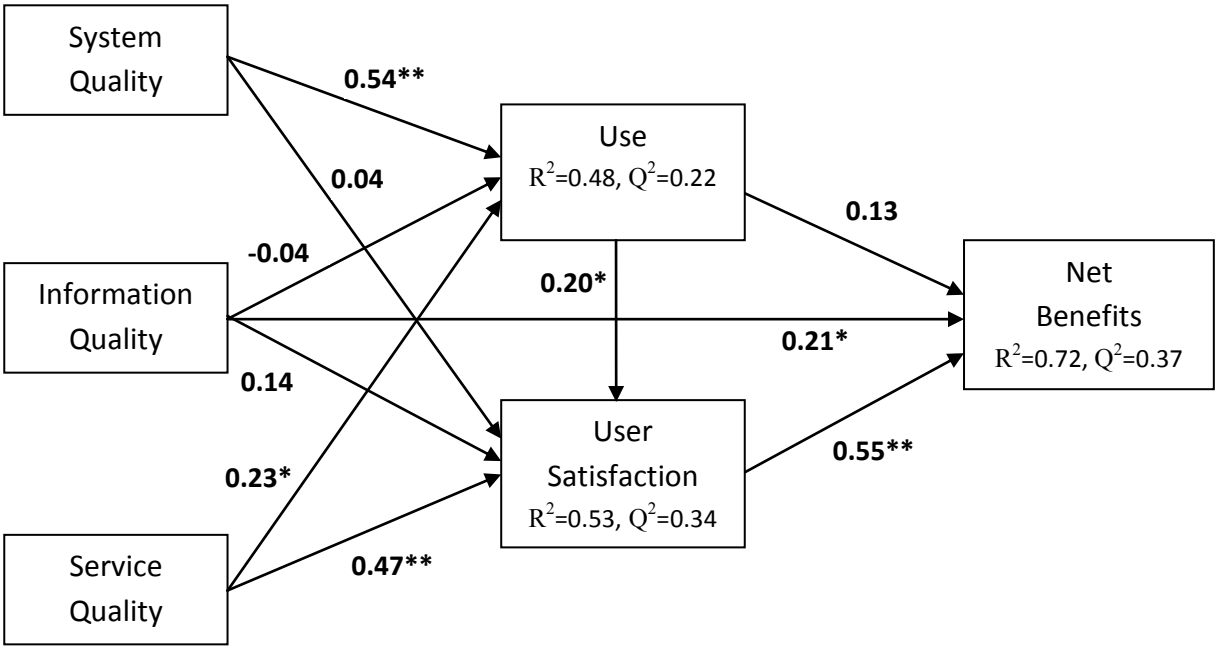
7.2 *Structural model testing*

The proposed research model could not be drawn in PLS with all the proposed relationships due to several constraints:

1. PLS does not allow drawing mutual influences, i.e. paths leading from construct A to construct B and then from construct B to A (example: H2.8 and H2.9; H2.11 and H2.12).
2. It is not allowed to draw feedback loops or extended feedback loops (A->B->C->A). For example, Use leads to Net Benefits (H2.10), Net Benefits leads to User Satisfaction (H2.12) and then User Satisfaction back to Use (H2.9).

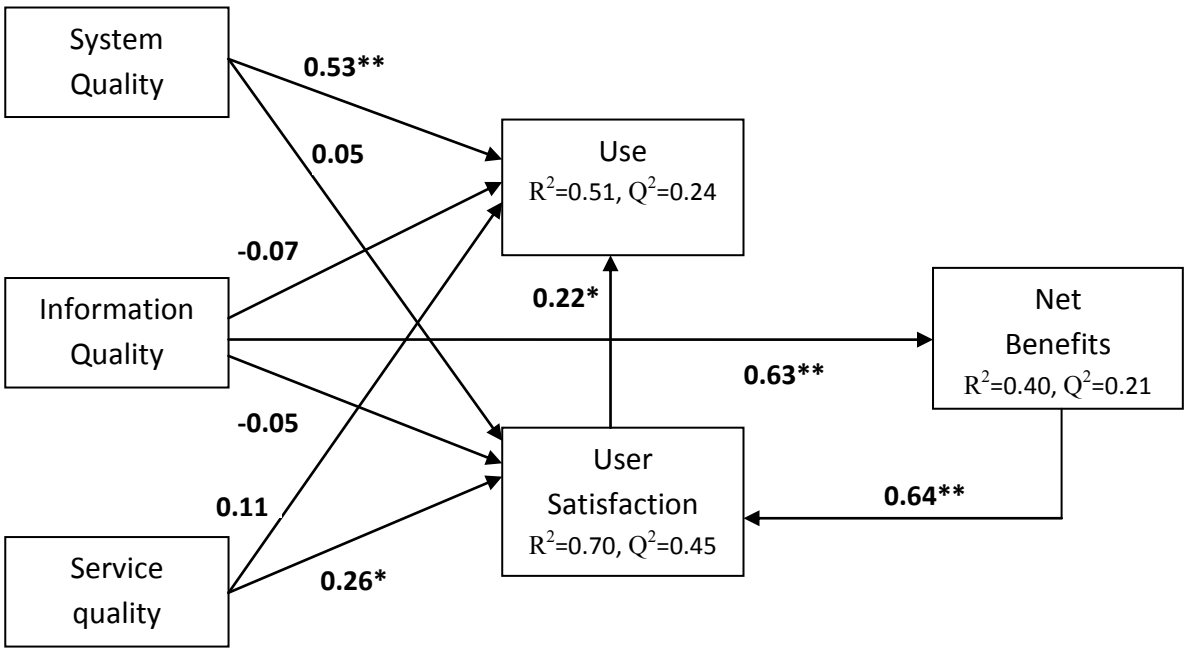
Therefore, the proposed research model was decomposed into two separate structural models that would be analyzed in PLS in order to test all the hypotheses. In the first model, all the hypotheses were tested except H2.9 and H2.12. In the second model the latter hypotheses were included in the model, but due to the constraints of PLS, H2.8, H2.10 and H2.11 were parsed out from the model. The results for the first and the second structural model are shown in Figures 20 and 21, respectively. Appendix L shows detailed results from the bootstrap procedure for both models.

Figure 20. First structural model



* p<0.05, ** p<0.001

Figure 21. Second structural model



* p<0.05, ** p<0.001

The analysis process started by examining the model quality coefficients and the paths between the constructs for the first structural model. Coefficient of determination (R^2) indicated a substantial level for Net Benefits (0.72), and moderate level for Use (0.48) and User Satisfaction (0.53). However, taking into consideration significant paths that explain the Use and User Satisfaction constructs, "moderate" R^2 was acceptable for those constructs. According to Henseler *et al*. (2009), if an endogenous latent variable is explained by only a few (i.e. one or two) exogenous latent variables, "moderate" R^2 is acceptable. However, in case an endogenous latent variable is explained by several exogenous variables, R^2 should exceed the 0.67 cutoff for the substantial level. Prediction relevance (Q^2) for all endogenous constructs was above zero, which gave evidence that the observed values were well constructed and that the model had predictive relevance (see Table 33). GoF value was 0.56, which could be evaluated as an acceptable overall fit. For example, Karim (2009) reported GoF of 0.37 as acceptable.

The analysis of beta coefficients and the bootstrap procedure results (cases=150, samples=500) showed the following (see Figure 20 also):

1. System Quality has a significant positive influence on Use of the ePortfolio ($\beta = 0.54, p < 0.001$).
2. Information Quality has a positive effect on Net Benefits ($\beta = 0.21, p < 0.05$).
3. Service Quality has a significant positive effect on both Use ($\beta = 0.23, p < 0.05$) and User Satisfaction ($\beta = 0.47, p < 0.001$).
4. Use has a significant positive effect on User Satisfaction ($\beta = 0.20, p < 0.05$).
5. User Satisfaction has a positive effect on Net Benefits ($\beta = 0.55, p < 0.001$).

The remaining relationships in the model were evaluated as non-significant.

To test the two remaining hypotheses (H2.9 and H2.12), a different model was specified due to the previously explained reasons. The coefficient of determination (R^2) for the second structural model indicated a substantial level for User Satisfaction (0.70) and a moderate level for Use (0.51) and Net Benefits (0.40). Taking into consideration significant paths that explained the Use and Net Benefits constructs, "moderate" R^2 was acceptable for these constructs. Prediction relevance (Q^2) for all the endogenous constructs was above zero, which gave evidence that the observed values were well constructed and that the model had predictive relevance (see Table 33). GoF value was 0.54, which could be evaluated as an acceptable overall fit.

The analysis of beta coefficients and the bootstrap procedure results (cases=150, samples=500) showed the following (see Figure 21 also):

1. Greater User Satisfaction is related to greater Use of ePortfolio ($\beta = 0.22, p < 0.05$).
2. Net Benefits have a positive effect on User Satisfaction ($\beta = 0.64, p < 0.001$).
3. All the paths from the first model remained significant, except the one leading from Service Quality towards Use (H2.6).

Table 33. Communalities, determination and predictability coefficients in both structural models

	First model			Second model		
Constructs	Communalities	R^2	Q^2	Communalities	R^2	Q^2
SYSQ	0.51			0.51		
INFQ	0.54			0.54		
SERVQ	0.58			0.58		
USE	0.51	0.48	0.22	0.51	0.51	0.24
USAT	0.48	0.53	0.34	0.48	0.70	0.45
NETB	0.66	0.72	0.37	0.66	0.40	0.21
Average	*0.55*	*0.58*		*0.55*	*0.54*	
GoF	*0.56*			*0.54*		

* Q^2 was calculated by blindfolding procedure with the omission distance parameter set to 73

Prior to a deeper analysis of the paths in the structural model it was necessary to compare the results obtained from the two structural models, determine the cause of the changed weights of some of the paths and explain the change in the coefficient of determination (R^2) values. It should be mentioned once again that the aim of the second model test was to assess the significance of the paths that could not be analyzed with the first model due to restrictions in PLS.

In order to interpret the PLS results, one should take into consideration both indirect effects and direct effects (Henseler *et al.*, 2009; Wang&Wang, 2009). The first group of variables (System Quality, Information Quality and Service Quality) is exogenous and therefore only has the causing effect in the model.

Paths leading from System Quality remained almost unchanged. The situation was somewhat different with Information Quality, where the path leading from this construct to Net Benefits changed positively to a great extent. This can be attributed to the fact that Information Quality has a direct effect on Net Benefits as well as an indirect effect on User Satisfaction and Use. In the first model such a relationship was not assumed. Therefore, the change in the beta value can be attributed to the change that is

needed to describe User Satisfaction and the actual Use of ePortfolio. Since this influence would remain in the final model, the beta coefficient (β) obtained from the second structural model would be used as default ($\beta = 0.63, p < 0.001$).

The path leading from Service Quality to Use changed in significance, while the path leading from Service Quality to User Satisfaction caused less effect than in the first model. Both changes can be explained by the fact that Service Quality has a significant indirect effect on Net Benefits (0.26). Moreover, in the first model Service Quality affected the User Satisfaction indirectly through the Use construct (0.04). In the second model, paths leading from Use to User Satisfaction as well as from User Satisfaction to Net Benefits were dropped, which changed the strength of relationships in the model as well as their significance. Since the paths leading from Use to User Satisfaction, and those from User Satisfaction to Net Benefits would be allowed in the final model, both values and significance of the beta coefficients from the first model would be retained.

In respect to coefficient of determination (R^2), the changes in paths affected User Satisfaction and Net Benefits, while the Use construct was practically left intact. It means that although User Satisfaction influences Use, most of its variance is explained by the System Quality and Service Quality constructs. In addition, it is obvious that the Net Benefits construct captures much more variance if it is explained by both User Satisfaction and Information Quality than if it is only explained by the latter. Moreover, it was shown that Use also indirectly influences Net Benefits (0.11). As for User Satisfaction, it is evident that the path leading to it from Net Benefits causes much more variance, which is explained by this construct.

Table 34. Summary of hypotheses testing

Hypothesis	Relationship	t-value	Standardized Coefficient(β)	Result
H2.1	System Quality -> Use	7.29**	0.54	Supported
H2.2	System Quality -> User Satisfaction	0.38	0.04	Rejected
H2.3	Information Quality -> Use	0.51	-0.04	Rejected
H2.4	Information Quality -> User Satisfaction	1.44	0.14	Rejected
H2.5	Information Quality -> Net Benefits	3.37**	0.63	Supported
H2.6	Service Quality -> Use	2,41*	0.23	Supported
H2.7	Service Quality -> User Satisfaction	4.87**	0.47	Supported
H2.8	Use -> User Satisfaction	2.40*	0.20	Supported
H2.9	User Satisfaction-> Use	2,51*	0.22	Supported
H2.10	Use -> Net Benefits	1.52	0.13	Rejected
H2.11	User Satisfaction -> Net Benefits	5.42**	0.55	Supported
H2.12	Net Benefits -> User Satisfaction	6.24**	0.63	Supported

* p<0.05, ** p<0.001; t-values are calculated by the bootstrap with 150 cases and 500 samples

Taking into account the differences between the two structural models and the corresponding explanations as well as the results of hypotheses testing shown in Table 34, a more detailed analysis of the effect size and predictive relevance was carried out on paths that were identified as significant.

Two additional criteria for assessing structural models in PLS can be found in literature. Karim (2009) and Henseler *et al*. (2010) stress the **significance of effect size (f^2)** and the **relative impact** of the structural model on the observed measures for latent dependent variable that is evaluated by means of q^2.

The effect size (f^2) of a single predictor can be calculated by comparing the explained variance when the predictor is either included or not included in the model, that is:

$$f^2 = (R^2_{included} - R^2_{excluded})/(1 - R^2_{included}),$$

where $R^2_{included}$ represents the amount of variance explained when the predictor variable is included in the model and $R^2_{excluded}$ represents the amount of variance explained by the latent variable when the predictor variable is parsed out from the model. According to Henseler *et al*. (2010), f^2 values of 0.02, 0.15, and 0.35 signify small, medium, and large effects on the structural level, respectively.

With respect to construct prediction relevance (Q^2) and in correspondence to f^2, the relative impact of the structural model on the observed measures for latent variables can be assessed as:

$$q^2 = (Q^2_{included} - Q^2_{excluded})/(1 - Q^2_{included}),$$

where $Q^2_{included}$ represents the construct's prediction relevance when the predictor variable is included in the model and $Q^2_{excluded}$ represents the construct's prediction relevance when the predictor variable is parsed out from the model. Q^2 is calculated as cross-validated redundancy (F^2_j). According to Henseler *et al*. (2010), q^2 values of 0.02, 0.15, and 0.35, respectively, reveal a small, medium, or large predictive relevance of a certain latent variable, thus explaining the endogenous latent variable under evaluation.

Both f^2 and q^2 values were calculated for significant paths in the model and are presented in Table 35.

Table 35. The effect and relevance of paths in the final structural model

Hypothesis	Relationship	t-value	β-value	f^2	q^2
H2.1	System Quality -> Use	7.29**	0.54	0.27	0.08
H2.5	Information Quality -> Net Benefits	3.37**	0.63	0.12	0.03
H2.6	Service Quality -> Use	2,41*	0.23	0.03	0.02
H2.7	Service Quality -> User Satisfaction	4.87**	0.47	0.08	0.05
H2.8	Use -> User Satisfaction	2.40*	0.20	0.04	0.02
H2.9	User Satisfaction-> Use	2.51*	0.22	0.04	0.01
H2.11	User Satisfaction -> Net Benefits	5.42**	0.55	0.68	0.16
H2.12	Net Benefits -> User Satisfaction	6.24**	0.63	0.61	0.23

* p<0.05, ** p<0.001; t-values are calculated by the bootstrap with 150 cases and 500 samples; Q^2 used in q2 was calculated by blindfolding procedure with the omission distance parameter set to 73

By observing the results shown in Table 35 it is evident that the paths leading from User Satisfaction to Net Benefits and vice versa have a large effect size and medium predictive relevance. The path leading from System Quality to Use has a medium effect size and small predictive relevance. All the other paths have both a small effect size and predictive relevance.

Table 36. Effects of variables in the final structural model

	Use		User Satisfaction		Net Benefits	
	Direct effects	Indirect effects	Direct effects	Indirect effects	Direct effects	Indirect effects
System Quality	0.54	-	-	0.11	-	0.06
Information Quality	-	0.09	-	0.40	0.63	-
Service Quality	0.23	0.06	0.47	0.05	-	0.29
Use	-	-	0.20	-	-	0.11
User Satisfaction	0.22	-	-	-	0.55	-
Net Benefits	-	0.14	0.64	-	-	-

In addition to the effects and relevance of the paths several authors such as Haenlein&Kaplan (2004), Karim (2009) and Henseler *et al*. (2010) recommend that besides the direct effects hypothesized in the model, indirect effects should also be examined to gain insight into possible moderating or mediating effects of particular latent variables. Indirect effects can be calculated as a product of direct paths (Loehlin, 2009). For example, System Quality has an indirect effect on User Satisfaction through the Use construct. This particular indirect effect can be subsequently calculated as a product of direct paths leading from System Quality to Use and from Use to User Satisfaction. Table 36 shows both direct and indirect effects in the model.

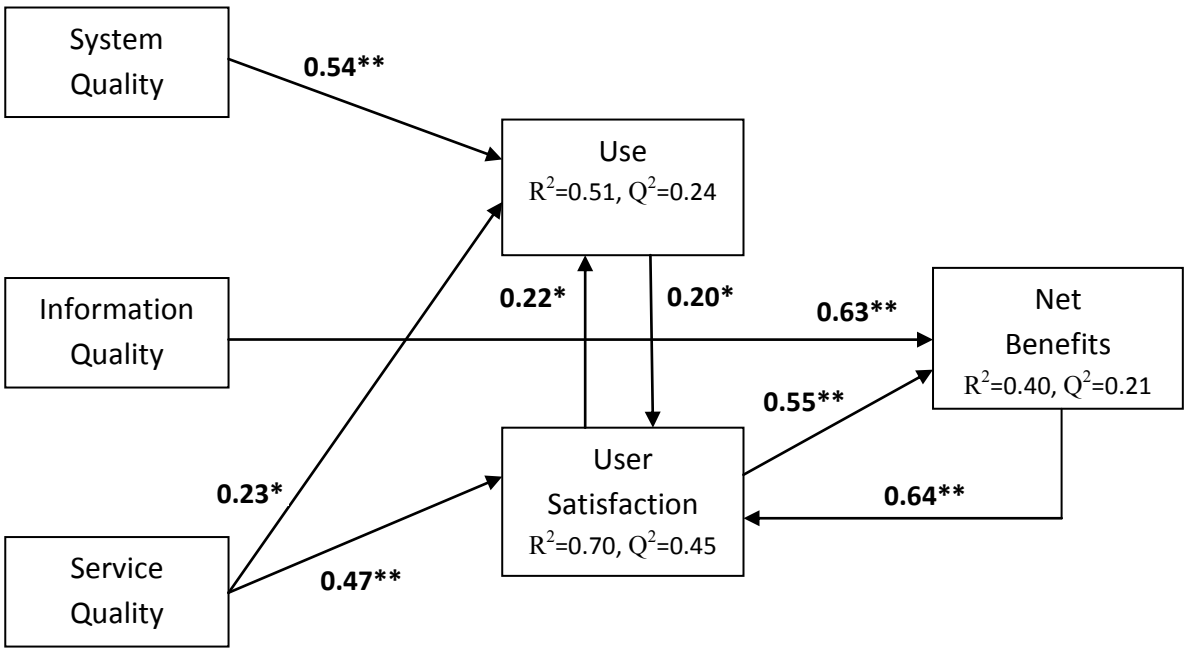
After a detailed analysis of indirect effects in the final model, several conclusions can be drawn:

1. User Satisfaction can be identified as an important mediating variable because all constructs in the model affect other constructs through this variable.
2. Use mediates the relationship between System Quality and User Satisfaction as well as between Service Quality and User Satisfaction.
3. Information Quality has a strong indirect effect on User Satisfaction, and a noticeable indirect effect on Use.
4. Service Quality also has a strong indirect effect on Net Benefits, and a minor indirect effect on Use of ePortfolio.
5. System Quality has a noticeable indirect effect on User Satisfaction.

The remaining indirect effects shown in Table 36 are weak but not negligible.

To summarize, Figure 22 shows the significant paths in the model that were identified and evaluated in detail in terms of their predictive relevance and effect size. Moreover, the constructs were analyzed for predictability and reliability. In addition, the global goodness-of-fit index was calculated to show an overall model fit. While the significant paths were explained in detail, the model was identified as satisfactory taking into account all the previously mentioned indices supported by PLS. Although two models were suggested due to limitations in PLS and both were evaluated as satisfactory, the identified paths can be joined into a single model explaining the success of an ePortfolio.

Figure 22. The final structural model with significant paths



* p<0.05, ** p<0.001

Therefore, the hypothesis H2 stating that **"Based on the developed instrument, D&M IS Success Model and ePortfolio literature, it is possible to develop an ePortfolio Success Model"** is supported.

8 Results and discussion

This chapter discusses the results of the data analysis presented in previous chapters and is divided into two sections. The first section focuses on the instrument developed to measure ePortfolio success. The second section discusses the ePortfolio Success Model based on the measurement model.

8.1 *Instrument for measuring ePortfolio success*

The ePortfolio instrument is the first comprehensive measurement model that assesses ePortfolio success from the individual perspective. Prior to instrument development, as a rationale for applying the D&M Model on ePortfolio, evidence that ePortfolio can be interpreted as IS was provided. A series of methodological procedures were carried out in Chapter 4 in order to show that ePortfolio is indeed an IS. The comprehensiveness of the instrument was presented in Chapter 5, with the description of how the emerging ePortfolio literature and international ePortfolio experts were used to create an initial set of items for the instrument. The instrument was subsequently made more comprehensive by involving all the interested parties, from student to employer, in the item creation process. The empirical testing of the instrument was discussed in Chapter 6. Through a series of well accepted and rigorous developmental methodologies and statistical procedures, a valid and reliable instrument for measuring the ePortfolio success from the students' perspective was developed. A summary of the final ePortfolio success instrument composed of 46 items is presented in Table 37.

Table 37. Final items for the ePortfolio success instrument

System Quality
Usability
Using the system is easy to learn.
Help functions are available and sufficient for using the system.
The system's sitemap clearly shows the organization of materials.
The views (i.e. selected collections of artifacts for self-presentation) are easy to manage.
It is possible to quickly search (e.g. using a search engine) through ePortfolio content.
The system includes necessary features and functions for managing ePortfolio.
Functionality
The system is always up-and-running as necessary.
The system is compatible with other systems I frequently use (e.g. Web 2.0 tools such as Blog, Wiki and similar).
The system can be accessed with a conventional Web browser without much preparation.
Information Quality
Validity
The information provided by the ePortfolio is complete.
The information provided by the ePortfolio is always up to date.
The information provided by the ePortfolio is relevant.
The information provided by the ePortfolio is concise (contains only necessary data).
Format
The information provided by the ePortfolio appears readable, clear and well formatted.
The information provided by the ePortfolio is easy to understand.
The information provided by the ePortfolio is in a readily usable form.
Service Quality
A specific person (or group) is available for assistance with system difficulties.
E-mail and other forms of on-line help are available in case of problems with using the system.
Teachers/ePortfolio support staff are helpful for using the system.
Teachers/ePortfolio staff are competent to answer questions.
The institution gives the user individual attention.
Teachers/ePortfolio staff are always willing to help.
Teachers/ePortfolio staff respond promptly.
EPortfolio use is well described within the course requirements (e.g. ePortfolio tasks, evaluation of work in the ePortfolio, extra credits).

Table 37. Final items for the ePortfolio success instrument (continued)

Use
Deep Structure Usage
While using the ePortfolio, I use available features for organizing my content.
While using the ePortfolio, I collaborate with my peers in organizing ePortfolio content.
While using the ePortfolio, I use features that help me to join the groups.
Facilitating Conditions
While using the ePortfolio, I use features that help me to set view permissions for different views (ePortfolios).
I have the knowledge necessary to use the system.
I was able to complete a task using the system even if there was no one around to tell me what to do as I go.
User Satisfaction
I like working with the system.
The system makes work more interesting.
Using the system is a good idea.
I find the system useful in learning.
The degree of freedom for expressing one's own individuality is satisfactory.
The ePortfolio presentation capabilities (e.g. quick upload, format and presentation of personal information) are satisfactory.
Net Benefits
Enhanced Learning
The ePortfolio encourages me to develop a positive attitude to lifelong learning.
The ePortfolio helps me to make connections between formal (i.e. structured learning within the school or faculty) and informal (i.e. unstructured learning occurring in everyday life) learning experiences.
The ePortfolio helps me to fulfill learning outcomes.
Using ePortfolio leads to increased transparency in evaluation.
The enhanced communication between me and educators enhances the chances for my success.
Personal Growth and Development
I am able to evaluate progress towards achievement of my personal goals.
I am able to choose my co-workers among peers according to various criteria (interests) presented in ePortfolio.
I am able to compare myself with others.
I am able to show my personal growth and development over time.
Potential employers can view my showcase Portfolio within the context of my institution's requirements, assessment criteria, and my personal descriptions of achievements.

Regarding the fact that the instrument is based on the D&M Model, it accordingly comprises six major dimensions: System Quality (9 items), Information Quality (7 items), Service Quality (8 items), Use (6 items), User Satisfaction (6 items) and Net Benefits (10 items). Service quality and User Satisfaction dimensions are single-factor constructs, while other dimensions contain two unidimensional factors that are measured by at least two items (see Table 37). Evidences from convergent and discriminant validity showed that each factor measures only its prospective construct that is different from other constructs.

The fact that the instrument was designed to assess ePortfolio success through 6 dimensions at the individual level allows educational institutions that use ePortfolio to assess its success from the end-user's (i.e. students') perspective. Using this instrument, an educational institution can find out, for example, whether the ePortfolio system needs improvement or whether the institution needs to raise the quality of services for its students. In other words, the ePortfolio success instrument allows educational institutions to pinpoint specific areas that need improvement. Of course, certain results, such as the feedback obtained through User Satisfaction or Net Benefits cannot be directly improved by the institution. Therefore, if the institution wants to raise the satisfaction of its students or wants them to gain greater benefits from ePortfolio, it needs to be aware of the relationships that exist between the dimensions of ePortfolio success. A more detailed explanation of relationships between the dimensions depicted in the ePortfolio Success Model is given in the next section.

In respect to the ePortfolio success instrument, it should be mentioned that educational institutions can also use it for comparison with other institutions, self-benchmarking or monitoring personal progress over time. The first two evaluations can be done anytime, whereas the latter should be performed in the way to ensure at least three month intervals between the initial evaluation and re-evaluation. This requirement is explained with the fact that the time needed for students to perceive changes, for example in service quality or system quality, and to actually react to such changes in terms of higher satisfaction or realize that some of the benefits became much clearer and more visible, can be measured in months. With such evaluation, changes that indicate improvements or degradation in ePortfolio implementation and usage can be detected.

To ensure the generalization of the ePortfolio success instrument, the data from a cross-sectional field survey was used in this research. Therefore, the resulting instrument is applicable to educational institutions worldwide. When applied, the instrument needs to be administered to a wide range of students to ensure appropriate representation of the diverse uses of the ePortfolio by students. The average score for each dimension and/or each factor within that dimension would be indicators of successful implementation and use of a particular ePortfolio system.

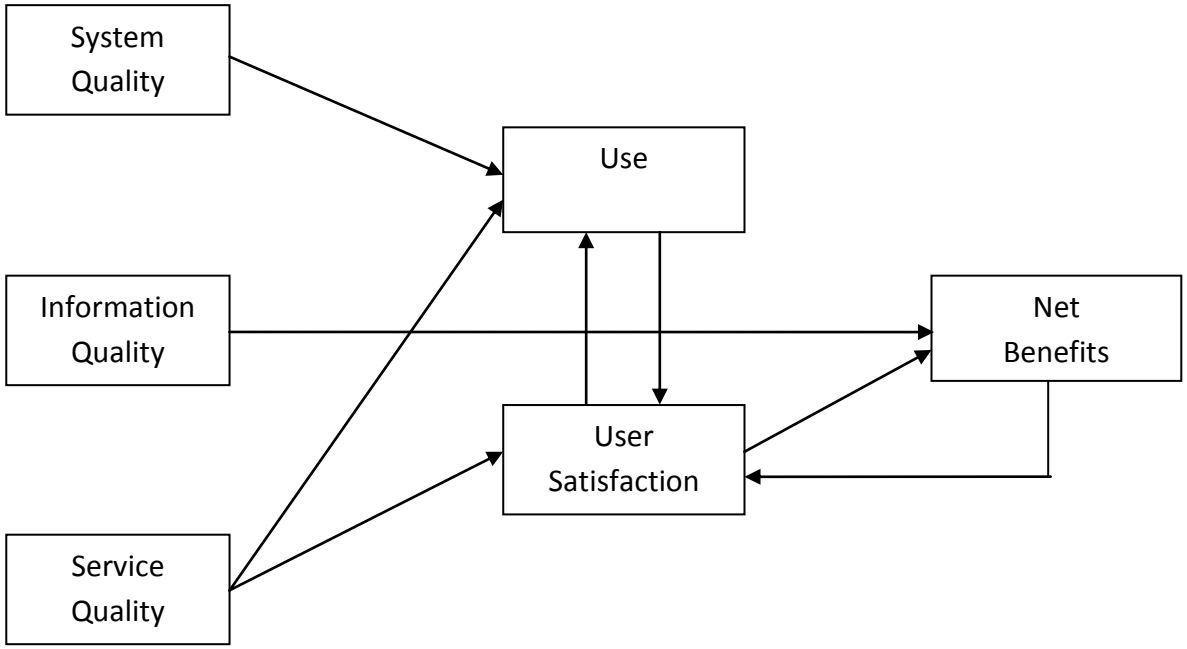
The ePortfolio success instrument addresses the question "How well is ePortfolio implemented and used?" taking into account the end-user's perception. When applied within an educational institution among students, it can provide a valuable insight into all the components that make a successful implementation of an ePortfolio system. Based on the results of the ePortfolio success instrument, institutions that have introduced major changes and succeeded to improve the ePortfolio implementation and usage could provide others with examples of best practice.

On the whole, the goal of developing measures to assess successful implementation and usage of ePortfolio was successfully achieved in this dissertation. The resulting instrument is not only comprehensive enough to cover all the aspects of ePortfolio implementation and usage but also sensitive enough to pinpoint areas that need improvement. Therefore, the instrument could be a very useful tool for educational organizations to detect potential problems in ePortfolio usage and implementation as well as to monitor progress toward their improvement.

8.2 *The ePortfolio Success Model*

By creating a valid instrument to measure successful implementation and usage of ePortfolio, relationships between the dimensions could be explored. It should be noted again, however, that the ePortfolio success instrument can only indicate the dimensions that need improvement. It can neither reveal the potential causes of those problems nor provide general guidelines on how the problems should be solved or which dimensions should be primarily concerned in the process. Besides, some dimensions like User Satisfaction obviously depend on other dimensions and cannot be directly controlled by the institution. For that reason, a set of statistical procedures was used to identify whether the proposed relationships between the dimensions exist. The whole process, described in detail in Chapter 7, has resulted in the final ePortfolio Success Model shown in Figure 23.

Figure 23. The proposed ePortfolio Success Model



The principal aim of the ePortfolio Success Model is to show the effects its dimensions have on each other. Furthermore, based on the established relationships, institutions can consider dimensions to be affected in order to improve the success of ePortfolio

implementation and usage. For example, if the instrument pinpoints User Satisfaction as a problematic dimension, the institution will be made aware that it should try to improve Service Quality and, possibly, System Quality, to improve the benchmark of User Satisfaction. Higher User Satisfaction will lead to higher Net Benefits that will in turn affect User Satisfaction again.

Moreover, Figure 23 clearly shows that Use and User Satisfaction dimensions are very tightly connected, that is, Use affects User Satisfaction and vice versa. Such relationships are in accordance with the DeLone&McLean's theory which argues that the six dimensions should be interrelated showing not only process flows but causality flows as well (DeLone&McLean, 2003). The same applies to Net Benefits and User Satisfaction.

Another interesting finding is that Information Quality neither affects Use nor User Satisfaction, at least not directly. Instead, it was shown that the Information Quality dimension affects Net Benefits, and from there User Satisfaction and Use. This is in line with expectations, since information is a product of Use and is in direct service of benefits that arise from ePortfolio usage. Namely, Users use ePortfolio to produce information about themselves or to be assessed based on the produced information. Therefore, information from ePortfolio is a direct product that can be used as a trigger for other activities in Lifelong Learning. The quality of produced information in ePortfolio actually presents an added value to the individual and to the society. Based on the information produced in ePortfolio, the individual sees the benefits in terms of enhanced learning and personal growth and development. Owing to those benefits, the individual will be satisfied with ePortfolio, which will lead to a greater use of that system.

The ePortfolio Success Model addresses the questions “Where to start the improvement process and what effects on other dimensions will it have?” or “What can I expect if I improve certain dimension?”. It is intended for educational institutions that employ ePortfolio and have students as users. Based on the ePortfolio success instrument intended for students, institutions can be guided by the ePortfolio Success Model on how to improve their ePortfolio usage and implementation.

On the whole, the goal of developing the model that is based on the well known D&M Model and reflects relationships between the dimensions of ePortfolio success was successfully achieved in this dissertation. The resulting model revealed the very important fact of information and its quality being a direct product of ePortfolio usage. Therefore, the resulting model could prove very useful for educational organizations in indicating the dimensions that will be or need to be affected by the improvement process.

9 Conclusion

This doctoral dissertation focused on two main aims: to develop an ePortfolio success instrument for assessing ePortfolio success and to develop a corresponding ePortfolio Success Model that would explain the relationships between the dimensions of ePortfolio success. Achieving the aforementioned aims required a comprehensive preliminary research to be carried out; involvement of international ePortfolio experts; and a whole set of recent statistical techniques and findings to be applied for data analysis and interpretation. In the following sections the scientific contribution of the dissertation are presented through a brief review of procedures undertaken to achieve the aims. The limitations of this study are also brought up, followed by directions for future research.

9.1 *Scientific contribution*

The original scientific contribution of this dissertation is twofold and as such can be explained in terms of contributing to theory and methodology. Its theoretical contribution refers to providing evidence that ePortfolio is an IS, proposal of the ePortfolio meta-model, ePortfolio success instrument development and validation, ePortfolio Success Model proposal as well as the validation and identification of critical success factors for ePortfolio implementation. Methodological contribution comprehends the use of different scientific approaches to provide evidence that ePortfolio is an IS. A combination of existing instrument development and model testing methodologies and techniques was used to design the ePortfolio success instrument and to propose the ePortfolio success model. Each of the contributions is described separately below.

9.1.1 Theoretical contribution

This dissertation is the first to show that ePortfolio is an IS. This allows for a whole new field of IS research methodologies to be applied to ePortfolio. By introducing the IS field

to the field of ePortfolio and vice versa two direct benefits were achieved. First, ePortfolio can be greatly improved by comprehending it as an IS and applying a whole new set of measures and techniques that may eventually lead to development of new theories. On the other hand, establishing that ePortfolio is IS implies that the IS field will be introduced to a specific type of IS that supports Lifelong Learning, in contrast to traditional business systems. This may expand the comprehension of IS and eventually lead to the development of new ideas and approaches in the theory of IS. Moreover, the Genetic taxonomy method and the Genetic Taxonomy Space were used to support the direct comparison between ePortfolio and other types of IS. In addition, the difference between ePortfolio as a system and ePortfolio as a tool was demonstrated thus providing further clarification of different ways of conceiving ePortfolio.

The ePortfolio meta-model was developed as a result of the extensive ePortfolio literature overview and personal experience in ePortfolio usage and implementation. That comprehensive five-scenario model depicts a possible usage of ePortfolio as a central system in Lifelong Learning. It can be valuable to individuals, educational institutions as well as employment organizations in explaining the information flow, the potential for its usage in different contexts and the benefits for all parties.

According to Chang&King (2005), instrument development contributes to a field by providing valid and interpretable measures in theory building and hypothesis testing. Based on the IS literature that emphasizes the multi-dimensional nature of IS success (for examples, see Seddon, 1997; Gable *et al*., 2003; Sedera *et al*., 2004; DeLone&McLean, 2003 and others), in this dissertation an instrument for assessing the ePortfolio success from the individual's perspective in the academic environment was developed and validated. The successful validation of the ePortfolio success instrument supported the proposition that the success of an ePortfolio is multi-dimensional and that it can be measured through six dimensions suggested by DeLone&McLean (2003). The results of data analysis also supported this proposition by confirming the structures in the ePortfolio success instrument. Therefore, the success of an ePortfolio system is indeed multi-dimensional and can be accessed through six major dimensions proposed by the D&M Model (DeLone&McLean, 2003): System Quality, Information Quality, Service Quality, Use, User Satisfaction and Net Benefits. For the instrument to be comprehensive

and applicable in all universities worldwide, in this dissertation a set of international ePortfolio experts was used to create an initial pool of ePortfolio measurement items and several universities across Europe and USA were used to validate the instrument. Moreover, additional comprehensiveness was introduced by involving all the interested parties, from student to employer.

The model of ePortfolio success was also developed and validated based on the aforementioned instrument. Significant paths between the major dimensions were found, which allows us to conclude that the model provides significant insight into relationships between the dimensions of ePortfolio success in the academic environment. Beside significant direct connections between the dimensions, indirect influences were also found as well as those that mediate relationships between other dimensions of ePortfolio success.

This dissertation also contributes to the field of ePortfolio by proposing a new set of critical success factors firstly established by Gathercoal *et al*. (2002). The set of critical success factors is extremely valuable and vital for institutions that plan to implement ePortfolio since, according to Gathercoal *et al*. (2002) they need to be present and active in order to implement an ePortfolio system. Identifying the presence or absence of those factors in universities that implemented ePortfolio on one hand and explaining the connection between them and ePortfolio implementation success on the other can significantly contribute to new theories regarding the ePortfolio implementation and usage.

9.1.2 Methodological contribution

This dissertation demonstrated the use of different scientific approaches to provide evidence that ePortfolio is an IS. Except for the descriptive method, this dissertation used the Genetic taxonomy method (Brumec, 1997) and provided a rationale for the existence of ePortfolio, its development, source and origin. Moreover, the Genetic Taxonomy Space was used to show the difference between ePortfolio as a tool and ePortfolio as a system. Successful application of the Genetic taxonomy method and the

Genetic Taxonomy Space provides validation for the methodology and adds to the accumulation of knowledge on its use.

A significant methodological contribution of this dissertation is the development of the ePortfolio success instrument. This instrument enables the comprehensive assessment of ePortfolio success in the academic environment through six dimensions and is applicable at the individual level of analysis. Moreover, the instrument enables researchers to assess ePortfolio success in different universities or within the same university over a period of time. A comparison of results between universities would allow for accumulation of knowledge about ePortfolio success, while comparing the results within a single institution collected over a period of time would enable a detailed analysis of progress in successful implementation of ePortfolio.

While following recommendations in Straub *et al*. (2004) as the backbone for instrument development, several other recommendations were also combined and followed in this dissertation (e.g. Gefen *et al*., 2000, Moore&Benbasat, 2001; Gefen&Straub, 2005), resulting in the dissertation's value and applicability. Owing to rigor in the early stages of instrument development, items that had good content validity were obtained. The usage of Q-sorting ensured that items converged to their prospective constructs while differentiating them from other constructs. Confirmatory factor analysis was applied for further clearing on instrument items (Segar, 1997; Straub *et al*., 2004, Gefen&Straub,2005), while exploratory factor analysis was used for further extraction of subcategories within dimensions (Gefen&Straub, 2005). Finally, the two-phase pair wise model fitting (Segars&Groover, 1998) resulted in a good model fit for the ePortfolio success instrument. Successful application of the instrument development methodology in IS provides validation for the methodology and adds to the accumulation of knowledge on its use.

Using PLS SEM to detect significant paths between the dimensions of ePortfolio success is another contribution to methodology. Apart from detecting direct paths, the power of PLS SEM was demonstrated by detecting and explaining indirect impacts between dimensions and validating the model fit. Due to limitations in path analysis, the proposed model was decomposed into two models in order to analyze all the

hypothesized paths. By careful interpretation of the results from both models, a unique model was identified that explains relationships between the dimensions of ePortfolio success. Decomposition of the model as well as the subsequent integration of results into one general model presents a valuable contribution to the methodology used for path estimation. Successful application of PLS SEM to detect and explain relationships in the ePortfolio Success Model also provides validation for the methodology used.

9.2 *Limitations of the study*

There are several limitations of this dissertation that need to be considered when interpreting the results. The first is the inadequate number of institutions for CSFs analysis and the consequently low response rate within institutions. For a stable CSFs analysis the institutions' sample should have included around 100 or more institutions, each one of them providing at least 40-50 students. Since the desired number of data points was not accomplished, the analysis of the moderating effect that CSFs have on the Portfolio success was omitted from this dissertation.

On the other hand, the data points to analyze and validate the ePortfolio success instrument were sufficient. To alleviate the concern that the results may not be generally applicable, the sample was thoroughly analyzed in terms of age of the respondents, frequency of ePortfolio usage, number of artefacts in ePortfolio and number of courses in which the respondents used ePortfolio. The analysis showed that the age span on the whole encompasses the student population. Other attributes also showed that the sample encompassed a variety of students, from the ones that have a small number of artefacts and work with ePortfolio on a monthly basis to the ones that have a great number of artefacts and work with ePortfolio on a daily basis. The low response rate obtained in the study, although a cause for concern, can be attributed to the fact that most institutions that reported the use of ePortfolio are still in very early stages of implementation and usage and therefore currently hardly have any students who have experience with using the system.

In this dissertation the ePortfolio success instrument was developed, along with the corresponding model to be applied at the individual level of analysis in the academic environment. In other words, the ePortfolio success can be used by an academic institution for interpreting the results of ePortfolio implementation based on students' responses. Furthermore, the ePortfolio Success Model can be used by an academic institution in the process of improving the implementation and usage of ePortfolio. Finally, the low concentration of respondents aged above 31 also limits the generalizability of research findings to older students, which especially applies to part-time students.

9.3 *Implications for further research*

In this dissertation an instrument was developed to assess the success of an ePortfolio system following the D&M Model of IS success. Based on data analysis, the ePortfolio Success Model was proposed. The current study can be further extended and verified by conducting additional exploratory factor analysis with a greater number of respondents from Europe and USA to confirm the generalizability of the instrument and to detect possible additional dimensions or factors within dimensions. Furthermore, in respect to the required number of respondents, SEM analysis in LISREL could be performed to detect if certain correlations exist between the dimensions in the model. Moreover, the model fit can be re-tested in LISREL to verify the fit determined in this dissertation.

In addition, the authors of the D&M Model that was followed in this dissertation emphasize two possible units of analysis regarding the model: individual and organizational. This dissertation assessed the ePortfolio success at the individual level, from the point of view of a student. One possible direction for further work is to analyze the ePortfolio success at the organizational level. In that case a large pool of institutions that actively use ePortfolio is needed and the initial pool of items developed for this instrument should be re-determined and filtered to correspond to the organizational level of perception.

Another important aspect that was not covered in this dissertation due to a lack of respondents was the analysis of CSFs as moderating factors in the ePortfolio Success Model. This certainly presents a very solid starting point for further research. Since CSFs have already been identified, a large number of institutions that use ePortfolio together with several dozen students within each institution would be needed to test the moderating effects of CSFs. A scenario of such possible future research is as follows: After the institutions complete the CSFs survey and students complete the ePortfolio success survey, the ePortfolio Success Model for each institution is obtained. The success models of each institution are then analyzed and compared. The existence or absence of paths between the dimensions in accordance with CSFs that were identified at the institutional level will point to the moderating effect of the CSFs.

Appendix A: EPortfolio experts involved in research

All data is used and published with permission from experts involved in this research. The experts filled out the personal/professional information sheet attached to the instrument evaluation sheet. The table below contains formatted data and basic statistics about the experts.

No	Occupation	Scientific area	Country	Years of experience in e-learning	Expertise in e-learning (1-3)	Years of experience in ePortfolio	Expertise in ePortfolio (1-3)
1	Assistant/ Researcher	SS	Austria	7	3	5	3
2	Student	SS	Croatia	4	2	2	2
3	Associate Professor	HS	New Zealand	15	3	9	3
4	Assistant /Researcher	HS	Poland	5	3	2	3
5	Assistant /Researcher	HS	Poland	10	3	3	3
6	Student	HS	Poland	2	2	1	2
7	Assistant Professor	SS	Russia	2	2	5	3
8	Full Professor	SS	Russia	5	3	5	3
9	Administrator	NS	Slovenia	5	3	3	3
10	Assistant Professor	SS	Slovenia	7	3	2	2
11	Assistant Professor	TS	Slovenia	5	3	3	3
12	Assistant Professor	SS	Slovenia	10	3	4	3
13	Assistant Professor	TS	Slovenia	10	3	5	3
14	Full Professor	SS	Spain	15	3	15	3
15	Administrator	n/a	UK	5	3	4	3
16	Administrator	n/a	USA	10	3	8	3
17	Assistant Professor	TS	USA	3	3	2	2
18	Administrator	n/a	USA	3	2	3	3
			Mean:	**6.83**	**2.78**	**4.50**	**2.78**
			Standard deviation:	**4.02**	**0.43**	**3.35**	**0.43**

** SS = Social Sciences; NS = Natural Sciences; HS = Humanistic Sciences; TS = Technical Sciences*

In total, there were 12 male and 6 female respondents. Both students involved in the research were graduate students. The age range of all respondents was from 22 to 55. As can be seen from the table, their average length of experience in e-learning was 6.83 years while that in ePortfolio was 4.5 years. All of the respondents self-evaluated their expertise on the scale from 1 to 3 (1–familiar only with LMS/ePortfolio applications, 2–experienced both in using LMS/ePortfolio applications and LMS/ePortfolio as a pedagogical tool; and 3–have experience in LMS/ePortfolio implementation at the institutional level as well as a pedagogical tool and in using the system). In both cases (e-learning and ePortfolio) their average score was 2.78, which shows a respectable level of expertise.

Appendix B: Excel spreadsheet used for CSFs identification

Dear Sir/Madam,

This is the second part of instrument evaluation. This time your task is much easier and will take about 30 minutes at the most.

On next page, under the title "Critical Success Factors (CFS)" you will find a list of all ePortfolio related critical success factors according to Love *et al.,* 2004.

Love *et al*. (2004) comprehend CFSs as factors that need to be present and active in order to implement an ePortfolio system.

Your task will be to mark with "x" only those factors you believe to be critical.

If you believe that a certain critical success factor in the list is no longer critical (because it is fulfilled in most cases, such as the factor "A high-speed Internet connection exists", which is fulfilled in most cases today), please put "0" next to it.

Example:

One critical success factor states:

All classrooms have Internet access with computer display projection units.

If you find this not to be critical for ePortfolio success any longer, put "0" in the column to the right. Otherwise put "x" next to it.

As in the first evaluation, most of the document fields are locked in this second stage as well.

Thank you very much for your effort.

Sincerely,

Igor Balaban
Faculty of Organization and Informatics
Varazdin
Croatia

	Critical success factors = factors which have to be present and active in order to implement an ePortfolio system.	x = success factor 0 = not a success factor	If you have put 0(zero), please explain why you believe this is not a critical success factor any more OR if you think the statement should be reworded, please do it here
1.	Students and educators are encouraged to use ePortfolio (rewards for educators, extra scores for students within course).		
2.	Faculty participants are not punished for negative feedback on student evaluations of teaching.		
3.	All participants have equitable access to the ePortfolio services.		
4.	All classrooms have Internet access with computer display projection units.		
5.	Students complete Portfolios as a program requirement.		
6.	Students complete Portfolios as requirements in courses.		
7.	The student's work in the ePortfolio defines the student to faculty and recruiters.		
8.	Multiple faculty/supervisors/mentors read and comment on students' portfolio work.		
9.	Faculty members routinely give students assignments in written form.		
10.	Students routinely address unstructured problems.		
11.	Faculty grade and provide feedback on students' work.		
12.	The push for adoption and implementation of ePortfolios comes from faculty.		
13.	A group of faculty members has the commitment and stamina to make the ePortfolio system work.		

14.	An implementation plan exists, with reasonable milestones that are measurable and that collectively lead to full implementation.		
15.	Open computer lab assistance is available for students and faculty.		
16.	Opportunities exist for student/faculty/mentor training (multiple times and places).		
17.	Documentation about using the ePortfolio as a pedagogical tool is available for faculty/mentors and students.		
18.	Faculty commit to casting course assignments into a uniform format, such as Statement of standard; Student Assignment; Detail/Help/Internet resources; Assessment Description.		
19.	Teams of faculty agree to cast program standards into a uniform format to adopt ePortfolio as an assessment tool.		
20.	Faculty teams periodically review and revise the content of the curriculum and are aware of the content of courses making up the entire program.		
21.	Courses and/or program requirements are designed and sequenced to build student mastery of standards.		
If you believe there are more factors that could be critical for successful ePortfolio implementation, please specify them below and assign them to a corresponding connection (relationship) number.			
1.			
2.			
3.			
4.			
5.			

Appendix C: First version of statements sent to experts for evaluation

Dear Sir/Madam,

Thank you for being a part of a team that will be the first to read the questionnaire and evaluate it with valuable comments. You have been chosen as an expert very well familiar with ePortfolio systems and therefore have the knowledge and ability to make valuable contribution to this questionnaire. This questionnaire is an essential part of my PhD and it is of vital importance for it to be correctly designed in order to get valid data. The estimated time needed for evaluation is approximately 2 hours.

To make the process of completing the questionnaire as easy as possible I have included the following guidelines:

1. This phase is only intended to ensure content validity and construct validity of the instrument.

2. The goal is to ensure that:

a) Instrument contains only necessary statements by rating the importance of each statement (Column D: Importance for ePortfolio implementation)

b) All the statements are clear enough for the potential respondents, for which you are invited to add comments and propose reformulated statements (Columns E&F).

c) Each statement is assigned to only one category (construct).

d) Instrument contains all the necessary statements related to ePortfolio, for which you are invited to add statements that you find are missing or necessary.

3. **Document structure**:

Instructions – first worksheet you are reading now to prepare for filling the questionnaire.

1. User data – contains fields for entering some information about yourself.

2. Instrument evaluation – the 'main' worksheet that contains all instrument statements.

3. Comments – contains fields in which you can post your comments.

Instructions for filling the questionnaire:

1. **Carefully read the instructions** (this page). In case of any issues or problems, please do not hesitate to contact me any time at igor.balaban@foi.hr.

2. **Fill the User data page** with required information.

3. **Start with the instrument evaluation** on the 3rd worksheet (Page name: 2. Instrument evaluation). Please evaluate the statements according to the following instructions:

a) ***Column C contains instrument statements***.

b) ***Rank each statement from 1 to 3 according to the instructions in column D***. Put 0 (zero) if you believe you are not the right person to rank a specific statement. For example, you will put 0 if you are an educator and you believe the statement is intended to be ranked by a student, institution or employer and vice versa.

c***) If you think the statement should be reworded, please explain why*** (briefly, in a few words) in column E. Also, use the same column (E) to explain why you were not able to rank the statement, if this was the case.

d) ***If you think the statement should be reworded, do it in column F***. Otherwise, leave the column blank.

e) ***Assign each statement to one of the following categories***: 1. System Quality, 2. Service Quality, 3. Information Quality, 4. Use, 5. User Satisfaction, 6. Net Benefits or 7. Other. Please consider that only one answer per statement is possible.

In addition, please find the explanation for each category. These explanations are also stated as comments in each category header on the 3rd worksheet (Instrument evaluation).

1. System Quality = the desirable characteristics of an ePortfolio system. For example: ease of use, system flexibility, reliability, response times etc.

2. Information Quality = the desirable characteristics of the system outputs. For example: relevance, understandability, accuracy, conciseness, completeness, usability, understandability etc.

3. Service quality = the quality of the support that system users receive from the ePortfolio department and IT support personnel. For example: responsiveness, empathy of the personnel staff etc.

4. Use = the degree and manner in which users (students, educators, managers...) utilize the capabilities of an ePortfolio system. For example: amount of use, frequency of use, nature of use, extent of use, purpose of use etc.

5. User Satisfaction = users' level of satisfaction with the system as a whole. For example: attitude toward using technology, anxiety etc.

6. Net Benefits = the extent to which ePortfolio is contributing to the success of individuals, groups, organizations and industries. For example: enhanced learning, personal growth and development etc.

7. Other if you believe the statement does not belong to any of the categories from 1 to 6.

f) ***If you find some statements missing but necessary*** for ePortfolio implementation, please:

1. Add them at the end of the instrument (row 179 and below);

2. Rank them;

3. Assign them to the corresponding category.

Additional notes:

1. Instrument evaluation worksheet has some fixed parts: 1. Header *&* 2. Statements

2. Try to scroll with the horizontal slider (at the bottom of the screen): you will notice that statements remain fixed while other columns are moving left or right. This is to make the evaluation process easier.

3. After completing the instrument evaluation add your comments in the next worksheet – 3. Comments.

Important:

1. All the fields that should not be filled are locked. Only the fields that are requested to be filled remained unlocked.

2. It is not necessary to evaluate the whole instrument at once! You can save your work at any time by saving the Excel document using the Save button somewhere on your Computer.

Thank you very much for your effort!

Sincerely,

Igor Balaban
Faculty of Organization and Informatics
Varazdin
Croatia

Statements evaluation sheet:

	STATEMENTS	Importance for ePortfolio implementation (1 - 3) 1 - Not relevant 2 - Important(but not essential) 3 - Essential 0 - can not answer	Pre-test comment (Here you can indicate why you can not respond to the statement OR explain the reason(s) if you think this statement should be modified/reworded; OTHERWISE leave it blank)	If you think this statement should be reworded, do it here (leave it blank if you agree with the statement or if you could not rank the statement)	Which construct do you think the statement belongs to? (Mark field with X: only one possible answer for each item)						
					System quality	Information Quality	Service Quality	Use	User satisfaction	Net benefits	Other
1.	I can reflect on artifacts.										
2.	Information from the ePortfolio appears readable, clear and well formatted.										
3.	Information from the ePortfolio is easy to understand.										
4.	The system is always up-and-running as necessary.										
5.	Message presentation is always the same (position, terminology, style...).										
6.	The teacher/instructor understand your specific needs.										
7.	I would find the system easy to use.										
8.	The system is easy to learn.										
9.	The system is compatible with other systems I use.										
10.	The potential for enhanced communication between peers stimulates my motivation to work and learn trough the ePortfolio system.										
11.	Reflections enable me to get insight into individual thinking processes, introspection, and thoughts on problem-solving.										
12.	The systems' user interface can be easily adapted to one's personal approach.										
13.	The information produced by the ePortfolio is valid (presents real evidence of acomplishements).										
14.	Reflections enable me to observe on intellectual strengths and weaknesses.										
15.	The data entry screens clearly show the spaces reserved to record the data.										
16.	If I use the system, I will increase my chances of being awarded.										
17.	Sitemap of the portfolio system clearly shows site construction and organization of materials.										
18.	When I was using ePortfolio, I used features that helped me organize my artifacts.										
19.	My ePortfolio enables me to learn more efectively through interaction with other students including the feedback received from them.										
20.	The same terminology is used throughout the application.										
21.	I am able to compare myself with others.										
22.	The information provided by the ePortfolio is complete.										
23.	The ePortfolio staff has been helpful in the use of the system.										
24.	The system can be easily modified, corrected or improved.										
25.	When I was using ePortfolio, I was able to block out all other distractions.										
26.	The system does not delete/destroy any information without asking for a confirmation and getting a positive response.										
27.	The system can work with other systems such as a CMS or connect to LDAP server for authentication.										
28.	Security policy exist and clearly states all related security issues.										
29.	In case of an artifact update, the view that contains that artifact can also be automatically updated.										
30.	FAQ page is included and covers all relevant questions.										
31.	The ePortfolio provide up to date information.										
32.	I predict I would use the system in the next <n> months.										
33.	Information needed from the ePortfolio is always available.										
34.	I can monitor the efficiency of strategies I use in teaching.										
35.	My interaction with the system would be clear and understandable.										
36.	The system is somewhat intimidating to me.										
37.	Help functions are available/accesible throughout the application.										
38.	Users are able to quickly search and retrieve part or full portfolio materials.										
39.	The system includes controls to detect unauthorized access.										
40.	A certain degree of freedom for you to express your own individuality and personal strengths is allowed.										
41.	I feel apprehensive about using the system.										
42.	ePortfolio helped me to make connections among my formal(structured learning within school or faculty) and informal(unstructured learning, occurs in everyday life) learning experiences.										
43.	ePortfolio brings about benefits that are more important than its costs (time and money).										
44.	Learning to operate the system is easy for me.										
45.	ePortfolio completion is well described within program requirements.										

46.	The assessment data generated from the ePortfolio system can be used each semester to assist with program assessment and revision.											
47.	Users are to access the system with a simple conventional Web browser without much preparation.											
48.	I can show how artefacts match my goals and standards.											
49.	Privacy policy exist and clearly states all related privacy issues.											
50.	I can solve problems much easier by using ePortfolio with all its features.											
51.	The information provided by the ePortfolio is verifiable (it can be checked by some other means).											
52.	Error messages clearly indicate the actions to be taken to rectify errors.											
53.	Teachers/instructors give you prompt service/response.											
54.	Data entry screens are organized in such a way that the data elements are logically grouped together.											
55.	I plan to use the system in the next <n> months.											
56.	The ePortfolio provides output that seems to be exactly what is needed.											
57.	The organizations' facilties from which user can access it's Portfolio are visually appealing.											
58.	Users can easily access exclusive/unique information available only through the ePortfolio system.											
59.	Evaluation criteria for selecting and assessing the e-portfolio contents, as well as the overall e-portfolio goal, are clear and very well explained prior to developing the e-portfolio.											
60.	The mean and frequency of students work can be easily monitored.											
61.	ePortfolio helped me to relate my learning to a wider context.											
62.	I can show my comprehensive profile through ePortfolio.											
63.	I can monitor changes in my ideas, criterias and attitudes.											
64.	I like working with the system.											
65.	The behaviour of teachers instils confidence in you.											
66.	ePortfolio encouraged me to develop a positive attitude to life-long learning.											
67.	I intend to use the system in the next <n> months.											
68.	ePortfolio helped me to understand how I learn.											
69.	I can generate portals for displaying work samples and achievements within the same curricular structure.											
70.	When I was using ePortfolio, I used features that helped me test different views.											
71.	The system includes necessary features and functions.											
72.	Information from the ePortfolio is always timely.											
73.	I am able to evaluate progress towards achievement of my personal goals.											
74.	The documentation is easy to access and use.											
75.	Users find the organization(University) which provides the portfolio service to have a good credibility.											
76.	When I was using ePortfolio, my attention did not get diverted very easily.											
77.	It is possible to export data into other applications.											
78.	Working with the system is fun.											
79.	I could complete a job or task using the system if I had just the built-in help facility for assistance.											
80.	Teachers/instructors/ePortfolio staff have the knowledge to answer your questions.											
81.	In general, the organization has supported the use of the system.											
82.	Using ePortfolio has lead to increased transparency for evaluation and benchmarking.											
83.	The system never modifies a field without asking for a confirmation and getting a positive answer.											
84.	When I was using ePortfolio, I felt completely absorbed in what I was doing.											
85.	I can articulate personal goals.											
86.	Terms of use as well as ethics regulations are clearly shown.											
87.	I can generate portals for displaying work samples and achievements within institutional standard.											
88.	I could complete a job or task using the system if I could call someone for help if I got stuck.											
89.	I can use the assessment data generated within ePortfolio system each semester to assist with course revision.											
90.	Users can create views in flexible styles and formats so that the overall presentation is not confined in linear or hierarchical structure.											
91.	The enhanced communication between students and educators enhances the chances for student success.											
92.	The system makes work more interesting.											
93.	The views(a selected collection of artifacts for self-presentation) are easy to create and understand.											
94.	Error messages adequately describe the nature of the problem.											
95.	The terms used in data-entry screens and menus are familiar to users.											
96.	I can monitor my own improvement.											
97.	Menus are hierarchical, that is, they go from general to detailed choices.											
98.	When I was using ePortfolio, I used features that helped me joining the groups.											

99.	The system is able to easily scale up as more contents are stored and more concurrent sessions with an increasing number of users access the system.											
100.	Thesystem responds quickly enough.											
101.	Users can collaborate (work together) on creating and organizing portfolios from scratch to completion.											
102.	The organizations' ePortfolio office staff are neat appearing.											
103.	Information from the ePortfolio is in a form that is readily usable.											
104.	It would be easy for me to become skillful at using the system.											
105.	Reflections enable me to develop decision-making skills.											
106.	The system meets (the organization's) requirements											
107.	I have the resources necessary to use the system.											
108.	I can show my personal growth and development over the time.											
109.	The organizaton has a modern looking equipment available for accessing ePortfolio services.											
110.	Using the system is a good idea.											
111.	I can choose my co-workers according to various criteria presented in ePortfolio.											
112.	There is ability to repeat instructional implementation by copying course content as well as goals and standards from one instructor to others, each time enriching the content through additional resources and new curricular initiatives.											
113.	The system provides reports showing all unauthorized accesses and errors within a given period.											
114.	It feels safe working with the ePortfolio.											
115.	It scares me to think that I could lose a lot of information using the system by hitting the wrong key.											
116.	I hesitate to use the system for fear of making mistakes I cannot correct.											
117.	Potential employers can view showcase Portfolio with the benefit of contextual clues from the institution, assessment criteria, and student-generated descriptions of achievements.											
118.	When I was using ePortfolio, I used features that helped me to tag my artefacts.											
119.	ePortfolio has resulted in improved learning outcomes or outputs.											
120.	The use of ePortfolio enabled me to receive important comments and suggestions from my teacher.											
121.	It is not difficult to get access to information that is in the ePortfolio.											
122.	I have improved my general skills for education/learning.											
123.	Each user owns a unique password.											
124.	When you have a problem regarding ePortfolio, the organization shows a sincere interest in solving it.											
125.	I can enrich a course content based on received feedback in ePortfolio.											
126.	Data recovery and retrieval procedures are available in case of an application malfunction.											
127.	Your personal information feels secure.											
128.	People who are important to me think that I should use the system.											
129.	Using the ePortfolio helped me to become more effective, independent and confident self-directed learner.											
130.	To achieve a task with a portfolio system, a minimal number of screens, tasks and actions are required.											
131.	It can be ascertained which students met or exceed standards linked to specific work samples and achievements.											
132.	I would find the system useful in teaching and learning.											
133.	ePortfolio clearly reflect learning objectives as identified in the course curriculum.											
134.	The faculty/institution gives you individual attention.											
135.	ePortfolio has resulted in better positioning among others.											
136.	When I was using ePortfolio, I did not use features that would help me present my artifacts.											
137.	ePortfolio enabled me to track the efficiency of teaching (changes in attitudes, increased interest for some part of the content, interpretation clarity, ...)											
138.	Menus have a maximum of three to four sub-menus.											
139.	The system is broken up into separate and independent modules.											
140.	I can nominate who can provide feedback for each item in my ePortfolio.											
141.	The users can be easily trained to access and operate the system - build their own portfolios.											
142.	I could complete a job or task using the system if there was no one around to tell me what to do as I go.											
143.	Using the system enables me to present my acomplishements more quickly.											
144.	The system provides the capability to import data from other applications.											
145.	The system does not require increasing resources over time to maintain the daily operation and minor refinements.											

146.	All headings (screens, menus, reports) are always at the same place.											
147.	A specific person (or group) is available for assistance with system difficulties.											
148.	I have the knowledge necessary to use the system.											
149.	I could complete a job or task using the system if I had a lot of time to complete the job for which the software was provided.											
150.	The system is easy to use.											
151.	The system could be used in other organizational environments, similar to the one in which it is presently used, without any major modification.											
152.	Teachers/instructors are always willing to help you.											
153.	Standards, department goals and other descriptors can be linked to specific ePortfolio items.											
154.	People who influence my behavior think that I should use the system.											
155.	Help functions provide sufficient information for using the application.											
156.	ePortfolio has resulted in improved quality assurance process.											
157.	ePortfolio provide evidence of students' understanding of course-specific knowledge and skills.											
158.	Information from the ePortfolio is concise (contain only necesarry data).											
159.	E-mail and telephone contacts are available in case of problems while using ePortfolio.											
160.	I have improved my general skills for career management.											
161.	Only authorized users can access and change the data files or a part of them.											
162.	Using the system increases my learning capacities.											
163.	I have the ability to generate my own views for displaying work samples and achievements.											
164.	The system performs an automatic backup of the data.											
165.	There is ability to copy course syllabi and assignments along with complete links to standards and department goals from one semester to the next, each time enriching the content through additional resources and new curricular innitiatives.											
166.	Educator can give summative assessment to students work based on stored artefacts and feedback.											
167.	ePortfolio enabled me to have multiple opportunities to better evaluate the products of my work based on feedback received from educators.											
168.	ePortfolios are organized by curricular requirements and electives or by standards established by cadre of educators or the institution.											
169.	When I was using ePortfolio, I got distracted very easily.											
170.	Information available from the ePortfolio is important.											
171.	I can nominate who can view my Portfolio.											
172.	When I was using ePortfolio, I felt totally immersed in what I was doing.											
173.	The system features should always perform consistently and provide services under the stated normal condition for a defined time.											
174.	On-line help is available.											
If you think some additional statement(s) is needed, please: 1. add it below, 2. rate it and 3. indicate which construct it belongs to												
1.												
2.												
3.												
4.												
5.												
6.												
7.												
8.												
9.												
10.												
11.												
12.												
13.												
14.												
15.												

Appendix D: Field-test instrument statements

SYSTEM QUALITY	
	USABILITY
SYSQ1	Using the system is easy to learn.
SYSQ2	Help functions are available and sufficient for using the system.
SYSQ3	The system's sitemap clearly shows the organization of materials.
SYSQ4	The views (i.e. selected collections of artifacts for self-presentation) are easy to manage.
SYSQ5	It is possible to quickly search (e.g. using a search engine) through ePortfolio content.
SYSQ6	The system includes necessary features and functions for managing ePortfolio.
	FUNCTIONALITY
SYSQ7	The system is always up-and-running as necessary.
SYSQ8	The system is compatible with other systems I frequently use (e.g. Web 2.0 tools).
SYSQ9	The system supports import and export of data (html, pdf and other useful formats).
SYSQ10	The system can be accessed with a conventional Web browser without much preparation.
SYSQ11	In case of content update, the same content is automatically updated throughout the system.
	USER INTERFACE
SYSQ12	The system's user interface is easy to use.
SYSQ13	The system's user interface can be easily customized.
SYSQ14	Message presentation is always the same (position, terminology, style...).
SYSQ15	Error messages are clear and understandable.
	SECURITY
SYSQ16	Each user owns a unique password.
SYSQ17	Only authorized users can access and change the ePortfolio content.
SYSQ18	It is possible to set up the view permissions for individual ePortfolios or ePortfolio views.
SYSQ19	The system does not modify/delete any data without asking for confirmation and getting a positive response.

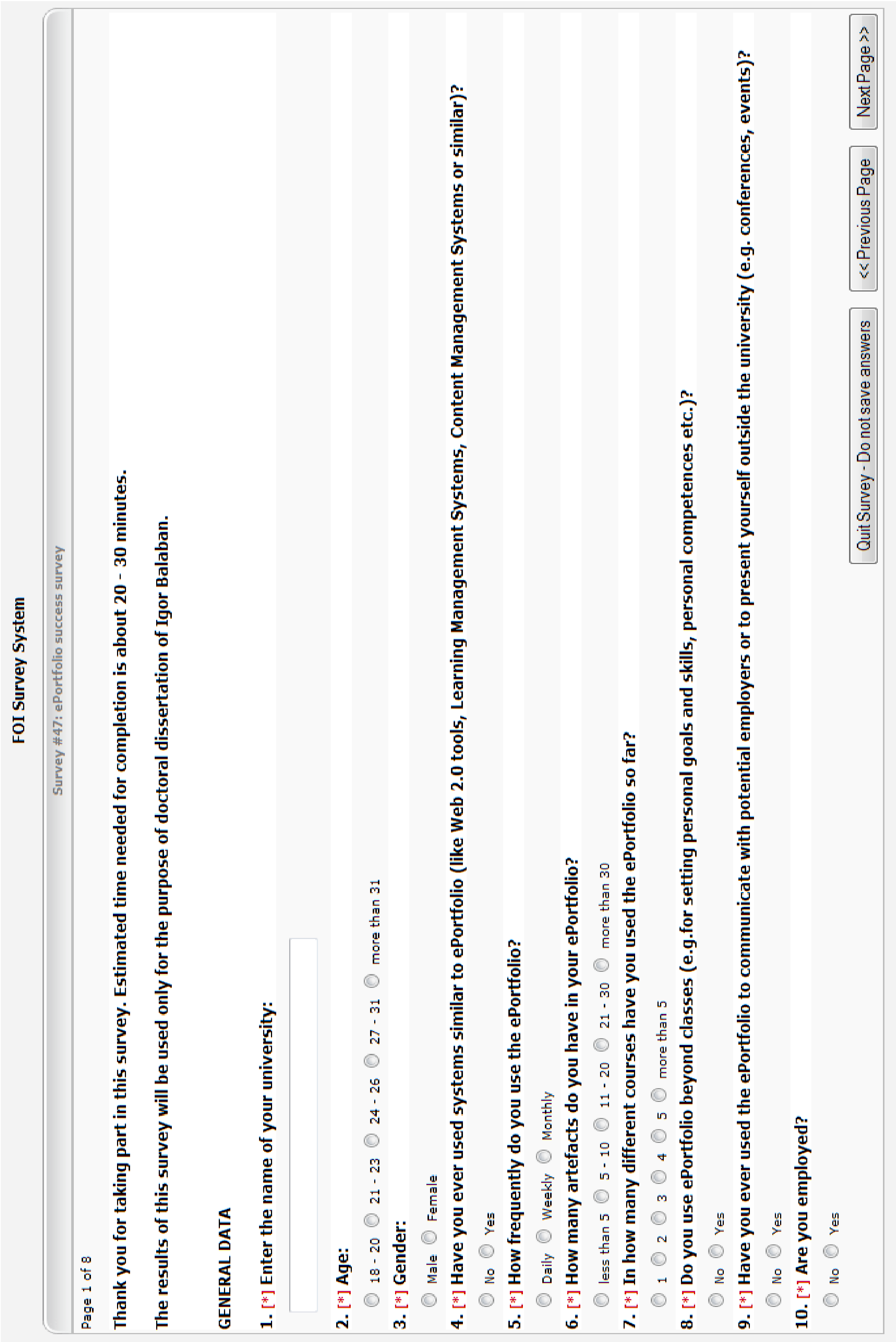
INFORMATION QUALITY	
	VALIDITY
IQ1	The information provided by the ePortfolio is valid (i.e. presents real evidence of accomplishments).
IQ2	The information provided by the ePortfolio is complete.
IQ3	The information provided by the ePortfolio is always up to date.
IQ4	The information provided by the ePortfolio is verifiable (it can be checked by means of verification mechanisms).
IQ5	The information provided by the ePortfolio is relevant.
	FORMAT
IQ6	The information provided by the ePortfolio appears readable, clear and well formatted.
IQ7	The information provided by the ePortfolio is easy to understand.
IQ8	The information provided by the ePortfolio is in a readily usable form.
IQ9	The information provided by the ePortfolio is concise (contains only necessary data).

SERVICE QUALITY	
	ASSURANCE FOR THE END-USERS
SERQ1	A specific person (or group) is available for assistance with system difficulties.
SERQ2	E-mail and other forms of on-line help are available in case of problems with using the system.
SERQ3	Teachers/ePortfolio support staff are helpful for using the system.
SERQ4	Teachers/ePortfolio staff are competent to answer questions.
	EMPATHY
SERQ5	The institution gives the user individual attention.
SERQ6	Teachers/ePortfolio staff are always willing to help.
SERQ7	Teachers/ePortfolio staff respond promptly.
	CLARITY
SERQ8	Terms of use are clearly shown (in the ePortfolio application, institution's web site, within the course description...).
SERQ9	EPortfolio use is well described within the course requirements (e.g. ePortfolio tasks, evaluation of work in the ePortfolio, extra credits...).
USE	
	DEEP STRUCTURE USAGE
U1	While using the ePortfolio, I used available features for organizing my content.
U2	While using the ePortfolio, I collaborated with my peers in organizing ePortfolio content.
U3	While using the ePortfolio, I used features that helped me to tag my artefacts.
U4*	While using the ePortfolio, I used features that helped me to join the groups.
U5*	While using the ePortfolio, I used features that helped me to set view permissions for different views (ePortfolios).
	FACILITATING CONDITIONS
U6	I have the knowledge necessary to use the system.
U7	I was able to complete a task using the system even if there was no one around to tell me what to do as I go.
U8	I have the resources necessary to use the system (e.g. PC, internet connection, instructions, tasks).
USER SATISFACTION	
	ATTITUDE TOWARD USING THE SYSTEM
US1	I like working with the system.
US2	The system makes work more interesting.
US3	Using the system is a good idea.
	USEFULNESS
US4	I find the system useful in learning.
US5	The degree of freedom for expressing one's own individuality and personal strengths is satisfactory.
US6	The ePortfolio presentation capabilities (e.g. quick upload, format and presentation of personal information) are satisfactory.

	NET BENEFITS
	ENHANCED LEARNING
NB1	The ePortfolio encouraged me to develop a positive attitude to lifelong learning.
NB2	The ePortfolio helps me to make connections between formal (i.e. structured learning within the school or faculty) and informal (i.e. unstructured learning occurring in everyday life) learning experiences.
NB3	The ePortfolio helps me to fulfill learning outcomes.
NB4	Using ePortfolio led to increased transparency in evaluation.
NB5	The enhanced communication between me and educators enhances the chances for my success.
	PERSONAL GROWTH AND DEVELOPMENT
NB6	I am able to evaluate progress towards achievement of my personal goals.
NB7	I am able to choose my co-workers among peers according to various criteria (interests) presented in ePortfolio.
NB8	I am able to compare myself with others.
NB9	I am able to show my personal growth and development over time.
NB10	Writing reflections enable me to develop decision-making skills.
NB11	Potential employers can view my showcase Portfolio with the benefit of contextual clues from the institution, assessment criteria, and my personal descriptions of achievements.

* Statements that had been eliminated during the earlier culling, but were restored after the pilot-test in order to increase the reliability of the Use scale

Appendix E: Screenshots of ePortfolio success instrument (Final version – English)


FOI Survey System

Survey #47: ePortfolio success survey

Page 1 of 8

Thank you for taking part in this survey. Estimated time needed for completion is about 20 - 30 minutes.

The results of this survey will be used only for the purpose of doctoral dissertation of Igor Balaban.

GENERAL DATA

1. [*] Enter the name of your university:

2. [*] Age:

18 - 20 21 - 23 24 - 26 27 - 31 more than 31

3. [*] Gender:

Male Female

4. [*] Have you ever used systems similar to ePortfolio (like Web 2.0 tools, Learning Management Systems, Content Management Systems or similar)?

No Yes

5. [*] How frequently do you use the ePortfolio?

Daily Weekly Monthly

6. [*] How many artefacts do you have in your ePortfolio?

less than 5 5 - 10 11 - 20 21 - 30 more than 30

7. [*] In how many different courses have you used the ePortfolio so far?

1 2 3 4 5 more than 5

8. [*] Do you use ePortfolio beyond classes (e.g.for setting personal goals and skills, personal competences etc.)?

No Yes

9. [*] Have you ever used the ePortfolio to communicate with potential employers or to present yourself outside the university (e.g. conferences, events)?

No Yes

10. [*] Are you employed?

No Yes

Quit Survey - Do not save answers | << Previous Page | Next Page >>

FOI Survey System

Survey #47: ePortfolio success survey

Please give your answers to the statements below in accordance with how much they correspond to you and your attitudes toward the ePortfolio.

Please select ONE of the following replies considering the descriptions provided:

1 – completely untrue | 2 – mostly untrue | 3 – neither true nor untrue | 4 – mostly true | 5 – completely true

1 – I disagree | 2 – I mostly disagree | 3 – I can't decide | 4 – I mostly agree | 5 – I completely agree

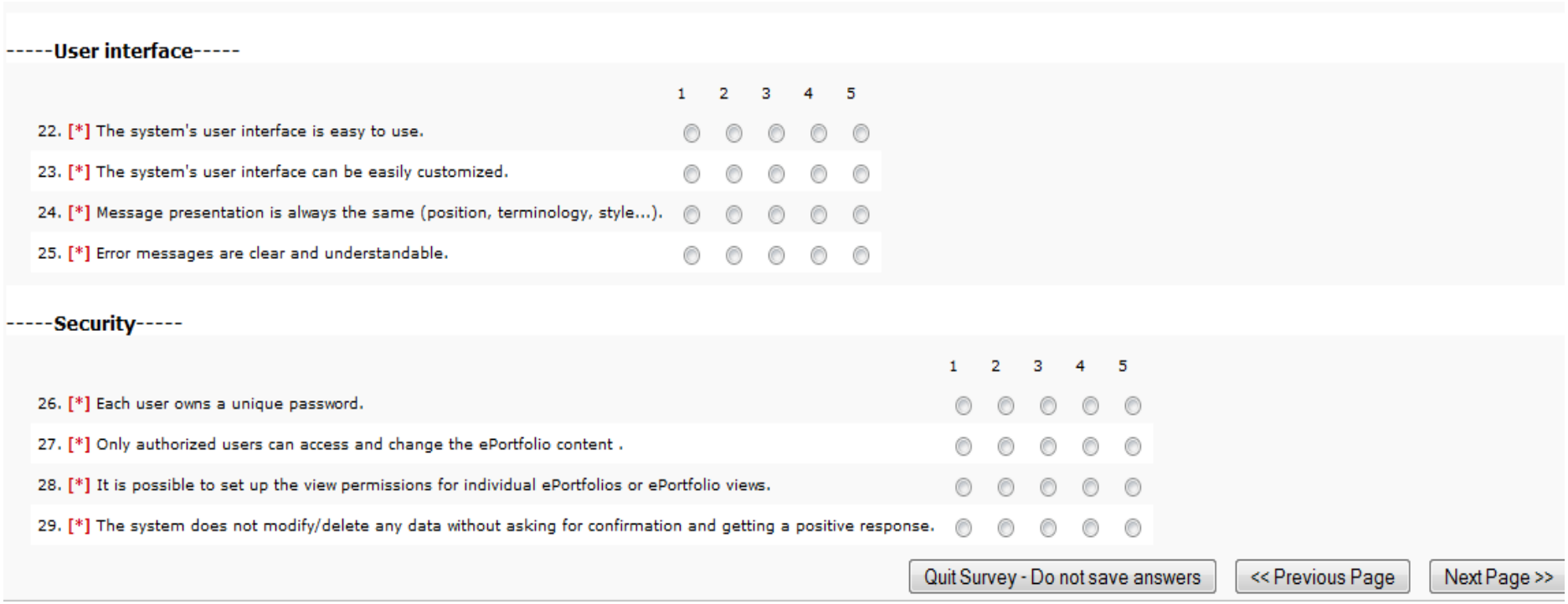
SYSTEM QUALITY = the characteristics of an ePortfolio system(application).

-----Usability-----

	1	2	3	4	5
11. [*] Using the system is easy to learn.	○	○	○	○	○
12. [*] Help functions are available and sufficient for using the system.	○	○	○	○	○
13. [*] The system's sitemap clearly shows the organization of materials.	○	○	○	○	○
14. [*] The views(i.e. selected collections of artifacts for self-presentation) are easy to manage.	○	○	○	○	○
15. [*] It is possible to quickly search (e.g. using a search engine) through ePortfolio content.	○	○	○	○	○
16. [*] The system includes necessary features and functions for managing ePortfolio.	○	○	○	○	○

-----Functionality-----

	1	2	3	4	5
17. [*] The system is always up-and-running as necessary.	○	○	○	○	○
18. [*] The system is compatible with other systems I frequently use (e.g. Web 2.0 tools such as Blog, Wiki and similar).	○	○	○	○	○
19. [*] The system supports import and export of data (html, pdf and other useful formats).	○	○	○	○	○
20. [*] The system can be accessed with a conventional Web browser without much preparation.	○	○	○	○	○
21. [*] In case of content update, the same content is automatically updated throughout the system.	○	○	○	○	○



-----**User interface**-----

	1	2	3	4	5
22. [*] The system's user interface is easy to use.	○	○	○	○	○
23. [*] The system's user interface can be easily customized.	○	○	○	○	○
24. [*] Message presentation is always the same (position, terminology, style...).	○	○	○	○	○
25. [*] Error messages are clear and understandable.	○	○	○	○	○

-----**Security**-----

	1	2	3	4	5
26. [*] Each user owns a unique password.	○	○	○	○	○
27. [*] Only authorized users can access and change the ePortfolio content .	○	○	○	○	○
28. [*] It is possible to set up the view permissions for individual ePortfolios or ePortfolio views.	○	○	○	○	○
29. [*] The system does not modify/delete any data without asking for confirmation and getting a positive response.	○	○	○	○	○

Quit Survey - Do not save answers | << Previous Page | Next Page >>

FOI Survey System

Survey #47: ePortfolio success survey

Page 3 of 8

Please select ONE of the following replies considering the descriptions provided:

1 – completely untrue | 2 – mostly untrue | 3 – neither true nor untrue | 4 – mostly true | 5 – completely true

1 – I disagree | 2 – I mostly disagree | 3 – I can't decide | 4 – I mostly agree | 5 – I completely agree

INFORMATION QUALITY = the quality of system's outputs (ePortfolio views you were able to see - yours and others).

-----Validity-----

	1	2	3	4	5
30. [*] The information provided by the ePortfolio is valid (i.e. presents real evidence of accomplishments).	○	○	○	○	○
31. [*] The information provided by the ePortfolio is complete.	○	○	○	○	○
32. [*] The information provided by the ePortfolio is always up to date.	○	○	○	○	○
33. [*] The accuracy of the information provided by the ePortfolio is verifiable (it can be checked by means of verification mechanisms, e.g. using digital signature).	○	○	○	○	○
34. [*] The information provided by the ePortfolio is relevant.	○	○	○	○	○

-----Format-----

	1	2	3	4	5
35. [*] The information provided by the ePortfolio appears readable, clear and well formatted.	○	○	○	○	○
36. [*] The information provided by the ePortfolio is easy to understand.	○	○	○	○	○
37. [*] The information provided by the ePortfolio is concise (contains only necesarry data).	○	○	○	○	○
38. [*] The information provided by the ePortfolio is in a readily usable form.	○	○	○	○	○

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FOI Survey System

Survey #47: ePortfolio success survey

Page 4 of 8

Please select ONE of the following replies considering the descriptions provided:

1 – completely untrue | 2 – mostly untrue | 3 – neither true nor untrue | 4 – mostly true | 5 – completely true

1 – I disagree | 2 – I mostly disagree | 3 – I can't decide | 4 – I mostly agree | 5 – I completely agree

SERVICE QUALITY = the support that system users receive from the ePortfolio department and IT support personnel.

-----Assurance for the end-users-----

	1	2	3	4	5
39. [*] A specific person (or group) is available for assistance with system difficulties.	○	○	○	○	○
40. [*] E-mail and other forms of on-line help are available in case of problems with using the system.	○	○	○	○	○
41. [*] Teachers/ePortfolio support staff are helpful for using the system.	○	○	○	○	○
42. [*] Teachers/ePortfolio staff are competent to answer questions.	○	○	○	○	○

-----Empathy-----

	1	2	3	4	5
43. [*] The institution gives the user individual attention.	○	○	○	○	○
44. [*] Teachers/ePortfolio staff are always willing to help.	○	○	○	○	○
45. [*] Teachers/ePortfolio staff respond promptly.	○	○	○	○	○

----Clarity-----

	1	2	3	4	5
46. [*] Terms of use are clearly shown (in the ePortfolio application, institution's web site, within the course description...).	○	○	○	○	○
47. [*] EPortfolio use is well described within the course requirements (e.g. ePortfolio tasks, evaluation of work in the ePortfolio, extra credits..).	○	○	○	○	○

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FOI Survey System

Survey #47: ePortfolio success survey

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Please select ONE of the following replies considering the descriptions provided:

1 – completely untrue | 2 – mostly untrue | 3 – neither true nor untrue | 4 – mostly true | 5 – completely true

1 – I disagree | 2 – I mostly disagree | 3 – I can't decide | 4 – I mostly agree | 5 – I completely agree

USE = the degree and manner in which users utilize the capabilities of an ePortfolio system.

-----Deep structure usage-----

	1	2	3	4	5
48. [*] While using the ePortfolio, I use available features for organizing my content.	○	○	○	○	○
49. [*] While using the ePortfolio, I collaborate with my peers in organizing ePortfolio content.	○	○	○	○	○
50. [*] While using the ePortfolio, I use features that help me to tag my artefacts.	○	○	○	○	○
51. [*] While using the ePortfolio, I use features that help me to join the groups.	○	○	○	○	○
52. [*] While using the ePortfolio, I use features that help me to set view permissions for different views (ePortfolios).	○	○	○	○	○

-----Facilitating conditions-----

	1	2	3	4	5
53. [*] I have the knowledge necessary to use the system.	○	○	○	○	○
54. [*] I was able to complete a task using the system even if there was no one around to tell me what to do as I go.	○	○	○	○	○
55. [*] I have the resources necessary to use the system (e.g. PC, internet connection, instructions, tasks) .	○	○	○	○	○

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FOI Survey System

Survey #47: ePortfolio success survey

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Please select ONE of the following replies considering the descriptions provided:

1 – completely untrue | 2 – mostly untrue | 3 – neither true nor untrue | 4 – mostly true | 5 – completely true

1 – I disagree | 2 – I mostly disagree | 3 – I can't decide | 4 – I mostly agree | 5 – I completely agree

USER SATISFACTION = users' level of satisfaction with the system as a whole.

-----Attitude towards using the system-----

	1	2	3	4	5
56. [*] I like working with the system.	○	○	○	○	○
57. [*] The system makes work more interesting.	○	○	○	○	○
58. [*] Using the system is a good idea.	○	○	○	○	○

-----Usefulness-----

	1	2	3	4	5
59. [*] I find the system useful in learning.	○	○	○	○	○
60. [*] The degree of freedom for expressing one's own individuality is satisfactory.	○	○	○	○	○
61. [*] The ePortfolio presentation capabilities (e.g. quick upload, format and presentation of personal information) are satisfactory.	○	○	○	○	○

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FOI Survey System

Survey #47: ePortfolio success survey

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Please select ONE of the following replies considering the descriptions provided:

1 – completely untrue | 2 – mostly untrue | 3 – neither true nor untrue | 4 – mostly true | 5 – completely true

1 – I disagree | 2 – I mostly disagree | 3 – I can't decide | 4 – I mostly agree | 5 – I completely agree

NET BENEFITS = the extent to which ePortfolio is contributing to the success of individuals.

-----Enhanced learning-----

	1	2	3	4	5
62. [*] The ePortfolio encourages me to develop a positive attitude to lifelong learning.	○	○	○	○	○
63. [*] The ePortfolio helps me to make connections between formal(i.e. structured learning within the school or faculty) and informal(unstructured learning occurring in everyday life) learning experiences.	○	○	○	○	○
64. [*] The ePortfolio helps me to fulfill learning outcomes.	○	○	○	○	○
65. [*] Using ePortfolio leads to increased transparency in evaluation.	○	○	○	○	○
66. [*] The enhanced communication between me and educators enhances the chances for my success.	○	○	○	○	○

-----Personal growth and development-----

	1	2	3	4	5
67. [*] I am able to evaluate progress towards achievement of my personal goals.	○	○	○	○	○
68. [*] I am able to choose my co-workers among peers according to various criteria(interests) presented in ePortfolio.	○	○	○	○	○
69. [*] I am able to compare myself with others.	○	○	○	○	○
70. [*] I am able to show my personal growth and development over time.	○	○	○	○	○
71. [*] Writting reflections enable me to develop decision-making skills.	○	○	○	○	○
72. [*] Potential employers can view my showcase Portfolio within the context of my institution's requirements, assessment criteria, and my personal descriptions of achievements.	○	○	○	○	○

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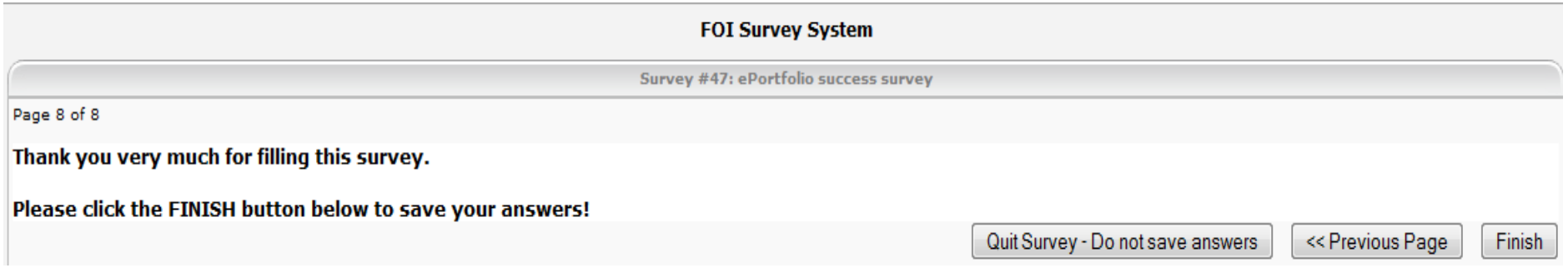
FOI Survey System
Survey #47: ePortfolio success survey
Page 8 of 8
Thank you very much for filling this survey.
Please click the FINISH button below to save your answers!
Quit Survey - Do not save answers
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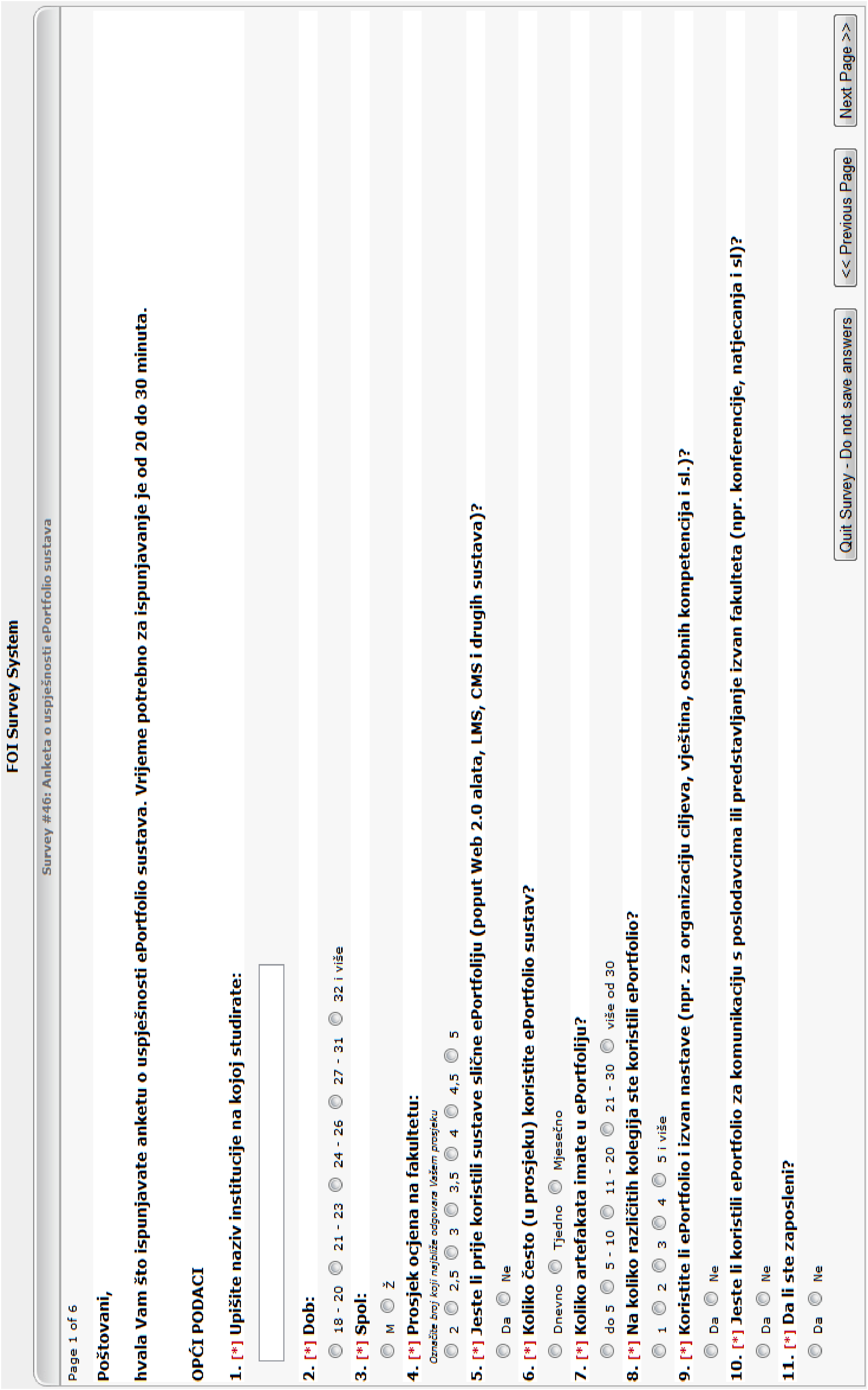
Finish

Appendix F: Screenshots of ePortfolio success instrument (Final version – Croatian)


FOI Survey System

Survey #46: Anketa o uspješnosti ePortfolio sustava

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Poštovani,

hvala Vam što ispunjavate anketu o uspješnosti ePortfolio sustava. Vrijeme potrebno za ispunjavanje je od 20 do 30 minuta.

OPĆI PODACI

1. [*] Upišite naziv institucije na kojoj studirate:

2. [*] Dob:
18 - 20 / 21 - 23 / 24 - 26 / 27 - 31 / 32 i više

3. [*] Spol:
M / Ž

4. [*] Prosjek ocjena na fakultetu:
Označite broj koji najbliže odgovara Vašem prosjeku
2 / 2,5 / 3 / 3,5 / 4 / 4,5 / 5

5. [*] Jeste li prije koristili sustave slične ePortfoliju (poput Web 2.0 alata, LMS, CMS i drugih sustava)?
Da / Ne

6. [*] Koliko često (u prosjeku) koristite ePortfolio sustav?
Dnevno / Tjedno / Mjesečno

7. [*] Koliko artefakata imate u ePortfoliju?
do 5 / 5 - 10 / 11 - 20 / 21 - 30 / više od 30

8. [*] Na koliko različitih kolegija ste koristili ePortfolio?
1 / 2 / 3 / 4 / 5 i više

9. [*] Koristite li ePortfolio i izvan nastave (npr. za organizaciju ciljeva, vještina, osobnih kompetencija i sl.)?
Da / Ne

10. [*] Jeste li koristili ePortfolio za komunikaciju s poslodavcima ili predstavljanje izvan fakulteta (npr. konferencije, natjecanja i sl)?
Da / Ne

11. [*] Da li ste zaposleni?
Da / Ne

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FOI Survey System

Survey #48: Anketa o uspješnosti ePortfolio sustava - FOI

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Molimo da odgovorite na sljedeće tvrdnje imajući u vidu koliko se te tvrdnje odnose na Vas i Vaše stavove o ePortfolio sustavu.

Odaberite JEDNU tvrdnju u skladu s uputama:

1 – potpuno netočno | 2 – uglavnom netočno | 3 – niti točno, niti netočno | 4 – uglavnom točno | 5 – potpuno točno

1 – ne slažem se | 2 – uglavnom se ne slažem | 3 – ne mogu se odlučiti, neopredijeljen(a) | 4 – uglavnom se slažem | 5 – potpuno se slažem

KVALITETA SUSTAVA = kvaliteta ePortfolio aplikacije

-----Upotrebljivost-----

	1	2	3	4	5
14. [*] Jednostavno je naučiti raditi sa sustavom.	○	○	○	○	○
15. [*] Sustav pomoći postoji i dostatan je za korištenje sustava.	○	○	○	○	○
16. [*] Mapa web mjesta(sitemap ili kazalo sadržaja) jasno prikazuje organizaciju sadržaja.	○	○	○	○	○
17. [*] Pogledima (tj. odabranim kolekcijama artefakata za samoprezentaciju) je jednostavno upravljati.	○	○	○	○	○
18. [*] Moguća je brza pretraga (npr. pomoću tražilice) sadržaja pohranjenih u sustavu.	○	○	○	○	○
19. [*] Sustav uključuje sve potrebne funkcionalnosti za upravljanje ePortfolijem.	○	○	○	○	○

-----Funkcionalnost-----

	1	2	3	4	5
20. [*] Sustav je uvijek dostupan i radi uredno.	○	○	○	○	○
21. [*] Sustav je kompatibilan s drugim sustavima koje često koristim (npr. LMS, CMS, Web 2.0 alati).	○	○	○	○	○
22. [*] Sustav podržava uvoz i izvoz podataka (import/eksport html-a, pdf-a i drugih korisnih formata).	○	○	○	○	○
23. [*] Sustavu je moguće pristupiti pomoću jednostavnog Web preglednika bez mnogo pripreme.	○	○	○	○	○
24. [*] Prilikom ažuriranja sadržaja, isti se sadržaj automatski ažurira kroz sustav.	○	○	○	○	○

-----**Korisničko sučelje**-----

	1	2	3	4	5
25. [*] Korisničko sučelje se može vrlo lako prilagoditi pojedinačnom korisniku.	◯	◯	◯	◯	◯
26. [*] Korisničko sučelje je jednostavno za korištenje.	◯	◯	◯	◯	◯
27. [*] Prikaz poruka u sustavu je uvijek isti (mjesto prikaza, terminologija, stil...).	◯	◯	◯	◯	◯
28. [*] Poruke o greškama su jasne i razumljive.	◯	◯	◯	◯	◯

-----**Sigurnost**-----

	1	2	3	4	5
29. [*] Svaki korisnik posjeduje vlastitu (jedinstvenu) lozinku.	◯	◯	◯	◯	◯
30. [*] Samo autorizirani korisnici mogu pristupiti i promijeniti sadržaj u ePortfoliju.	◯	◯	◯	◯	◯
31. [*] Moguće je odrediti tko može vidjeti moj ePortfolio ili pojedine poglede (ePortfolio views).	◯	◯	◯	◯	◯
32. [*] Sustav ne mijenja/briše podatke bez prethodnog upita i pozitivnog odgovora.	◯	◯	◯	◯	◯

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FOI Survey System

Survey #48: Anketa o uspješnosti ePortfolio sustava - FOI

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Odaberite JEDNU tvrdnju u skladu s uputama:

1 – potpuno netočno | 2 – uglavnom netočno | 3 – niti točno, niti netočno | 4 – uglavnom točno | 5 – potpuno točno

1 – ne slažem se | 2 – uglavnom se ne slažem | 3 – ne mogu se odlučiti, neopredijeljen(a) | 4 – uglavnom se slažem | 5 – potpuno se slažem

KVALITETA INFORMACIJE = kvaliteta izlazne informacije iz ePortfolio sustava (tvrdnje se odnose na sve informacije odnosno sadržaje u ePortfolio sustavu koje ste imali prilike vidjeti-vaše i tuđe)

-----Valjanost-----

	1	2	3	4	5
33. [*] Informacija iz ePortfolija je valjana (predstavlja stvarni dokaz o nekom postignuću).	○	○	○	○	○
34. [*] Informacija iz ePortfolija je potpuna.	○	○	○	○	○
35. [*] Informacija iz ePortfolija je ažurna.	○	○	○	○	○
36. [*] Informaciju iz ePortfolija je moguće provjeriti (pomoću nekih od mehanizama za verifikaciju).	○	○	○	○	○
37. [*] Informacija iz ePortfolija je važna.	○	○	○	○	○

-----Oblikovanje-----

	1	2	3	4	5
38. [*] Informacija iz ePortfolija je čitljiva, jasna i funkcionalno oblikovana.	○	○	○	○	○
39. [*] Informacija iz ePortfolija lako je razumljiva.	○	○	○	○	○

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FOI Survey System

Survey #48: Anketa o uspješnosti ePortfolio sustava - FOI

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Odaberite JEDNU tvrdnju u skladu s uputama:

1 – potpuno netočno | 2 – uglavnom netočno | 3 – niti točno, niti netočno | 4 – uglavnom točno | 5 – potpuno točno

1 – ne slažem se | 2 – uglavnom se ne slažem | 3 – ne mogu se odlučiti, neopredijeljen(a) | 4 – uglavnom se slažem | 5 – potpuno se slažem

KVALITETA USLUGE = kvaliteta podrške koja se pruža krajnjem korisniku

-----Jamstvo za krajnje korisnike-----

	1	2	3	4	5
40. [*] Određena osoba (ili skupina) dostupna je za pomoć prilikom poteškoća u radu sa sustavom.	○	○	○	○	○
41. [*] E-mail i drugi oblici on-line pomoći su uvijek dostupni u slučaju poteškoća s korištenjem sustava.	○	○	○	○	○
42. [*] Nastavnici/osoblje za ePortfolio podršku je od pomoći u korištenju sustava.	○	○	○	○	○
43. [*] Nastavnici/osoblje zaduženo za ePortfolio mogu kompetentno odgovarati na pitanja.	○	○	○	○	○

-----Suosjećanje-----

	1	2	3	4	5
44. [*] Fakultet svakom korisniku pristupa individualno.	○	○	○	○	○
45. [*] Nastavnici/osoblje za ePortfolio podršku su uvijek spremni pomoći.	○	○	○	○	○
46. [*] Nastavnici/osoblje za ePortfolio podršku brzo odgovaraju na upite.	○	○	○	○	○

-----Jasnoća-----

	1	2	3	4	5
47. [*] Način korištenja ePortfolija je jasno opisan u uvjetima kolegija/predmeta (npr. zadaci u ePortfoliju, ocjenjivanje rada, dodatni bodovi i sl.).	○	○	○	○	○
48. [*] Informacija iz ePortfolija je u obliku koji je lako iskoristiv.	○	○	○	○	○
49. [*] Uvjeti korištenja ePortfolija su jasno naznačeni (npr. u ePortfolio sustavu, na web stranicama institucije, u opisu kolegija i sl.).	○	○	○	○	○
50. [*] Informacija iz ePortfolija je sažeta (sadrži samo potrebne podatke).	○	○	○	○	○

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Odaberite JEDNU tvrdnju u skladu s uputama:

1 – potpuno netočno | 2 – uglavnom netočno | 3 – niti točno, niti netočno | 4 – uglavnom točno | 5 – potpuno točno

1 – ne slažem se | 2 – uglavnom se ne slažem | 3 – ne mogu se odlučiti, neopredijeljen(a) | 4 – uglavnom se slažem | 5 – potpuno se slažem

KORIŠTENJE SUSTAVA = korištenje pojedinih dijelova (ili određenih funkcionalnosti) aplikacije

-----Strukturirano korištenje sustava-----

	1	2	3	4	5
51. [*] Tijekom korištenja ePortfolija koristio/koristila sam dostupne mogućnosti za organizaciju sadržaja.	○	○	○	○	○
52. [*] Tijekom korištenja ePortfolija koristio/koristila sam funkcije za označavanje artefakata(artefact tagging).	○	○	○	○	○
53. [*] Tijekom korištenja ePortfolija surađivao/surađivala sam s kolegama u organiziranju ePortfolio materijala.	○	○	○	○	○
54. [*] Tijekom korištenja ePortfolio koristio/koristila sam funkcije za pridruživanje grupama.	○	○	○	○	○
55. [*] Tijekom korištenja ePortfolija koristio/koristila sam funkcije za davanje prava pristupa(pogleda) različitim pogledima(ePortfolijima).	○	○	○	○	○

-----Olakšavajuće okolnosti-----

	1	2	3	4	5
56. [*] Bilo je moguće ispuniti zadatak korištenjem sustava bez pomoći sa strane.	○	○	○	○	○
57. [*] Posjedujem znanje neophodno za korištenje sustava.	○	○	○	○	○
58. [*] Dostupni su mi resursi neophodni za korištenje sustava (npr. računalo, internetska veza, upute i zadaci).	○	○	○	○	○

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Survey #48: Anketa o uspješnosti ePortfolio sustava - FOI

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Odaberite JEDNU tvrdnju u skladu s uputama:

1 – potpuno netočno | 2 – uglavnom netočno | 3 – niti točno, niti netočno | 4 – uglavnom točno | 5 – potpuno točno

1 – ne slažem se | 2 – uglavnom se ne slažem | 3 – ne mogu se odlučiti, neopredijeljen(a) | 4 – uglavnom se slažem | 5 – potpuno se slažem

ZADOVOLJSTVO KORISNIKA = zadovoljstvo korištenjem sustava(aplikacije) i izlaznih informacija

-----Stav prema korištenju sustava-----

	1	2	3	4	5
59. [*] Volim raditi sa sustavom.	○	○	○	○	○
60. [*] Sustav čini svakodnevni rad/učenje mnogo zanimljivijim.	○	○	○	○	○
61. [*] Korištenje sustava je dobra ideja.	○	○	○	○	○

-----Iskoristivost-----

	1	2	3	4	5
62. [*] Smatram sustav korisnim pri učenju.	○	○	○	○	○
63. [*] Zadovoljan/zadovoljna sam sa stupnjem slobode za izražavanje osobnosti i vlastitih snaga.	○	○	○	○	○
64. [*] Zadovoljan/zadovoljna sam prezentacijskim mogućnostima ePortfolio sustava(brz upload, oblikovanje i prezentacija osobnih informacija).	○	○	○	○	○

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Odaberite JEDNU tvrdnju u skladu s uputama:

1 – potpuno netočno | 2 – uglavnom netočno | 3 – niti točno, niti netočno | 4 – uglavnom točno | 5 – potpuno točno

1 – ne slažem se | 2 – uglavnom se ne slažem | 3 – ne mogu se odlučiti, neopredijeljen(a) | 4 – uglavnom se slažem | 5 – potpuno se slažem

IZRAVNE KORISTI ZA POJEDINCA = (pozitivni) učinci od korištenja ePortfolio sustava u sklopu cjeloživotnog učenja

-----Poboljšano učenje-----

	1	2	3	4	5
65. [*] Eportfolio me potaknuo na razvijanje pozitivnog stava prema cjeloživotnom učenju.	○	○	○	○	○
66. [*] Eportfolio mi je pomogao u povezivanju formalnog(strukturirano učenje u školi i na fakultetu) i neformalnog(nestrukturirano učenje kroz svakodnevni život) učenja.	○	○	○	○	○
67. [*] Korištenje ePortfolija povećalo je transparentnost prilikom ocjenjivanja.	○	○	○	○	○
68. [*] Eportfolio pomaže u ostvarivanju ishoda učenja.	○	○	○	○	○
69. [*] Poboljšana komunikacija između mene i nastavnika povećava šanse za moj uspjeh.	○	○	○	○	○

-----Osobni rast i razvoj-----

	1	2	3	4	5
70. [*] U mogućnosti sam pokazati vlastiti rast i razvoj kroz određeno vremensko razdoblje.	○	○	○	○	○
71. [*] U mogućnosti sam odabrati suradnike među vršnjacima prema različitim kriterijima(interesima) opisanim u ePortfolio sustavu.	○	○	○	○	○
72. [*] U mogućnosti sam usporediti se s drugima.	○	○	○	○	○
73. [*] U mogućnosti sam ocijeniti napredak prema postizanju osobnih ciljeva.	○	○	○	○	○
74. [*] Sastavljanje kritičkih osvrta(reflection) omogućuje mi razvoj vještina za donošenje odluka.	○	○	○	○	○
75. [*] Potencijalni poslodavci mogu pregledati moj prezentacijski ePortfolio potkrijepljen uvidom u institucionalni kontekst, kriterije za procjenu znanja, te opise vlastitih postignuća.	○	○	○	○	○

Quit Survey - Do not save answers | << Previous Page | Next Page >>

FOI Survey System

Survey #48: Anketa o uspješnosti ePortfolio sustava - FOI

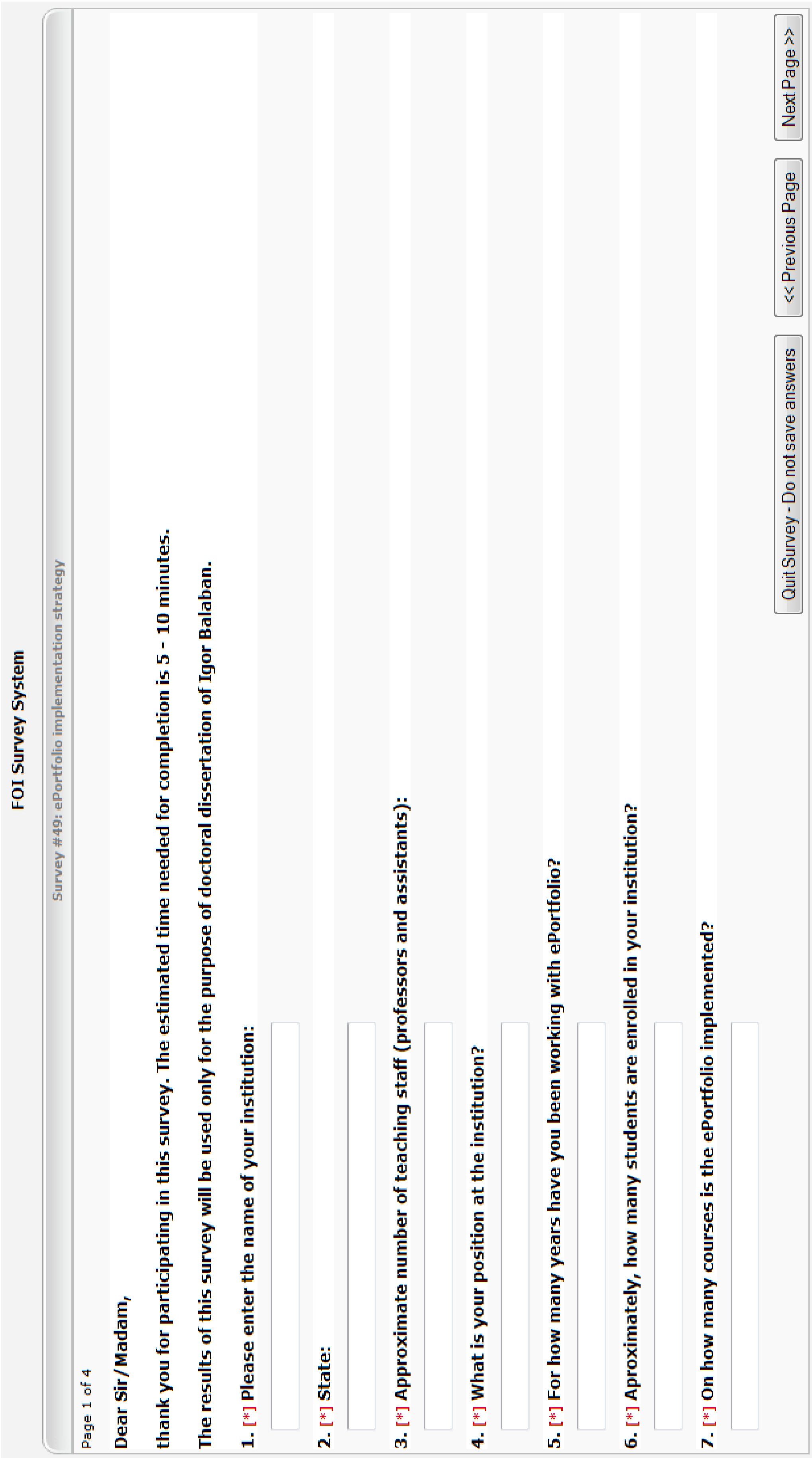
Page 8 of 8

Hvala što ste popunili ovaj upitnik.

Molimo kliknite na gumbić FINISH kako biste spremili rezultate!

Quit Survey - Do not save answers | << Previous Page | Finish

Appendix G: Screenshots of CSFs survey (Final version)



FOI Survey System

Survey #49: ePortfolio implementation strategy

Page 1 of 4

Dear Sir/Madam,

thank you for participating in this survey. The estimated time needed for completion is 5 - 10 minutes.

The results of this survey will be used only for the purpose of doctoral dissertation of Igor Balaban.

1. [*] Please enter the name of your institution:

2. [*] State:

3. [*] Approximate number of teaching staff (professors and assistants):

4. [*] What is your position at the institution?

5. [*] For how many years have you been working with ePortfolio?

6. [*] Aproximately, how many students are enrolled in your institution?

7. [*] On how many courses is the ePortfolio implemented?

Quit Survey - Do not save answers

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Next Page >>

FOI Survey System

Survey #49: ePortfolio implementation strategy

Page 2 of 4

8. [*] Please check the boxes that match your institution's ePortfolio strategy:

- [ ] Students and educators are encouraged to use ePortfolio (rewards for educators, extra scores for students within course).
- [ ] Faculty participants are not punished for negative feedback on student evaluations of teaching.
- [ ] All participants have equitable access to the ePortfolio services.
- [ ] Students complete Portfolios as requirements in courses.
- [ ] The student's work in the ePortfolio strongly contributes to define the student to faculty and recruiters.
- [ ] Faculty grade and provide feedback on students' work.
- [ ] The push for adoption and implementation of ePortfolios comes from faculty management, students and educators.
- [ ] A group of faculty members has the commitment and stamina to make the ePortfolio system implementation work.
- [ ] An implementation plan exist, with reasonable milestones that are measurable and that collectively lead to full implementation(adoption).
- [ ] Opportunities exist for student/faculty/mentor training (multiple times and places).
- [ ] Faculty commit to casting course assignments into a uniform format to adopt ePortfolio as an assessment tool.
- [ ] Financial and other material and techincal resources are commited to the implementation and evaluation of ePortfolio.
- [ ] The e-portfolio initiative is part of the strategic IT vision of the institution.
- [ ] The e-portfolio is approached as a process, not a product.
- [ ] Faculty teams periodically review and revise the content of the curriculum and are aware of the content of courses making up the entire program.
- [ ] The long-term adoption (assimilation) of the ePortfolio system is approached as an organizational change management initiative.
- [ ] There is a permanent e-portfolio adoption (post-implementation) group monitoring and looking for mutual technology-organization adaptation.

Quit Survey - Do not save answers | << Previous Page | Next Page >>

FOI Survey System

Survey #49: ePortfolio implementation strategy

Page 3 of 4

9. [*] Please check the button that best describes the ePortfolio maturity level at which your institution is currently at:

○ Level 1 ○ Level 2 ○ Level 3 ○ Level 4 ○ Level 5

Level 1:
Students develop portfolios on their own initiative. It is not mandatory to have a personal Portfolio and students are unaware of each other's activities. There is no template or official Portfolio system. Student work can be presented either on paper or on some electronic media (hard-drive, cd-rom, web...).

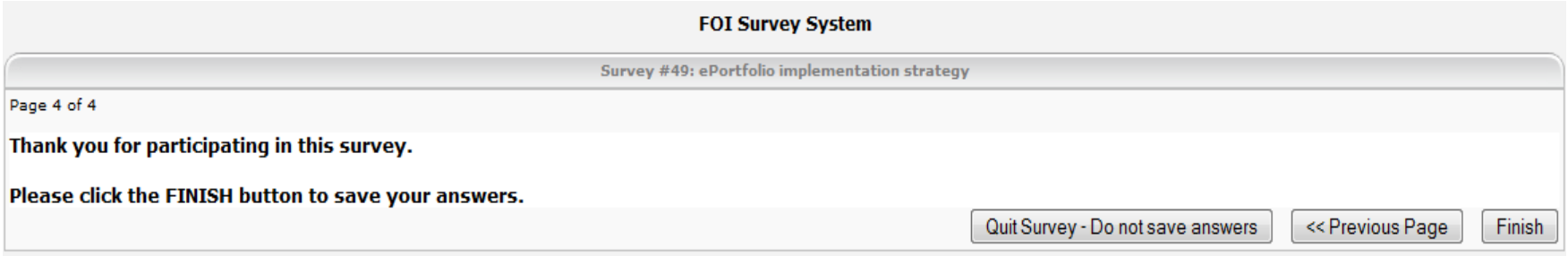
Level 2:
Institution identified a template which will help students to organize their work. Their work can be guided by educator, department or institution. No formal feedback from educator still exists, but students can see each other's work. Data can be on paper or electronic media.

Level 3:
From this level only the electronic version of Portfolio exist on the Web and it is called a Webfolio. In Webfolio students can nominate who can view which items in their Portfolios. Furthermore, it is possible to leave comments on someone's work. This level is enriched with input from educators, student and institution itself. Employers can also easily view student's Portfolio.

Level 4:
Portfolios allow students to receive feedback from mentors and educators. System is advanced so educator can "lock out" students from making further iterations on some work assignment. Portfolio is used by students and by educators as well. Educators are given the opportunity to copy course syllabi and assignments from one semester to the next. Employers can see student's assignments along with course syllabi, assessment criteria and many other things. The advanced usage of Portfolio can be clearly seen in this stage.

Level 5:
Portfolios are very structured and organized according to institution standards. Students and educators have the finest possibilities for managing their Portfolio. Portfolio is of the highest value for students, educators, institution and employers. Student work along with feedbacks, summative and formative assessments, syllabi, links to standards, goals and other taxonomies. At this stage, Portfolio can be used to assist with program assessment and revision.

Quit Survey - Do not save answers | << Previous Page | Next Page >>


FOI Survey System
Survey #49: ePortfolio implementation strategy
Page 4 of 4
Thank you for participating in this survey.
Please click the FINISH button to save your answers.
Quit Survey - Do not save answers
<< Previous Page
Finish

Appendix H: Invitation letter to Institution Representative

Dear (the name of Institution Representative the mail was addressed to),

My name is Igor Balaban and I am working as a novice researcher (PhD student) at the University of Zagreb, Croatia. Currently I am in the final stage of my PhD research that deals with an ePortfolio Success Model. My research supervisors are Dr. Enrique Mu, Carlow faculty member, and Dr. Blazenka Divjak from the University of Zagreb, Croatia.

The aim of my research is to develop an instrument that will assess the ePortfolio success at the individual level. Moreover, the instrument results will serve as a basis for building an ePortfolio Success Model.

For that purpose I have developed two different questionnaires. The first of them should be filled by an institution representative (such as the dean, director or university/faculty board member) who is familiar with ePortfolio implementation. The second survey should be filled by students that have used ePortfolio in two or more courses. Since only two institutions in Croatia are using ePortfolio (one of which is mine) I need respondents from other institutions outside Croatia in order to finish my work. Therefore I kindly ask you for help in filling the surveys.

I will summarize the tasks as follows:

There are two surveys:

The first one should be filled by students who worked with ePortfolio in at least two or more courses. The estimated time for completion is 15-20 minutes.

Link: http://tinyurl.com/ePortfolio-eng

The second one should be filled by an institution representative (e.g. an institution representative or educator who has knowledge about ePortfolio implementation at the institution). The time needed for completion is about 5 minutes at the most. This survey is very short.

Link: http://tinyurl.com/ePortfolioCSF

Both surveys are available online, so there will be no need for students to do it in class. They could work from home if necessary. The data will be used only for my research and surveys are anonymous. The data about the institution will not be revealed in any way. If you are interested, I can provide you with a report on your institution's score after I analyze the data.

I sincerely hope you will find some time to help me with my research.

Thank you very much in advance.

Sincerely,

Igor Balaban

igor.balaban@foi.hr

University of Zagreb, Croatia

Appendix I: Invitation letter to students

Dear students,

My name is Igor Balaban and I am working as a novice researcher (PhD student) at the University of Zagreb, Croatia. Currently I am in the final stage of my PhD research that deals with an ePortfolio Success Model. My research supervisors are Dr. Enrique Mu, Carlow faculty member, and Dr. Blazenka Divjak from the University of Zagreb, Croatia. The aim of my research is to develop an instrument that will assess ePortfolio success at the individual level. Moreover, the instrument results will serve as a basis for building an ePortfolio Success Model.

For this study to have a broad validity it is fundamental that students from all over the world participate. Therefore I kindly ask you for help with collecting the data by filling the survey since you have experience with ePortfolio.

Your task would be to fill the survey available at

http://tinyurl.com/ePortfolio-eng

The estimated time for completion is about 20 minutes. The data will be used only for my research and surveys are anonymous. If you decide not to take the survey after you've seen the questions, just click "Quit survey". Otherwise, please save your answers by clicking the "Finish" button on the last page of the survey. If you are interested in the results, I can share those with you upon your request.

I would like to stress that you are not required to participate and if you decide not to participate, your decision will not affect your current or future relations with the University staff or teachers. In addition, please be informed that this activity has been approved by the University.

Thank you for your valuable contribution to this research.

Sincerely,

Igor Balaban

igor.balaban@foi.hr

University of Zagreb, Croatia

Appendix J: List of institutions that participated in CSFs survey

	Institution name	Country	Number of students that participated in the ePortfolio success survey**
1.	Bucks New University	UK	5
2.	Carlow University	USA	19
3.	Clemson University	USA	0
4.	Curtin University	Australia	0
5.	Duke University	USA	0
6.	Faculty of Organization and Informatics	Croatia	81
7.	George Mason University	USA	0
8.	London Metropolitan University	UK	0
9.	Music Academy in Zagreb	Croatia	20
10.	Northern Illinois University	USA	0
11.	Northumbria University	UK	0
12.	Roger Williams University	UK	0
13.	Siberian Federal University	Russia	19
14.	Universidad a Distancia de Madrid	Spain	11
15.	University in Maribor	Slovenia	11
16.	University of Alcala	Spain	0
17.	University of Bedfordshire	UK	0
18.	University of Cincinnati	USA	0
19.	University of Denver	USA	0
20.	University of Wolverhampton	UK	0
21.	Virginia Tech	USA	0
	Total*		**146** (+ 40 anonymous)

* 7 Universities wanted to stay anonymous (4 from USA,2 from UK and 1 from Slovenia). In total 40 students from some of the listed Universities participated in the ePortfolio success survey

** Only the number of usable responses is shown in the column

Appendix K: Results from the bootstrap procedure for CFA

Bootstrapping procedure was carried out with 150 cases and 500 samples. The table below presents outer loadings for each item in respect to its prospective construct.

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	Standard Error (STERR)	T Statistics (|O/STERR|)
IQ1 <- INFORMATION QUALITY	**0.577083**	0.567142	0.087298	0.087298	6.610520
IQ2 <- INFORMATION QUALITY	0.690219	0.687259	0.065985	0.065985	10.460231
IQ3 <- INFORMATION QUALITY	0.701764	0.704333	0.067831	0.067831	10.345815
IQ4 <- INFORMATION QUALITY	**0.446134**	0.442164	0.115157	0.115157	3.874151
IQ5 <- INFORMATION QUALITY	0.678486	0.671362	0.075095	0.075095	9.034974
IQ6 <- INFORMATION QUALITY	0.751940	0.746413	0.055661	0.055661	13.509302
IQ7 <- INFORMATION QUALITY	0.808771	0.807186	0.038435	0.038435	21.042705
IQ8 <- INFORMATION QUALITY	0.671238	0.660374	0.071415	0.071415	9.399169
IQ9 <- INFORMATION QUALITY	0.680846	0.679754	0.050028	0.050028	13.609253
NB1 <- NET BENEFITS	0.759218	0.755732	0.044165	0.044165	17.190554
NB10 <- NET BENEFITS	0.787915	0.784259	0.039486	0.039486	19.954106
NB11 <- NET BENEFITS	0.674504	0.667339	0.082335	0.082335	8.192197
NB2 <- NET BENEFITS	0.746051	0.748120	0.047560	0.047560	15.686498
NB3 <- NET BENEFITS	0.696590	0.693236	0.052443	0.052443	13.282712
NB4 <- NET BENEFITS	0.742822	0.738447	0.043608	0.043608	17.034227
NB5 <- NET BENEFITS	0.752747	0.745853	0.049252	0.049252	15.283478
NB6 <- NET BENEFITS	0.766011	0.762212	0.045541	0.045541	16.820353
NB7 <- NET BENEFITS	0.744107	0.738751	0.049767	0.049767	14.951883
NB8 <- NET BENEFITS	0.664441	0.659461	0.069129	0.069129	9.611577

NB9 <- NET BENEFITS	0.739294	0.731123	0.059040	0.059040	12.521949
SERQ1 <- SERVICE QUALITY	0.740163	0.733070	0.046001	0.046001	16.089985
SERQ2 <- SERVICE QUALITY	0.716132	0.705860	0.056622	0.056622	12.647529
SERQ3 <- SERVICE QUALITY	0.708389	0.703640	0.052916	0.052916	13.386969
SERQ4 <- SERVICE QUALITY	0.803482	0.802206	0.036173	0.036173	22.212042
SERQ5 <- SERVICE QUALITY	0.785144	0.781845	0.036643	0.036643	21.426900
SERQ6 <- SERVICE QUALITY	0.792601	0.788403	0.039577	0.039577	20.026829
SERQ7 <- SERVICE QUALITY	0.781353	0.773626	0.045055	0.045055	17.342221
SERQ8 <- SERVICE QUALITY	**0.605710**	0.598939	0.063309	0.063309	9.567575
SERQ9 <- SERVICE QUALITY	0.723628	0.717497	0.049226	0.049226	14.700248
SYSQ1 <- SYSTEM QUALITY	0.716786	0.708768	0.055394	0.055394	12.939855
SYSQ10 <- SYSTEM QUALITY	0.712839	0.694971	0.061025	0.061025	11.681155
SYSQ11 <- SYSTEM QUALITY	**0.572681**	0.568633	0.091921	0.091921	6.230125
SYSQ12 <- SYSTEM QUALITY	**0.568821**	0.566337	0.077844	0.077844	7.307232
SYSQ13 <- SYSTEM QUALITY	0.529772	0.532575	0.094734	0.094734	5.592209
SYSQ14 <- SYSTEM QUALITY	**0.549721**	0.543968	0.089597	0.089597	6.135478
SYSQ15 <- SYSTEM QUALITY	**0.552829**	0.554055	0.080591	0.080591	6.859703
SYSQ16 <- SYSTEM QUALITY	**0.379806**	0.384278	0.103952	0.103952	3.653677
SYSQ17 <- SYSTEM QUALITY	**0.495889**	0.499175	0.097348	0.097348	5.093964
SYSQ18 <- SYSTEM QUALITY	0.566902	0.566320	0.093447	0.093447	6.066563
SYSQ19 <- SYSTEM QUALITY	**0.499517**	0.499824	0.097901	0.097901	5.102258
SYSQ2 <- SYSTEM QUALITY	0.620707	0.612443	0.060774	0.060774	10.213326
SYSQ3 <- SYSTEM QUALITY	0.612729	0.606032	0.081358	0.081358	7.531305
SYSQ4 <- SYSTEM QUALITY	0.683700	0.682749	0.051628	0.051628	13.242824
SYSQ5 <- SYSTEM QUALITY	0.631699	0.628534	0.057982	0.057982	10.894671
SYSQ6 <- SYSTEM QUALITY	0.796558	0.792308	0.034187	0.034187	23.299988

SYSQ7 <- SYSTEM QUALITY	0.624702	0.614946	0.064106	0.064106	9.744774
SYSQ8 <- SYSTEM QUALITY	0.653261	0.643466	0.060058	0.060058	10.877124
SYSQ9 <- SYSTEM QUALITY	**0.579944**	0.568864	0.087142	0.087142	6.655181
U1 <- USE	0.694487	0.689934	0.063349	0.063349	10.962861
U2 <- USE	0.634499	0.625312	0.069636	0.069636	9.111663
U3 <- USE	**0.501862**	0.494343	0.089313	0.089313	5.619110
U4 <- USE	0.759175	0.757254	0.041859	0.041859	18.136574
U5 <- USE	0.710591	0.708228	0.057019	0.057019	12.462388
U6 <- USE	0.666156	0.659052	0.064351	0.064351	10.351858
U7 <- USE	0.643135	0.635399	0.074814	0.074814	8.596502
U8 <- USE	**0.513575**	0.497932	0.114571	0.114571	4.482607
US1 <- USER SATISFACTION	0.841420	0.838839	0.031405	0.031405	26.792764
US2 <- USER SATISFACTION	0.786633	0.783212	0.040944	0.040944	19.212328
US3 <- USER SATISFACTION	0.865372	0.862945	0.028245	0.028245	30.638512
US4 <- USER SATISFACTION	0.800268	0.797630	0.038943	0.038943	20.549758
US5 <- USER SATISFACTION	0.823774	0.821575	0.029487	0.029487	27.936847
US6 <- USER SATISFACTION	0.737640	0.730845	0.051034	0.051034	14.453929

* Bolded values refer to items that should be dropped from further analysis due to loadings below 0.6 cut-off value

Appendix L: Structural model testing – bootstrap results

First structural model

Paths	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	Standard Error (STERR)	T Statistics (|O/STERR|)
Information Quality -> Net Benefits	0.233316	0.240911	0.069083	0.069083	3.377308
Information Quality -> Use	-0.047537	-0.031063	0.091175	0.091175	0.521386
Information Quality -> User Satisfaction	0.13097	0.147731	0.085481	0.085481	1.532161
Service Quality -> Use	0.220163	0.206777	0.103562	0.103562	2.125896
Service Quality -> User Satisfaction	0.464924	0.455525	0.087347	0.087347	5.322705
System Quality -> Use	0.553212	0.556648	0.08091	0.08091	6.837401
System Quality -> User Satisfaction	0.035509	0.044511	0.086785	0.086785	0.409162
Use -> Net Benefits	0.143486	0.140507	0.072308	0.072308	1.984383
Use -> User Satisfaction	0.208683	0.201886	0.082406	0.082406	2.532373
User Satisfaction -> Net Benefits	0.600603	0.592397	0.076565	0.076565	7.844392

Second structural model

Paths	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	Standard Error (STERR)	T Statistics (|O/STERR|)
Information Quality -> Net Benefits	0.62812	0.627812	0.067882	0.067882	9.253095
Information Quality -> Use	-0.073722	-0.066862	0.089709	0.089709	0.821789
Information Quality -> User Satisfaction	-0.04831	-0.04825	0.073321	0.073321	0.658876
Net Benefits -> User Satisfaction	0.636191	0.639609	0.081618	0.081618	7.794715
Service Quality -> Use	0.10864	0.117688	0.097216	0.097216	1.117512
Service Quality -> User Satisfaction	0.252642	0.253811	0.086496	0.086496	2.920851
System Quality -> Use	0.522514	0.519017	0.07958	0.07958	6.565913
System Quality -> User Satisfaction	0.055098	0.052516	0.074824	0.074824	0.736367
User Satisfaction -> Use	0.220487	0.211868	0.084097	0.084097	2.621827

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Doktorska disertacija

Razvoj Modela uspješnosti ePortfolio sustava

I. Balaban

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Elektronički Portfolio ili ePortfolio predstavlja proširenje e-učenja, te se vrlo snažno popularizira u posljednjih nekoliko godina. Kako je područje još uvijek vrlo neistraženo, ne postoji model koji opisuje mogućnosti uspješne implementacije ePortfolio sustava koji bi obuhvaćao pojedinca (studenta, nastavnika), akademsku instituciju, te poslodavca (industrije). Dosadašnja istraživanja upućuju na važnost ePortfolio sustava, te sugeriraju izgradnju cjelovitog modela koji će obuhvaćati i pedagoški i ICT potencijal ePortfolio sustava.

U ovoj doktorskoj disertaciji razvit će se instrument za vrednovanje uspješnosti ePortfolija korištenjem DeLone i McLean poboljšanog modela uspješnosti informacijskog sustava (u daljnjem tekstu: D&M model) kao okvira za procjenu. Na temelju rezultata razvijenog instrumenta i spomenutog D&M modela predložit će se cjeloviti model uspješnosti ePortfolio sustava.

Rad nije objavljen.

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Cjeloživotno učenje
DeLone&Mclean model
Eportfolio
Instrument
Model
PLS
SEM
Uspješnost informacijskog sustava

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Doctoral Dissertation

Development of an ePortfolio System Success Model: An Information System approach

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Electronic Portfolio constitutes an extension to e-learning and has therefore been very strongly popularized in the last few years. Since the field of ePortfolio is still unexplored, there is not a model to describe the successful implementation of an ePortfolio taking into account the individual (student, educator), academic institution, and industry (employer) level. However, research conducted so far refer to the importance of ePortfolio system and suggest the need to develop an integral model which will comprehend both the pedagogical and ICT potential of an ePortfolio system.

In this doctoral dissertation, an instrument to evaluate ePortfolio success, using the DeLone&McLean updated IS success model as the assessment framework, will be developed. Based on the results of instrument developed and D&M model, an integral model of ePortfolio success will be proposed.

The thesis was not published.

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Information system success
DeLone&Mclean model
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Lifelong learning
Model
PLS
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2000.-2004.	Demonstrator na Fakultetu organizacije i informatike Varaždin, kolegij "Matematika"
2004.-2005.	Član projektnog tima "E!2963 EuroLearn IT Center - Learning Management System For E-Learning", voditelj prof. dr. sc. Željko Hutinski
2004.-2006.	Član projektnog tima "Razvoj metoda upravljanja sigurnošću informacijskih sustava", voditelj: prof. dr. sc. Željko Hutinski
2007.-2009.	Član ICT Skills i ICT Support modula u sklopu Tempus InterProject "Enhancing Absoption Capacity of EU Programmes in Croatia", koordinator: Blaženka Divjak
2008.	E-mentor u sklopu FP6 STREP projekta "iCamp - Innovative, Inclusive, Interactive & Intercultural Learning Campus", Trials 3, nositelj Barbara Kieslinger
2009.-2010.	Član projektnog tima znanstveno-tehnološke suradnje sa Slovenijom "Evaluacija kvalitete i upotrebljivosti online tečajeva i Web 2.0 alata u e-učenju", voditelj u Hrvatskoj prof. dr. sc. Goran Bubaš
2009.-2011.	Član projektnog tima "Portal za testiranje i promociju edukacije pomoću Web 2.0 alata", glavni istraživač prof. dr. sc. Goran Bubaš

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