IMPROVING THE REALIZATION OF IT DEMANDS: A DESIGN THEORY FOR END-TO-END DEMAND MANAGEMENT

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Abstract

With the growing penetration of IT and its critical role within organizations, the number of requests for IT services and solutions is steadily increasing. However, many companies lack a consolidated view of all these requests or demands. They also struggle to track and report on the conversion of demands into IT solutions. Given the importance of managing demands for effective IT landscape development and for satisfying business users, our research aims at developing a design theory for an end-to-end demand management process. It is based on an extensive action design research study involving experts from 13 companies. The main contribution is a set of seven principles that guide the effective design of IT demand management. By focusing on the process from the emergent demand to the ready-to-use solution, our work closes a gap in existing research which is fragmented into requirements engineering, project portfolio management, and IT governance streams.

Keywords: IT demand management, Requirements engineering, IT portfolio management, Design science, Action research
Introduction

Aligning IT and business is a necessary precondition for fully exploiting IT’s potential to realize productivity gains (Henderson and Venkatraman 1993; Kearns and Sabherwal 2006). While the importance of alignment is widely recognized, existing literature emphasizes the alignment between business and IT strategies, and between business and IT structures (Sabherwal and Chan 2001; Sabherwal et al. 2001). Little attention has been paid so far to the process of identifying business needs, translating them into adequate IT solutions, and aligning the supply of IT resources. However, many companies lack a consolidated view of all the requests or demands that IT receives, due to numerous entry channels and multiple processes for handling requests. They also struggle to track and report the conversion of demands into ready-to-use IT solutions. Although effective demand management is considered a core capability of proactive value-generating organizations (Croxton et al. 2002; Walters and Rainbird 2004), IT departments often act as an order-taker with a focus on singular user requirements or systems, and provide little transparency concerning the extent to which these requests are actually implemented and within which timeframes. This lack of visibility, traceability, and management of demands creates not only dissatisfied requestors and users, but also induces further problems such as inappropriate IT investments and a lack of business-IT alignment.

Although awareness of the need to improve and implement IT demand management (ITDM) is increasing in practice (Deloitte 2011; Oracle 2009), we still lack a scientifically grounded and holistic understanding of IT demand management. Existing research is fragmented, and the different research streams – requirements engineering (RE), project portfolio management, and IT governance – cover only partial aspects of the end-to-end process from emerging requests to ready-to-use solutions. This research gap is also underpinned by RE literature’s technical focus and recent critiques of RE approaches (see Hansen et al. 2007; Jarke et al. 2011). “Despite RE’s regularly documented and acknowledged importance, little work has been done on developing ways to improve the requirements process” (Niazi et al. 2008). Given the importance of managing demands for effective IT landscape development and for satisfying business users, our research proposes a design theory (Gregor and Jones 2007; Walls et al. 1992) for an end-to-end IT demand management process. It is based on a 31-month action design research study at a large automotive manufacturer and is complemented by an in-depth evaluation by demand management experts of 12 other organizations. This paper presents three main parts of our design theory: It starts by defining relevant IT demand management challenges and design goals. It then describes design principles as the main components of an IT demand management design theory and briefly illustrates the expository instantiation. Our design theory not only contributes to the scientific understanding of ITDM that previously received little academic attention, but also provides practitioners with advice on how to organize and improve their ITDM processes.

The paper is organized as follows: the next section reviews extant literature. We then outline our research approach and process. Next, we present our end-to-end demand management design theory in terms of the design goals, which represent the design theory’s purpose and scope, and seven selected design principles that should be applied to design IT demand management within organizations. We then present our evaluation approach and results. Finally, we provide our contributions to the IS literature, as well as for practitioners, and outline further research opportunities.

Theoretical Foundations

Prior research related to the management of IT demands or requests is diversified: Besides the myriad of IS development (ISD) methodologies (see Iivari et al. 2000), RE has a long tradition and focuses on how requirements are determined (Cheng and Atlee 2007; Pohl 2010). Project portfolio management (PPM) (Archer and Ghasemzadeh 1999; Jeffery and Leliveld 2004) and IT governance (ITG) (van Grembergen 2004) describe the collection and periodical planning of ideas and project proposals as part of IT management processes. ITDM is an emergent discourse emphasizing the different demand sources and their alignment with IT supply (Mercury 2006; Mohrmann et al. 2007; Symons et al. 2006). Since current research provides no theory-based understanding of ITDM, the next sections will first clarify our understanding of the terms demand and requirement. Thereafter, we will elaborate on the fragmented literature streams and the gaps with regard to the end-to-end concept of IT demand management.
**Requirements vs. Demands as Requests for New or Changed IT Solutions**

The RE literature (e.g. Robertson and Robertson 1999; Sommerville and Sawyer 2006) considers requirements as the basis for system development activities. The IEEE standard 610.12-1990 defines a requirement as “(1) a condition or capability needed by a user to solve a problem or achieve an objective (functional requirement); (2) a condition or capability that must be met or possessed by a system or a system component to satisfy a contract, standard, specification, or other formally imposed document (non-functional requirement); (3) a documented representation of a condition or capability as in (1) or (2).” While this distinction is frequently used in software development, it does not address the multiple facets of requirements formulation. Requirements can be formulated from two perspectives: as goals or problems to be discovered and documented, or as solutions to be specified for a given set of goals and problems (Bergman et al. 2002; Hansen et al. 2007; Pohl 2010). Furthermore, requirements can be refined on different levels of abstraction (Gorschek and Wohlin 2006). The maturity model CMMI (Carnegie Mellon Software Engineering Institute 2010) suggests the step-wise refining of stakeholders’ needs into customer requirements and, subsequently, into product requirements. Such customer requirements are the result of eliciting, consolidating, and resolving conflicts between the needs of the relevant stakeholders in a way that is acceptable to the customer. Product and product component requirements represent the refining of customer requirements into developer language; the developer uses these requirements to guide the design and to build the software.

While RE focuses on the conditions, capabilities, and specifications required for single systems’ developments, the demand management literature takes a broader scope, as depicted in Figure 1. It concentrates on the sources, forms, and impact of all kinds of requests on the entire IT landscape. A well-established classification in the sparse ITDM literature (e.g. Alonso et al. 2008; Alonso et al. 2009; Mohrmann et al. 2007; Symons et al. 2006) distinguishes between three types of demands: (1) strategic demands represent requests for new projects that will have a major strategic impact or be a major innovation by providing an organization with new products and services (e.g. new ERP solution or a new hardware technology); (2) tactical demands represent requests for routine or day-to-day activities that are difficult to forecast and anticipate (e.g. helpdesk calls, bug-fixing requests, and the onboarding of new employees); (3) operational demands, which represent requests from IT and its own internally driven activities with a focus on IT assets and their maintenance (e.g. improving the network security, adding storage capacity, and running software patches). In addition, Mercury (2006) considers application enhancements as requests for upgrades or revisions to existing applications and business processes.

For this study, we conclude: first, demands are all types of requests that call for new or changed IT solutions. Second, they are continuously raised by different stakeholders. Third, demands emerge in various forms and shapes on different abstraction levels, which must be refined during the process if a comprehensive understanding of the goals and constraints are to be gained and to provide a complete specification of the solution.

<table>
<thead>
<tr>
<th>Phases</th>
<th>Elicitation and collection</th>
<th>Evaluation, prioritization, and planning</th>
<th>Specification and realization</th>
<th>Deployment and operation</th>
<th>Limitations</th>
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<tbody>
<tr>
<td>Single project or IT system</td>
<td>ISD</td>
<td>RE</td>
<td>PPM</td>
<td>ITDM (93-10)</td>
<td>ISD: Single system development view RE: Over-mixation methods and techniques, lacking organizational integration PPM: Strong focus on portfolio and approval ITDM: Focus on sources and forms of demands (typology), no scientific grounding</td>
</tr>
<tr>
<td>Entire project portfolio or IT landscape</td>
<td>partly covered</td>
<td>fully covered</td>
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**Figure 1. Scope and Phases of End-to-end Demand Management vs. Related Research Streams**
From Requests to IT Solutions: The Lacking End-to-End Perspective

Organizations convert their IT demands into IT solutions via multiple steps, as depicted in Figure 1. RE mostly focuses on the first stages of the ISD process (IEEE 1997; IEEE 2008b) to prepare and support the design and development of a specific IT solution. It “is a cooperative, iterative, and incremental process, which aims at ensuring that (1) all relevant requirements are explicitly known and understood at the required level of detail, (2) a sufficient agreement about the system requirements is achieved between the stakeholders involved, as well as (3) all requirements are documented and specified in compliance with the relevant documentation formats and rules” (Pohl 2010). RE is mostly concerned with the different activities, techniques, and methodologies applied in this process (see Cheng and Atlee 2007; Pohl 2010).

The main RE activities are requirements elicitation, analysis and modeling, documentation or specification, as well as validation and verification. Moreover, requirements management activities, such as the identification of requirements traceability, as well as requirements organization and change management, complement the RE activities (see Cheng and Atlee 2007; Pohl 2010). In practice, many IT departments struggle to successfully manage and determine their stakeholders’ requirements because they face different kinds of uncertainty (Jarke et al. 2011): first, requirements identity denotes that the de facto customer needs are often not available, because stakeholders are unable to verbalize, do not know what they need and want, or their needs are inconsistent and incomplete (Salmans 2009; Sawyer et al. 1997). Second, requirements volatility implies that unplanned and uncontrolled requirement changes continuously impede successful requirements management and solution delivery (Kappelman et al. 2006). Third, requirements complexity – due to heterogenic stakeholder groups, various language domains, and different locations – also constrains requirements’ understandability and comprehension (Mathiassen et al. 2007). Fourth, requirements fidelity uncertainty denotes uncertainty about derivations taken from the world and applied to models (Jarke et al. 2011) and that, for instance, do not consider alternative IT solution potentials. Fifth, requirements monitoring uncertainty summarizes the difficulties with observing and analyzing the world, the requirements, and their alignment (Jarke et al. 2011), which are, for instance, due to a lack of alignment with the business strategy or of reliable requirements tracking processes (Kappelman et al. 2006). Examples of such RE challenges have been documented in a wide range of studies as they cause ISD projects to fail (e.g. El Emam et al. 1996; Kappelman et al. 2006; Standish Group International 2009). In this context, Kim and Peterson (2003) report an overemphasis on the technical aspects instead of a focus on organizational integration (i.e. the alignment of IS and business goals) as a contributing factor to ISD failure. Concentrating on RE’s technology and methodological aspects is therefore not the answer; technology integration within a coherent, integrated business and enterprise architecture is required (Finkelstein 2007; Hansen et al. 2007; Jarke et al. 2011). So far, ISD and RE literature “has maintained a focus on processes for the development of a single system and conceived it in isolation from the broader socio-technical ecology within an organization” (Jarke et al. 2011). Furthermore, Ebert (2006) notes that although RE research and practice “have paid a lot of attention to downstream processes around project execution, they haven’t sufficiently researched upstream processes, even though they’re also a part of RE. This is often because of these processes’ complexity (that is, their heterogeneous and overlapping ownerships, vague processes, and unclear impacts of stakeholders).” For example, RE is unavoidably intertwined with resource allocation and decision-making on IT investments.

Resource allocation and decision-making is addressed by project and project portfolio management. PPM starts with the collection, checking, and classification (pre-screening) of project proposals (Archer and Ghasemzadeh 1999; Jeffery and Leliveld 2004). An evaluation stage assesses an individual project – through, for example, a feasibility study – against the strategic objectives, and prepares the portfolio planning (Archer and Ghasemzadeh 1999). During portfolio planning, the optimal project mix is prioritized and selected, which includes budget and resource allocation, as well as the final portfolio decisions (Bardhan et al. 2004). Finally, during the project phases, PPM traces the approved projects through on-going portfolio monitoring. PPM focuses on processing strategic project proposals as individual demand entities without involving RE tasks that specify the entities’ contents. Furthermore, PPM literature mostly focuses on specific activities, such as the project selection (Frey and Buxmann 2011), instead of a continuous end-to-end process.

According to Symons et al. (2006), ITDM is “a critical IT governance process that extends beyond merely aggregating requests for IT resources.” Therefore, ITDM must understand the business needs and strategies to align the supply of IT resources. Additionally, ITDM facilitates meaningful conversations on costs and performance tradeoffs associated with the consumption of IT services and resources in order to
influence and modify end user behavior. Furthermore, ITDM supports the delivery of a portfolio of services based on a shared understanding and dialogue. Specifically, Symons et al. (2006) propose an ITDM cycle that IT departments could use continuously to align them with the end users. Mohrmann et al. (2007), as well Alonso et al. (2008) depict a similar understanding of ITDM. Mohrmann et al. (2007) describe ITDM best practices in healthcare IT projects by delineating what should be done in terms of (1) a defined and well-communicated intake and tracking process for all projects, (2) resource planning and allocation of the right resources in terms of having the right roles and skills level at the right time, (3) portfolio management to show the strategic alignment, financials, risks, and the required resources, all of which are based on executive decision-making, and (4) a governance process that seeks to establish resource managers, a resource allocation strategy, consistency in work planning and project management methodology, standardized resource roles and pools, as well as a reporting strategy, trainings, and communication.

To conclude, although the RE and ITDM literature specifically focus on identifying, evaluating, and tracing demands and requirements, they differ in scope (see Figure 1) and are currently not directly related to each other. They are also poorly linked with PPM and other “upstream” processes. Since ITDM is essential for the effective development of an IT landscape and the satisfaction of users, a shift is required from the system to the organizational perspective. This calls for investigating the end-to-end ITDM process from the emergent request to the ready-to-use solution.

Research Methodology and Process

Given our objective to develop prescriptive knowledge in terms of Gregor’s (2006) type V theory and to theorize the design of ITDM in organizations, we employ design science as the central research paradigm (Hevner et al. 2004; Iivari 2007; March and Smith 1995). It is important to note that our research interest goes beyond building purposeful artifacts (Hevner et al. 2004), and lies in deriving universal statements about ITDM’s design in complex organizational settings. More specifically, we aim at the classification, comparison, and further development of ITDM’s body of knowledge in terms of a design theory (Gregor and Jones 2007; van Aken 2004; Walls et al. 1992). Our design theorizing should thus not only contain goal-oriented prescriptions of ITDM artifacts’ design, but also knowledge to inform and justify the design (Gregor and Jones 2007; Markus et al. 2002; Walls et al. 1992).

We utilized action design research (ADR) based on the framework by Sein et al. (2011), which is a “research method for generating prescriptive design knowledge through building and evaluating ensemble IT artifacts in an organizational setting” (Sein et al. 2011). Our ADR approach covers four stages – as shown in Figure 2 – and we started solving immediate and relevant problems by employing purposeful artifacts, since these are regarded as the central basis of design theories (Gregor 2009). Stages 1 and 2 were conducted as a collaborative research study with a large car manufacturer, called “GerCar” in this paper, and focused on ITDM artifact design. For 31 months (September 2009 to April 2012), we have been working with GerCar to analyze their existing practices and issues with the goal to design a new ITDM process. Stages 3 and 4 were aimed at generalizing and formalizing our situated learning to a design theory and involved demand management experts’ in-depth evaluation of 12 other organizations.

We identified GerCar as a suitable candidate to support our general study goals because (1) of its willingness to cooperate and make multiple information sources available to researchers, (2) its IT department wished to solve its immediate ITDM challenges by implementing a consistent process, and (3) its heavy reliance on efficient and effective IT solutions in a complex organizational setting. Not only GerCar’s organizational structure with several global brands and global presence, but also its IT landscape can be characterized as very complex, as they involve more than 4,000 IT employees, 30 IT departments, 600 IT projects, and 1,000 IT systems. By not having an organization-wide, consistent, and controlled ITDM process, the large number of IT demands from the businesses and IT increases the complexity of the IT landscape continually, which also is reflected in redundant IT systems and functions at the different car brands and locations. To gain deep insights into the specific ITDM challenges and approaches, we made regular on-site visits (at two- to four-week intervals). The strong cooperation allowed us not only to make direct observations, to conduct semi-structured interviews, to access physical artifacts, such as organization-specific documentation and tools, but also to influence the organizational setting with the research results. Moreover, regular jour-fixes and workshops created a common understanding as well as a controlled design process for artifacts. We could thus capture a problem situation encountered in a
specific organizational context, construct ITDM artifacts that address a class of problems and are applicable to different GerCar locations and brands, as well as learn from this intervention.

The first building, intervention, and evaluation (BIE) cycle sought to develop an ITDM process model to be implemented in GerCar’s IT department. Given the shortcomings in related work, we analyzed existing process models from GerCar, software vendors, and the literature with regard to end-to-end ITDM. To analyze their content, we implemented – by means of tables – an a priori coding scheme, and constructed an alpha version ITDM process model. Simultaneously, we documented different views of the alpha version artifact – such as those provided by major decision points, result documents, integrated enterprise architecture practices, and roles –, as well as providing a consistent glossary. Concurrent evaluation and reciprocal shaping guaranteed the incorporation of additional knowledge from mutual organizational work practices.

The first BIE cycle culminated in a second BIE cycle, whose goal was not only to detail the existing artifact, but also to instantiate a more mature version in selected organizational units. Consequently, we intensively collaborated with one IT unit to develop an applicable and standardized method for their demand collection and management. We used consensus-oriented conceptual modeling (Becker and Niehaves 2007) with business process modeling notation (BPMN) to build a beta version ITDM process model. The organizational intervention allowed us to gain further insights into the current practice, whereas existing empirical material and secondary data sources, such as practitioner training material, contributed to the modeling.

We conducted reflection and learning cycles parallel with the two BIE cycles and followed a pluralistic research methodology to gain richer and more reliable research results (Mingers 2001). To gain deep insights and illuminate the context effects, we placed special emphasis on the qualitative data (Johns 2006). We collected and categorized all empirical material and secondary data sources – such as GerCar’s documentation templates, process and method descriptions, as well as third party documents from practitioners’ conferences, consultancies, and software vendors – in a central research study database. We captured the different BIE results in this database and used multiple key words and categories to characterize the contents. Additionally, several workshops with GerCar provided valuable feedback and deep insights into current approaches, resulting in six major artifact revisions. Once a stable version of the artifact had been achieved, GerCar began to implement the end-to-end ITDM process in two tool prototypes. Furthermore, we presented the learning from the BIE cycles, for evaluation and feedback to IT experts from an auditing firm. Considering different organizational contexts within GerCar and the auditing firm helped us transfer the situated learning (e.g. GerCar’s ITDM artifacts) to a broader class of problems and goals.
Table 1. Detailed ADR Process with Data Collection and Analysis Methodologies

<table>
<thead>
<tr>
<th>Collaborative research study with GerCar</th>
<th>Expert interviews and evaluation with 12 companies</th>
<th>Research team internal</th>
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<tbody>
<tr>
<td><strong>Phase goal and results:</strong> Define overall research setting and identify current GerCar-specific ITDM challenges (“practice-inspired research”) – (1) Defined research goals and results, (2) preliminary ITDM challenges and design goals, (3) preliminary solution opportunities</td>
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<td>One ADR team kick-off workshop (5 hours); direct observation and field notes; analysis of internal documents and a recent consultancy study at GerCar.</td>
<td>Analysis of prior ITDM literature and related work on IS development, requirements engineering, project management (“Theory-ingrained artifact”).</td>
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<tr>
<td><strong>Phase goal and results:</strong> Develop and introduce an end-to-end ITDM process model in GerCar’s IT department – (1) Evaluated alpha version artifact documentation of the end-to-end ITDM process with process, information, organization views, (2) preliminary design principles based on alpha version artifact documentation</td>
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<tr>
<td>Content analysis of 15 RE / ITDM process models from GerCar units; concurrent evaluation based on 6 semi-structured expert interviews (90-140 min); 2 alpha version artifact evaluation workshops (105/180 min); 9 workshops (90-240 min) to prepare intervention.</td>
<td>Content analysis of 19 RE / ITDM process models from software vendors and IT frameworks (“Theory-ingrained artifact”).</td>
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<tr>
<td><strong>Phase goal and results:</strong> Detail alpha version artifact documentation and introduce ITDM process in selected organizational units of the IT department – (1) Evaluated beta version artifact documentation of end-to-end ITDM process (e.g., BPMN, UML diagrams, hierarchical documentation, tool prototype), (2) utilization of artifact documentation to implement ITDM in selected units supporting vehicle construction as well as sourcing process</td>
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<td>Consensus-oriented conceptual modeling of the to-be ITDM process in BPMN; 6 development workshops (60-120 min) to detail demand collection and maintenance activities; 6 beta version artifact evaluation workshops (60-90 min) with IT and business stakeholders; 6 workshops (60-180 min) with EA team, to validate the integrated EA practices; 3 complete BPMN model walkthrough evaluation workshops (240-300 min) (questionnaire-supported).</td>
<td>Analysis of prior literature and related work to derive ITDM process details: activities, techniques, results, information objects, roles (“Theory-ingrained artifact”).</td>
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<tr>
<td><strong>Phase goal and results:</strong> Derive a broader class of problems, goals, and solutions from GerCar-specific challenges and specific ITDM design – (1) Generalized ITDM challenges and design goals, (2) preliminary design principles based on beta version artifact documentation</td>
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<tr>
<td>2 beta version artifact evaluation workshops with an auditing firm (300/360 min) (questionnaire-supported).</td>
<td>Data triangulation based on artifacts (differences in model revisions), interview findings, evaluation results, field notes, as well as secondary data sources and extant literature.</td>
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<td><strong>Phase goal and results:</strong> Classify situated learning into general solution concepts, i.e. the design theory structure acc. to Gregor and Jones (2007) and evaluate the design theory to ensure generalizability – (1) Evaluated ITDM design theory according to five design goals and seven design principles</td>
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<td>Participation in questionnaire-based design theory evaluation (1 respondent).</td>
<td>Interview-based design theory evaluation at 11 organizations involving 14 experts (90-180 min); Questionnaire-based design theory evaluation based on 11 respondents (excluding GerCar).</td>
<td>Formalization of design theory components based on 3 researcher workshops (180 min), pattern-matching within empirical material and beta version artifact documents.</td>
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Finally, the *formalization of learning stage* was aimed at converting our situated learning into general solution concepts based on a formalized design theory documentation (Gregor and Jones 2007). We synthesized the design goals, design principles, and propositions that we developed during the BIE cycles and formulated them fully during this stage. In addition, we reviewed the literature to justify and explain our design decisions and the testable propositions. Finally, to verify the design theory’s validity and generalizability and to ensure its relevance for practice (Benbasat and Zmud 1999), we conducted a series of interviews in 11 organizations from different industries involving 14 experts. We identified the interviewed experts through our personal network and professional network sites (e.g. XING), based on their work experience in IT demand management. During the interviews, one researcher provided a high-level overview of the artifacts and constructs, subsequently presenting the design goals and design principles. As we put special emphasis on high-quality feedback, we discussed the experts’ experiences, as well as their opinions on the presented design goals and principles. Their feedback was protocolled for later analysis. To improve our understanding of ITDM design decisions and their justification, we also discussed the company-specific ITDM approaches and outcomes during the interviews. In addition, we asked all the experts to answer a questionnaire that would provide us with standardized quantitative evaluation feedback.

### A Design Theory for End-to-End Demand Management

Although design science research (DSR) is an acknowledged IS research stream (Hevner and Chatterjee 2010; Iivari 2007), and developing design knowledge is very important (Kuechler and Vaishnavi 2008; Winter 2008), there is to date no commonly accepted ways of designing and documenting design theories (see Baskerville and Pries-Heje 2010; Fischer et al. 2010). Thus, for our purposes, we adopt the recommendations by Gregor and Jones (2007), who propose the following eight documentation components: the 1. purpose and scope, 2. constructs, 3. principle of form and function, 4. artifact mutability, 5. testable propositions, 6. justificatory knowledge, 7. principles of implementation, and 8. expository instantiation. Owing to space limitations, we will concentrate on the design theory’s constructs and principles of form and function, which are represented by seven design principles and supported with justificatory knowledge and testable propositions. We also define the purpose and scope by describing five design goals, which specify what the ITDM theory is for and what its boundaries are. In addition, we briefly illustrate the artifact mutability with results from our design theory evaluation and describe the expository instantiation using GerCar’s ITDM process model as an example.

### Design Goals

During the problem formulation stage, we analyzed the practical challenges of the different demand management initiatives at GerCar, and used expert interviews and workshops to translate them into suitable design goals. We then generalized the design goals (DG) further in the reflection and learning as well as the formalization of learning stages. These design goals represent the design theory’s purpose and scope as they specify its practice-inspired *causa finalis* (Gregor and Jones 2007; Sein et al. 2011). In the following, we provide an overview of and define five generalized design goals:

One of the primary challenges of ITDM relates to the uncontrolled and inconsistent processing of requestors’ demands. Different organizational units and projects collect and process demands in various ways, and often follow “implementation by acclamation,” i.e. the demands are not systematically evaluated, prioritized, and made transparent for approval. Because demands elicitation is mostly a once-off effort – for instance, at the start of an IT project or in annual budget planning cycles –, requestors find it difficult to address their continuously evolving changes and to track their realization. Likewise, we observed long cycles between the initial request and its realization, whereas requestors complained about the lack of transparency regarding the extent to which these requests are actually implemented and the timeframes required to do. Consequently, DG1 concerns the *managed demand processing* and distinguishes between two subgoals: (a) “*ex ante predictability of the handling routine*” to ensure that all kinds of demands are systematically documented, evaluated, and processed, as well as (b) “*ex post traceability of all demands*” to ensure that a demand’s current status is transparent and traceable from elicitation to realization.

In many situations, multiple reconciliations with the requestors are necessary to resolve ill-defined
demands and circumvent complex solution designs. Similarly, vague specifications generate coordination overheads during the development phase, because requirements must be clarified or contradictions must be resolved. We noticed, for example, test cases cannot be properly derived from the requirements, which causes extra work and implies the risk that the initial requirements are not properly addressed by the IT solution. In addition, GerCar reports that too rigid and complex methodologies and decision making structures lengthens or even halts the process. Thus, DG2 addresses the key challenges that hinder an efficient ITDM processing. Focusing on ITDM’s effort, cost, and time criticality issues, its subgoals are: (a) “minimized overhead and redundant efforts” to ensure that demands are processed as efficiently possible, and (b) “demand processing in adequate time” to ensure that demands are processed within acceptable timeframes for all stakeholders.

Unresolved customer demands and insufficient realization are two other key issues that our design theory will address. Moreover, demands seem to be “well-known” even before elicitation, but are poorly analyzed and documented. If key stakeholders are not interviewed or the business processes are not well understood, further realization challenges emerge. Additionally, solutions are never really tested for their fit with the original requirements because test cases are either insufficient (due to vague requirements), or are defined in the project’s later stages. In the case of GerCar, these problems are also due to GerCar’s “standardized system development” methodology, which indeed includes defined RE templates, not being binding or consistently used in practice. Consequently, DG3 aims at increasing “realization success from requestors’ perspective,” with the subgoals of: (a) “improved reliability of the handling routine” to avoid unresolved demands and secure dependable demand handling, and (b) “improved fit between the demand and solution” to ensure that the IT solutions fulfill the requestors’ true requirements.

Large-scale organizations’ demand realization is generally driven by their annual budgeting cycles. This approach implies that efforts to enhance the existing IT system and to develop new project ideas are based on prior experience and planned beforehand, and that they generally remain at a certain fixed level. This fixed budget level is spent to retain knowledge (e.g. developer resources, on-site), whereas its allocation is mostly topic-driven (i.e. for organizational units, projects, and IT systems). However, yearly cycles hamper allocating an appropriate budget for the influx of demands during the fiscal year. Besides, singular and non-recurring budget approvals are risky because they lead to bulky never-ending projects, in which “changes keep the projects running”. GerCar is unable to identify inefficient solution designs due to a lack of business cases and financial evaluation. Proper portfolio planning with hard budget approval criteria is often lacking. Hence, DG4 addresses the effectiveness of resource allocation, with its focus on (a) “effective budget allocation” and on (b) “effective staffing and skills allocation”. This effectiveness ensures that organizations, given their existing competencies and workload, have adequate financial resources and assign key resources to realize the existing set of demands.

Finally, if projects are initiated independently, their goals are unlikely to align or may even conflict with the strategic business and IT goals. Additionally, a lack of collaboration and the differing terminologies used by business and IT could lead to problems with successful demand realization. Decentralized governance and failure to consider alternative solutions could result in different customer demands leading to redundant, stove-piped applications and increased IT landscape complexity. DG5 seeks to address these issues in order to warrant demands’ consistency with mid- and long-term business and IT goals” by (a) “improving business-IT alignment,” as well as (b) “facilitating a managed IT landscape and its controlled development.” The former ensures that the IT solutions derived from demands support and comply with the business strategy and planning, while the latter ensures support and attainment through the IT strategy and planning.

Design Principles

The following design principles (DP) describe the focal aspects of the end-to-end ITDM process. The documentation captures our main design decisions and group process-, information-, and organization-related topics. The documentation is based on the structure of Gregor and Jones’s (2007) design theory components. In addition this documentation describes the form and function of each DP, addressing how the principle should be realized, and which constructs to employ. It also represents basic concepts containing justificatory knowledge regarding theories and empirical work that rationalize our design. Lastly, we depict testable propositions that determine the relationships between each principle and the design goals, which can then be evaluated. Table 2 presents seven DPs, their key characteristics and
related design goals, as well as an excerpt of the testable propositions.

**DP1** addresses the allocation of standardized milestones to the ITDM process. Milestones act as single-points-of-truth, where process outcomes can be controlled, measured, and evaluated according to standardized performance criteria, which are based on organizational information needs (Eisenhardt 1985; Kirsch 1996; Nidumolu and Subramani 2003; PMI 2004). Applied to ITDM, our study identifies eight standardized milestones as mandatory and well-defined decision points in the end-to-end process from an emerging demand until its realization. In general, milestones should be introduced either to decide on further demand processing, to control the results' quality and compliance (i.e. those of demand specifications), or to finally approve demand commitments, plans, prioritizations, and sign-offs. Accordingly, we propose upstream milestones for the initial collection, high-level specification, and evaluation. A planning milestone should capture the resource allocation and approval decisions. Finally, downstream milestones control the initiation, specification, implementation, and deployment to achieve an adequate IT solution. Hence, since we believe that demands evolve during the ITDM process (see Jarke et al. 2011), each milestone freezes their outcomes selectively and constantly re-integrates them to arrive at a consistent solution.

While pursuing the overall goal of an end-to-end ITDM process, **DP2** directs the process variants of different demand types on the basis of their characteristics to allow for adequate and efficient demand processing. The heterogeneity of demands can be tackled during the ITDM process with variants that handle the different types of demands. Variants combine distinct ITDM process phases and determine the further demand handling. Their variation is defined at each milestone and takes certain demands’ characteristics, which represent the reason for variation, into account. First, direct realization variants center on rapid demand realization and omit the early phases of the ITDM processes. Their variation is a result of high priority, low efforts, known solutions, and assignment to existing realization projects or budgets. Second, (pre-)specification and evaluation variants determine the processing on the basis of a demand’s complexity, as well as its specification maturity. Third, budget, portfolio, and release planning variants typically depend on budget size and cost allocation.

**DP3** implies comprehensive demand analysis and specifications to support effective decisions. In the course of the ITDM process, the analysis and specifications continuously refine a demand’s documentation by involving multiple stakeholders (i.e. requestors and process owners, developers, enterprise architects, IT operations). They can be complemented by enterprise architecture models and analyses, which allow a better illustration and visualization of the as-is and to-be situations. **DP3** thus builds on the separation of concerns and abstraction (Bergman et al. 2002; Gorschek and Wohlin 2006; Jarke et al. 2011), as well as on enterprise architecture concepts to represent multiple refinement and stakeholder perspectives. More specifically, **DP3** aims at refining and relating the demand specification to the stakeholders’ perspectives: A basic specification documents a request uniformly and informally, e.g. by providing fundamental information (e.g. demand name, requestor, problem statement) and high-level specifications about the demands’ context and scope. It thereby allows for preparing the demand’s architectural and financial evaluation, as well as for its prioritization and approval decisions. The functional specification documents the to-be solution from a non-technical user perspective to lay the foundation of the detailed technical specification, as well as to prepare test and approval documentation. Finally, the technical or system specification refines the non-technical to-be solution into a technical to-be solution to prepare its implementation and operation.

**DP4** defines the information exchange and complementary activities between ITDM and its adjacent processes. Our study reveals the importance of integrating ITDM with other IT processes, notably project portfolio management, which includes the budget, project, and benefits management (e.g. Jeffery and Lelieveld 2004; PMI 2004; van Schaik 1985; Ward et al. 1996), IS development, which includes test and quality management (e.g. IEEE 2008a; IEEE 2008b), release management (e.g. Betz 2006; van Schaik 1985), IT service, operations, and infrastructure management (e.g. Cabinet Office 2011), as well as enterprise architecture management (e.g. Ahlemann et al. 2012; Lankhorst 2005). **DP4** determines that the ITDM inputs and outputs, as well as the process’s interaction and interfaces, should be clearly defined. An ITDM output represents information generated during the ITDM process and used in the adjacent process. Similarly, an input that flows in has to be used in the ITDM process. Our study reveals the significance of **DP4** in general, but different ITDM experts mentioned concerns regarding the strict guidelines for integration points. They propose a pragmatic ITDM integration approach. It should be flexible and adaptable to react to current organizational needs, such as time-to-market, as well as to
changes in the information availability, budget, releases, and partner settings.

Table 2. Overview on ITDM Design Principles and Their Testable Propositions

<table>
<thead>
<tr>
<th>Design principles and description</th>
<th>Testable propositions (excerpt)</th>
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<tr>
<td><strong>DP1. Standardized milestones:</strong> A sequence of mandatory and well-defined decision points from an emergent demand until its realization in an IT solution. [Addressed design goals: 3a, 1b, 5b]</td>
<td>Standardized milestones, including defined decision-making criteria, will foster a manageable IT landscape and its controlled development. A sequence of standardized milestones:  - supports demand status monitoring, thereby increasing demand handling traceability.  - avoids breaks and losses throughout the demand management process, thereby increasing demand handling reliability.</td>
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<td><strong>DP2. Process variants for different demand types:</strong> Processing variants for different characterized demand types to allow for adequate and efficient demand processing. [Addressed design goals: 2b, 2a, 4b]</td>
<td>Specified process variants for different demand types, ensure that:  - simple demands can be treated with less effort, thereby minimizing overheads and redundancies.  - simple demands can be treated within shorter timeframes, thereby increasing the demand processing speed.  - the most appropriate teams handle the demand, thereby improving the allocation of staff and skills.</td>
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<tr>
<td><strong>DP3. Multi-perspective demand analysis and specification:</strong> Comprehensive top-down specifications that involve multiple stakeholders and utilize enterprise architecture (EA) models and analyses to support effective decisions. [Addressed design goals: 5a, 3b, 5b]</td>
<td>Multi-perspective specifications that:  - involve business and IT stakeholder perspectives, thereby improving business-IT alignment by complying with the mid-term to long-term business strategy and planning.  - continuously detail and refine information about a demand's problem space (as-is) and solution space (to-be), thereby improving the fit between demand and solution.  - result in committed specification documents from both the business and the IT side, thereby improving the fit between demand and solution.</td>
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<td><strong>DP4. Integration with adjacent processes:</strong> Well-defined information exchange and complementary activities between ITDM and its adjacent processes. [Addressed design goals: 2a, 5b, 3b, 4b]</td>
<td>If ITDM is integrated with the:  - IT project portfolio planning, release planning and EAM process, dependencies between demands will be detected at an early stage and redundant realization efforts will be minimized.  - IT project portfolio planning and release planning process, the staff and skills for demand realization will be more effectively allocated.  - Testing and quality management process, IT solutions will be designed and tested on the basis of the original demands, thereby improving the fit between demand and solution.  - EAM process, the management of the IT landscape and its controlled development will be improved.</td>
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<td><strong>DP5. Central demand storage:</strong> Single-point-of-truth to collect, manage, share, and retrieve all demands’ status and processing information at any time. [Addressed design goals: 1b, 3a, 5b]</td>
<td>Demand storage that:  - captures demand status will increase demand handling traceability.  - consistently stores all demands with their status and specification information will increase demand handling reliability.</td>
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<tr>
<td><strong>DP6. Synergetic demand processing:</strong> Joint processing of similar demands based on content-related, processing-related, and asset-related groups. [Addressed design goals: 5b, 2a, 1b]</td>
<td>If dependencies between similar demands are identified, these demands can be jointly evaluated and processed, thereby minimizing overheads and redundant efforts. If processing-related or IT asset-related dependencies between similar demands are transparent, they can be taken into account when preparing IT projects, which in turn will improve the IT landscape's manageability and its controlled development. If processing-related dependencies between similar demands are identified, these demands can be jointly processed, thereby increasing their traceability.</td>
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<tr>
<td><strong>DP7. Effective decision making committees:</strong> Hierarchical decision-making / escalation procedures based on functional domains and involving business, IT, and other stakeholder. [Addressed design goals: 1a, 5a, 3b]</td>
<td>Defining decision-making, coordination, and escalation authorities on different hierarchical levels (vertical span-of-control) will increase demand handling predictability. Decision-making bodies that engage stakeholders from business and IT will contribute to improving business-IT alignment.</td>
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</table>

DP5 proposes a central demand storage that can uniformly collect, manage, share, and retrieve all demands’ status and processing information at any time. As single-point-of-truth, centralized demand
storage seeks to support the free circulation of demand information – which can avoid significant negative effects on the organization’s performance (Hoopes and Postrel 1999) – in an organization from the requestor’s demand to the ready-to-use solution. This storage provides a consolidated view of all requests for IT solutions and their current processing state. To achieve these goals, our research, in accordance with other studies on repositories (e.g. Dibbern et al. 2009; Lang and Duggan 2001; OMG 2005; Vitharana et al. 2012), indicates that the following key features should be included: (1) A “basic information” structure (see DP3), (2) standardized input-output channels to users and to adjacent processes, (3) search, traceability and relationships, as well as classification functionality, and (4) version control, status monitoring, and reporting functionality.

DP6 advises the joint processing of similar demands to prevent redundant efforts and to realize synergic results. DP6 builds on (1) a strong coupling between similar demand attributes, and (2) defined relationships that group cohesive demands (see Yourdon and Constantine 1979). Thereby, content-related demands concern similar business, customer, and product requirements (functional cohesion) and may require common functionality or reusable artifacts, such as specifications, models, and test cases. IT asset-related demands consolidate similar demands for the same IT assets into an IT release to guarantee their synergetic realization and deployment. In almost the same manner, processing-related demands concern similar time frames, such as the realization or rollout dates, and consolidate demands for the same products or services, business processes or user groups to guarantee their synergetic handling and realization.

DP7 prescribes the rules for ITDM’s decision-making and the escalation procedures of various committees. Since decision-making can be difficult in a complex organizational environment, this principle proposes using hierarchical and functional domains (see Aier and Schönerr 2007; Kohlborn et al. 2009) to identify responsibilities and to involve the relevant stakeholders. In keeping with stakeholder theory (Freeman et al. 2004; Mitchell et al. 1997), an ITDM decision making committee is composed of a group of stakeholders from business, IT, and other organizational units to enforce effective decisions regarding the demand problem and solution spaces in order to move towards a satisfying solution (Bergman et al. 2002). Besides its decision making and enforcement tasks, a committee’s responsibilities encompass regular discussions on and commitment to specifications, the evaluation and prioritization of demands, as well as coordination and controlling duties. Its further responsibilities deal with regular meeting organization, documentation format definitions, moderation to reach agreement, as well as protocols and decisions’ wrap-up controls. In generally, our study suggests distinguishing between a committee’s business-, authorization-, and coordination-driven responsibilities in the ITDM process.

**Expository Instantiation at GerCar**

The following section will illustrate how we applied the design principles in the expository instantiation “for the purpose of theory representation or exposition” (Gregor and Jones 2007). During the two BIE cycles, we designed and evaluated different ITDM artifacts for GerCar. These artifacts were process models, organizational models, and role profiles, as well as data models on different abstraction levels. In addition, we developed an Excel-based prototype to collect demand information.

Figure 3 shows a high-level process model with the nine phases of GerCar’s ITDM process. This overview shows the main requestors of IT solutions, the most important tasks, and the milestones.

This process model contains three upstream phases, i.e. collecting and classifying, analyzing and prespecifying, as well as evaluating and prioritizing demands. First, all demands are centrally collected, their description is checked regarding contents and quality, and responsibility for them is assigned; second, the demand manager analyzes their context and scope and develops a high-level specification; third, the demands are evaluated and prioritized by multiple stakeholders, who make well-informed decisions on their resource allocation, as well as on the realization priorities and dates. These phases incorporate DP1 and DP2 directly. They include the following four milestones (see DP1): M1 (demand is collected, understood, prioritized, and categorized), Q1 (demand is pre-specified and committed), as well as M2 (demand is evaluated for strategy fit and synergies), and M3 (demand is commercially evaluated and prioritized). Thereby, the GerCar milestones reveal the design theory’s artifact mutability in two ways: first, the instantiation splits one minimal set evaluation milestone into two (M2, M3); second, it divides stakeholder accountabilities between committee involvement at Qs and those of a single role at Ms. In addition, the process model accounts for DP2 by illustrating three process variants as dashed lines.
between the activities. These variants and demand types are defined in the detailed process description. Furthermore, a detailed process description of phase two considers DP3 by describing the roles contributing to the analysis and high-level specification.

![Figure 3. GerCar’s End-to-end ITDM Process Model (High-level View)](image)

Phase 4 represents “planning and decide on demands.” This phase seeks to prioritize and allocate adequate and sufficient resources to consolidated demands in the form of IT project proposals. At the end of this phase, each authorized IT project proposal is assigned a dedicated budget and human resources. Additionally, the solution scope is propagated to the to-be IT landscape and release plans. Phase four mainly refers to DP4 and DP6. A detailed process model describes the interfaces and information exchange with the budgeting, project portfolio management, IT landscape planning, and release management processes (see DP4). In almost the same manner, the data model describes how similar demands are grouped into IT project proposals (see DP6). Finally, phases five to nine comprises GerCar’s main activities related to the realization of an IT solution. Thereby, the phases rely on typical IS development stages. Similar to phase two, the phases’ detailed process description consider DP3 by describing the roles contributing to the demands’ realization and specifications. The milestones are also adapted to organization-specific needs by, for example, emphasizing the specific quality gates for specification and implementation. DP5 and DP7 are not directly visible in the process model depiction, because they focus on information and organizational structures. Accordingly, DP5 is instantiated in various data models, which define the basic demand information in the central data storage, as well as in our demand collection prototype. DP7 uses RACI matrices and role profiles to define responsibilities and competencies, as well as escalation paths along the end-to-end process.

**Design Theory Evaluation**

To evaluate our design theory, we performed a questionnaire-based evaluation. The interviewees had to judge (1) the design goals, (2) the design principles’ utility (i.e. purpose and relevance), their direct applicability and adequacy (Böhmann et al. 2006; Fettke and Loos 2003; Hevner et al. 2004), as well as (3) the testable propositions’ effectiveness (i.e. the design principles’ contribution to the design goals) on a five-point Likert-scale. This scale indicates a respondent’s degree of agreement with a specific statement and ranges from 5 – “fully agree” to 1 – “don’t agree”, as well as having a “not applicable” category. Each section was complemented by an open question to identify further design goals, principles, and cause-and-effect relations. The average feedback on each design goal is above 4.27, which can be interpreted as agreement. Furthermore, all estimated standard derivations are below 0.79, which indicates that the
experts considered the demand management goals as adequate and very relevant. Despite this common appreciation, our qualitative data indicates that the experts favor different design goals. On the one hand, some companies focus on long-term goals such as supporting sustainable IT solutions and identifying the “right things to do” instead of “doing things right.” The IT department in these companies has a constitutive instead of an administrative demand management, and seeks to become a “business department’s advocate.” On the other hand, some companies focus on the short-term demand and solution fit, as well as transparency. For these companies, the realization success and traceability of all the demands are more important than the long-term goals. These organizations act as the “business department’s workbench.” However, we interpret the fact that all the average agreements are above 4.27 as evidence that our design goals are valid for the “advocates,” as well as the “workbench” demand management types. The average evaluation of the design principles’ purpose and relevance is above 4.67, with a maximum standard deviation of 0.78 and, therewith, solid within the area of agreement. Applicability is evaluated with a minimum average of 4.45 and a maximum standard deviation of 0.80, which is solid within the area of agreement with the exception of DP3. DP3 only reports an average of 4.17, with a standard derivation of 0.94, and is therefore only just within the area of agreement. Our qualitative data indicates that, with regard to this outlier, some respondents still see specifications as an IT delivery’s responsibility and not part of demand management, or because it is hard to pre-define standardized specification methods and structures for all demand endeavors. The average evaluation value for the design principles’ effectiveness regarding its support of the design goals is above 4.28, which implies that the interviewed experts agree with the presented testable propositions.

From our expert interviews and evaluation, we gained insights into the variations of ITDM processes and identified three artifact mutability factors: (1) organizational setting and complexity, (2) governance structures, and (3) information needs. First, the organizational setting and complexity affect the design principles’ instantiation. For example, the size and structure of the organization determine whether milestones should be consolidated, or whether additional ones should be added in order to guarantee adequate reconciliations and decisions (see DP1). Furthermore, it is less important for small organizations to formally integrate ITDM with adjacent processes. Since an employee usually performs different roles in a small organization, he or she ensures the integration with adjacent processes. Likewise, the horizontal and vertical committees (see DP7) depend on the organization-specific settings. Second, governance structures determine mutability. Organizations can opt for either content-related (i.e. checking input quality) or approval-related (i.e. checking input existence) decisions, depending on their decision-making culture (see DP1, DP4, and DP7). Furthermore, governance structures determine the stakeholder involvement in ITDM, for example, the varying accountabilities (i.e. single roles vs. committees) at specific milestones (see DP1). Third, different information needs affect the design principles’ organizational implementation, for example, regarding additional or detailed process variants (see DP2), adapted specification documents, EA model structures (see DP3), storage information attributes (see DP5), as well as similarity measures to identify synergetic demands (see DP6).

Summary and Conclusion

This paper’s main scientific contribution is a design theory that guides organizations in introducing effective IT demand management. It synthesizes prescriptive knowledge about ITDM, which was derived from our in-depth experiences with ITDM processes, supported by justificatory knowledge from scientific and “practitioner-in-use” literature, and empirically validated by experts from a total of 13 organizations. This paper identifies a set of five design goals and seven design principles, i.e. principles of form and function, for end-to-end process from emerging requests to ready-to-use IT solutions.

To the best of our knowledge, our work is one of the first academic studies on ITDM. By emphasizing the end-to-end demand management process and focusing on the design principles, our research goes beyond existing work: On the one hand, it integrates and complements fragmented approaches in RE, PPM, and ISD, which focus on single systems development or IT project portfolios. It also addresses a number of issues raised in current RE literature. First, it integrates RE with upstream processes and organizational decision-making; second, it links RE in single software development projects with architectural goals, and the management of complex IT landscapes with non-linear dependencies. On the other hand, the formulation of a design theory allows for condensing prescriptive knowledge to derive different instantiations for specific organizational settings, while focusing on the most critical design
characteristics. It thereby helps practitioners individually define their ITDM approach; more specifically, their ITDM processes and structures, and information models. Researchers may use our design theory as a basis for further empirical studies by building on the testable propositions, as well as for analyzing different instantiations and identifying contextual factors. The systematic development and formulation of our research findings as a design theory also addresses some of the methodological weaknesses of prior RE and PPM research. These research streams often develop prescriptive knowledge, such as methodologies and processes, without providing empirical validation.

Our research has certain limitations: most importantly, we build our design theory on knowledge gained in a collaborative research project with one organization. While design-oriented action research in an organization is a recommended research approach to the iterative development of design theory results (see Siponen et al. 2006; Walls et al. 1992), such studies do not prove the universal validity of the research. In order to address this issue, we continuously evaluated our artifacts and design theory components and conducted an in-depth expert evaluation with 13 additional organizations. This increases the analytical generalizability of our findings, but does not imply statistical generalizability. We therefore strongly encourage future studies to build on our work and empirically validate our findings. A second limitation relates to the immaturity of ITDM in research and practice. Consequently, we could not rely on scientifically grounded definitions or conceptualizations, but had to extend our literature review to practitioner publications. Since many companies are in the early stage of introducing ITDM, we still lack wide-spread practical experiences with the concept and demonstrated proofs of design effectiveness.

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