

A METHOD FOR MANAGING IT-BASED BOUNDARY OBJECTS: DESIGN AND APPLICATION IN THE PUBLIC SECTOR

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Abstract

To achieve high-quality services offerings, public administrations need to cooperate with other institutions across organizational boundaries. The required cooperation may lead to a complex network including several of the thousands public administrations, enterprises and citizens on the different federal layers of a single country. Key challenge for achieving smooth end-to-end processes in such setting is a proper management of information exchanges at the interfaces between networked actors, as it is the exchange of information that glues together separated chunks of a process. This article conceptualizes the digital information assets residing at the interfaces between the different actors as IT-based boundaries objects. It further reports on a design research process that was initiated by the German Federal Ministry of Interior, which felt the need for a nationwide management method for those IT-based boundary objects. The achieved method extends the BOMOS framework as developed by the Dutch government and adopted by the European Commission. Notably, the method assists in designing and maintaining IT-based boundary objects while it takes horizontal and vertical division of competences in federal legislative and administrative structures into account. The main contributions of this article are the description of the method, the demonstration of its application, and an evaluation of its utility.

Keywords: Public administration, IT-based boundary objects, Information exchange, Standardization.

1 Introduction

Modern businesses and public administrations alike depend on business processes that go beyond organizational boundaries as networked business models became an indisputable reality in today's economy (Legner and Lebreton, 2007). Several empirical studies underpin this observation. For instance, Capgemini recently concludes that to be ready for 2020, companies need to "significantly increase their degree of collaboration as well as their networking capability" (Falge et al., 2012). Public administrations likewise need to cooperate with several other institutions or people such as other public administrations, private enterprises, and citizens in order to deliver services to their clients (EC, 2004). Smooth end-to-end IT support across organizational boundaries is needed so that service can be provided efficiently (EC, 2004). In order to glue together the separated chunks of such business processes, the exchange of purposeful information is needed (Zhao et al., 2007) that is standardized in a way so that each partner in a value chain can make sense of it (Rukanova, 2005).

The management literature suggested the concept of *boundary spanners* for analyzing how to bridge organizational boundaries between diverse communities of practice of the described kind. While boundary spanners can be either individuals that perform boundary-spanning roles (experts that facilitate sharing of expertise between communities) (Levina and Vaast, 2005) or artifacts, this article will concentrate on the latter kind. The term *boundary object* is used in this paper to denote artifacts for the transfer of knowledge and information at the interface of different communities. Design drawings, physical prototypes (Carlile, 2002; Star, 2010; Star and Griesemer, 1989), and standardized forms have been quoted as prototypical boundary objects in previous studies (Griesemer and Leigh Star, 1989). This article further concentrates on a subset of boundary objects which is maintained, provided and consumed through information technology, and is called *IT-based boundary objects* (Becker et al., 2013) including examples such as standardized digital forms, data elements, reference processes, vocabularies (code lists/ontologies). In a networked business scenario, designated IT-based boundary objects will have to cater for at least two purposes to become actual boundary objects in-use (Levina and Vaast, 2005). They need to maintain a single *shared identity* for all involved participants while at the same time maintain the flexibility to be *locally useful*, so that diverse individual needs of the participants can be met (Star and Griesemer, 1989).

In public administrations, important (non-IT-based) boundary objects include forms, records, (floating) files, descriptions of administrative procedures, and output documents (e.g., ID cards or notifications). Important IT-based boundary objects are e-forms (such as online forms or PDF forms), electronic records, electronic files, digitally designed process models, and electronic output documents (such as receipts and certificates). Notably, the boundary objects "constitute the inputs or outputs of a service or are involved during their execution" (Sourouni et al., 2008 p.343). IT-based boundary objects may feature a hierarchical structure as they may include other boundary objects. For example, an e-form may consist of several fields/checkboxes and field groups.

Wenger (1998) argued that boundary objects can contribute to shared identity and local usefulness due to four characteristics: Modularity, i.e., stakeholders use only that subsets of the provided information which is needed for their tasks. Abstraction, i.e., boundary objects may abstract from details that are not relevant to all stakeholders. Accommodation, i.e., information is generic enough to assist different activities. Standardization, i.e., it is interpretable by diverse stakeholders due to, e.g., standardized codes.

However, at the same time these characteristics make the management of IT-based boundary objects challenging in two ways. The first *challenge (A)* refers to reusability and interoperability of boundary objects, which is due to their modular structure and the existence of interrelation between different boundary objects. The second *challenge (B)* is due to the many stakeholders of the boundary objects and that their interests and demands towards the boundary object may differ. Against the background of these challenges, the European guidelines for management and government (BOMOS) give advice

to the management of IT-based boundary objects (Folmer and Punter, 2011). While BOMOS is a collection of best practices on topics related to the management of IT standards, it is lacking best practices on certain aspects, including the operational management of IT-based boundary objects.

The objective of this research therefore is to extend BOMOS through the design of a method for the operational management of IT-based boundary objects. The two main contributions of this article accordingly respond to each of the two described *challenges A and B*. With regard to *challenge A*, the proposed method features a generic process model for the management of IT-based boundary objects. With regard to *challenge B*, the proposed method suggests a role model which assists in including the diverse stakeholders of the boundary objects.

The remainder of this article is structured as follows: Section 2 provides research background on the management of IT-based boundary objects and the BOMOS model. Section 3 explains the method and the setting of the presented research. Section 4 states objectives towards the desired method before Section 5 reports on the method's actual design. Section 6 demonstrates the application of the method in a fictitious case. Section 7 is the evaluation that gives evidence to the methods utility. Section 8 concludes and provides a brief research outlook.

2 Research Background

In order to achieve the ultimate goals of shared identity and local usefulness, IT-based boundary objects require ongoing maintenance as the users' requirements change continuously (Steinfeld et al., 2007) and the objects will keep evolving as new IT-technology arrives (Steinfeld et al., 2007; Zhao et al., 2005). A purposeful management of boundary objects is of crucial importance. If it fails, the adoption and diffusion of a boundary object in practice can be expected to be low (Folmer and Punter, 2011). The concept of ensuring proper management of information assets is known as data governance (Ladley, 2012).

Research in the area of data quality suggests managing information as a product (Lee et al., 2006). This literature also suggests principles that are helpful for managing IT-based boundary objects. These principles include the need for understanding the customers' needs, assigning a product manager to information products, and establishing management processes based on a well-defined production process and life-cycle (Lee et al., 2006). However, setting up the actual management for high quality content and positive adoption is a daunting task, even if the mentioned principles are considered.

What is making this management task complex is the heterogeneous nature of both the boundary object and the preferences of potential stakeholders towards the objects (Zhao et al., 2005). The following subsections discuss both types of challenges and possible contributions of BOMOS for the management of IT-based boundary objects.

2.1 Heterogeneity of IT-based Boundary Objects

IT-based boundary objects are heterogeneous information structures due to different reasons (Damsgaard and Truex, 2000). A boundary object can often be decomposed into other boundary objects. (E.g., a digital form may consist of standardized data fields, which can be seen as different boundary objects.) IT-based boundary objects are also often layered constructs (Albrecht et al., 2005). A layered approach increases reusability and interoperability as it facilitates the use of general concepts (for reusability) and specific solutions (for interoperability). A layered approach can implement different types of hierarchies including the following or any other combination:

- *Country level*: International, European, National, Regional, Municipality
- *Domain level*: Industry, Industry Sector, Profession, Functional Area (e.g., Procurement)
- *Content level*: Legal, Organizational, Semantics, Technical

Examples of initiatives where a layered design approach was followed include the following: European invoice standards; international reference processes for the electro technical industry (RosettaNet); forms of municipal public administrations containing data elements standardized by the UN/CEFACT; domain vocabularies for government, logistics, chemical industry that have implemented UN/CEFACT Naming and Design Rules. (See <http://semic.eu> for many European government-related IT-based boundary objects.)

Accordingly, an IT-based boundary object is a complex asset consisting of multiple components (tied together within an architecture), that might be owned and maintained by different organizations with different maintenance processes that do influence each other but are not necessarily aligned.

2.2 Diversity of Stakeholders and Their Interest

To ensure that IT-based boundary objects meet business needs, the participation of representative members of heterogeneous user groups is needed while the natural tendency to splinter into rival homogeneous groups needs to be avoided (Markus et al., 2006). Thus, the challenge is to involve all stakeholder groups (and thus not all individual stakeholders) and to make sure that they do not drift apart during standardization. This can be achieved by finding a way to ensure the collective participation of representative members of heterogeneous user groups. Each IT-based boundary object initiative therefore should develop a set of tactics that brings together the development and the adoption dilemmas. The chosen tactics for development will influence the adoption of the standard as the tactics for development will influence the content (quality) and, thereby, again the standard's adoption (Markus et al., 2006).

However, stakeholders are often not addressed properly and lacking commitment in practice. How to deal with different kinds of stakeholders within the development and maintenance processes is often considered to be problematic (Folmer and Punter, 2011). There is a variety of stakeholders, and even within a specific kind of stakeholders, individual organizations might differ substantially (e.g., regarding market share, innovation-readiness, etc.). Also, the business cases differ for each stakeholder, just as the knowledge levels do. Software vendors are often “forgotten” while their knowledge is highly valuable and essential for adoption.

Especially in the government world, openness is a key requirement in this context. Openness deals with involving all stakeholders. The challenge is to create a structure that does not exclude certain stakeholders, but also avoids a deadlock situation in which nobody decides and everybody is equal.

2.3 The BOMOS Management and Government Model

While originating from a Dutch government setting, BOMOS has been adopted by the European Commission (ISA/JoinUp) to become a European approach for developing and maintaining open standards. BOMOS is intended to be used in open standardization projects and has a strong focus on semantic standards. In recent versions (Dutch Standardisation Forum, 2012) BOMOS has been applied for the standardization of a broader range of information objects including IT-based boundary objects. Figure 1 depicts the main asset of BOMOS: a normative framework of activities required for the development and management of an open standard. It includes three core areas: strategy, tactics, and operational, which are flanked by two supporting areas of activities – communication and implementation support. The implementation of development and management activities is situation-dependent. This includes that not all of the elements have to be implemented in each situation necessarily, or in similar ways. In essence, BOMOS is a collection of best practices for activities. The core activity areas are described briefly below.

The *strategy* area summarizes activities related to the long-term management of the standard. The *tactics* area is concerned with maintaining a community, an adoption strategy and a quality policy as well as setting up property rights and defining architecture guidelines.

The *operational* area is concerned with executive activities that lead to new versions of standards. First, the initiation addresses the identification of new ideas (e.g., for a new specification or new working group) and all activities associated with setting them up successfully (e.g. analysis of interests, business case, agenda). Second, the draft of the requirements of the specification needs to be developed and managed. Third, the development follows. On a conceptual level, the intrinsic development of solutions for the ideas, preferences and requirements set during previous phases need to be merged. These solutions are intended to be further elaborated in the specification or a new version of it. Fourth, execution refers to implementing the actual amendments based on the conceptual solutions in the specification. Finally, documentation provides a suitable reflection of the results of the primary management process.

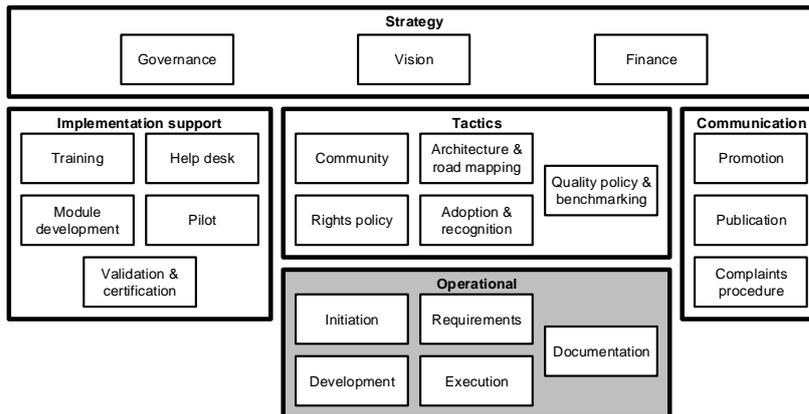


Figure 1. BOMOS activity model.

2.4 Operational Management of IT-Enabled Boundary Objects with BOMOS

While obviously all the described activity areas are of crucial importance for a successful management of IT-based boundary objects, the focus of this article will be on the operational level. Related to the problem description, two main contributions of BOMOS can be expected.

Firstly, BOMOS is likely to help defining the operational management process of IT-enabled boundary objects. However, while BOMOS addresses the topic and emphasizes its importance, unfortunately BOMOS does not cover it with enough detail for an implementable solution. Accordingly, there remains the need for designing an operational management process. Subsequently, we will report on the development of such a process, which may become part of BOMOS in the future.

A second important issue mentioned in the problem description is the involvement of the standard's various stakeholders. BOMOS again offers support for this challenge in the form of ideas for stakeholder involvement in roles. BOMOS advises to use a stakeholder analysis. This tool can be helpful by identifying the stakeholders that need to be involved in setting up the IT-based boundary object, but is also useful for predicting and influencing the adoption of the object in a later stage. Moreover, BOMOS is stressing the importance of openness, and uses the work of (Krechmer, 2006) to increase openness. Openness is used to increase stakeholder participation by not excluding organizations at meetings and by having clear change procedures.

3 Research Method

3.1 Objective-centered Design Science Research Methodology process

This article pursues the Design Science Research (DSR) paradigm as its purpose is to help solving “identified organization problems” (Hevner et al., 2004 p.77) through the development of an innovative IT artifact (March and Smith, 1995), i.e. a method. From a researcher’s perspective, DSR implies a “learning through building” (Kuechler and Vaishnavi 2011, p. 126) approach, as the construction and evaluation of the artifacts is a means to study distinct phenomena in a certain research domain (Kuechler and Vaishnavi, 2008). This also includes, e.g., the management of IT-based boundary objects in public administrations.

Generally speaking, a research methodology gives advice to the “combination of the process, methods, and tools” (Nunamaker et al., 1991 p.91) to be employed in a research project. The Design Science Research Methodology (DSRM) has been proposed to guide the design and development of IT artifacts in DSR projects. The DSRM is based on a sound methodological foundation including previous work of authors such as Nunamaker et al. (1991), Takeaeda et al. (1990), and Walls et al. (2004). The methodology features a nominal procedure model that consists of six steps: First, the research problem is identified and motivated. Second, objectives of the solution are described by answering why and how the desired solution addresses the research problem. Third, the design and development of the artifact is described including, e.g., the specification of the solution’s functionality and design. Fourth, the demonstration shows that the general idea works – typically by solving “one or more instances of the problem” (Peffer et al., 2007 p.55) thereby indicating the solution’s utility. Fifth, the evaluation observes and measures “how well an artifact supports a solution to the problem” (p. 56) which can be done in different ways including quantitative studies or the comparison of an artifact’s functionality with the objectives prior to the design. Sixth, results need to be communicated to all the stakeholders of a research project. Peffer et al. suggest different phases as entry points into the procedure model depending on the nature of the research project. Problem-centered initiation means that research is triggered as the researcher observes a certain problem or taps into future research needs from prior projects. Objective-centered initiation is triggered externally by an industry or research need. In case of design-and-development initiation researchers try adapting artifacts so they can be used in a different problem context. The client/context-centered initiation is chosen to apply rigor to the development of an artifact retrospectively.

This article follows an objective-centered initiated DSRM process in order to develop a method for the management of IT-based boundary objects, because the need for the method was observed by the German Federal Ministry of Interior and the researchers were contracted for the development of an appropriate method. The subsequent sections report on the activities and outcomes of the distinct steps prescribed by the DSRM. Section 4 defines the objectives of the desired solution. Section 5 describes the design and development of the artifact. Section 6 demonstrates its application. Section 7 is the evaluation of the method’s effectiveness with regard to the objectives of the desired solution.

3.2 Project setting

The quality of information provided by public administrations is essentially important. It has to follow the criteria correctness, comprehensibility, actuality, and accessibility. The general idea of the project called “Federal Information Management (FIM)” is to address these criteria and – besides the conceptualization of the information structures – to set up a procedure model and guidelines for the creation and maintenance of IT-based boundary objects relevant for the public sector. These IT-based boundary objects are related to the three areas “descriptions of public services” (e.g., textual descriptions or input/output objects), “processes” (e.g., process models), and “forms” (e.g., complete forms or single fields within a form). The proposed procedure model and guidelines have to cover the creation,

maintenance, and use of these IT-based boundary objects with respect to the competences and responsibilities distributed over the three federal levels of Germany. The project FIM was initiated by the German Federal Ministry of Interior in summer 2011 and its duration is set from 2012 to 2015. Currently, the concept development phase of the project is completed and the implementation phase has begun.

4 Objectives of the Solution

Since our study follows an objective-centered initiated DSRM approach, the objectives of the desired solution are directly derived from the specific demand of the project. The overall objective is to provide a concept for managing IT-based boundary objects in and between public administrations in order to facilitate smooth end-to-end IT support across organizational boundaries for more efficient public service provision. It is intended that this concept for managing IT-based boundary objects can become a detailed implementation of the “operational process” as introduced in BOMOS. The project's principal stated the following questions at the beginning of the project:

- Which users and user groups (stakeholders) will be necessary for creating, maintaining and using IT-based boundary objects?
- Which actions/activities will be necessary for the creation, maintenance and use of IT-based boundary objects?
- How will the activities be performed?
- Who will be allowed to use and adapt the information?
- How will the changes be implemented?

Based on these questions, we derived a generic set of both functional and non-functional requirements, including their rationale. This was done iteratively in the course of several intense workshops with experts from practice (especially from public administration and the related software industry). Although the requirements were elaborated in a public administration context, they seem to be generically applicable to all situations where different types of IT-based boundary objects have to be managed on different hierarchy levels.

Requirement	Rationale
<i>Functional</i>	
REQ 1: The solution has to cope with hierarchies/different decision levels	We know that objects exist from different components with different owners on different levels. Even the semantic content can be the responsibility of a specific level of hierarchy (e.g. municipality, state, federal), which the management model should accommodate.
REQ 2: The solution has to cope with different types of IT-based boundary objects (such as forms or processes)	Although all IT-based boundary objects, a form has its own characteristics in comparison to a reference process. The management process has to be generic enough to handle a wide range of IT-based boundary objects, and not too specific for only form (as example).
REQ 3: The solution has to cope with different abstraction levels of IT-based boundary objects (e.g., instantiation, model, meta-model, and meta-data/guidelines)	Even related to the same object (e.g. a form), we deal with several abstractions, such as the actual instances, the model, metadata, process guidelines, etc., that all have to be managed by the defined process.
REQ 4: The solution has to be able to differentiate between major and minor issues	Not all changes are the same. Some are fixes of errors, some are new functionality, and some are nice to have, while others are essential to comply with law. The process has to deal with this, not implying that all issues have to be dealt with in the same way.
REQ 5: The solution has to provide	Not all stakeholders should be allowed to make all kind of changes and

a comprehensive rights and role management	decisions. The rights should be dependent on the role being assigned.
<i>Non functional</i>	
REQ 6: The solution has to be flexible in the sense of fast and uncomplicated update procedures	The process may not become cumbersome that it takes months to implement changes. The approach should be practical in the sense that changes do take a minimum in time and effort to implement, and not leading to an abundance of changes.
REQ 7: The solution should support and align with the adoption of IT-based boundary objects	The management process should not hinder adoption (implementation in practice) of IT-based boundary objects. Actually, it should be designed in such a way that there is maximum benefit between management process and adoption of the objects.
REQ 8: The solution has to be open for further stakeholder involvement	Not only as prerequisite for openness, but mainly in order to improve both quality and adoption of the boundary objects, is it necessary to include a wide-range of stakeholders.

Table 1. Fit of Requirements.

5 A Method for Managing IT-based boundary Objects

Based on these requirements, the researchers designed a method with the intention to guide the creation and maintenance of IT-based boundary objects. This innovative IT artifact particularly consists of a procedure model that implements the common separation of duties in federal legislations on different hierarchical levels (cf. REQ 1) and, therefore, makes a purposeful extension to the BOMOS framework on the level of operational management.

From a top-down perspective, IT-based boundary objects can be created as reference objects (analogously to the concept of a reference model in the domain of conceptual modelling (Becker et al., 2004)), meaning that they can be adapted and provided as more specific reference information objects for the subsequent levels (top-down cascade). In Figure 2, this is represented by the arrows that point to the next levels on the “reference information”-layer. Additionally, on following levels, reference information objects can be instantiated as concrete IT-based boundary objects that can actually be used and applied. This is represented by the arrows that point to the next levels and go from the “reference information”-layer to the “information instance”-layer.

From a bottom-up perspective, the need for new IT-based boundary objects, or for changing existing objects, can be passed on from lower levels to higher levels (bottom-up cascade). This is represented by the large arrow at the bottom of Figure 2.

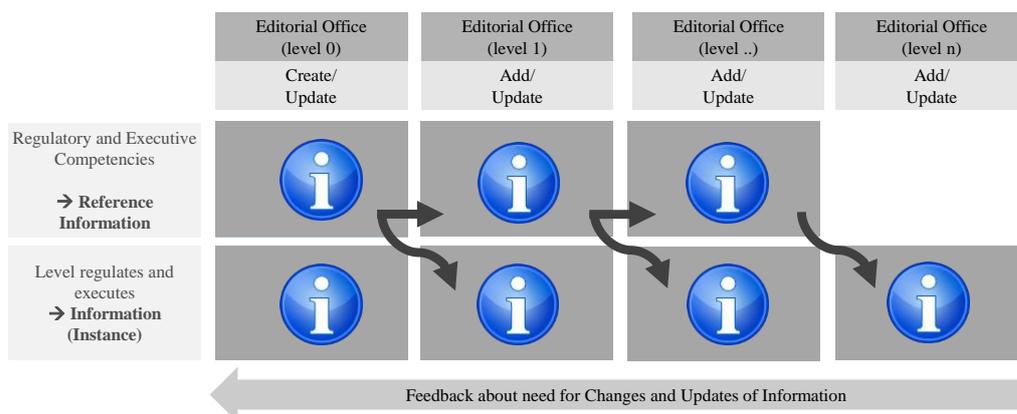


Figure 2. Procedure model principle.

Besides the decision levels, a *coordination unit* is to be implemented which is methodologically responsible for the entire concept. This coordination unit takes care about the valid usage of all elements

necessary to create information and is able to assure the quality of the created information. For quality assurance from a content perspective, it has the right and capability to involve officials from the responsible organizations of the corresponding decision level.

For further specification of the procedure model on every decision level, *editorial offices* have to be defined, which are in close contact to the coordination unit. The following roles are necessary within these offices:

The *Information Manager* is the coordinator of all tasks on a specific decision level. He is responsible for the entire process on his level and collects every request for changes or updates or coordinates the implementation of changes given by a higher level. For this, he has to be able to evaluate whether a request for changes from his level has to be addressed on the same level or if he has to hand it over to an information manager on a higher level. He is allowed to advise other roles on the same level and provide them with tasks necessary to implement changes or updates. Finally, he is the single point of contact for the central coordination unit for his decision level or his organizational unit.

The *Creator* of the IT-based boundary objects has to be an expert for a specific topic within his decision level resp. organization on a certain decision level. So there will be several instantiations (on person) of that role. The Creator will set up reference information objects and – together with a method expert – assure the quality. He has to be able to collect relevant information and is able to apply the methods to create and update IT-based boundary objects.

The *Method Expert* will support creation and maintenance of (reference) information objects. He is the authority for methodological quality assurance and in regular exchange with the Creator who is responsible for the quality. He will teach the Creators how to use the underlying mechanisms and methods and advise them in the creation and update phases.

The *User* of information will instantiate reference information objects and will adapt them while using the underlying mechanisms and methods.

Based on this organizational structure and these roles, 11 activities have been defined (cf. Table 2) for every decision level (cf. Table 2), which describe the overall editorial process starting from the announcement of a change request going to the final implementation of a change. Depending on the reason for a change request, there are different entry points for the process.

Activity	Description
<i>A1/A2: Handing in of a change request</i>	Requests for change can be handed in by a Creator or a User of information.
<i>A3: Consolidation of a change request</i>	The Information Manager picks up the request for changes, checks it, and decides whether it can be solved on the same level or whether it has to be handed over to a level above. Depending on the level, the request for changes can come from a Creator or User from the same level or from the level below.
<i>A4: Assignment of a change request</i>	The Information Manager picks up the request for changes, checks it, and decides whether it can be solved on the same level or whether it has to be handed over to a level above. Depending on the level, the request for changes can come from a Creator or User from the same level or from the level below.
<i>A5: Prepare and send change request</i>	If the Information Manager has to assign the request to a level above or the coordination unit he prepares a decision letter and sends it.
<i>A6: Prepare changes from a method's perspective</i>	If the change request can be solved on the same level, it will be handed over to the method expert who has to check the request and has to prepare everything necessary from a methods perspective.
<i>A7: Get new/updated information from a level above</i>	If – either after a request was handed over to a level above and solved or based on changes in other areas – a major update of information is necessary, the information manager of a certain level gets the information manager(s) of the anterior level.
<i>A8: Prepare and perform changes</i>	After either activity A6 was performed or activity A7 was performed the responsible creator of information has to check and implement necessary changes.

A9: <i>Quality check</i>	The method expert will get the result of activity A8. He will check it from a method's perspective and either accept or reject it. If he rejects, he will assign it back to activity A8.
A10: <i>Final approval of changes</i>	If the quality check was successful, the Creator of information will finally approve it.
A11: <i>Use changes</i>	Approved changes will either be handed over to the users or be handed over to the level below (see activity A7). If it is handed over to the users, they will check and adapt the changes.

Table 2. *Fit of Requirements.*

Following the cascade, every change request has to be announced to the next higher level, if the current level is not responsible. To shorten this principle for trivial issues, it is allowed to directly hand it over to them without following the complete cascade over all hierarchy levels.

Similarly to the fact that not every change request needs a complete bottom-up process until it reaches the coordination unit, not every change request needs a complete top-down process. For this, we distinguish incidents in *major* and *minor changes*. If the changes are minor ones and not critically important for the correct use of information (e.g., a spelling mistake is corrected or a description is just clarified), the coordination unit can decide to not follow the complete process but to just publish the change. This would skip the check and validation on every level and directly sets the change into use.

Finally, we have to remark that in case of more complicated and bigger changes it could be necessary to completely abstract from the defined and standardized editorial process and to set up a project to define changes including stakeholders from several levels within the complete structure.

6 Demonstration

The following section will demonstrate the applicability of the proposed approach. This is done by describing how the procedure model from section 5 was applied in a fictitious case. The model was instantiated in a German public administration project on information management called 'Federal Information Management (FIM)'.

The following example shows how the procedure model addresses a change request for a single IT-based boundary object resulting from a change in a directive of the European Commission. The trigger for the fictitious change request is a change in EU law regarding the export of firearms. The EU Directive No. 258/2012 is restricting and regulating the production and trade of firearms. This made it necessary, amongst other things, to modify the existing application form for the permit to export firearms (by adding another attachment to the form). The respective form is the IT-based boundary object that has to be changed according to the procedure model for major changes.

Act.	Description
A2	The change request is stated by the German Federal Office of Economics and Export Control (BAFA) on federal state level.
A3	The Information Manager receives the change request. He checks whether there are other, similar change requests that can be consolidated with the change request at hand. This is not the case in this example.
A4	Since the request was stated on federal state level, it is not necessary to check whether the request has to be handed to the next higher level. This would have been necessary if the request was stated, e.g., on local government level. However, on federal level it is necessary to check whether the change may affect other administrative departments on the same or on lower federal levels. Besides this, it is necessary to ensure compliance with quality criteria of new IT-based boundary objects. Therefore, the Information Manager delivers the change request to a higher organization unit which is called Coordination Unit (A6/A7).
A5	The Information Manager is now delivering the change request to the Method Expert on federal state

	level. The Method Expert prepares the change from a methodological perspective. The type of preparation depends on the type of change request and the type of IT-based boundary object. In the case of changing an application form, the Method Expert attaches certain content-related and technical guidelines for the modification of forms to the change request. This will help the Creator with implementing the changes later in the process.
A6	The Information Manager also delivers the change request to the Coordination Unit. If the change request would have been made on a lower federal level, the Information Manager at this point would hand the request over to the Information Manager of the next higher federal level. The check by the Coordination Unit in this example reveals that the change is only affecting one specific form in one department on federal state level.
A7	The result from the activities of the Coordination Unit is communicated back to the Information Manager. The Coordination Unit created a reference object (form template), which now can be instantiated by Creators and Users. The Information Manager informs the respective Creator that he can use the form template during his modifications of the application form.
A8	The Creator receives the methodically enriched change request from the Method Expert. He now implements the modifications of the respective form in the system. Therefore, he creates the form attachment by using existing form fields (and field groups) and/or by creating new form fields (and field groups). During this process, he is closely linked with the Method Expert who is advising on the methodological implementation of the changes (e.g., in the information system).
A9	After the changes are made, the resulting modified form has to pass a methodological quality check by the Method Expert. The Method Expert approves of the modifications (if not, he would have sent the form back to the Creator with respective annotations).
A10	After the methodological approval, the Creator can give his final approval. Since the modifications only affect one department on federal state level, they do not have to be communicated to the next lower federal level. They are now ready to use by the User.
A11	The User (German Federal Office of Economics and Export Control) uses the modified form to in his public services.

Table 3. Fit of Requirements.

7 Evaluation

This section contains an evaluation in three parts: First, the demonstration of the previous section is evaluated. In the second part, we discuss our proposed method in relation to the requirements, and in the third part, the method will be discussed while being related to other scientific work.

7.1 Evidence from stakeholders' feedback

We evaluated our proposed procedure model (cf. section 5) by continuously discussing it in three different focus groups and by incorporating the resulting feedback and modification suggestions. This ensured the applicability and utility of the solution. The three groups represented three different aspects, namely organizational aspects, user requirements, and further stakeholder requirements:

(1) The first group consisted of decision makers as well as domain experts and IT experts from the state, federal states and municipal level, who took the role of a steering committee. This group was founded by the so-called central German IT-board and focused on organizational aspects of the solution. They discussed, e.g., matters of competencies and provided valuable feedback that was incorporated by the research team. The group held two all-day workshops (in the conceptual phase and in the later project phase) where the status of the solution was discussed.

(2) The second group mainly consisted of decision makers from the municipal level, representing the later users of the proposed procedure model. The project's principal appointed this group. They held three all-day workshops (at the beginning, in the middle and at the end of the project) where they provided feedback from a user's perspective, especially regarding the feasibility of the solution's process steps (A1-A11).

(3) The third group contained stakeholders from public administrations coming from all federal levels, from relevant industrial stakeholders and from other stakeholders like standardization organizations. Those stakeholders were integrated in an early stage of the project and provided valuable feedback for different aspects. In the two all-day workshops (at the beginning and in the middle of the project), especially matters of technical feasibility were discussed by industry-related members of the group. Again, the feedback from these workshops was incorporated into the solution by the research team.

The process of documentation and incorporation of the feedback was conducted similarly in all workshops of the three groups. Summary minutes were created for every workshop, which contained the main modification recommendations. The respective group was always asked to approve the minutes directly after the workshop. The approved minutes were then analyzed by the research team regarding feasibility, validity and value of the recommendations. Afterwards, the research team operationalized the recommendations from the workshop minutes. Finally, the operationalized modifications were discussed with and approved by the project’s principal before they were integrated into the solution.

Besides these minutes, the proposed procedure was documented in two main project documents. The first document contained a detailed requirements analysis and a to-be solution for the procedure model. The second document contained a detailed description of the final solution. Both documents served as a basis for the discussions in the respective focus group workshops and for the subsequent modifications.

By conducting such intense discussions and maintaining short feedback cycles with different groups (representing three different aspects of the solution), we can assume that a practical application of the final solution is feasible and valuable. Therefore, this constitutes first evidence for the solution’s overall value.

7.2 Fit to objectives

In this section we describe if and how the requirements stated in Section 4 (cf. Table 1) are met by the proposed method. Table 4 summarizes the discussion for each requirement.

Req.	Fit
REQ 1	The cascade in the proposed method allows to have unlimited hierarchy and number of decision levels.
REQ 2	The editorial process is so generic that it can cover all types of IT-based boundary objects. It might even be argued that the process is useful in a much broader sense than only IT-based boundary objects.
REQ 3	Again the process model is generic and useful for all types of IT-based boundary objects. More particular the model distinguishes reference objects with the instances (e.g., form template and specific form).
REQ 4	A distinction between major and minor changes has been implemented in the process. For minor changes of IT-based boundary objects, the check and validation process is significantly shortened. Major changes of IT-based boundary objects usually have to run through the cascade. Fundamental changes of the process itself or the guidelines are conducted outside of the process in individual projects. In future more sophisticated differentiation can be added when practice shows this is needed. Also steps can be taken to align version management in this process.
REQ 5	Four roles (Information Manager, Creator, Method Expert, User) have been introduced, each having different rights and responsibilities.
REQ 6	Four roles and eleven steps is a rather straight forwarded process model and not complicated. The process itself is not a limitation for a fast procedure. However, since there are no time limits defined for each of the process steps, the process cycle time also depends on the individual performance of the roles involved. In future maximum time slots might be added to avoid that the process halts at a certain step. There is a risk that this might happen especially when changing the level in the cascade.

REQ 7	The cascading principle, but also the pragmatic approach and the well-defined process will lead to an involvement of major stakeholders, provide trust, and by that improve adoption in practice.
REQ 8	The approach is open for government involvement on all levels because of the cascading principle. It further provides interfaces for the involvement of software suppliers of form solutions. IT-based boundary objects will be defined in a standardized and open way so that they can also be used by external stakeholders. The process in principle even allows for external stakeholders to trigger change requests for certain IT-based boundary objects.

Table 4. *Fit of Requirements.*

8 Implications, Conclusions & Further Research

This work proposes a generally applicable and flexible, cascading management process model for IT-based boundary objects, including role descriptions. It is both a knowledge contribution to the area of management of IT-based boundary objects, and a practical addition to existing work. To increase adoption of this management process, we propose to make it part of the BOMOS best practices of management and governance of IT-based boundary objects. Thus, it can be combined with other practical solutions related to IT-based boundary objects, such as setting up a finance model, implement openness, quality checks, etc. It will then become a comprehensive solution for the organizations involved in managing and governing IT-based boundary objects.

Setting up a management of IT-based boundary objects is often neglected although it is of major importance for the adoption success of the objects. Developing IT-based boundary objects is financially often better supported in projects than defining according management processes. However, a proper management process is crucial so that designated boundary objects become boundary objects in-use. In subsidized projects aimed at the development of IT-based boundary objects for governments it should become mandatory to set up the management procedure as early as the design phase of IT-based boundary objects (Folmer and Punter, 2011).

The management of IT-based boundary objects is crucial for providing high-quality service offerings to the public administrations' clients. This is due to the many actors involved in the service delivery and due to the fact that they actually connect separated process chunks in value networks. However, this management task is complex because of the heterogeneous structure of the boundary objects and stakeholders who may differ in views and requirements towards the objects. In response, this article reports on the development of a method that takes into account the particularities of federal administrative and legislative structures by implementing a cascade and suggesting a domain specific role management approach. The method is a detailed solution for handling the operational (management) process which is part of BOMOS but currently lacking detail, and therefore the suggested method is also expected to be an important step for making the BOMOS approach better applicable in practice.

Like any research, this research has limitations, which will be addressed by the plans for further research. The demonstration in a fictitious scenario and the evaluation through stakeholders' feedback and fit to the objectives provides evidence to the applicability and utility of the method. However, our proposed method and its application in the public sector need evaluation in practice. This evaluation is in progress and first insights show that many parts of the procedure model are working well. Additionally, we have to validate the cascade and its application in the real world quite carefully. The question is: Will the processes be manageable? Further, aspects from the BOMOS framework may provide valuable input on operational level, which can be used and integrated. For instance, BOMOS contains best practices on release planning (bundling of changes/updates), which could be combined and integrated with the proposed method. This fits in current plans being discussed on European level to work on a new integrated version of BOMOS, including validation in broad range of European government settings. Speaking in design science terminology, more build & evaluate iterations are needed. Nevertheless, the current results are ready to be used in practice to improve and guide the management processes of IT-based boundary objects.

References

- Albrecht, C.C., Dean, D.L. and Hansen, J. V (2005). Marketplace and technology standards for B2B e-commerce: Progress, challenges, and the state of the art. *Information and Management*, 42 (6), 865–875.
- Becker, J. et al. (2013). Bridging the Gap Between Manufacturing and Service Through IT-Based Boundary Objects. *IEEE Transactions on Engineering Management*, 60 (3), 468–482.
- Becker, J., Delfmann, P. and Knackstedt, R. (2004). Construction of Reference Modeling Languages - A Framework for the Specification of Adaptation Mechanisms for Conceptual Information Models. *Wirtschaftsinformatik*, 46 (4), 215–264.
- Carlile, P.R. (2002). A pragmatic view of knowledge and boundaries: Boundary objects in new product development. *Organization Science*, 13 (4), 442–455.
- Damsgaard, J. and Truex, D. (2000). Binary trading relations and the limits of EDI standards: The Procrustean bed of standards. *European Journal of Information Systems*, 9 (3), 173–188.
- Dutch Standardisation Forum (2012). BOMOS2i: The practical approach.
- EC (2004). European Interoperability Framework for Pan-European eGovernment Services. IDABC, ed. Brussels, European Commission.
- Falge, C., Otto, B. and Österle, H. (2012). Data Quality Requirements of Collaborative Business Processes. In *Proceedings of the 45th Hawaii International Conference on System Sciences (HICSS)*. Hawaii.
- Folmer, E. and Punter, M. (2011). Management and Development Model for Open Standards (BOMOS) version 2 The Hague, Netherlands Open in Connection.
- Griesemer, J.R. and Leigh Star, S. (1989). Institutional Ecology, “Translations” and Boundary Objects: Amateurs and Professionals in Berkeley’s Museum of Vertebrate Zoology, 1907-39. *Social Studies Of Science*, 19 (3), 387–420.
- Hevner, A.R. et al. (2004). Design Science in Information Systems Research. *MIS Quarterly*, 28 (1), 75–105.
- Krechmer, K. (2006). Open Standards Requirements K. Jakobs, ed. *Advanced Topics in Information Technology Standards and Standardization Research*, 1 , 27–48.
- Kuechler, B. and Vaishnavi, V. (2008). Theory Development in Design Science Research: Anatomy of a Research Project. In *Proceedings of the Proceedings of the 3rd International Conference on Design Science Research in Information Systems and Technology*. Atlanta, Georgia.
- Ladley, J. (2012). *Data Governance - How to Design, Deploy, and Sustain an Effective Data Governance Program* Waltham, MA, Morgan Kaufmann.
- Lee, Y.W. et al. (2006). *Journey to Data Quality* Cambridge, Massachusetts, The MIT Press.
- Legner, C. and Lebreton, B. (2007). Preface to the Focus Theme Section: “Business Interoperability” *Business Interoperability Research: Present Achievements and Upcoming Challenges*. *Electronic Markets*, 17 (3), 176–186.
- Levina, N. and Vaast, E. (2005). The emergence of boundary spanning competence in practice: implications for implementation and use of information systems. *Management Information Systems Quarterly*, 29 (2), 335–364.
- March, S.T. and Smith, G.F. (1995). Design and natural science research on information technology. *Decision Support Systems*, 15 (4), 251–266.
- Markus, M.L. et al. (2006). Industry-wide Information Systems standardization as collective action: The case of U.S. residential mortgage industry. *MIS Quarterly*, 30 (SI), 439–465.
- Nunamaker, J.F., Chen, M. and Purdin, T.D.M. (1991). Systems development in information systems research. *Journal of Management Information Systems*, 7 (3), 89–106.
- Peppers, K. et al. (2007). A design science research methodology for information systems research. *Journal of Management Information Systems*, 24 (3), 45–77.

- Rukanova, B. (2005). Business transactions and standards: towards a system of concepts and a method for early problem identification in standard implementation projects. Enschede, University of Twente.
- Sourouni, A.-M. et al. (2008). Electronic Government. In Proceedings of the Lecture Notes in Computer Science 5184. 340–351, Berlin, Heidelberg.
- Star, S.L. (2010). This is not a boundary object: Reflections on the origin of a concept. *Science, Technology & Human Values*, 35 (5), 601–617.
- Star, S.L. and Griesemer, J.R. (1989). Institutional ecology, translations' and boundary objects: Amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39. *Social Studies of Science*, 19 (3), 387–420.
- Steinfeld, C.W. et al. (2007). Promoting e-business through vertical IS standards: lessons from the US home mortgage industry S. Greenstein and V. Stango, eds. *Standards and Public Policy*, 160–207.
- Takaeda, H., Veerkamp, P. and Yoshikawa, H. (1990). Modelin design processes. *AI Magazine*, 11 (4), 37–48.
- Walls, J.G., Widmeyer, G.R. and Sawy, O.A. El (2004). Assessing Information System Design Theory in Perspective: How Useful was our 1992 Initial Rendition? *Journal of Information Technology Theory and Application (JITTA)*, 6 (2), 43–58.
- Wenger, E. (1998). *Communities of Practice. Learning, Meaning, and Identity* Cambridge, Cambridge University Press.
- Zhao, K., Xia, M. and Shaw, M.J. (2007). An integrated model of consortium-based e-business standardization: Collaborative development and adoption with network externalities. *Journal of Management Information Systems*, 23 (4), 247–271.
- Zhao, K., Xia, M. and Shaw, M.J. (2005). Vertical e-business standards and standards developing organizations: A conceptual framework. *Electronic Markets*, 15 (4), 289–300.