Enterprise Engineering for Business Opportunity Recognition - A Design Science Approach

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Abstract: Recognizing business opportunities in a timely and accurate way is crucial for business operation today. Due to steadily improving technologies in almost all areas relevant for organizations, organizational actors need multifaceted support when digital transformation processes are instantiated, targeting technology utilization for business opportunities. Although initial triggers enable a quick start of transformation processes, requirements evolve over time whenever stakeholders adopt novel organizational practices and technologies to achieve business objectives according to recognized opportunities. Consequently, requirements need to be refined by the time of emergence, and handled step-by-step to implement respective digital transformation steps. For structuring this socio-technical, and thus, complex endeavor, we suggest and introduce a design science approach for methodology development. The initial development step has its focus on relevant knowledge items and relations guiding organizational actors when elaborating on digital transformation processes. Streamlining technology, technical and organizational issues when recognizing transformation potential facilitates the exploration of corresponding business practices.

Keywords: Digital Transformation, Opportunity Recognition, Framework, Design Science Research

1 Introduction

The increasingly dynamic organizational environments resulting of radical societal, technological and market developments challenge established organizational practices [1]. The resulting situation has been described as hyper-turbulent market conditions in which competitive advantages are gained and eroded by market participants capabilities of reconfiguring organizational resources [2]. Following this context organizational capabilities focused on enabling this reconfiguration have been of increasing interest for researchers and practitioners. A focus on specific capability constructs like agility, ambidexterity or innovation as well as more dynamic approaches towards the concept of organizational capabilities in general have been described as result as well as driver of these increasingly turbulent environments [3–5]. Whilst these capability constructs show differences in their conceptualization, they strongly indicate the necessity for organizations to obtain capabilities enabling them to react to changed circumstances to sustainably navigate the turbulent environments they find themselves in.

The application of technology, information technology (IT) in particular, to gain competitive advantage can be considered as one of the most volatile and complex aspects of organizational environments. A variety of research fields investigate the intersection of traditional aspects of organizational change with digital technologies and testify to the increasing importance and complexity of integrating technology into modern organizations. Whilst research interest in the fields of Digital Innovation, Digital Entrepreneurship or Digital Transformation has skyrocketed in the past years, detailed reviews of the fields indicate conceptual ambiguity and numerous knowledge gaps [3, 6, 7].

Within organizations the pressure resulting from the complexity of adapting to shifting technological circumstances changed in a large part by technological developments challenges established ways of cooperation between technology and domain experts. Expectations towards the IT departments change from being reactive service providers towards becoming proactive drivers of IT induced change [8], roles dedicated towards the identification and adaption of potentials induced by technologies are introduced [9], and strategic concepts are altered to focus on the integration of such potentials at the highest level of organizational planning [10]. Whilst such organizational processes intended to identify potential ways of technology-usage are increasingly established they have been described as under researched, lacking conceptual underpinnings and knowledge on involved micro processes [6].

Such processes require the integration of diverse technical and organizational knowledge elements carried by individuals distributed within and outside the organization and therefore reflect a complex enterprise engineering problem. In a previous study a description framework for micro processes and knowledge elements involved in digital transformation opportunity recognition (DTOR) has been developed to reduce problem complexity [11]. Yet to support practitioners and collect application experience, for feasibility testing, a corresponding methodology has to be developed. This paper describes our approach to designing and developing such a DTOR methodology thereby expanding on the previous work which solely focused on the provision of a description framework.

The structure of the paper is as follows: section two presents and motivates the application of design science research for digital transformation opportunity recognition; section three further elaborates on our approach for designing and evaluating our methodology for its capability to feature completeness with respect to content and its integrative capacity of the presented complex setting through the provision of sharing cognitive structures; section four concludes the paper reflecting on the presented approach and presenting an outlook on future research.

2 DTOR Methodology Development as DSR Approach

For developing the DTOR methodology, we rely on a design science research (DSR) approach to integrate relevance and rigor [12, 13], but also develop an artefact iteratively [14]. In their seminal work, Hevner et al. [13] discuss that DSR does not only focus on the design of an artefact, but also integrates relevance and rigor as "truth and utility are inseparable" [13]. It has been stated that differentiating routine design from design science research is important [13, 16]. The latter aims at solving existing problems that occur in reality (e.g., in companies) focusing on people, organizations and technology [13]. The solution, hence, contributes to the knowledge in the field [13]. Focusing on existing, real-world problems is a precondition to fulfill the relevance requirement of research [12, 13]. To meet the requirement of rigor, DSR projects have to be based on an existing knowledge base, in particular existing foundations and methodologies [12, 13]. By applying the appropriate methodologies based on the identified foundations, DSR produces a "viable artefact in the form of a construct, a model, a method, or an instantiation" [13]. Furthermore, it has been often stated, that creating artefacts directly depends on underlying kernel theories [13, 14, 17, 18] as part of the existing knowledge but also as way to test the artefact [19]. To apply DSR, methods and processes are at hand, be there high level design processes [19, 20] or more operational frameworks [14]. Peffers et al. [14] provide a method and process of six activities, defining possible research entry points for DSR as well as likely process iterations. The six activities include (1) problem identification and motivation, (2) define objectives of a solution, (3) design and development, (4) demonstration, (5) evaluation, and (6) communication [14]. Depending on the initiation or intended solution, the research entry points relate to activities 1 to 4 [14]. Consequently, DSR projects based on this framework do not necessarily cover all activities.

We follow a DSR approach for developing the DTOR methodology due to various reasons. The underlying research problem investigates how organizations are able to tackle the challenge to identify digital opportunities to stay competitive [2]. To the best of our knowledge, there is currently no structured model, method or framework to solve this problem [6]. Hence, and secondly, it is necessary to design and develop a new artefact, as solving this problem is not possible via routine design [13, 16, 21]. Adopting a problem-centered approach, the DTOR methodology development starts with the first activity as defined by Peffers et al. [14]. We rely on the existing body of knowledge for safeguarding rigor but also to clarify the contribution of the DTOR methodology [12, 13]. Identifying dynamic capabilities as a kernel theory for strengthening theoretical integration [14, 19], our research design foresees iterations on different stages to learn from demonstration and evaluation for developing a stable artefact [14, 21]. Moreover, each artefact design is challenged by various problem dimensions on different levels as enabled by DSR [14, 19], as the improvement of the problem context evolves along each design cycle (cf. https://wwwhome.ewi.utwente.nl/~roelw/DSM90minutes.pdf).

2.1 DTOR Methodology Development

The design cycle for the proposed DTOR methodology has three dimensions (see Table 1). Many DSR projects focus on developing an artefact such constructs, models, methods and instantiations [13]. Due to the complexity of the underlying research problem, the DTOR methodology integrates a model, consisting of abstractions and representations, a method referring to algorithms and practices, and instantiations implemented in or related to the organizations context, i.e. an organization [13]. Therefore, in the current state of this research, we identified three problem dimensions on different levels. For each dimension, in line with Peffers et al. [14], we distinguished objectives, artefact design, demonstration and evaluation.

The first problem dimension is nurtured by observations in the business realm and academic literature. By reviewing the literature, we found some non-integrative and standalone approaches to tackle DTOR. Concise capturing of constitutive elements and their relations according to the DTOR process is missing. Identifying and defining such constitutive elements and a set of their patterns with respect to content is hence the objective of this dimension. Consequently, the artefact design focuses on a semantic definition and visibility of constitutive elements and their relations. Demonstration relies on a case-based approach in a workshop setting conveying semantics and appearance in a mutually adjusted way providing distributed knowledge elements. Evaluation considers definition and accuracy of the constitutive elements and their relations, but also completeness and integration capability (as further described in section 3).

The next dimension refers to procedural deficiencies of the DTOR process. Combining the constitutive elements is challenging, as they are distributed among various knowledge carriers (i.e., people in an organization). Even more, diverse motivations for DTOR processes (e.g., identifying general opportunities of technologies for the company vs. identifying specific technologies for a business unit) exist. Thus, we aim at providing a DTOR process to overcome these challenges. In designing the artefact, we focus on two different aspects. First, allowing identification of the goal of a specific DTOR process and ensuring that people involved are able to develop a common understanding of that goal. Second, we focus on the mapping of settings towards DTOR process scenarios. Therefore, collaboration features in this context need to part of the design. For demonstration, we plan developing a process case for a more detailed procedure. This includes specifying actor roles (e.g., humans, digital services or systems), activities and functions, data inputs and outputs, as well as the flow of control including entry and end states in an experimental setting to control for biases. The focus of the evaluation lays on running the DTOR process from the actor or system perspective and checking for completeness, structural adequacy and outcome.

Finally, hindrances when applying DTOR lack methods for problem identification (i.e., the DTOR process). In addition, they lack structured adoption of non-integrative standalone approaches with procedural deficiencies for specific organizational contexts. Hence, we aim at providing some guidance for identification and adoption of instances of constitutive elements of the DTOR process in an integrative and organization-specific way. In the artifact design, we focus on a set of principles for instantiating the DTOR process based on specific organizational context in given scenarios. Consequently, demonstration relies on a scenario case demonstrating the instantiation, involving stakeholders from the field, legacy systems and overlaying technologies for rapid prototyping. The evaluation is similar to the second problem dimension, but with focus on evaluation completeness of processes in terms of scope, level of detail, structural adequacy, and outcome.

Table 1. Problem dimension and DSRM [14]

Problem identification	Objectives	Artefact design	Demonstration	Evaluation
Non-integrative - standalone approaches; constitutive elements and relations of DTOR process not identified	Provision of a set of constitutive elements and instances of these elements including their structural relations	Semantic definition and visibility	Case-based approach (workshop)	Analyzing results of workshop settings
Procedural deficiencies of DTOR process	Provision of a process for DTOR	Ensuring common understanding of goal	Process case (experimental setting)	Analyzing results of experimental setting
DTOR application hindrances	Guidance for identification and adoption of instances of constitutive elements	Set of principles for instantiating the DTOR	Scenario case (experimental setting)	Analyzing results of experimental setting

3 Completeness and Integration Capability

As previously mentioned, we have identified three distinct dimensions on the design science research problem at hand. We intend to follow a procedural approach engaging the identified research problem by initially focusing on the first of these problem dimensions. The following section therefore provides a more detailed description of the first design cycle in this research project.

3.1 Problem Description and Objectives

As presented in section two, the first problem dimension identified with respect to the proposed DSR approach is the lack of knowledge on such processes' constitutive elements and their relations. The individual and collaborative inability to structure the diverse and numerous elements required for DTOR processes confronts individuals and organizations with an unstructured and set of distributed and possibly relevant knowledge elements that requires high migration effort. The complexity of the challenge "roams free" and reduces the individuals and thereby the organization's capability for sensing potential opportunities provided by digital technologies in their respective domains.

We assume that by fulfilling two central objectives - completeness and integration capability – a defined set of DTOR processes' constitutive elements and their structural relations can provide the foundation for overcoming the challenges resulting from the inherent complexity of DTOR processes. The first objective of completeness can be described by two requirements. First conceptual completeness – reflecting the capability of providing an abstract structure incorporating all knowledge elements and their relations relevant in a DTOR process. Secondly, completeness with respect to content– reflecting its capability of providing a complete set of content categories for the abstract constitutive elements. The second central objective, i.e. integration capability, is reflected by the necessity to provide a structure for facilitating shared understanding, supporting the integration of instantiations of elements constituting and resulting from collaboratively executed DTOR processes.

3.2 Artefact Design

To develop the artefact we plan several design cycles. The first cycle aims at fulfilling three basic requirements: (1) conceptual completeness, (2) completeness with respect to content, and (3) integration capability. The following section will outline the artefact design structured along these three requirements.

Conceptual Completeness. At the center of our initial artefact design stands the DTOR framework [11]. It was developed following a design perspective on the DTOR process and provides a description framework for involved conceptual elements as well as their relationships. The DTOR framework represents the recognition process for digital transformation opportunities as an organizational actor's technology-informed view on certain organizational representations, which can then result in the recognition of DT opportunities. Based on the Function-Behaviour-Structure (FBS) Ontology [23] - a description language for design processes independent of the design domain - and the situated (FBS) framework [24] – a model of a designer's interaction with design elements in three worlds -, the DTOR framework provides a rich set of conceptual underpinnings and micro processes for DTOR processes. The three core conceptual elements of the DTOR framework are an organizational representation (OR) a technology lens (TL) and finally. a digital transformation opportunity (DTO). Figure 1 depicts the DTOR framework in its basic form.

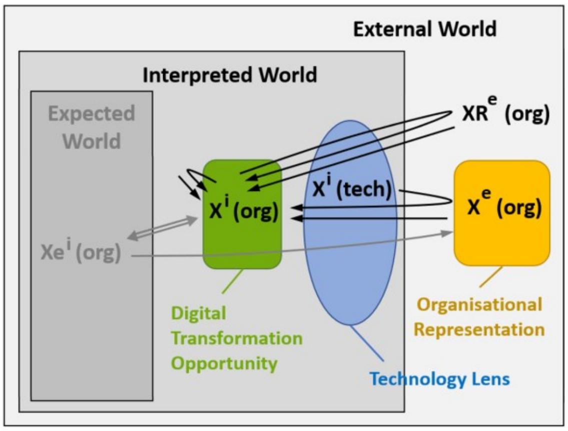

Figure 1. DTOR Framework [11]

A DTO represent potential technology driven alteration to an organizations value creation path and is a hypothetical construct therefore located within the interpreted world of a designer. An OR is an externalized depiction of an organization or one of its aspects therefore located in the external world. Finally, a TL represents the internal representation of a technological construct along its dimensions of function, behavior and structure and is again located in the interpreted world. DTOs can be identified by (1) reflecting external requirements on the organization, by (2) reflecting external representations of the existing organization through a certain TL or (3) through constructive memory processes using current and previously interpreted ORs as a basis for producing DTOs via push-pull processes.

The DTOR framework provides a rich and detailed overview of micro processes involved in DTOR processes. Whilst this fits the purpose of a detailed description framework, not all aspects (e.g. providing detailed process descriptions of internal thought processes of a designer) can be considered relevant for the objective of the proposed artefact. In our artefact design focused on providing conceptual completeness we have therefore included the three central elements of OR, TL, and DTO as well as the central idea of reflecting onto certain ORs through TL whilst omitting more detailed micro processes irrelevant for potential appliers of the DTOR methodology.

Completeness with respect to Content. The second requirement of this initial design cycle for the DTOR methodology is focused on the artefact's capability of providing a complete set of content categories of the constitutive elements. To develop such a set, we chose a deductive approach. After identifying exemplars for digital transformation initiatives within literature we used a three-staged approach to derive defined categories for each of the three central DTOR elements. For the first step, literature cited in a recent literature review on digital transformation was defined as a candidate set for coding by an individual researcher. Instances of digital transformation initiatives which contained information on the effected OR, the utilized TL and the resulting DTOs were coded in an open coding approach [25] until theoretical saturation was reached [26]. In the second step a team of independent researchers developed a categorization scheme as well as a coding sheet [27] based the initial results of the first step. In the final (currently ongoing) stage the coding sheet is utilized by another researcher to identify triplets of OR, TL and DTO in reports of public organizations. After a first adoption of the coding sheet following results from the third step, we currently identify a set of seven categories for OR, ten for TL and nine categories for DTOs. At the current stage the derived content categories are still formalized as definitions utilized in a coding process. Table 2 provides an example for each category per constitutive element.

Table 2. Content categories - examples

Title	Corresponding Element	Definition
Business Model	OR	is defined as an organizational perspective focusing on how the organization creates, delivers and captures value.
Composite Technology	TL	refers to the representation of a composite technology, consisting of a combination of physical technology, software technology, and work techniques as self-contained structure concept.
Insight Opportunity	DTO	refers to a potential support of organizational value creation activities resulting from alterations in information supply.

The next step in artefact development will be to transform these representations of the identified categories as patterns for OR, TL and DTOs thereby enabling the provision of a complete set of patterns with respect to content for the constitutive elements derived from the DTOR framework.

Integration Capability. The third requirement with respect to the proposed artefact in its first design cycle is its capability to serve as a shared conceptual structure capturing integrating instantiations of elements constituting and resulting from real world DTOR processes. Concerning the design of the artefact this requirement is a challenge in two ways: (1) to provide a shared conceptual structure that can be conveyed within the time constraints of a methodology application, a focus on certain elements of the detailed DTOR description framework becomes necessary, (2) the integration capability of the proposed artefact will be dependent on the way it is conveyed to appliers of the artefact via the proposed treatment. Concerning challenge one – as previously stated – we have decided to limit the set of constitutive elements to the core aspects of the DTOR framework for the first design cycle. We do not exclude adding additional elements presented in the initial framework in later cycles yet currently expect that the identified elements will be sufficient to provide the required integration capability. Concerning challenge two, we currently identify the approach of separating our treatment into two stages as most promising. First, a unilateral and indirect communication instrument to convey the content of the artefact, secondly, a bilateral person-to-person communication focused on ensuring the correct understanding of the presented artefact and providing us with feedback for artefact design. Alternatively, we have considered following the approach of understanding the treatment as individual artefact within its own design cycle.

3.3 Demonstration and Evaluation

For demonstration of the artefact – which represents the subsequent activity in Peffers et al.'s [14] DSRM - we are planning to utilize a case-based approach. As participants we are considering students of the business and business informatics domain each primed with different knowledge elements concerning a hypothetical organization. These knowledge elements will include several ORs and TLs as the test case. We intend to demonstrate the proposed artefact in three different workshop settings based on the test case: (1) participants do not receive any guidance (control group), (2) treatment will be limited to the unilateral and bidirectional communication instrument, (3) in addition to unilateral and bidirectional communication instrument a researcher will be present to guide group work. Following this approach, we expect to gain insights regarding the fitting of the current artefact with respect to the design objectives.

Evaluation draws from the demonstration in different ways. Fist, in case the current artefact design is generally insufficient we expect to be able further refining the artefact. Secondly, we focus on the evaluation of completeness. Conceptual completeness of the elements and relations can be concluded from the applicability of the framework for coding without the need of further instructions. However, regarding completeness with respect to content, we assume that it can hardly be evaluated directly in the workshops, but rather evolves from design. Finally, we evaluate against integration capability of the framework by applying post-hoc interviews. Overall, we focus on evaluating definition (e.g., rephrasing the constructs in the according context) and intelligibility specificity (respectively accuracy) of the constitutive elements and their relations.

4 Discussion and Outlook

The presented research in progress details the current design science approach for developing a methodology for a business opportunity recognition framework. The development of the methodology aims to structure the process for organizational actors when being challenged to identify opportunities for technology utilization within the organization. Timely recognition of such opportunities is of high strategic importance, albeit its complexity which results from intertwining technology-related decision making with business development.

In order to reduce the complexity we suggest to structure the development of the methodology along the design science research stages and steps as proposed by Peffers et al. [14]. Since three different underlying problem dimensions could be defined for opportunity recognition, the design cycles can be structured accordingly. In this paper we provided the motivation for the first identified problem dimension, i.e. the relevant entities that need to be considered for opportunity recognition and reviewed the respective state of analysis and development.

Based on our analysis of the developed framework for digital transformation opportunity recognition (DTOR) the methodology development can be tackled by the defined DSR approach, since it allows capturing recognition processes' constitutive elements and their relations. In this way the knowledge gap for defining the universe of discourse can be narrowed step-by-step. Knowing this universe not only establishes an ontology for the DTOR developments, but rather helps overcoming individual or collective difficulties to structure the diverse and numerous elements required for DTOR processes. It enables establishing individuals and organizations a terminological and conceptual ground with pre-structured and possibly relevant knowledge items, and thus facilitates migration effort in heterogeneous transformation settings.

From an evaluation perspective the proposed Design Science approach fits to the components and layering of criteria relevant for each design cycle, as having been applied to Information Systems so far (cf. [28]). The dimensions of research identified for methodology development refer to the evolution perspective, and need to be refined to address the goal, environment, structure, and activities explicitly, as they are the constitutive elements and their relations, fundamental for the upcoming steps in methodology development. The model providing an abstraction of evaluation methods represents items relevant for checking ontologies relevant for methods and their appropriation. They need to be generic, including intelligibility for addressed stakeholders, to be utilized in various contexts of the addressed DTOR methodology development.

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