MANAGING THIRD-PARTY FUNDING PROJECTS AT GERMAN STATE UNIVERSITIES - A THEORETICAL DEDUCTION OF DESIGN PRINCIPLES FOR IMPLEMENTING AN IT-ARTIFACT

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Abstract
While striving for excellence in science, funds for researchers are increasingly granted based on performance-oriented criteria. One of these criteria is the amount of third-party funds which motivates scientists to increasingly raise those funds. In addition to this, the performance-oriented granting of funds also leads to stagnating basic funds and financing difficulties at universities. Thus, scientists are also faced with the challenge of financing their research activities and for this purpose third-party funding provides a financing alternative. Consequently, the importance of third-party funding (TPF) rises. However, during the application phase of those third-party funding projects a large amount of data and documents is created. Because of the university structure, this situation results in various problems (e.g. heterogeneous storage, redundancies and inconsistencies). Due to increased importance of TPF, the amount of third-party funds rises and problems intensify while management activities in such projects are rarely supported by information technology. For addressing the mentioned problems, we develop an integrated IT-based third-party funding management system (TPFMS). We accomplish the implementation of the TPFMS by a prior deduction of design principles for implementing an IT-artifact using principal-agent and task closure theory.

Keywords: Third-party funding, university, electronic document management, design principles.

1 Introduction

During the last years, the amount of third-party funds in Germany increased. In the year 2000, German universities received 2.83 billion € from third parties. This amount increased to 6.37 billion € in the year 2011, which conforms to an increase of 125 percent. However, the basic funds only raised 36 percent in the same period (Statistisches Bundesamt, 2013). Thus, third-party funds are very important to researchers for financing their research activities at state universities in Germany. Similar developments can be observed in other European countries because of the bologna process and the associated changes of the university structures (dependence on third-party funds) (Higher Education Statistics Agency, 2013; Dominicis et al., 2011). Besides this, there is a variety of complex and comprehensive rules to apply for a third-party funding project (TPFP) and also for project execution. This complexity of rules is caused by the great number of donors. E.g. an application for a TPFP can be made to many federal ministries, which have its own guidelines. Even a donor can have more than one guideline: The German Research Foundation, for instance, provides several third-party funding programmes (e.g. research grants, collaborative research centres, research training groups), in which different rules are relevant. The universities have to deal with this high complexity of rules.
Consequently, during TPFPs a lot of administrative tasks have to be done. In these tasks, a large amount of data and documents is produced and has to be managed: e.g. grant agreements, contracts or intermediate and final usage verifications for reporting to the donor. Due to the increasing importance of third-party funds, the situation deteriorates considerably. Scientists have to deal with administrative tasks more often than before (e.g. periodic reporting), which leads to less time for research.

Furthermore, TPFPs are not carried out by scientists alone. There are several other internal project stakeholders like research, financial or human resource departments (primarily from university administrators). The university administration has the problem that the number of employees has mostly not been adapted to the increased amount of third-party funds, which leads to a process bottleneck. In addition, the situation between both parties is complicated, because on the one hand scientists often have an aversion for university administrators and its departments (Altvater, 2007) and on the other hand, administrators say that they do not work as secretaries of the researchers. This situation promotes the fact that each project stakeholder manages all project-attached documents and records in different structures and separate ways (Gröger et al., 2013). There is no consistent data storage within TPFPs. Both parties have paper documents and electronic documents locally or on internal network shares. As a result, media breaks arise at departmental boundaries and redundancies exist (Ebeling et al., 2011). Also because of the aversion, interaction and communication between scientists and university administrators does not take place regularly. As a consequence, inconsistencies emerge (Ebeling et al., 2011). Hence, duplication of work, high search effort, low regularity and traceability (according to the regulations of donors or university administrators), high communication overhead and low transparency arise (Gröger and Schumann, 2013).

In this paper, we take an integrated view on TPFPs to improve the situation. Our research problem includes aspects from information system design, process improvement and requirements specification. The objective of the paper is to deduce design principles (level 2) (Gregor and Hevner, 2013), which help guiding the design of an artifact that is able to improve the process of managing TPFPs at universities. While one objective of e-government projects is to conceptualize, simplify and realize information, communication and transaction processes […] by using digital information and communication technology (Buhl and Löffler, 2011) and while universities are a special kind of public institution, our deduction of design principles for supporting the third-party funding (TPF) process in universities can be classified into the area of e-government. Currently, there are no theoretical based studies that address the information system design of an integrated third-party funding management system (TPFMS) (Gröger and Schumann, 2014). Hence, there is no previous work to rely on. We close this gap by providing theory-based design principles (level 2) for the development of an integrated TPFMS. Thus, our first research question is:

**RQ1:** What are the general requirements of a third-party funding management system?

Subsequently, we built an instance and describe how this TPFMS (called EDMA) can overcome the deficiencies in the third-party funding (TPF) process and solve the above mentioned problems. Since IT-systems in public institution are not all about the technology, we also involve rethinking the way a public institution operates (Schaupp et al., 2009). According to this, our second research question is:

**RQ2:** How should a third-party funding management system be designed and implemented to support the third-party funding process?

The answer to the research question is not only interesting from the perspective of German universities. The above mentioned situation and problems can also be found in other countries in Europe, because they have comparable administration and clearing processes within TPFP. Furthermore, there are also donors, which operate in the European area. For instance, the European Union provides several research programmes like the European Fund for regional Development or the Framework Programme. Consequently, our work is relevant to universities around Europe.
The paper is organized as follows: After this introduction, we give an overview about related research (section 2). Then, we take a closer look at our research design. We hereby follow the design science paradigm (section 3). In section 4, we deduce our design principles using principal agent and task closure theory. Subsequently, we take these design principles and validate them from a practical view. For this purpose, we built an instantiation (EDMA) by using action design research (Sein et al., 2011) (section 5). After this, we evaluate the derived design principles (section 6). Finally, we give a short outlook on further research (section 7).

2 Basics and Related Research

The term TPF is defined differently in the literature (Kulicke and Stahlecker, 2010; Hornbostel, 2001). In this article we use the common definition of the German Federal Bureau of Statistics. They define third-party funds as funds for supporting research and development as well as young researchers and teaching that are raised in addition to regular university budgets by public or private entities (Statistisches Bundesamt, 2011). Consequently, a TPFP is a research project, which is financed by third-party funds. The funds are tied to a specific research project and only for a limited period of time. In these projects, several employees from different departments (scientific and administrative) are involved. Moreover, a lot of data and documents is generated. In most cases, all project members have their own separated paper-based and electronic document storage. IT-support for managing documents currently includes only network shares. There is no unified system for execution of a TPFP. Information flows (data and documents) take place via letters or e-mail. Thus, several problems occur (Gröger and Schumann, 2013). The Situation within TPFPs is summarized and stated in figure 1.

Based on the above mentioned aspects, it can be concluded that there is a need for support. An information system (IS) can improve the situation. As our goal is to identify general requirements and components (design principles) for an IS in TPF context, we follow a broad approach and define third-party funding management systems (TPFMSs) as IS that support and create value in one or more management activities within a third-party funding project (TPFP).

![Figure 1. Organizational structure within TPFP](image-url)
systems in universities are presented and instances of knowledge management systems for research and innovation activities at universities are described (Martens and Teuteberg, 2009; Cantu et al., 2005; Rieger et al., 2009; Schramm, 2003).

The research process itself, research networking as well as strategic planning and research reporting are not in the focus of this article, because these three aspects are well-discussed in the literature. We are focusing on the fourth aspect – administrative tasks of a TPFP. This aspect is investigated by a recent systematic literature review (Gröger and Schumann, 2013). According to this literature review only a few publications can be found which address the administrative tasks in TPFPs. The authors identified only the following relevant articles (Gröger and Schumann, 2013): The first article elaborates problems in managing TPFPs. The current IT-support in these projects is determined by expert interviews (Ebeling et al., 2011). Subsequently, in another article authors deduce requirements for an IT-supported research resource management system (Ebeling et al., 2013). However, these requirements mainly meet reporting and controlling requirements of a decentralized research institute within a TPFP. The above mentioned problems with data and document management or information flows in TPFPs are not considered. In addition, requirements do not include the view of university administrators (administrational view) and are not deduced by using theories. As our objective is to derive theory-based requirements for TPFMSs, there is no previous work to rely on.

3 Theoretical Concept & Method

To answer our research questions, we follow the design science paradigm (Gregor and Hevner, 2013; Hevner et al., 2004). Basically, this article contains two approaches (theoretical and practical) for deriving design principles. First, for deducing design principles theoretically, we use the framework for theory development in design science research (DSR) proposed by Kuechler and Vaishnavi (Kuechler and Vaishnavi, 2012). Following this approach, we utilize principal agent theory (PA-theory) (Eisenhardt, 1989; Jensen and Meckling, 1976) and task closure theory (TC-theory) (Straub and Karahanna, 1998) as our kernel theories. Subsequently, we develop a design relevant explanatory/predictive theory (DREPT) according to Kuechler and Vaishnavi which links kernel theories and design (Kuechler and Vaishnavi, 2012). The DREPT explains why an artifact has the effects it does (Kuechler and Vaishnavi, 2012). Thus, we use the DREPT for explaining how a TPFMS can reduce information asymmetries and improve the communication situation in TPFPs. After this, we transfer the DREPT into design principles.

In our next step (second approach), we validate our theoretically deduced design principles. For this purpose, we use the action design research (ADR) approach developed by Sein et al. (Sein et al., 2011). This approach also allows expanding our theoretically deduced design principles by offering the possibility to get strong insights in the practical work. ADR is a research method which can be used to generate design principles through building and evaluating an IT artifact in an organizational setting (Sein et al., 2011). According to this approach, we go through the four stages of the ADR framework (problem formulation; building, intervention and evaluation; reflection and learning; formalization of learning) and build an instantiation (called EDMA) that can be used in administrative tasks in TPFPs. The approach of Sein et al. is distinguished by its iterative character (Sein et al., 2011). After the problem formulation (stage 1), researchers have to build, intervene and evaluate (BIE) the design of the artefact in a target environment (stage 2). This stage is an iterative one – so researchers have to go through the BIE-cycle for several times until there is no additional cycle needed (e. g. if practitioners’ requirements and wishes are satisfied). Parallel to the first two stages, researches must reflect and learn from the solution building (stage 3) to ensure that contributions to knowledge can be identified. After finishing the last BIE-cycle the situated learning from the ADR project must be generalized respectively formalized (stage 4). Since the artifact must be theory-ingrained (Sein et al., 2011), we used our theoretically deduced principles (first approach) as a basis of the development
of our prototype. By formalizing our learning from the ADR activities (stage 4) we are able to validate and enhance the design principles.

Due to the deduction of design principles and the creation of a prototype (EDMA), we provide a contribution which includes a better solution in the form of more efficient and effective technologies. Hence, our contribution can be classified as an improvement according to Gregor and Hevner (Gregor and Hevner, 2013). To provide convincing evidence of its improvement compared with current solutions, an artifact must be evaluated (Gregor and Hevner, 2013). To achieve an evaluation of our design principles, we draw on our experience of the more than one-year use of EDMA and evaluate the effects descriptively (Hevner et al., 2004). We hereby show that our DREPT is supported by the prototype. The rigor of our research is given by using rigorous methods in both the construction (DSR theory development framework, ADR) and evaluation (descriptive) of the designed artifact (Hevner et al., 2004).

4 Deducing Design Principles for TPFMSs

4.1 Kernel Theories: PA- and TC-Theory

PA-theory describes the relationship between two contracting parties (principal and agent) where a principal instructs an agent to complete a task (Jensen and Meckling, 1976). In this situation, two cases are possible: At first, complete information is available. This means that a principal always knows what an agent is doing. Second, activities are not traceable for a principal. So, a principal does not actually know what the agent is doing (Eisenhardt, 1989). In PA-theory the second case is relevant, because information asymmetries in terms of “hidden information” or “hidden action” occur between contracting parties and lead to moral hazard (Hart and Holmström, 1987). While “hidden action” describes the situation in which a principal can observe the outcome of an agent, but not the actions that led to the outcome (e.g. invested effort), the term “hidden information” means that an agent observes some information which a principal does not know (e.g. task relevant information) (Arrow, 1985). Both situations can be exploited by the agent (moral hazard). To reduce information asymmetries, a principal can use screening activities (Stiglitz, 1975) and the agent can apply signaling activities (Spence, 1973). However, an effort which is called “agency costs” arises for both activities (Jensen and Meckling, 1976).

PA-theory can be transferred to research projects or in TPF context (Bolli and Somogyi, 2011; Eisenhardt, 1989). Basically, two views are possible: The first view is the relationship between donor (principal) and scientists (or the university as agent), in which scientists have more information about a TPF than a donor. Thereby, it is very difficult for a donor to monitor how scientists use provided funds and which effort they take to reach research objectives. Hence, donors provide guidelines for reporting (signaling) which are very complex and heterogeneous. Resulting from these guidelines, an administration and documentation effort arises at universities (Ebeling et al., 2011). Because of the organizational structure within a university and the mentioned circumstances in TPFs (see figure 1), the administration and documentation effort leads to distributed and heterogeneous file and data storage. This is confirmed in several case studies (Gröger et al., 2013; Ebeling et al., 2011). It is common knowledge that distributed and heterogeneous file and data storage results in redundancies, inconsistencies, media breaks and information asymmetries.

In the second view, a relationship between internal project stakeholders can also be explained by PA-theory. In this situation, it is not clear which project stakeholders act like agents and which act like principals. For various reasons (e.g. no added value, no suitable medium for providing information, aversion), information from centralized departments are not made available to the decentralized research institutes and vice versa. Consequently, information asymmetries between internal project stakeholders appear and cannot be reduced because of distributed and heterogeneous file and data storage. This hidden information together with redundancies, inconsistencies and media breaks results
in low transparency in the TPF-process, high search effort for documents and other information, low regularity and traceability (according to the regulations of donors or university administrators), duplication of work as well as high communication overhead (Gröger and Schumann, 2013). Finally, this leads to inefficient TPF-processes and high administrative costs. The situation is summarized in figure 2.

The second used kernel theory in this paper is task closure theory (TC-theory). The term task closure is defined in the theory “as the completion of a communication transmission segment” (Straub and Karahanna, 1998). TC-theory was introduced by Straub and Karahanna (Straub and Karahanna, 1998) in order to examine the impact of recipient availability on media choice for communication. The authors illustrate that the variable (recipient availability) is very important for communicators, because they feel the need to bring closure to their tasks and if a recipient is temporarily unavailable, communicators are willing to choose a medium which allows reaching task closure (regardless of suitability of a medium) (Straub and Karahanna, 1998). On the one hand, according to TC-theory, a lower task fragmentation and a higher productivity arise, if a medium is chosen which allows reaching TC. On the other hand, a media selection that does not result in TC leads to a higher task fragmentation and a lower productivity (Straub and Karahanna, 1998). The problem is that choosing a suitable medium does not always result in completed communication (TC) (Straub and Karahanna, 1998). Consequently, communicators would choose an unsuitable medium to reach TC. Hence, a suitable medium should be provided which allows bringing closure in a task.

In case of TPFPs, project stakeholders often choose a medium for transferring information (documents and data), which (a) do not lead to TC or (b) lead to TC, but the communication medium is not suitable (e. g. e-mail or paper-based), because of the uncomfortable and unstructured communication process. The variable (un)availability is given by the fact, that university administrators (contact persons) are not always known among scientists. Furthermore, there are office hours in centralized departments, which are unfavorable for scientists (due to countercyclical working times). Consequently, in many cases a recipient is temporally unavailable. According to this, a medium has to be provided for project stakeholders, which makes it possible to complete the transfer of information (documents and data) between different project stakeholders in a suitable form in order to achieve a higher productivity in TPF-processes.

Figure 2. Problems in TPFPs and their dependencies deduced from PA-theory

4.2 DREPT

As mentioned before, in TPFPs, lots of data and documents are produced and have to be distributed as well as retained (in the following, we subsume data and documents under information) (Gröger and Schumann, 2013; Ebeling et al., 2011). There are information asymmetries between donors and scientists and also between scientists and centralized departments (internal project stakeholders). Several problems emerge from this (see figure 2). To reduce information asymmetries, the availability of information about TPFPs must be enhanced. This can be done by using a TPFMS, which stores all
project related information and thereby offers the opportunity for retrieval of information by project stakeholders.

In addition, deduced from TC-theory, the ability for information retrieval must be given even if a contact person (person who has the information; recipient) is not available in such a way that information needs can be met at any time and in an appropriate form. Thus, control about the communication act is carried out by the message initiator which minimizes job interruption and leads to a higher productivity (Straub and Karahanna, 1998) in the TPF-process. According to this, we state:

**Proposition 1:** TPFMSs reduce information asymmetries by providing TPFP relevant information to project stakeholders at any time regardless of availability of a contact person (recipient) and thus enhance productivity.

In this case, TPFMSs work like a principal screening tool (Stiglitz, 1975). However, before information can be provided to a principal, they must be gathered which causes agency costs (Jensen and Meckling, 1976). For reducing agency costs by means of TPFMSs, the collection and storage of information (signaling) for the screening activities of a principal must be simplified and assisted. Up to now, information is forwarded in an unstructured manner on paper or via e-mail and subsequently transferred into inconsistent and redundant records or data collections (Ebeling et al., 2011). By providing a consistent and centralized TPFMS, agents are able to perform their signaling activities in a structured manner. Consequently, agency costs will decrease in comparison with the situation without a TPFMS. Another aspect that should be considered is the duplication of work. So far, in most cases, agents store and archive their information and documents on local storages (see section 2). Furthermore, they have to forward information to project stakeholders (principals). By digitally storing this information in a TPFMS, local storage or archiving is not necessary anymore. In these cases, a centralized TPFMS thus allows generating added value for agents. If added value exceeds (reduced) agency costs, agents get an incentive for signaling activities (Connelly et al., 2010) in a way that hidden information become available.

According to TC-theory, it must be possible for communicators (agents) to complete the information provision process (TC). That means information provision must be independent of availability of a recipient. It should be noted that the task of provision must be as simple as possible and feasible with the available information in each of the areas (e.g., only meta-data which are known in decentralized departments are inquired). If this is not the case, the communicator (agent) needs an available contact person (recipient) which compensates the information deficit. A contact person, which is at any time available, cannot be guaranteed. Hence, it is possible that a situation arises which does not lead to TC (Straub and Karahanna, 1998). In order to avoid this, a TPFMS needs to be adapted to a particular scenario or role with the result that no contact person is needed for information provision. Thus, TC can be reached and this increases the productivity of the task. According to this, we state:

**Proposition 2:** TPFMSs reduce agency costs by collecting TPFP related information using a procedure that allows an anytime information provision by a communicator (TC) and thus enhances productivity.

### 4.3 Deduction of Design Principles

As mentioned in section 3, our design principles are deduced from justificatory knowledge (Gregor and Jones, 2007) (PA- and TC-theory). For this purpose, we proceed as follows: In our first step, we describe three conditions which have to be observed since otherwise our design principles are not useable. In the second step, we derive seven capabilities which provide information about the properties of a TPFMS. After this, we combine the capabilities and transfer them into design principles.

As we used PA-theory as our kernel theory, there are three conditions to consider: At first, with respect to proposition 1, if there are no information asymmetries between TPFP stakeholders as stated in
section 4.1, the above mentioned problems do not occur and our design principles are not useful and practicable. Second, concerning proposition 2, we describe a difficult process of information collection. If the collection process does not have to be simplified because the process is structured and trivial, agency costs cannot be reduced by using a TPFMS. Hence, our design principles are not suitable. The third aspect is also related to proposition 2. In section 4.2, we explained a situation where no incentives for signaling are given before introducing a TPFMS. However, if there are incentives and TPFMSs are therefore not used, TPFMSs cannot create an added value and consequently our design principles are not applicable. If these mentioned conditions are fulfilled (information asymmetries exist, information collection is difficult, and no incentives for signalling are present), the usage of a TPFMS which is based on our design principles is suitable. For this purpose, a TPFMS has to possess the following capabilities: As noted in previous sections, a TPFMS must be able to collect, to store and to archive information (data and documents) of a TPFP in order to present this information to other project stakeholders. Consequently, the problem of distributed and heterogeneous storage of files and data can be reduced. In order to improve the situation regarding regularity and traceability (according to the regulations of donors or university administrators) the collection and storage of information must be done in a structured manner. Since there are several donors and TPFP-types (e.g. research grants, collaborative research centres), it is necessary to have a specific information collection and storage structure for each kind of TPFP-type (C1). Furthermore, a TPFMS must be able to share gathered information structured with other project stakeholders (C2). Thereby information asymmetries are reduced. Concerning TC-theory, it must be possible for every project stakeholder to get all information about a TPFP (information retrieval) and also to provide all relevant information regardless of availability of a recipient in order to obtain a higher productivity (C3). To bring closure in communication in TPFPs it is also necessary to support the communication processes between all project stakeholders (C4). With the purpose of facilitating the use of a TPFMS (to get process completion) the possible user activities need to be adjusted to the field of function of a user (project stakeholder). These mentioned capabilities allow the deduction of the following design principles.

![Figure 3. Theory deduced design principles for a TPFMS](image)

A TPFMS must have a user interface for information provision and retrieval. Hereby, the user interface must allow continuous transmission of information as well as satisfy the information needs of project stakeholders. The user interface also must be easy to use in order that every project stakeholder is able to use it (DP1). For storing and archiving electronic information, an electronic storage medium is necessary. This storage medium must face the requirements of an external audit, which can be conducted by the donor (DP2). Moreover, there is a need for structuring information. This need can be met by record models, which define a clear structure for files for different donors (DP3). Information retrieval is always bound to a correct selection of information. To enhance the selection, a search
function that is based on a meta data model is needed (DP4). Furthermore, a workflow component is able to satisfy the requirement of process support in TPFPs. But the view on a workflow must be adjusted, in order that the view of a particular process participant is reflected and task closure can be reached (DP5). For instance, the data to be entered must be adjusted to the needs of the particular workflow participant. Figure 3 shows our theoretically deduced design principles for TPFMSs.

5 Prototype Implementation: EDMA

Since our theoretically deduced design principles have to be validated, we used action design research (ADR) according to Sein et al. (Sein et al., 2011) – so we intervened in TPF-processes by introducing a TPFMS (called EDMA) at a German state university and at the same time studied the effects (Myers, 2009). The problem formulation (first ADR-stage) has already been conducted. We showed that a practice-inspired research is present (principle 1) and our artifact is theory-ingrained (principle 2) by carrying out ADR based on the theoretically deduced design principles (see section 4). In the second stage (building, intervention, evaluation – BIE) we moved through four recursive BIE-cycles (principle 3). As our objective was to validate the principles and expand them from a practical view if necessary, we conducted workshops with practitioners at the university for articulating the design of EDMA. The practitioners hereby came from university internal departments (principle 4) (see figure 1). Since it is very important for a successful e-government system to meet the users’ needs (Schaupp et al., 2009) we also included scientists and faculty administrators into our group of practitioners. Consequently, we received not only the bureaucrat view, but also the view of all users (Schaupp et al., 2009). The decisions were evaluated after each iteration (principle 5) (see BIE-cycles in table 1). Parallel to this, we reflected on the design and redesign during the project and learned from this (stage 3, principle 6) (Sein et al., 2011). The procedure during BIE-cycles is illustrated in table 1 and will be described in the following:

<table>
<thead>
<tr>
<th>BIE-Cycle</th>
<th>Description of BIE-Cycle</th>
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<tbody>
<tr>
<td>1</td>
<td>take theoretically deduced design principles</td>
</tr>
<tr>
<td></td>
<td>during workshops: articulate proposals for selection of a suitable user interface (basic system) (DP1), an electronic storage medium (DP2), record models (DP3), meta data models (DP4) and workflows (DP5)</td>
</tr>
<tr>
<td></td>
<td>evaluate and improve the proposals</td>
</tr>
<tr>
<td></td>
<td>repeat until no additional cycles are necessary (\rightarrow) receive defined instance requirements</td>
</tr>
<tr>
<td>2</td>
<td>implementation</td>
</tr>
<tr>
<td></td>
<td>implementation and customizing (prototype 1)</td>
</tr>
<tr>
<td></td>
<td>testing, evaluation and improvement (until no additional cycles are necessary)</td>
</tr>
<tr>
<td>3</td>
<td>redesign and reshaping</td>
</tr>
<tr>
<td></td>
<td>get new requirements or capabilities from practitioners</td>
</tr>
<tr>
<td></td>
<td>during workshops: recursive work for definition of the instance requirements (roles and rights, controlling functionalities, system administration tools)</td>
</tr>
<tr>
<td></td>
<td>evaluate and improve the definitions</td>
</tr>
<tr>
<td></td>
<td>repeat until no additional cycles are necessary (\rightarrow) receive defined instance requirements</td>
</tr>
<tr>
<td>4</td>
<td>expansion</td>
</tr>
<tr>
<td></td>
<td>expansion of prototype 1 with instantiation design principles derived from BIE-cycle 3</td>
</tr>
<tr>
<td></td>
<td>testing, evaluation and improvement (until no additional cycles are necessary)</td>
</tr>
</tbody>
</table>

Table 1. Four BIE-Cycles during EDMA Implementation

During the workshops (BIE-cycle 1), we made the decision that the SAP solution “Records Management” should be the basis of our prototype, because other SAP solutions are productively used so that users already gained experience in this field (e. g., user interface handling; DP1). Furthermore, we took the already used “FileNet” archive system as our storage medium and connected it with the SAP system via interface (DP2). A major portion of the time was consumed to develop record models
for the different donors (DP3). In the end, we defined 22 record models which describe a structure for document storage. Consequently, we also developed 22 meta data models by adapting the models to a specific donor (DP4). In the next conceptual step we elaborated the specific TPF-process at the state university and identified potential sub processes that can be mapped into a workflow component (DP5). After this, the decision was made by the practitioners, that at first only the third-party funding notification has to be mapped into the workflow component (further information about the notification: Universität Giessen, 2013).

In our next step (BIE-cycle 2), we implemented a prototype based on the results of BIE-cycle 1. The prototype was evaluated by practitioners and subsequently improved by us until all needs of the practitioners were satisfied. However, during the evaluation practitioners have expressed further system capabilities for an adequate use of a TPFMS: First, it must be possible for privacy reasons to deny the access for a user to non-relevant information (C5). Second, a TPFMS must cover aspects like project costing, reporting or execution (C6). Third, it may happen, for example, that donors modify their policies or guidelines or process participants change. Hence, it must be easy to apply these changes to a TPFMS (C7). Consequently, we moved through a redesign cycle (BIE-cycle 3) and obtained the following results: At first, we developed five roles (C5), which help to overcome the privacy requirements of the practitioners (see table 2). These roles limit the access to non-relevant information respectively functionalities and can be assigned to specific employees depending on their particular responsibility.

<table>
<thead>
<tr>
<th>Role</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>centralized departments</td>
<td>information provision and retrieval, without organizational affiliation</td>
</tr>
<tr>
<td>research institutes</td>
<td>information provision and retrieval, organizational affiliation</td>
</tr>
<tr>
<td>faculty</td>
<td>information retrieval, verification of the TPF notification, organizational affiliation</td>
</tr>
<tr>
<td>system administrator</td>
<td>customizing, no limitations</td>
</tr>
<tr>
<td>info</td>
<td>information retrieval, without organizational affiliation</td>
</tr>
</tbody>
</table>

Table 2. Roles within EDMA

In order to meet the project controlling requirements (C6), we drafted some reports, which indicate income and expenses or display invoiced project staff, for example. Furthermore, we developed a project directory, with the result that project stakeholders are always able to find each other. Based on this directory, automated messages can be sent to project stakeholders (e.g., if new documents are provided). To maintain the prototype (C7), the administration tools of the SAP system can be used. For our additionally implemented functionalities we conceived further administration tools, in order to allow doing the maintenance tasks on the SAP user interface. The mentioned capabilities (C5, C6, C7) were continuously evaluated by the practitioners and refined by us until all requirements were satisfied. After this, we went through an expansion phase (BIE-cycle 4), in which we implemented the derived concept of BIE-cycle 3. Subsequently, we created use cases and tested the implementation for four weeks. During these tests the whole practitioners’ group was involved. Furthermore, the capabilities of EDMA are summarized in figure 4.

| (C1) EDMA collects, stores and archives data and documents about TPFPs in an adapted and project type specific structure. |
| (C2) EDMA provides TPF related information to project stakeholders in a structured and TPF-type specific manner. |
| (C3) EDMA offers the possibility for completing all information provision and information retrieval activities of all TPFP stakeholders. |
| (C4) EDMA provides TPF process support. |
| (C5) EDMA restricts the access to TPF information and limit activities to the field of functions in order to meet privacy requirements. |
| (C6) EDMA is able to support accounting and (project) management tasks. |
| (C7) EDMA includes the possibility to maintain the system. |

Figure 4. Capabilities of EDMA
6 Discussion and Evaluation

After describing the implementation details and completion of the BIE-stage, the learning must be formalized (stage 4) (Sein et al., 2011). For this purpose, we have to generalize the outcomes (principle 7). This is described in the following:

We used our theoretically deduced design principles as basis for our ADR and derived instance requirements by conducting workshops with practitioners. Hence, we were able to validate and to expand the theoretically deduced design principles. As we implemented five roles to meet the privacy requirements (C5) a role and rights concept was needed. Hence, this enables the possibility to limit activities and allows an overall project management within the organizational affiliation (DP6). Furthermore, as asked by the practitioners, we integrated reports in our prototype, which are adapted to the specific guidelines of the donors. A project directory for managing communication or contact persons was also implemented (C6). We combine these requirements and state that one component of a TPFMS must provide functionalities for project controlling and management (DP7). Finally, tools for maintaining our prototype were implemented (C7). Hence, there is a general need for system administration tools (DP8). Our design principles (theoretical & practical) are summarized in figure 5.

<table>
<thead>
<tr>
<th>A TPFMS should encompass…</th>
<th>theoretically deduced</th>
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</thead>
<tbody>
<tr>
<td>(DP1) …a user interface, which allows an intuitive information provision and retrieval regardless of the availability of a recipient (C1, C2, C3).</td>
<td></td>
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<tr>
<td>(DP2) …an electronic storage medium, which stores documents in an audit-proof and consistent manner in order to reduce heterogeneous file and data storage (C1).</td>
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<tr>
<td>(DP3) …models that specify the structure for records, which enable the unified storage and retrieval of data and documents. For this purpose, the models should be designed dependent on the guidelines of the donors and the type of TPFP (C1, C2).</td>
<td>derived through ADR</td>
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<tr>
<td>(DP4) …meta data models, which are adapted to the respective donors and a search function for selection of information (C2).</td>
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<tr>
<td>(DP5) …a workflow component, which is tailored to the views of process involved parties and allows the execution of processes in order to obtain a higher productivity within TPFPs (C3, C4).</td>
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<tr>
<td>(DP6) …a role and rights concept in order to control and restrict all activities of TPFP stakeholders to the field of functions and organizational affiliation (C5).</td>
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<tr>
<td>(DP7) …reports, which are adapted to the guidelines of the donors and a project directory for supporting project controlling and management as well as decision support and monitoring of a TPFP (C6).</td>
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<tr>
<td>(DP8) …a system administration tool, which allows the maintenance of the TPFMS without touching the program code (C7).</td>
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Figure 5. Design Principles for a TPFMS

According to the design science paradigm, our design principles must be evaluated (Gregor and Hevner, 2013; Aier and Fischer, 2011). So far, we created a DREPT (propositions) and transferred this into design principles. Then we used ADR to validate the theoretically derived design principles and extended them (see figure 5) during the development of an artifact (EDMA). To provide evidence regarding our design principles, we demonstrate the validity of our DREPT for EDMA. For this purpose, we descriptively evaluate our artifact (EDMA) (Hevner et al., 2004) with respect to the identified problems (see figure 2). Thereby, we utilize our experience we have gained by the more than one-year practical use of EDMA. The system currently includes more than 900 records, 5,000 documents and 800 TPF-notifications. There are about 400 users at the university. Subsequently, we are able to draw conclusions regarding the validity of our propositions (DREPT) and thus our design principles. This is discussed in the following:

Due to the selected SAP solution the handling of EDMA is easy for users, because they already gained experiences with other SAP solutions. Besides that, a comprehensive training was conducted to provide know-how in system handling. Thus, the user interface can be deployed in an intuitive way (DP1). With the help of the developed record and meta data models users are able to provide and retrieve information in a structured manner and thus the project administration and documentation effort is reducible and the availability of information increases (DP3, DP4). Users can also provide and retrieve information regardless of the availability of a recipient (communication overhead reduction), because the system is available at any time and there is only one storage medium which integrates all relevant and actual information in an audit-proof manner (no heterogeneous file and data
storage) (DP2). Redundancies and inconsistencies can be avoided. Furthermore, regularity and traceability (according to the regulations of donors or university administrators) within TPFPs are improved, since there are clear defined record models. Due to the representation of the workflow of a TPF-notification it is possible to enhance the efficiency within this process (DP5). Before EDMA was integrated, the workflow was paper based and media breaks existed. Now the TPF-notification process is conducted electronically. All information is transported digitally from participant to participant. It is possible at any time to view the status of the process and thus increase transparency. Moreover, the developed role and rights concept allows the specific restriction of all activities of the users (DP6). Due to this restriction, it can be ensured that the project stakeholders only get access to the functionalities of EDMA which they actually need. The same applies to information retrieval or provision. Project stakeholders are not able to get information which does not belong to their research institute or organizational unit (unless it is part of the field of functions). Consequently, privacy requirements can be met. By provision of a controlling tool, scientists are able to monitor their research projects (DP7). So they notice early if there are funds available or whether the funds have already been exhausted. Thereby, financing problems with a donor can be avoided. With the help of our developed administration tools, administrators are able to maintain the IT-system (EDMA) without touching the program code (DP8). The tools are designed in an order that only customizing is necessary. This simplifies the handling for administrators in order that changes can be conducted rapidly and thus increases the availability of the IT-system (EDMA).

The mentioned aspects are derived directly from our experience in the operational use of EDMA. It turns out that the identified problems (see figure 2) are addressed and reduced. In respect to proposition 1 (see section 4.2) this means that information retrieval is simplified and the availability of information within a TPFP increases by using EDMA and thus information asymmetries are reduced. It was also found that processes can be accelerated by using EDMA (medium allows task closure) and thus productivity increases. Hence, the first proposition of our DREPT can be supported. Regarding proposition 2 (see section 4.2) the operational use of EDMA shows that local storage or archiving of information is not necessary anymore. All information is stored centrally in an audit-proof manner. In addition, provision of information is assisted (e.g., defined workflows, restriction to field of function) in order that EDMA allows a continuous information provision. Consequently, as mentioned before the project administration and documentation effort decrease and thus lead to decreased agency costs and a higher productivity. Therefore, our second proposition can also be supported and hence our design principles are valid in this specific case.

However, the special context in TPFPs and the associated organizational situation as well as problems (see figure 1 and figure 2) are the reasons why our specific design principles are needed. The implementation of IS, that support either document management, project management, or workflow management is not enough in this context. As discussed above, there is a need for an integrated usage of these IS in order to improve the situation and solve the present problems. We achieved an integration of these IS by implementing EDMA. Our generalized capabilities of EDMA (design principles of TPFMS) represent the basis for an implementation. Thus, other universities are able to adopt these design principles in order to develop a TPFMS which enhances the management of TPFPs. Consequently, our work can be classified as an improvement (Gregor and Hevner, 2013). In a more general view, it is necessary in DSR to describe a clear class of problems (McKenney and Keen, 1974) in order to place the work against prior literature and show the contribution (Sein et al., 2011; Gregor and Hevner, 2013). The given class of problem addresses a combination of document, project, and workflow management tasks. Thus, if a similar situation regarding document, project, and workflow management exists in other fields (see figure 1 and figure 2), our findings can be applied to these fields (Exaptation) (Gregor and Hevner, 2013) in order to achieve similar improvements (like reducing information asymmetries and agency costs or enhancing processes) as we got in context of TPFPs. For this purpose, in future research our design principles have to be validated in other fields and possibly expanded.
7 Contribution and Outlook

In this paper, we contribute to the knowledge base of e-Government by developing design principles for third-party funding management systems (TPFMSs) (Gregor and Hevner, 2013). Our objective was to identify the general requirements of a TPFMS at state universities (RQ1). To achieve this objective, we apply principal agent and task closure theory to our context (kernel theories). These theories build our justificatory knowledge (Gregor and Jones, 2007). Based on this knowledge, we deduce design principles using the framework of Kuechler and Vaishnavi (Kuechler and Vaishnavi, 2012), which allows a mapping between kernel theories and the domain of interest by creating a design-relevant explanatory/predictive theory (DREPT). In our DREPT, we proposed that TPFMSs reduce information asymmetries between third-party funding project (TPFP) stakeholders and decrease agency costs that occur by screening and signaling activities within a TPFP. To validate our theoretically deduced design principles, we take the action design research (ADR) approach (Sein et al., 2011) and build a TPFMS (called EDMA) which manages the administrative tasks within TPFPs. Subsequently, we were able to show the validity of our theoretically deduced principles. However, we find three additional design principles (DP6, DP7, DP8).

The second objective of this article was to explain how a TPFMS must be designed and implemented for supporting a third-party funding process (RQ2). To answer our second research question, we used the designed artifact (EDMA) from our ADR and outline the implementation details. Since EDMA includes the design principles, we show that the propositions of our DREPT can be supported and information asymmetries as well as agency costs can be reduced.

However, there are also some limitations. At first, we only used one case for validating our design principles. In order to get well-developed design principles respectively establish an information system design theory (ISDT), there is a need to validate the principles in further cases. Especially some cases in other European countries are necessary to support the relevance and rigor of our design principles in the European context. It seems to us that the mentioned situation and problems (section 4) and the need for a solution are not only relevant to German universities. As already mentioned do other countries in Europe have a similar research system. In addition, donors like the European Union grant funds to universities all around Europe. Thus, it immediately suggests itself that our design principles are transferable or generalizable to other universities in the European area. This must be confirmed in future research. Second, we only evaluate our design principles descriptively by using our more than one-year experiences in operational use. Hence, in future research our design principles have to be evaluated empirically. In doing so, especially the adoption of the system has to be proven, since making the right information available is only one part of a successful system in public institution (Schaupp et al., 2009).

References


