EPortfolio as an Information System: The Genetic Taxonomy Approach

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Abstract. *In order to describe and explain the ePortfolio once it is developed and implemented only descriptive methods have been used so far. Considering the importance of the ePortfolio today, it is necessary to understand and demonstrate the reasons for its existence as well as its development, source and origin. For that purpose a genetic taxonomy introduced as an IS taxonomy in 1997 is used in this paper. In addition, the ePortfolio is defined in terms of the Genetic Taxonomy Space (GTS) that enables direct comparison with other types of Information Systems.*

Keywords. Information System, ePortfolio, Genetic taxonomy

1 Introduction

Electronic Portfolios constitute an extension to e-learning and have therefore been very strongly popularized over the last few years. Their similarity with the general purpose of the Information System (IS) can be noted if the ePortfolio is considered as a platform supporting real-life processes that are primarily related to learning, i.e. those referred to as LifeLong Learning (LLL) processes. Therefore, owing to its characteristics, it can be assumed that an ePortfolio is an IS. In this paper the genetic taxonomy approach is used to demonstrate that an ePortfolio can indeed be interpreted as an IS.

2 EPortfolio related research

Since the ePortfolio is primarily related to learning and was developed to support the learning process, there are numerous definitions of student learning portfolios by educators. However, in this research the ePortfolio is approached in a general sense and is therefore 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) presents a user-centered learning environment throughout a person's life. It thus encompasses all the three learning modes: formal, non-formal and informal learning. The term artefact stands for a representative collection of an individual's work which best shows their skills, competencies, achievements and talents. 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.

Several examples that indicate the relationship between an ePortfolio and an IS can be found in literature ([23], [34], [32]). In his description of the ePortfolio, Jafari approached its development using the IS framework [20]. Mu et al. attempted to conceptualize the functional requirements for ePortfolio systems referring to the ePortfolio as an IS which consists of people and technology operating within an organizational context [32]. Although the ePortfolio is frequently considered merely as an IT tool, the very concept of the ePortfolio actually comprises much more than that. As with any other IS, when it comes to ePortfolios, it is not sufficient to simply embrace the technology; it has to be adopted and used by people supporting all the required business processes in a proper way. Furthermore, an ePortfolio is a set of interrelated or "meshed" components and functionalities, which also applies to an IS. Therefore, ePortfolio applications should be put

in a wider context. Such an approach was taken in the research by Mu et al. [32] in order to understand ePortfolio functionalities and their prioritization criteria. Drawing on the literature about IS adoption and assimilation, they also discussed the challenges associated with the adoption of ePortfolios. In a survey conducted in the UK [34] it was argued that ePortfolios should support LLL. In that survey a significant discrepancy between ePortfolio applications and the requirements of a LLL environment as an organizational system to be supported with an ePortfolio was also reported. From the above-mentioned research it can be concluded that the ePortfolio has been interpreted as an electronic system that supports LLL.

The examples in this section justify the attempt to view the ePortfolio as an IS and suggest that it should be treated as such during its deployment, while paying particular attention to its organizational context.

3 Information System approach to ePortfolio

The aim of this paper is to prove that the ePortfolio is an IS. For this purpose two different approaches are used:

1. ***Descriptive method*** describes a phenomenon as such and is opposed to the genetic method. Moreover, Johnson [25] argues that the descriptive method is in contrast with exemplifying the causes of a phenomenon or ascertaining its value or significance. Since such an 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*** provides a rationale for the existence of an IS, its development, source and origin [12], [13]. It is derived from a philosophical approach named the "genetic method" (see [24], [39]) that tries to analyze and understand a phenomenon in terms of its genesis or origin. In case of an IS, it explains why a particular IS exists and how it operates to support business system processes[1].

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[1] According to [1] and [13], 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 performing of which some resources and time are necessary. Different participants perform the same activities differently due to differences in their skills and knowledge.

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 does therefore not need to be as exhaustive as the genetic one. In this paper more attention is given to the genetic taxonomy bearing in mind its complexity and the potential of using it in the IS design.

3.1 Descriptive methods

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

Considering the common attributes (3) of IS and ePortfolio presented in Table 1, 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 the ePortfolio as an 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, an ePortfolio is equivalent to an IS.

• Providing support to data and having ICT features is not enough to characterize an entity as an IS. An ePortfolio fulfils its purpose the moment an individual interacts with others by giving and receiving feedback in different forms. In other words, an ePortfolio fulfils its purpose when it is used within a community. Therefore, another important aspect of the ePortfolio are people and organizations that use

Table 1. Comparison of Information System and ePortfolio definitions

(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. [26]	A personal digital collection of information describing and illustrating a person's learning, career, experience and achievements. [17]	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. [1]	A meaningful collection of student work that demonstrates progress and/or mastery guided by standards and includes evidence of student self-reflection. [33]	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. [33]	An electronic learning record which enables an individual to store, organize and present their work and accomplishments. [8]	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.

it (either as users or/and as the audience). Those are also the most important elements of almost every IS. By recognizing those elements in the ePortfolio context, we can conclude that the ePortfolio is equivalent to an IS in terms of people, community and organization involvement.

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

3.2 Genetic taxonomy method

Every organizational system has a corresponding Information (Sub)System, without which it could not perform its functions properly. Interdependence of the two systems is shown in

Figure 1. Organizational system and its information subsystem (cf. [13]). Each organizational system involves people, business processes and certain resources to achieve some specific goals (for examples, see [1], [26], [28]). 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.

[33], [35], [36], [37], [38], etc.) as well as on personal experience ([2], [3], [4], [5], [6]) where numerous examples of ePortfolio usage can be
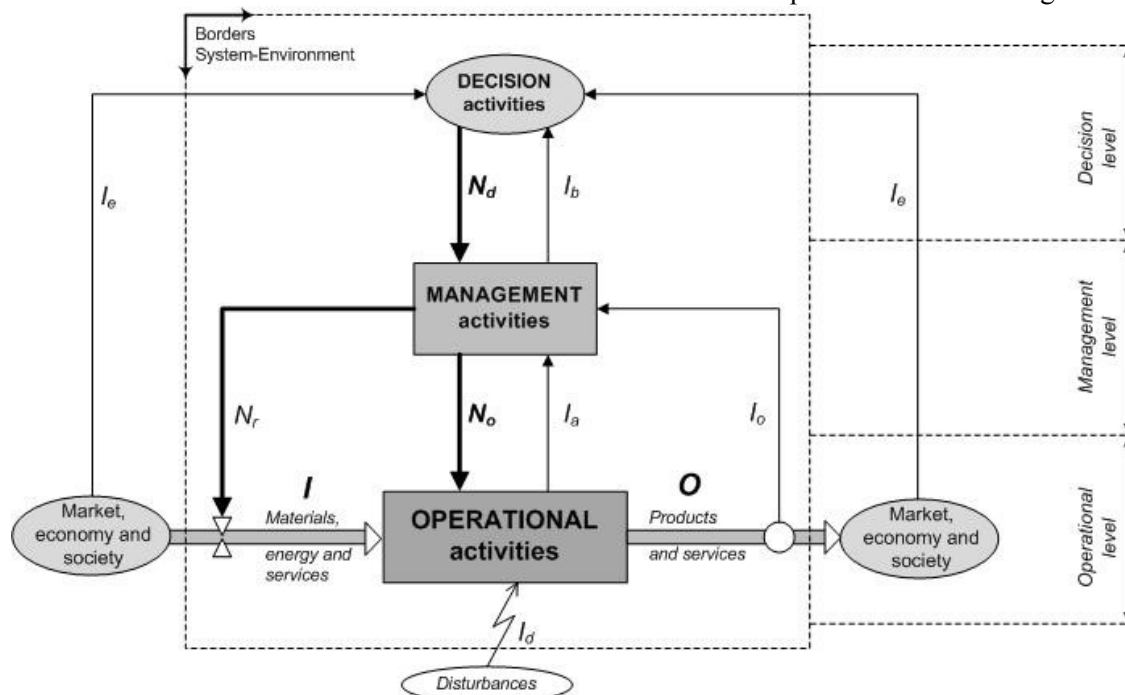

Figure 1. Organizational system and its information subsystem (cf. [13])

Many authors, like [1], [26], [28] and others, argue that an IS is not formless, but has a recognizable internal structure that is mostly hierarchical and enables optimal performance of its activities. Therefore each part of this complex system carries out a single set of activities, although their interaction is coordinated.

According to the relationships shown in Figure 1, 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 [1], [12], [13], [26], [27] and [29]): Operational Information Subsystem (OIS), Management Information Subsystem (MIS), and Decision-Making Information Subsystem (DIS).

In this paper the approach shown in Figure 1 is applied to the ePortfolio as an IS and to the user-centered LLL environment as an organizational system. It must be noted that the IS structure is shown in the centre of Figure 1, with activities that support the processes carried out at different organizational levels shown on the right. All the arrows represent information flows.

Based on an extensive ePortfolio literature overview ([7], [8], [9], [10], [11], [14], [15], [16], [18], [19], [20], [21], [22], [23], [30], [31],

found, an explanation is provided independently for each level in accordance with the original model shown in Figure 1:

At the **operational level** all the basic processes of an organizational system are carried out. These 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 an 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 an ePortfolio it includes

managing learning activities, Personal Learning Environment, ePortfolio artefacts and views, etc. To successfully manage the activities, information about activities at the operational level (I_a), information about outgoing effects of the system (I_o), and information about disturbances (I_d) is needed. In case of an ePortfolio, these three categories of information are represented as follows:

- I_a = created artefacts and views in the ePortfolio

- I_o = feedback from the audience delivered in multiple ways (inside the ePortfolio, by e-mail, verbally etc.)

- 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 (I_d) should be defined in the general sense as any disturbances coming from the environment, not necessarily negative ones. Moreover, in case of the 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 (N_d), orders about carrying out transformation processes (N_o) and input resources usage (N_r) are set at the management level. In the ePortfolio context, orders about carrying out transformation processes (N_o) include the ways of constructing the view and designing and formatting artefacts. Using input resources (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 (N_d) that represent instructions for management activities. In case of an ePortfolio, one's own mission and vision are set or re-examined. At this level individuals plan and develop their own career. Information about the influence of the environment (I_e) and information on business status (I_b) obtained from the management level is needed in order to carry out decision activities. In the ePortfolio context, these terms can be explained as follows:

- N_d = decisions about view templates for different uses, such as job finding or further education; view and artefact tagging strategy,

decisions about Personal Development Planning (PDP) activities

- I_b = usability, view completeness, tagging usefulness

- 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.

3.3 Genetic Taxonomy Space (GTS)

Since all Information Systems 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 2 comprises three different levels described as the taxonomy criteria. The criteria shown in such a way constitute a "Genetic Taxonomy Space" (GTS) allowing 27 partial subspaces to be identified. Each of them corresponds to one group (type) of an IS. The authors indicated that basic characteristics of the GTS are "its openness and applicability in IS strategic planning" [12], [13].

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

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

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

o 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)**

and

Figure 2. EPortfolio in Genetic Taxonomy Cube
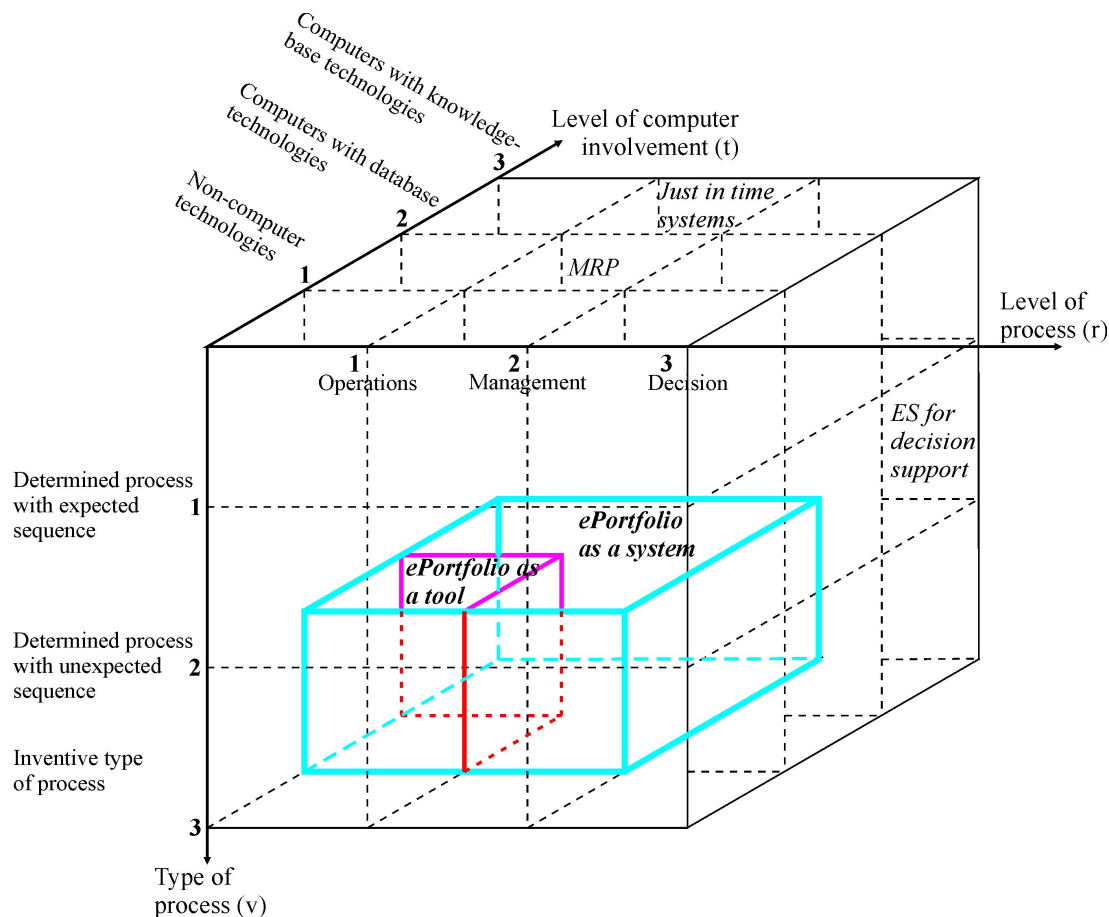
o   If an ePortfolio as a system is used as a pedagogical tool, the teacher uses it to partially manage teaching but it can also be used by the learner to manage one's learning. An ePortfolio as a system enables managing teaching and learning by using artefacts and feedbacks received from others as well as inputs from the environment. Therefore parameter 2 can be designated to the ePortfolio as a system. On the other hand, an ePortfolio as an IT tool provides

development and to manage teaching and learning. As a result, an IT tool becomes an instrument merely used for achieving higher goals. In that sense, parameter 3 is designated to the 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 $R_{v,r,t}=[3,2,3]$ for the ePortfolio as a system and $R_{v,r,t}=[3,1,2]$ for the ePortfolio as an

support only at the operations level while management activities are not directly supported. Therefore parameter 1 is designated to the ePortfolio as an IT tool.

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

An 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 the ePortfolio. On the other hand, an ePortfolio as a system uses an 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

IT tool. It has to be noted that when the Genetic Taxonomy Space is concerned the ePortfolio as a system takes up four times more space than the ePortfolio as a tool (see Fig. 2). This means that ePortfolio as a tool is entirely contained within the ePortfolio as a system.

To summarize, considering the results of the genetic approach to the ePortfolio it can be concluded that the ePortfolio can be explained and interpreted as an IS. Moreover, using this approach enables a new insight into the ePortfolio concept. We showed that conceiving of an ePortfolio as an IT tool and restricting its usage to such interpretation implies that all ePortfolio functionalities are not entirely used. In other words, the ePortfolio as an IT tool captures

only certain aspects of the ePortfolio as a system, which results in a significant misinterpretation of this phenomenon. Namely, by viewing the 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.

4   Conclusion

In this paper, departing from two contrary methods, the ePortfolio was approached as an IS. Both of them yielded the same result in proving that the ePortfolio can be conceived as an 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 the ePortfolio was considered as an IS that provides support to the organizational system.

Consequently, a new definition of the ePortfolio was proposed with respect to the genetic taxonomy. An 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, in the paper a distinction between the ePortfolio as an IT tool and the ePortfolio as a system was made. It was noted that the ePortfolio as an IT tool presents a subsystem of an ePortfolio as an IS. With respect to the GTS the smaller cube representing the 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 the ePortfolio only as an IT tool. Consequently, its possibilities, use and importance in LLL are often misinterpreted. The findings presented in this paper are intended to clarify the difference between the two terms so

as to enable future users and researchers to approach and comprehend the ePortfolio as a system rather than merely an IT tool.

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