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IT AMBIDEXTERITY – CONCEPTUALIZATION AT THE BUSINESS PROCESS LEVEL

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Abstract

In todays digitized and globalized economy, companies face increasing competitive pressures and unprecedented speed of change in business conditions. Considering limited IT budgets, process owners and IT departments need to decide how to divide their spending on efficiency-enhancing and flexibility-enhancing IT capabilities to optimally support their business processes. Turning from thinking of efficiency and flexibility as trade-off towards ambidexterity puts focus on simultaneously pursuing efficiency through exploitative and flexibility through explorative business process IT (BPIT) capabilities. While these capabilities have been analysed in combination at the organizational level and independently at the business process-level, there is scarce research on the combined effects of those activities for a particular business process. This research paper presents conceptualization and operationalization of ambidextrous IT capabilities at the business process level. In addition, further concepts that are relevant for analysis of BPIT ambidexterity, such as business process performance, operational ambidexterity and business process uncertainty are adapted to the process level. Thus, we intend to contribute to the area of business process management (BPM) and research on ambidexterity in IS through the expansion of existing work by providing constructs and scales for further research on these phenomena at the business process level.

Keywords: Business Process IT Ambidexterity, Ambidexterity, Business Process Management, Business Process Performance, Survey.

1 Introduction

Increasing competition in the global economy and shorter product and technology lifecycles drive companies towards aiming at the achievement of both efficiency and flexibility to stay competitive (Teece *et al.*, 1997; Gibson and Birkinshaw, 2004). Here the information technology (IT) capability, i.e. the provisioning of information technology (IT) to support business processes plays an increasingly important role and is acknowledged to contribute to efficiency and flexibility (Sambamurthy *et al.*, 2003; Chen *et al.*, 2013; Lee *et al.*, 2008; Lu and Ramamurthy, 2011), although organizations face significant trade-offs when pursuing these two conflicting objectives in parallel (Newell *et al.*, 2003; MacKinnon *et al.*, 2008; Kumar and Stylianou, 2013).

Business processes have been found central to the value-generation process for converting IT investments into firm performance (Melville *et al.*, 2004). As IT budgets are limited, the question is how much to invest into exploitative capabilities, i.e. leveraging existing IT capabilities to support business processes and explorative capabilities, which focus on gaining access to new and innovative IT capa-

bilities to support business processes. In such situations trade-off thinking is prevalent (Chen *et al.*, 2013). Recently a shift from such trade-off thinking towards paradoxical thinking could be observed in management research (Gibson and Birkinshaw, 2004). Simultaneously striving for short term efficiency through exploitation of available resources and for long term flexibility through exploration of new resources, has been conceptualized as organizational ambidexterity (Gibson and Birkinshaw, 2004; He and Wong, 2004).

Bringing the ambidexterity concept to the business process context, business process ambidexterity is considered as dynamic equilibrium of business process efficiency and flexibility and proposed to have an impact on business process performance (Xie *et al.*, 2011). Similarly the ambidexterity concept is adapted to the IT-capability context, i.e. addressing the trade-off between exploitative and explorative IT capabilities. While these capabilities have been extensively studied independently (Gebauer and Schober, 2006; Joachim *et al.*, 2013; Wagner *et al.*, 2011; Lee *et al.*, 2008), there is only limited research analysing those in combination (e.g. Tang and Rai, 2014; Lee *et al.*, 2015).

Furthermore, to our knowledge there is even less research focusing on the IT ambidexterity phenomenon at the business process level (e.g. Xie *et al.*, 2011). This is particularly surprising as there are numerous calls for more micro-level research at the business process level in various research fields (Benner and Tushman, 2003; Melville *et al.*, 2004; Turner *et al.*, 2013) and more behavioural research in the business process management (BPM) community (Recker and Mendling, 2015). However, existing constructs such as exploitative and explorative IT capabilities, environmental uncertainty and business process performance, are conceptualized at the organizational level and thus they are not suited for analysing IT ambidexterity at the business process level This leads to the research question guiding this work: *How to conceptualize and operationalize business process IT ambidexterity and its associated nomological net?*

This study contributes towards closing the outlined research gap by adapting relevant constructs and scales to the business process level. In this research in progress paper we present the results from the construct and scale development efforts we have undertaken as part of a large survey project. For these activities we guide our research by well-established procedures for scale development and scale translation (Moore and Benbasat, 1991; Cha *et al.*, 2007).

The structure of this paper is as follows. Second section provides an overview of relevant theoretical concepts around the phenomenon of IT ambidexterity and factors influencing IT ambidexterity. Furthermore we identify constructs that require adaptation for usage at the process level and provide reasoning for proposed changes. The methodological foundations of this study are outlined in section three, before we present the results from data analysis in section four. Section five provides a short outlook on further research as well as an overview of the contribution of this work and limitations.

2 Theoretical Foundations

2.1 IT Capabilities for Business Processes

Business processes have been identified as the locus of IT value generation (Melville *et al.*, 2004; Ray *et al.*, 2005; Schryen, 2013; Gattiker and Goodhue, 2005). A business process can be defined as *"the specific ordering of work activities across time and space with a beginning, an end and clearly identified inputs and outputs"* (Davenport, 1998). Business processes are implemented using IT resources, such as functional systems, enterprise systems or BPM platforms. The ability of an organization to leverage IT resources is defined as organizational IT capability (Chen *et al.*, 2013). Drilling deeper into the organizational IT capability we identify the ability to support a particular business process with diverse IT resources as ***business process IT (BPIT) capabilities***. Drawing on literature on the ambidextrous organizational IT capability (Lee *et al.*, 2008; Lee *et al.*, 2015) we identify two distinct types of activities: exploitation and exploration.

Exploitation is associated with mechanistic structures, tightly coupled systems as well as routinisation and control (He and Wong, 2004; Gibson and Birkinshaw, 2004). Accordingly, ***exploitative BPIT capabilities*** *focus on leveraging the usage of existing IT resources to support a particular business process* with the goal to get the highest yield out of those existing IT resources. This can be done through automation (Shang and Seddon, 2002), which can be increased by implementing so far manually performed tasks using IT. Furthermore tight coupling between IT resources is created through various integration mechanisms allowing automation not only of task activities but for complete business processes (Bahli and Ji, 2007).

In times of highly dynamic business environments IT flexibility is important to quickly adapt business processes to changing customer demands and to adopt innovative technologies (Kumar and Stylianou, 2013; Wagner *et al.*, 2011; Gebauer and Schober, 2006; Chen *et al.*, 2013; Afflerbach *et al.*, 2013; Lu and Ramamurthy, 2011). We define this activity of *identifying and implementing new and innovative IT resources to support a business process as* ***explorative BPIT capabilities***. To easily integrate new resources into existing IT infrastructures, integration mechanisms, such as service-oriented architectures need to be in-place (Schelp and Aier, 2009; Joachim *et al.*, 2013). Such mechanisms also allow for mixing of matching of task implementations to quickly adapt to changing requirements (Schilling, 2000), for instance complementing the core ERP system with individual spreadsheet solutions (Alter, 2014).

Individual effects of exploitative and explorative BPIT capabilities have been analysed independently (Gebauer and Schober, 2006; Afflerbach *et al.*, 2013; Chen *et al.*, 2013; Lee *et al.*, 2008; Lu and Ramamurthy, 2011), however to our knowledge there is little work on the impact of exploitative and explorative IT capabilities at the business process level. Organizational IT ambidexterity has been found to positively influence operational ambidexterity comprising business process alignment and adaptability, which leads to organizational agility (Lee *et al.*, 2015).

Business process performance is an important mediator within the conversion process of IT investments into business value (Melville *et al.*, 2004; Shang and Seddon, 2002). Thus IT contributes to organizational strategy and performance through a set of multiple interlinked business processes (Benner and Tushman, 2003). Consequently we identify various research-worthy phenomena at the business process level that require future research (Heckmann, 2015):

- Impact of business process IT ambidexterity on business process performance.
- Impact of different combination strategies for exploitative and explorative business process IT capabilities on business process performance.
- Interaction effects between business process IT ambidexterity and operational ambidexterity.
- Moderating effects of environmental factors.

Business process performance comprises three dimensions: cost, time and quality (Jones and Linderman, 2014; Karimi *et al.*, 2007). Cost reflects the efficiency-oriented perspective (Gebauer and Schober, 2006). The value of being able to respond fast and flexibly is addressed through time. Quality covers customer-orientation and the possibility to differentiate through particular business processes (Ray *et al.*, 2005). Performance can be seen as an absolute or a relative measure. Relative measures are used to compare performance before and after an intervention, e.g. implementation of an ERP (Karimi *et al.*, 2007) or to compare performance between companies. For this study business process performance is defined as *achievement of the objectives for a business process in relation to its external environment*.

The concept of ***business process uncertainty*** reflects the environmental and organizational uncertainty with regard to a single business process (Gebauer and Schober, 2006; Benner and Tushman, 2003) and is defined *as the difficulty to predict the exact tasks and resources that are required to perform a particular process.* Potential sources of environmental uncertainty are changes in customer behaviour or

legislation. Process uncertainty has found to be important for the value of flexibility and thus for the importance of explorative BPIT capabilities (Sambamurthy *et al.*, 2003; Gebauer and Schober, 2006; Jansen *et al.*, 2006). Companies operating in less turbulent market places need to adapt less frequently and to lower degrees than those in highly dynamic market environments (Tang and Rai, 2014). Thus the more turbulent the market place the more flexible a company must react and the more important becomes having the exploitation capability matched by appropriate exploration capability (Cao *et al.*, 2009).

2.2 Conceptualization – Construct Development

The previous sections introduced the theoretical context of ambidexterity in IS, potential research phenomena in this area and relevant constructs that may play a role in the analysis of phenomena in the context of IS ambidexterity at the business process level. To address those topics through quantitative research, scales for relevant constructs are required or new scales need to be developed or existing scales adapted. As existing literature does not provide adequate scales for process level research in the context of exploitative and explorative business process IT capabilities we adapt existing items to the business process level. An overview of referenced constructs and corresponding adaptations is presented in Table 1.

In many studies we find arguments to measure ***business process performance*** with respect to the specifics of a particular business process (Ray *et al.*, 2004). Consequently most scales for business process performance only address specific business processes, such as customer service (Ray *et al.*, 2005), sales (Reinartz *et al.*, 2004) or recruitment (Muenstermann *et al.*, 2010). Although these measurement scales are self-reported measures, they have been found to be positively correlated with objective measures, such as customer satisfaction measured through a customer survey and retention rate (Ray *et al.*, 2004). Thus we will develop a new instrument, building on existing conceptualizations of business process performance for other business processes (Ray *et al.*, 2005; Muenstermann *et al.*, 2010; Reinartz *et al.*, 2004; Karimi *et al.*, 2007). Throughout this process we follow established guidelines for scale development and validation (DeVellis, 2011; Moore and Benbasat, 1991).

For the measurement of *BPIT ambidexterity* through the dimensions of ***explorative*** and ***exploitative BPIT capabilities***, we adapt He and Wong's scale for organizational ambidexterity, consisting of items addressing exploration and exploitation (2004) to the context of this study following established procedures (DeVellis, 2011; Moore and Benbasat, 1991).

Construct	**Issues**	**Adaptation**
Exploitative IT Capabilities (He and Wong, 2004; Cao *et al.*, 2009; Tang and Rai, 2014; Lee *et al.*, 2015)	Exploitative IT capabilities are only conceptualized as an organizational capability. For process-level research a more fine-grained understanding is required.	Adapted Construct: Exploitative Business Process IT Capabilities
Explorative IT Capabilities (He and Wong, 2004; Cao *et al.*, 2009; Tang and Rai, 2014; Lee *et al.*, 2015)	Explorative IT capabilities are only conceptualized as an organizational capability. For process-level research a more fine-grained understanding is required.	Adapted Construct: Explorative Business Process IT Capabilities
Business Process Performance (Reinartz *et al.*, 2004; Ray *et al.*, 2005; Karimi *et al.*, 2007; Muenstermann *et al.*, 2010)	Business process performance is measured after a particular event, such as the introduction of an ERP system. For process-level analysis of already in-place processes other scales are required.	Adapted Scale

Business Process Alignment (Gibson and Birkinshaw, 2004)	Business process alignment is defined on the organizational or departmental level taking all processes within this entity into account. For analysis of a single business process the scale needs to be adapted to reflect the alignment between this process and all other processes within the entity under consideration.	Adapted Scale
Business Process Adaptability (Gibson and Birkinshaw, 2004)	Business process adaptability is defined on the organizational or departmental level taking all processes within this entity into account. For analysis of a single business process the scale needs to be adapted to reflect the adaptability of this particular business process.	Adapted Scale
Environmental Uncertainty (Jansen *et al.*, 2006)	Environmental uncertainty is conceptualized on the organizational level, indicating uncertainty of the market environment the organization operates in. For process-level analysis this has to be adapted to reflect only uncertainty regarding a single business process.	Adapted Construct: Business Process Uncertainty

Table 1. Required construct and scale adaptations.

3 Methodology

This section contains the methodological foundations that have been applied to adapt the relevant scales to the business-process level, which is depicted in Figure 1. As a first step extant literature regarding ambidexterity in IS research is identified and analysed. Here we identify three streams: Ambidextrous IT capability (e.g. Lee *et al.*, 2015), SCM ambidexterity (e.g. Tang and Rai, 2014) and IS development (ISD) ambidexterity (e.g. Tiwana, 2010). As we focus on operating rather than on development processes the literature regarding ISD is excluded from further analysis.

As next step we identify relevant construct definitions and scales and analyse those for suitability to use at the business process level. Constructs that do not fit this purpose are rephrased to reflect the changed scope following the logic introduced in the previous section. Rephrased items were translated following established guidelines from cross-cultural research (Cha *et al.*, 2007) and discussed with German and Taiwanese business experts from various industries covering multiple business processes. Insights from those discussions were incorporated into item formulation. Following suggestions for scale development we conduct two rounds of card sorting to assess construct validity and identify ambiguous items (Moore and Benbasat, 1991). The first round is conducted with Taiwanese Ph.D. students from the IS area and the second round with German IS master students in their last-year. Results from card sorting are discussed within the research team and required changes are made.

Figure 1. Overview of the activities that have been performed for conceptualization and validation of BPIT ambidexterity at the business-process-level.

The adapted constructs are then evaluated in a pre-test with 32 Taiwanese business professionals that satisfy the condition for survey participation of being a process owner, i.e. being accountable and responsible for a particular business process. Collection of data for the pre-test has been done using a paper-based instrument. Data analysis is conducted with Smart PLS (Ringle et al., 2015), which is preferable for the small sample size available during the pre-test (Lowry and Gaskin, 2014).

4 Results

Before presenting the results from our pre-test in depth we want to share the findings from the two-round card-sorting process. Overall we achieve a rough percentage agreement for category assignments of 74%, which is above the suggested threshold of 65% (Moore and Benbasat, 1991). We derive three insights from the card-sorting:

- Most constructs, including competitive intensity, exploitative and explorative BPIT seem to behave as expected. Only item EXPLOIT6 was not clearly sorted into the correct category leading to dropping this item.
- The items that comprise business process performance were identified as two distinguishable constructs, i.e. business process efficiency and business process satisfaction. The former is rather productivity-oriented while the latter is focusing on perceived performance.
- Our most problematic finding is that card sorters have problems in distinguishing between environmental uncertainty and business process complexity.

Based on those insights we adapt the instrument and conduct a pre-test with 32 participants. We identify two weaknesses in our sample, i.e. (1) no data points for processes with a volume of more than 100.000 process instances are included and (2) no participants from the utilities and government sectors participated.

We check for *discriminant validity* by analysing cross-loadings, Fornell-Larcker criterion and the Hetrotrait-Monotrait-Ratio (Lowry and Gaskin, 2014). In general items should load higher on their on factors than on others. While most constructs load cleanly we identify cross-loadings between process adaptability and process alignment as well as between exploitation and exploration. As cross-loadings for items, except EXPLOIT4, EXPLORE1 and EXPLORE2, differ more than 0.2 between the own and others factors they still load significantly higher on their own factor indicating adequate discriminant validity (Lowry and Gaskin, 2014). Consequently we drop those items. Furthermore we find that the square-root of the AVE for each item is greater than inter-item correlations supporting good quality. We further find the Hetero-Monotrait Ratio consistent with those finding, having all values below the threshold of 0.9.

Convergent validity is analysed using factor loadings and calculating average factor loading. We assume loadings above 0.50 for all items and average loadings of above 0.70 as acceptable quality thresholds. Based on factor loadings we dropped items with loadings below 0.50: EFF5, EFF6, BPC4, UNC4, ALIGN2 and ALIGN4. Furthermore we check for convergent validity using composite reliability and average variance extracted (AVE). For those constructs, values of above 0.70 and 0.50 respectively are acceptable (Hair *et al.*, 2006).

We compute Cronbach's Alpha as measure for *construct reliability*. Following established suggestions values above 0.70 are deemed to be acceptable (Hair *et al.*, 2006). An overview of all constructs with their average factor loadings, reliability and validity measures can be found in Table 2. Despite business process alignments value for Cronbach's Alpha, which is below 0.70, all thresholds are exceeded indicating a reliable and valid instrument. We further verify whether common method bias is an issues. As highly correlated variables, i.e. above 0.9 are an indicator for common method bias, we analyse the correlation matrix. Only between alignment and adaptability as well as between exploitation and exploration we find correlations above 0.5, but still far from 0.9 indicating that common method bias is no issue (Bagozzi *et al.*, 1991).

Construct	**Average Factor Loading (>0.70)**	**Cronbach Alpha (>0.70)**	**Composite Reliability (> 0.70)**	**AVE (> 0.50)**
Exploitative BPIT Capabilities	0.830	0.916	0.930	0.770
Explorative BPIT Capabilities	0,878	0.934	0.947	0.783
Business Process Alignment	0.810	0.624	0.814	0.692

Construct	Average Factor Loading (>0.70)	Cronbach Alpha (>0.70)	Composite Reliability (> 0.70)	AVE (> 0.50)
Business Process Adaptability	0.939	0.955	0.967	0.881
Business Process Performance	0.703	0.831	0.876	0.510
Business Process Complexity	0.788	0.806	0.869	0.625
Business Process Uncertainty	0.866	0.841	0.901	0.754
Competitive Intensity	0.841	0.872	0.912	0.727

Table 2. Quality Criteria for Constructs.

After presenting the overall results we want to present specifics of the constructs business process alignment and business process performance and discuss the implications. Factor loadings for two items of business process alignment are below the suggested value of 0.5 indicating to drop those items. Table 3 provides comparison of three potential models for this construct. Apparently Model 3 results in best values for quality criteria, although Cronbach's Alpha as reliability measure is still below the threshold of 0.7. Furthermore, it is not suggested to use only two items for a construct, thus this Model is no option (Lowry and Gaskin, 2014). We also analyse how the three factor model "Model 2" behaves after dropping the worst item align1. While Model 2 performs significantly better than the full model, only thresholds for convergent validity (i.e. AVE and composite reliability) are exceeded.

Business Process Alignment	Model 1 - Full	Model 2 – Three Factor	Model 3 – Two Factor
Average Factor Loadings	0.511	0.676	0.810
Cronbach Alpha	0.646	0.573	0.624
AVE	0.615	0.505	0.692
Composite Reliability	0.347	0.735	0.814

Table 3. Comparison of different construct models for business process alignment.

Comparison of these three models shows that other solutions need to be taken into account. After further analysis of potential outliers in the dataset we concluded that few strange cases make big impact. By observing the response directly, we found that items ALIGN2 and ALIGN4 are behaving slightly different from other two. As a solution we will rephrase those items. As ALIGN1 focuses on the outcome of process, it is important to also look at the process flow of the business process. As a consequence we perform the following changes:

- ALIGN2: *"This business process allows us to avoid wasting resources on unproductive activities not related to organizational goals"* into *"The activities in this process work cohesively to support organizational goals".*
- ALIGN4: *"The outcome of this process is highly related our organizational goals"* into *"The process allow participants to work collaboratively to support organizational goals"*.

Second construct that needs further discussion is *business process performance*. During card sorting we identify issues with this construct in distinguishing between business process efficiency and business process satisfaction. We further analysis this issue using data from the pre-test. An overview of four different models for this construct is provided in Table 4. Analysis shows that satisfaction (Model 2) exceeds all thresholds[1] while efficiency (Model 1) shows issues for average factor loadings as well as AVE below 0.5. Model 3 indicates that combining both to a single construct business process performance also faces issues. After dropping all items with factor loadings below 0.5 the overall combined construct (Model 4) performs significantly better: all thresholds are exceeded.

[1] Cronbach Alpha is counted as reached with a value of 0.695

Business Process Performance	Model 1 Efficiency	Model 2 Satisfaction	Model 3 Full	Model 4 Optimized
Average Factor Loadings	0.609	0.836	0.590	0.703
Cronbach Alpha	0.703	0.695	0.788	0.831
AVE	0.437	0.62	0.407	0.509
Composite Reliability	0.795	0.83	0.841	0.876

Table 4. Comparison of different construct models for business process performance.

The final survey instrument as well as translated questionnaires in German and Chinese languages can be obtained upon requesting the authors.

5 Contribution

This paper presents conceptual foundations of exploitative and explorative BPIT capabilities as the process-level adaptation of IT ambidexterity as well as adapted scales for those and other relevant constructs that can be used in process-level research on the phenomenon of IT ambidexterity. Furthermore we present the results from various activities we have undertaken to validate the derived scales including card sorting, panel discussion and a pre-test with 32 participants. By providing constructs and scales for research on IT ambidexterity as a process-level phenomenon this study addresses the call for more micro-level studies on the topic of ambidexterity to understand the details of the inherent complexity to provide actable guidance for managers in practice (Turner *et al.*, 2013; Benner and Tushman, 2003). We further address the call for more behavioural research in BPM (Recker and Mendling, 2015). Thus we contribute to the research stream on IT business value and to the BPM research community, as further research can use the provided constructs to address the highlighted gap of process-level research on the field of IT ambidexterity.

Reflecting our work, limitations need to be mentioned. The sample size of 32 is rather limited and representativeness of the overall sample is not necessarily given. The survey for the pre-test has only been conducted in a single cultural circle, i.e. the East-Asian hemisphere – here Taiwan. We are aware of these limitations but are still confident in our activities as we ensured overall validity and reliability of our developed constructs and scales through various complementary qualitative approaches, such as panel discussions and card sorting.

Various research opportunities exist within the area of business process IT ambidexterity as presented in the list with potential research phenomena in section 2.1. Addressing one of those questions as a next step, we will follow a confirmatory quantitative approach and conduct a survey on exploitative and explorative BPIT capabilities and their impact on business process performance within Germany and Taiwan (Heckmann, 2015).

Through these subsequent studies, we also contribute indirectly to practice. By increasing the understanding of BPIT ambidexterity, process owners and IT managers are sensitized for the interplay between exploitative and explorative BPIT capabilities in various environmental settings. For instance, in cases of high environmental uncertainty, it is important to balance those dimensions to achieve sustained business process performance. These guidelines can help practitioners to find the delicate balance between overinvesting into explorative BPIT capabilities and being vulnerable to changing business conditions.

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