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Developing IS Leaders through Integrated Teaching Processes

Design and Engineering of a Product-Service System

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Developing IS Leaders through Integrated Teaching Processes: Design and Engineering of a Product-Service System

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In today's world, no company can survive without innovation and nearly all modern forms of innovation relay on IT in some way. It is the task of IS professionals, to cope with these trends and enable innovation. New teaching approaches are said to be required in order to empower IS professionals to become leaders in their business. The purpose of this paper is show how integrated teaching processes for developing IS leaders can do so. A combination of a Design Science Research (DSR) approach and a Product-Service Systems (PSS) Engineering Method is used to develop and evaluate this teaching approach. We present the product model, process models for the approach and a prototype that supports the processes as well as we explain the concept of integrated modules. The approach is evaluated by application in reality. Results show the usefulness of both, the applied methodology and the approach itself for research and practice.

1 Introduction

After years of oversupply, IS (Information Systems) professionals such as Chief Information Officers (CIOs), IS project staff, or external consultants, are rare (Carter et al. 2011, p. 27). A so-called "war for talent" can be observed, which only can be overcome by suitable (on-the-job) training and further education (Peppard 2010; Boehm et al. 2011b). This is rather difficult because the importance of technical, personal, administrative and conceptual skills varies from step to step on the career ladder (Luftman 2004, p. 110). However, often IT training programs are targeted at starters and pure technical skills whilst neglecting skills required for leadership positions with their lifelong learning requirement (Smid 2001).

As companies often cannot manage training programs on their own, universities complement the internal education offerings to foster the dialogue between research and practice (Elliot 2011) by offering open or customized programs, especially for on-the-job training of IS professionals (Boehm et al. 2011b). This is a win-win-situation for both sides: While universities get in close contact with practitioners, participants of the programs get an optimal partner for questions concerning further education. However, often the design of teaching processes is difficult as service modeling – and teaching can be seen as the provision of a service (Shostack 1977) – is often a complex task (Weber et al. 2004).

Services are defined as a change of the state of the service receiver by a service provider with the help of a contract (Hara et al. 2009). Intangibility, heterogeneity, perishability, and simultaneity are the best characterizations for services (Fitzsimmons and Fitz-

simmons 1994). Services always have to be seen in conjunction with products because both are existing together (Shostack 1977). The joint development of products and services is also called Product-Service Systems Engineering (PSSE) (Weber et al. 2004).

The question of how to transfer process thinking to new areas has been asked for some time now within the field of business process management (BPM) (vom Brocke et al. 2011, 403). In the following, we combine PSSE and the Design Science Research (DSR) paradigm (Hevner et al. 2004) to design teaching processes. We strive to integrate coaching and personal development aspects with the flow perspective of processes to cross the borders of classic BPM. Therefore, we answer our research question: *How to design integrated teaching processes for developing IS leaders?*

For doing so, the paper is structured as follows: In the second section background information on process-oriented management of teaching and developing IS leaders is given. In section three, our applied methodology is explained – including reasoning for combining PSSE and DSR. Section four presents the results of the paper. After this, we evaluate our artifacts. Finally, a conclusion and an outlook are given.

2 Background

2.1 Process-oriented Management of Teaching

The roots of modern business process management (BPM) date back to the 1980s and early 1990s. Hammer (1990) discussed for the first time business process reengineering (BPR) and Davenport (1993) presented his concept of integrating BPR with total quality management (TQM). Today, BPM can be seen from either a pure IT perspective or be understood as a holistic management practice (vom Brocke et al. 2011). The essential BPM cycle starts with the creation of formal processes and then ensures an on-going management and refinement of these processes (Hammer 2010). Moreover, literature has discussed different aspects of BPM, for example related to maturity models (Pöppelbuß and Röglinger 2011), the support of business processes by software services (Kohlborn et al. 2009), sustainability (Stolze et al. 2012), and process monitoring (Janiesch et al. 2012). Within this article we follow a broad understanding of BPM as a way of thinking, shaping, designing, and managing organisations through their activity chains (processes). This inclusive understanding also allows subsuming more aspects into BPM.

An example for a management framework in the field of teaching IS professionals is depicted in Figure 1. It is based on an iterative assessment of 116 existing training programs together with expert interviews of researchers and practitioners (Boehm et al. 2011b). The authors identified core modules which can be grouped into methodology courses and personal skills modules. The first methodology module, Management in the Information Age (MIA), integrates aspects like internet economics, management basics as well as methods and approaches. In the field of IS Fundamentals (ISF), the basics of IS/IT, enterprise software, business intelligence, and operations research are covered. Enterprise Architecture Management (EAM) discusses all aspects of IT- and business-alignment and IT service management. Process-oriented approaches and methods belong to the field of Business Process Management (BPM). The IT Consulting (ITC) module focuses on knowledge and methods related to business and IT advice. Within the field of Managing Security, Compliance and Risk (MSCR) subjects like IT security, legislation, contracts, and risk management are discussed. Sustainability and Ethics (SE) deal with green IT, management ethics, and social aspects of information management as well as intercultural

studies. Finally, the personal skill modules cover aspects on Interpersonal skills, Leadership and conflict management as well as Project management.

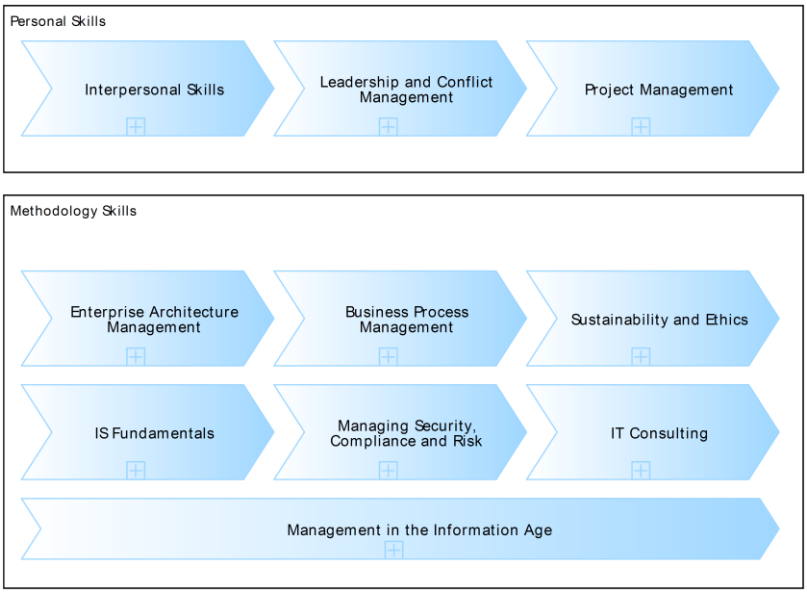

Figure 1. Framework for Teaching IS professionals (Boehm et al. 2011b)

2.2 Developing IS Leaders

CIOs, IS project and line staff, or IT consultants are IS professionals who work at the IT function within enterprises and ensure ongoing business processes (Luftman 2004). The head of this organizational unit responsible for IT is the CIO (Joia 2010). Her/his role of often defined in various ways and her/his power varies from company to company (Peppard 2010; Gerow et al. 2012). This is not optimal because CIOs should be able to get a deep understanding of their organizations in order to unfold their complete impact and work successfully (Carter et al. 2011). Many companies also often think that the role of the CIO is all about technology and therefore the focus is set on technical skills when hiring a new CIO (Peppard 2010). In fact, studies have shown that CIOs with strong political skills significantly can improve their influence on IT initiatives, for example (Gerow et al. 2012). One can say that a mixture of different skills is required in order to successfully work as a CIO (Boehm et al. 2013). A similar argumentation can be done for other IS professionals.

IS leadership development requires to cope with new trends and technologies. Every year, several institutions try to identify current technological trends that are covered in research or practice (Gartner Inc. 2011; Hopkins 2011; Luftman and Derksen 2012). According to Gartner Inc., media tablets in combination with bring your own device (BYOD) strategies, next-generation analytics and big data in terms of business intelligence as well as cloud computing are among top 10 strategic technologies (Gartner Inc. 2011). Forrester Research investigated this field by asking 208 IT executives which technologies are most important for their business. According to that study, business intelligence, mobile apps, and business process management are seen as most valuable technologies (Hopkins 2011). A survey by Luftman and Derksen (2012) among 195 U.S.-based organizations revealed the top 10 IT management issues in 2012. These are among others cost reduction, IT- and business-alignment, business agility, and speed to market. By comparing these three studies one recognizes that depending on perspective and applied method, even in

this small sample different trends are identified. Only for a small number of trends there is a match between the studies. This makes it even more difficult for IS professionals to get an overview on relevant trends and choose goal-oriented teaching offerings.

3 Method

Design Science Research (DSR) can be defined in short as "the construction of an information technology artifact and its evaluation" (Kuechler and Vaishnavi 2011). Artifacts are constructs, models, methods, and instantiations (March and Smith 1995). The main objective DSR is improvement of the environment by developing technology-based solutions to important and relevant business problems (Hevner et al. 2004; Gregor and Hevner 2013). The identification of these problems is the beginning of the research process (Hevner 2007). Based on this, the two key research activities of design theory refinement as well as its testing are conducted. The process is repeated if requirements and restrictions are not fulfilled (Peffers et al. 2007).

Although guidelines for conducting DSR have been proposed (Hevner et al. 2004), process models which aim at giving the research process a better structure have been developed (Peffers et al. 2007). The concept of nested problem solving also has been applied to DSR (Wieringa 2010). Nevertheless, most recommendations are only discussed on a conceptional level and often not detailed enough for immediate application. Furthermore, the specific aspects of (teaching) services and products are not considered. Within the field of service engineering the three steps of design, analysis, and synthesis have been early discussed (Shostack and Kingman-Brundage 1991, p. 249). Similar to DSR, the service is designed, evaluated, and then adapted. This principle has been extended by researchers from the field of Product-Service Systems Engineering (PSSE). A Product-Service System (PSS) in general is "a marketable set of products and services capable of jointly fulfilling a user's need" (Goedkoop et al. 1999). The advantage of this concept is the combined consideration of services and products in the development process. Also the supporting role of IT is acknowledged. Therefore, the application of PSSE is very suitable in our case because the approach shall be developed in parallel with a supporting software system.

In the following, DSR is used as foundation for applying the PSSE development method by Weber et al. (2004). This method has been adopted in a way that a process-oriented view on PSSE is applied. Figure 2 depicts the PSSE process using Business Process Model and Notation (BPMN) 2.0. This development process changes the order of the original service engineering steps. Development does not start with design but with an identification of customer requirements which provide the foundation for the definition of the to-be properties (cf. Figure 2). These properties are expressed in customer terminology. At this stage of the process no concrete products or services are specified. The properties are the customer-defined and non-changeable features of the PSS. The customer requirements are now grouped into functional aspects and transferred to the level of properties of the product model. This model is a central cornerstone as it summarizes the complete PSS. Within the following synthesis phase, requirements from customer perspective are transformed into constructor terminology and finally converted into characteristics. In this way, the developer-defined and modifiable characteristics can be derived. By following this procedure both the customer and the designer can each use their own terminology. Because there are discrepancies between the to-be properties and the characteristics, a further analysis is necessary in order to derive the as-is properties. Finally, the as-is properties are compared to and aligned with the to-be properties. The process is continued until the properties match or their difference is acceptably small. A continuously improvement and adaption to

new customer requirements is crucial because they tend to change over time (Weber et al. 2004). Although the cycles of synthesis and analysis can be interpreted as the evaluation and refinement step within the design cycle (2004), the application of PSSE allows a much more structured and straightforward development.

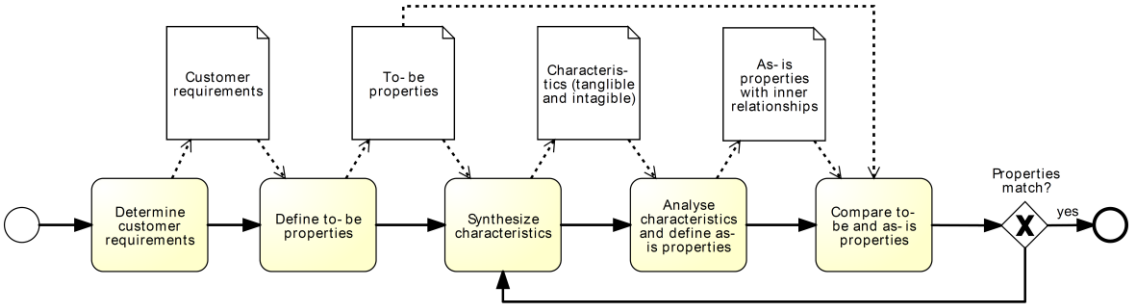

Figure 2. Process-oriented PSSE (based on Weber et al. 2004)

Developing the product model is only the first step in designing teaching processes. The product model can be seen as a blueprint for the developent of the further artifacts.
We continued our research and followed well established process management models – like for example the project management procedure models by Becker et al. (2003) and Thomas (2006) – when developing the teaching processes. In doing so, we recongized the importance of supporting management systems. This system – which has been implemented as a prototype – is the operationalization of the previousely defined processes. Before starting the development of the platform a comprehensive comparison of existing solutions took place. Results showed that no solution fulfills the to-be properties of the integrated approach. Existing solutions either are highly suited towards teaching university students or overstrain users in practice by an impenetrable diversity of features. Therefore, often tools like Microsoft Excel and Word are used to solve the project tasks.

DSR demands an evaluation of the artifact which has been built. However, a solely analysis of the developed prototype does not make sense, because it is only a small building block of the whole concept. Therefore, we decided to conduct the evaluation on another level of analysis. We used our approach to design, offer, and run through two courses – one in 2011 and one in 2012. For each course, three authors worked as administrative staff. Together with eight teachers/coaches, twenty-two participants in 2011 and fifteen participants in 2012 attended the offering. These courses have been evaluated by means of questionnaires and interviews. In doing so, we are able to evaluate the success of the complete package of developed artifacts.

4 Design of the Teaching Processes

4.1 Product Model

In order to be able to develop the product model, we first had to identify the requirements of IS professionals concerning teaching approaches (and software to support them). Based on a comprehensive literature review, 14 expert interviews have been conducted (cf. Table 1). These experts have been carefully selected in order to capture as much as different points of view as possible. All interviewed persons have proven experience with different forms of further education and especially teaching approaches offered by universities. The

results of the interviews have been used to derive the customer requirements (cf. Figure 3). Often, broadening of knowledge base, communication and networking as well as motivation for learning have been named as central requirements.

Table 1. Characterization of the interviewed Experts

No.	*Role*	*Size of Company*	*Industry*
1	CIO	550.000	Insurance
2	IT consultant	180.000	Consulting
3	Solution architect	10.000	Logistics
4	IT consultant	1	IT services
5	CIO	480	Automobile industry
6	IT consultant	850	Automobile industry
7	CIO	3.500	Food industry
8	IT project manager	1.500	IT services
9	IT project manager	150	Media industry
10	Training provider	16	University
11	Training provider	16	University
12	IT support	18	Legal
13	CIO	4	Legal
14	Senior developer	19.000	Publishing industry

IS professionals' requirements for teaching approaches

- Knowledge acquisition of new and trendy topics and broadening of knowledge base (wider knowledge),
- Communication among participants and between participants and instructor (networking),
- Becoming more familiar with different point of views,
- Motivation for learning,
- Demand meeting education offering,
- Appropriate price-performance ratio,
- Good reputation of provider,
- Practical experience of instructors,
- Issuing of certificates (especially crucial for technical training),
- Minimization of time consumption (in terms of rhythm of the courses and organizational effort),
- Limited group size (maximum of 25 participants) and heterogeneous group structure,
- Appropriate catering,
- Electronic distribution of documents, and
- Keeping in touch with participants beyond the end of the course.

Figure 3. Customer Requirements

The customer requirements depicted in Figure 3 now can be used to define the to-be properties as well as the synthesis of the characteristics in the product model (cf. Figure 2). For doing so, the list of requirements has been structured and rearranged by the authors.

Figure 4 shows the final product model, which is the result of several iterations and a minimization of ΔP. The logical relations and interdependencies between product and service components are illustrated by the inner relationships. The model shows the complexity of the teaching approach and made the necessity of the structured process documentation obvious.

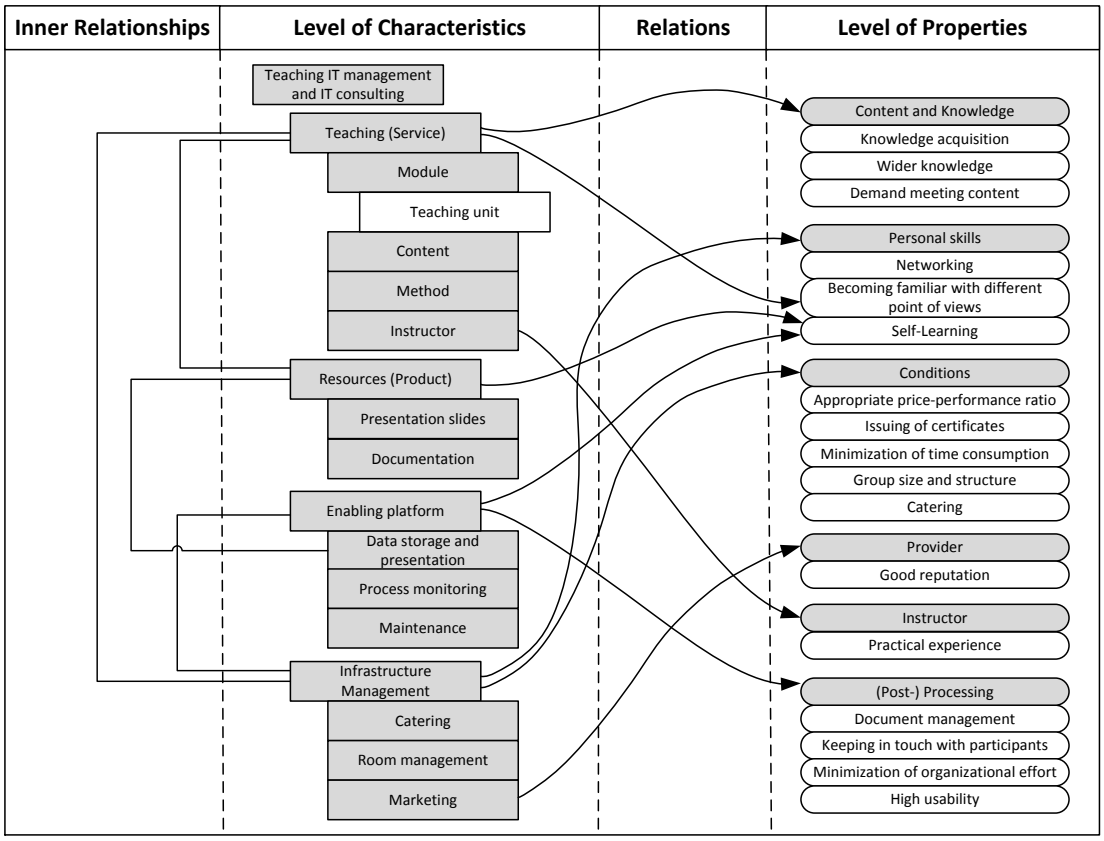

Figure 4. PSS Product Model

4.2 Procedure and Prototype

The procedure model was modeled using well established process management models from literature and the results of the previous research (cf. Figure 5). BPMN 2.0 was used as modeling language. We used the web-based modeling tool Signavio Process Editor (www.signavio.com). The Process Editor allows us to create process models for each (sub-) task. By clicking on the "+" one can navigate to the respective sub-models.

The procedure model consists of supporting activities and core activities. Project management and quality management support the project and ensure overall success. The core activities while setting up an integrated course consist of three phases: initiation, formal teaching and coaching and post-teaching. Within the initiation phase, an analysis of the state of the art takes place as well as the course is conceptualized and finally set up. This last activity is the bridge to the formal training and learning phase, which consist of the *4E activities*. Enrollment, execution, evaluation and evolution are now run through in cycles. Marketing activities, registration of participants as well as other organizational activities have to be done within the enrollment. The execution contains the actions teaching and coaching. While evaluation captures all activities related to the assessment of the modules, the evolution activity ensures that all stakeholders improve the approach constantly. If the actual training phase is over, a lifelong learning and the application of the taught skills has to be ensured within the post-teaching phase. Methods for doing so have to be discussed in the previous phase and are now applied. Parallel to the core activities,

comprehensive documentation takes place. This is necessary, because other institutions and universities should also be able to implement the approach.

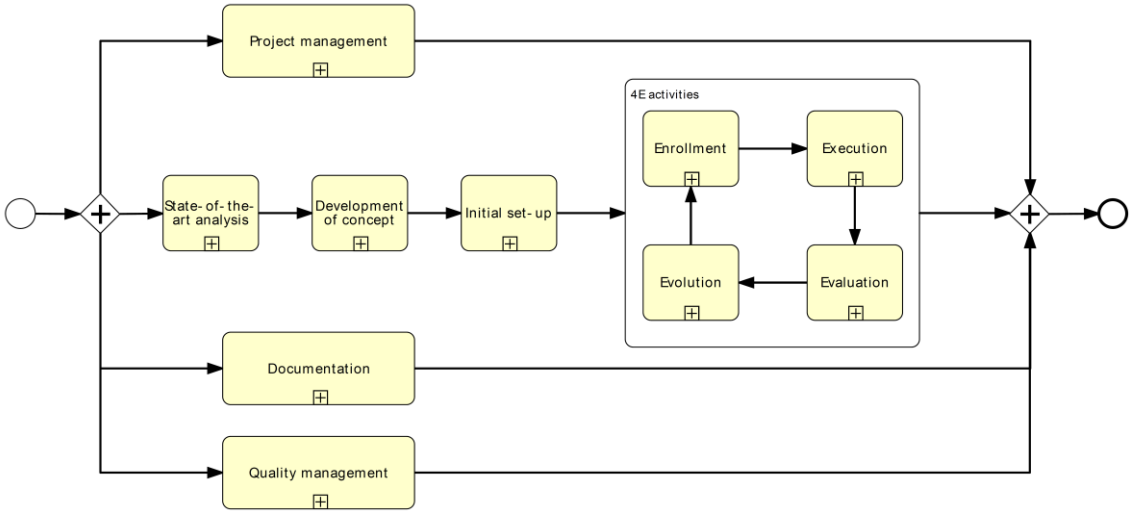

Figure 5. Procedure Model

To illustrate our process-oriented design, we present the enrollment process in detail (cp. Figure 6). Several sequential and some parallel tasks have to be done here. The process starts with the set-up of the time schedule. This is a rather creative task and depends a lot on the circumstances. Therefore, this task is not modeled in more detail. Next, for room management there is a sub-process-model which covers aspects like collecting of offerings for rooms, selecting the appropriate ones and making a reservation. The task of selecting instructors is more complex. Here, several iterations of selection and addressing of potential instructors are followed up by iterations of content and method discussions as well as checking of time schedule. When all instructors have been found, the caterer has to be informed. One and a half months before the first course, usually the acquisition of participants starts. Here, different media channels should be utilized. Now, a parallel procession of different tasks takes place: Registrations are processed, catering is planned in detail, social media groups and e-Learning system are set up as well as official letters of thanks for the instructors should be prepared and send out. The process ends with a final instruction of the assistants.

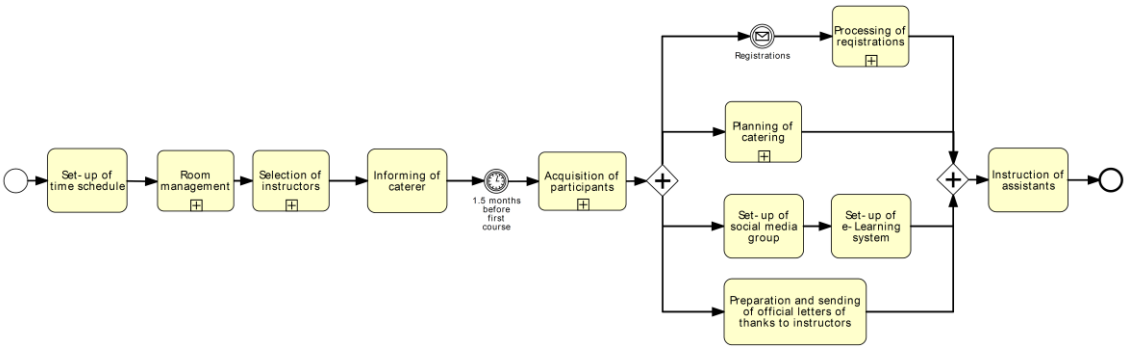

Figure 6. Enrollment Process

By developing the product model (cf. Figure 4) the importance of the enabling platform became visible. Based on the complete procedure model, the prototype can be developed.

The so-called cl2 (coaching and learning) platform was designed to be completely flexible in supporting the participants as well as the university in offering the course – as this is a requirement from the product model (cf. Figure 4). This web-based system is different to traditional project management software especially through the high degree of flexibility and usability. The foundational generic data model allows the flexible adaption of the system to individual needs. By using modern web technologies all tasks can be solved intuitively and comfortably. The core of the system is a slim skeletal structure. On this the user himself can create an individual and needs-oriented system with high flexibility. Instead of providing static structures, the platform itself only offers the basic features which are necessary for configuration. The generic data model (cf. Figure 7), which is necessary for implementation, discerns between object classes with its attributes on the one side (`objecttype`, `attributetype`, and `relationtype`) and instantiations of objects from an object class with its concrete attribute values on the other side (`object`, `attribute`, and `relation`). These six tables are sufficient to save all data of the web forms, documents and so on. Only additional tables for users, user settings, and templates are necessary.

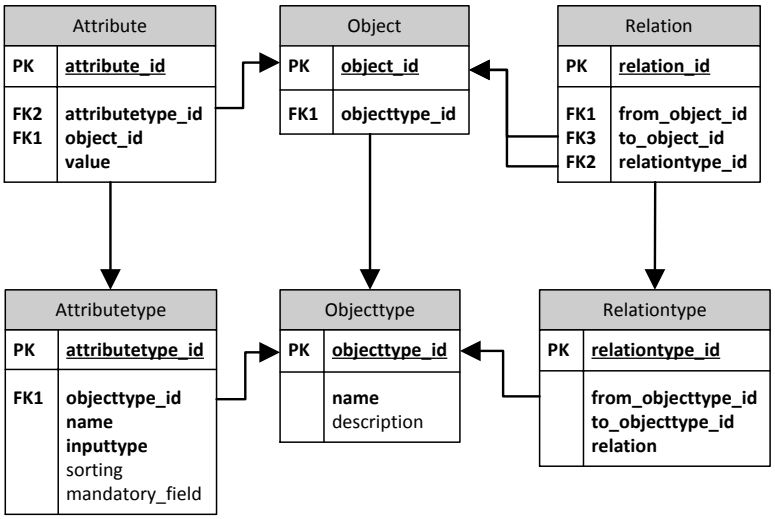

Figure 7. Generic Data Model of the cl2 Prototype

Usually, all coaching and learning processes can be subdivided into several phases which again contain different activities. Additionally, a number of stakeholders like instructors, participants, and organizers are involved. Therefore, the basic feature of the system is the simple and dynamic management of phases, activities, instructors, and any arbitrary further object classes. The classes and their attributes are not given and, hence, can be configured on demand. However, general tasks like creation of participant lists or writing of letters are built into the system. A wide range of export functionality is also available. The characteristic of the platform can be finally summarized in functional and non-functional characteristics (cf. Figure 8).

Functional characteristics	Non-functional characteristics
• Flexibility (multitude of possible fields of applications, generic data model, flexible definition of attributes and objects) • Document management (management of learning data, automatic generation of documents) • Correspondence management (e-mails, telephone calls, letters) • User and policy management (e.g. role-specific user rights)	• User-friendliness (drag & drop, no unnecessary reloads, inline editing) • Maintainability and expandability (well-documented source code, usage of widely used frameworks and programming standards)

Figure 8. Characteristics of the cl2 Prototype

The web-based system has been implemented using modern web technology. Based on the PHP programming language, which is the mostly used language in the Internet, the Zend framework version 1.1.11 has been chosen. It offers highest flexibility and directly supports techniques like AJAX (Asynchronous JavaScript and XML). For data storage a MySQL database is utilized. For layout and design, markup languages like HTML5 and CSS3 have been used. YAML, jQuery, and jQuery UI also have been deployed in order to ensure a high degree of usability.

Figure 9 shows a screenshot of the cl2 prototype. At the top the navigation bar can be found. Here the user can add, edit or delete new objects (Object Manager), manage templates e.g. for correspondence management, and administer the tool in terms of general settings, user rights and so on. On the right side, a menu bar of the created objects is placed. This bar is dynamically updated when changing the objects. By clicking on the "+"-icon a new instantiation of the respective object is created. The main space of the window is reserved for the actual content. In Figure 9 an exemplary event is shown. All depicted attributes can be easily changed and the order of appearance can be altered by drag and drop. Comfortable searching and the export of selectable information are also possible.

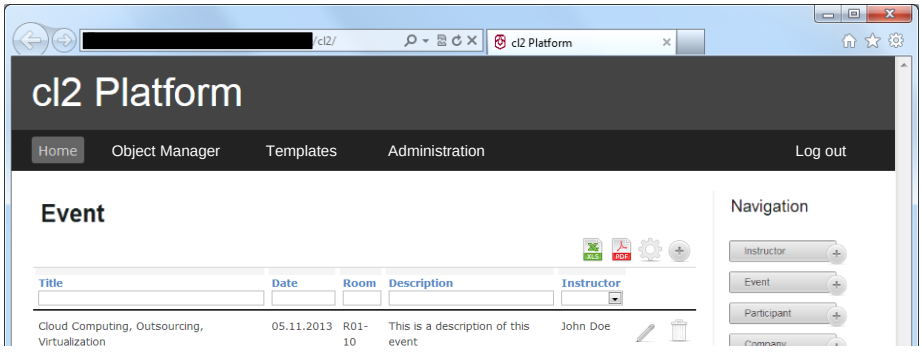

Figure 9. Screenshot of the cl2 Prototype

4.3 Integrated Modules

Next to product model, procedure, and prototype the concept of integrated models is crucial for our approach. The core idea is to mix topics as well as hard and soft skills on one module to create an integrated and holistic learning experience. It is crucial to note that this mixture should not take place arbitrarily. The respective teaching units have to be developed in close collaboration with instructor and organizer. Our procedure model docu-

ments this dialogue within the task selection of instructors. In general, a well-balanced combination of practically relevant content is required.

When developing the integrated modules using our approach, one should also relay on results in literature. For example the framework by Boehm et al. (2011a) can be suitable. This allows the developer to cover all relevant aspects for IS professionals.

5 Evaluation

The described approach has been evaluated twice. In autumn 2011 a first course has been offered containing an initial list of integrated modules (cf. Table 2). The 8 courses can be classified according to their focal content: innovative topics, classical topics and soft skill content. It is important to mention that this is only a brief characterization of each module. Twenty-two IS professionals participated.

Table 2. Integrated Modules in 2011

No.	*Module*	*Classification*
1	Holistic approach of IT management through IT-governance-mapping	Innovative
2	Company development with the help of cloud computing, outsourcing and virtualization	Innovative
3	Reorganization of the IT application architecture	Innovative
4	Implementation of process management in change projects	Classical
5	Management of customer and employee satisfaction as a core task of the CIO	Soft skills
6	Coaching methods for IT professionals	Soft skills
7	ERP consolidation and harmonization	Classical
8	IT further education strategies for the future	Soft skills

In autumn 2012, a second round has been offered. New instructors have been asked to discuss their current issues and therefore the list of integrated modules changed (cf. Table 3). Fifteen participants attended this course.

Table 3. Integrated Modules in 2012

No.	*Module*	*Classification*
1	Legal aspects of cloud computing	Innovative
2	Social business strategies	Innovative
3	Coaching methods for IT professionals	Soft skills
4	Information management and collaboration platforms	Innovative
5	Global efficiency and local needs as tasks of the CIO	Soft skills
6	IT reorganization and continuous development of the organization	Classical
7	IT strategies for medium-sized businesses	Classical
8	The role of IT in business process management and enterprise architecture management	Classical

Each integrated module has been evaluated using a questionnaire. The scale is -2 (not satisfied) to +2 (very satisfied). The compressed result of this evaluation is depicted in Figure 10. One can recognize that the level of satisfaction rose in nearly all variables. For example time and content have been particularly better assed in 2012 than it was the case in 2011. Also the general satisfaction is better in 2012. One has to note that all ratings are above 0 meaning that no variable has been rated worse than “ok”. The reason why results

are better in 2012 than in 2011 is the fact that in the second year, the cl2 platform has been comprehensively used to support processes. Therefore, only the complete package of products and services enables the delivery of integrated teaching processes.

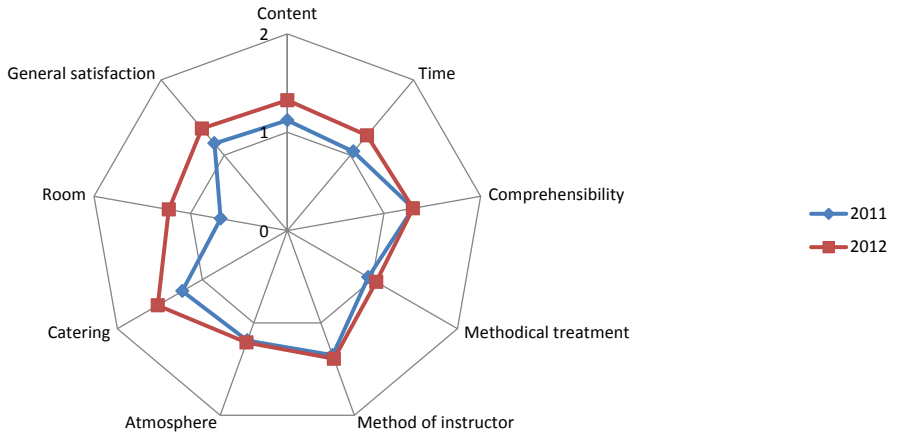

Figure 10. Evaluation of Modules

The success of the teaching also has been measured by conducting interviews with participants and handing out of questionnaires. Learning success was measured based on self-assessment method (Vygotsky 1962). After the last module in autumn 2012, skills before and after participation have been recorded on a scale from -2 (deficient) to +2 (very good). These values have been analyzed in a t-test for measuring the equality of means. Figure 11 depicts the means from before and after participation for those topics which differences are significant on a 0.15 level or better. Highest learning success can be therefore recorded for subjects like social business, internationalization, business intelligence, or IT- and business-alignment. But also for the other topics significant success has been reported. The results of this evaluation as well as the informal discussions with participants lead to the conclusion that our proposed service approach is suitable to ensure IS leadership development.

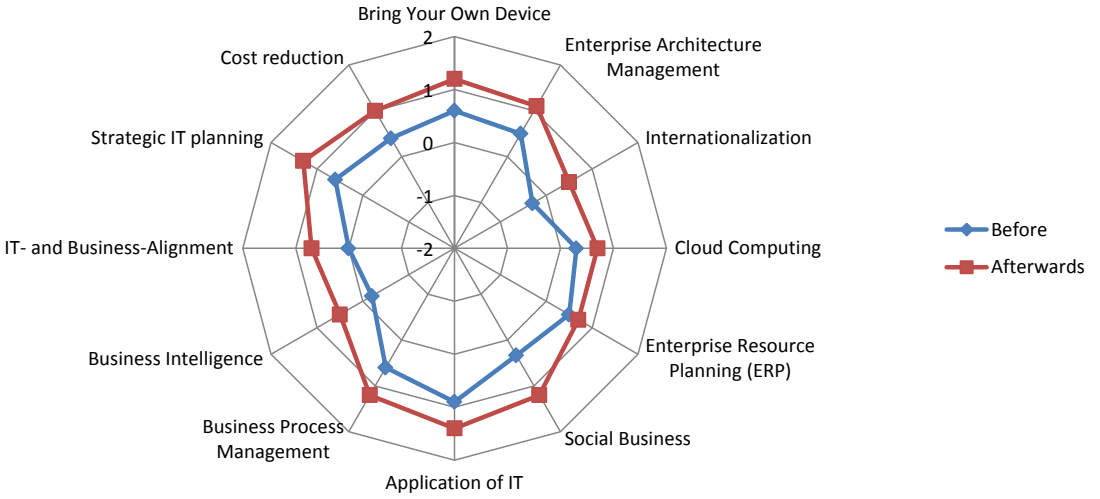

Figure 11. Evaluation of Learning Success

6 Conclusion and Outlook

We designed and evaluated teaching processes in form of product and procedure models as well as a prototype for developing IS leaders. The artifacts show their integration capability on three levels: (1) integration of stakeholders, (2) integration of IS professional training, and (3) integration of content and modules. Results show the success and viability of our method as well as illustrate the application of process thinking to the new area of teaching processes.

The concept of integration will be useful for other scientists. Our methodology of combining DSR and PSSE shows its viability and can be adopted in other research projects. We describe a new teaching and coaching concept which allows continuing education for self-education. From the practical point of view, our procedure model and module structure help practitioners in designing their own on-the-job training approaches. The models can be used as guidance for their work. Novel ideas are given and people are helped to help themselves. Participants are supported in looking beyond one's own cultural horizon.

Future research can adopt our approach and apply it to other fields within the IS discipline. Additionally, the prototype has to be continuously developed in order to extend functionality and transform it into a marketable product.

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