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# Is Modularity the Answer? The Role of Modularity as an Enabler of Shared Understanding Between Business and IT

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## Abstract

*In today's rapidly evolving business landscape, characterized by heightened competition and unpredictable market dynamics, organizations are under increasing pressure to adapt. In agile environments, too little shared understanding between business and IT is one reason for project failure. We focus on the effects of business process and IT modularity on agility through shared understanding among business and IT professionals. An understanding of the differentiated effects of architecture management on agility and shared understanding can help us to gain a richer understanding of the antecedents of agility. Using the work system theory to link modularity and shared understanding, we develop a theoretical model and test it using survey-based data from the banking industry. We find that in addition to the direct impact of facets of modularity on agility, shared understanding serves as a mediating factor that enhances the effectiveness of modularity on agility. However, modularity does not enable shared understanding between business and IT professionals per se. While modular IT architectures impact the shared understanding about business processes, modular business processes support shared understanding of business strategy.*

**Keywords:** Shared Understanding; Modularity; Organizational Agility.

## Introduction

Organizations today face mounting pressure to adapt due to intense competition and unpredictable market conditions in our fast-changing business environment. Agility is the capacity to respond swiftly, adeptly, and effectively to disruptive and unforeseen market events (Tallon et al., 2019). It has gained significant attention from scholars and practitioners alike and has become an essential determinant of a firm's overall performance (Johnson et al., 2024; Queiroz et al., 2023). Central to this ability is the role played by information technology (IT) in facilitating or impeding such adaptability. Consequently, scholars have initiated investigations of the antecedents of agility at the firm level and business units (Nazir & Pinsonneault, 2021; Queiroz et al., 2023). These suggest that IT resources and capabilities play a pivotal role in predicting agility (Tallon et al., 2019). Another acknowledged determinant of organizational success is a collective comprehension or shared understanding of the functions and interconnections in an enterprise (Lorenz & Buchwald, 2023). Shared understanding seems essential for achieving agility, as it enhances adaptability, enabling teams to respond quickly and effectively to changing requirements and market conditions (e.g., Preston & Karahanna, 2009; Reich & Benbasat, 2000). Shared understanding also represents a key factor in enabling strategic alignment, or fit, between IT and business strategy. However, firms have often struggled with aligning strategies and creating a shared understanding between business and IT that contributes to the desired organizational agility. Consequently, the recent strategy literature even suggests the merging of business and IT organizations (e.g., Digital Units (Lorson et al., 2023; Svahn et al., 2017)) and teams (e.g., BizDevOps (Frey et al., 2023)), and the fusion of strategy (Bharadwaj et al., 2013). While this seems to be the ultimate silver bullet to the business/IT alignment problem, it comes with its own challenges (Svahn et al., 2017). The need for alignment and shared understanding could just be shifted, from between business and IT to between other types of organizational entities with their own missions. Furthermore, such “fusion solutions” are only applicable to parts of the application layer. Practices such as bimodal IT explicitly propose two modes that are individually defined and managed (Haffke et al., 2017). Architects and “platform teams” responsible for maintaining and running the “operational backbone,” i.e., the entire IT infrastructure of mission-critical systems, are still necessary and usually operate outside of this scope. Overall, this means that alignment and shared understanding of a complex enterprise architecture (e.g., their business processes, data structures, and other systems (Ross et al., 2019)) remain (and probably are becoming even more) critical for a firm to thrive.

Those firms can be conceptualized as complex socio-technical systems characterized by numerous interdependent components, dynamic interactions, and emergent behaviors that cannot be fully predicted from their constituent parts (Benbya et al., 2020). This complexity presents significant challenges for alignment across the organization.

Modularity—the principle of partitioning complex systems into relatively independent, self-contained components with standardized interfaces—offers a promising approach to managing this complexity (Baldwin & Clark, 2000; Sanchez & Mahoney, 1996). By establishing clear boundaries and well-defined interaction protocols between system components, modularity reduces the cognitive burden required to comprehend the entire system. Rather than requiring exhaustive knowledge of all system details, organizational members can understand their own modules in depth while grasping only the essential interface specifications of other modules (Colfer & Baldwin, 2016; Simon, 1962). This architectural approach to complexity management facilitates the development of shared understanding across specialized functions and organizational boundaries.

The resulting enhanced comprehension of system components and their interactions directly contributes to organizational agility. When team members across the enterprise share a common mental model of the organization’s architecture, they can more rapidly identify the implications of external changes, determine required adaptations, and implement coordinated responses without disrupting the entire system (Tiwana & Konsynski, 2010). Thus, modularity serves as a critical enabling mechanism through which organizations can achieve the shared understanding necessary to respond effectively to unpredictable market dynamics and maintain competitive advantage in turbulent environments.

We argue that shared understanding is more difficult to achieve in non-modular than in modular systems. Following this idea, we assume that an enterprise built out of modules will help all stakeholders develop a shared understanding of the underlying business processes and IT systems and that this ultimately facilitates agility. This is a complementary explanation to the findings of Nazir and Pinsonneault (2021), which state that integration positively affects agility through knowledge exploitation and process coupling mechanisms and suggest that the relationship between system architecture and agility may be more nuanced than previously thought, with both integration and modularity potentially offering distinct pathways to agility depending on contextual factors and implementation approaches. Building on this, we challenge prior research that shared understanding’s relevance to performance in the business/IT collaboration will decrease and might even be a threat in a modularized environment, because a high level of information sharing in a modular system leads to low performance and resource overkill (e.g., Mani et al., 2010; Resick et al., 2014).

Given that shared understanding is critical for IT project outcomes and is relevant for agility, it is essential to gain deeper insights into this relationship between modularity and shared understanding. Accordingly, our research question is:

> *How does modularity influence agility by enabling shared understanding?*

To test our hypothesis of a positive relationship between modularity, shared understanding, and agility, we use survey-based data collected in the banking industry. The findings indicate that shared understanding has a positive impact on agility and that modularity influences shared understanding between business and IT in different ways.

In the following, we first provide an overview of the concepts of agility, shared understanding, and modularity. Then, we introduce the research model and derive our hypotheses. After describing our research methodology, we present our empirical results. Finally, we discuss the implications of our findings, including the contributions and limitations of our work.

## Theoretical Background

### Agility and IT Change Effectiveness

Agility is "the ability to respond to sudden and unanticipated market events with ease, speed, and dexterity" (Queiroz et al., 2022, p. 1093) and has long been recognized as a top concern among CIOs (Johnson et al., 2024). Research shows that aligned IT resources and strategic orientation are key drivers of agility (Nazir & Pinsonneault, 2021; Queiroz et al., 2023; Tallon et al., 2019). Shared understanding across business and IT further enhances coordinated, rapid responses (Hu et al., 2023; Liang et al., 2017). These findings align with recent systematic reviews emphasizing that agility is a multidimensional construct critical to navigating volatile and uncertain environments (Franco et al., 2024; Nguyen et al., 2024).

Tiwana and Kim (2015) define IT strategic agility with four dimensions: "(1) identifying IT opportunities, (2) educating top management on IT, (3) assessing emerging technologies, and (4) adapting technology to changing business needs" (p. 671). We build on the fourth—adaptation—to develop IT change effectiveness, which captures how effectively IT units eventually implement technological change.

Since the banking industry is characterized by centralized IT units or specialized vendors, using IT change effectiveness instead of agility seems adequate, as setups like joint teams are not usual. Pelletier et al. (2025) emphasize that agility in SMEs requires aligning dynamic and operational IT capabilities to execute digital transformations—a core manifestation of effective IT change.

Unlike broader views of agility, which span sensing, decision-making, and implementation, IT change effectiveness narrows attention to IT's execution of technological adaptations, a lens well-suited to studying how modularity enables shared understanding and effective change. Recent empirical work suggests that agility failures often stem from mismatches between IT capabilities and managerial practices (Pelletier & Raymond, 2024), reinforcing the need to study execution-specific mechanisms.

### Shared Understanding

Shared understanding (SU) plays a critical role across various strands of information systems (IS) research. It is central to business/IT alignment, where it enables strategic alignment (Johnson & Lederer, 2010; Preston & Karahanna, 2009; Sabherwal et al., 2019) and contributes to social alignment (e.g., Reich & Benbasat, 2000; Tan & Gallupe, 2006; Vermerris et al., 2014) and operational alignment (Vermerris et al., 2014; Wagner et al., 2014) between business and IT. SU also plays a critical role prominently in IS development research, where it is seen as a key factor in requirements engineering (e.g., Charaf et al., 2013; van den Hooff & de Winter, 2011; Yang et al., 2008), global collaboration (Vlaar et al., 2008), and system implementation (e.g., Davis et al., 2009).

Conceptualizations of SU are closely tied to their research context (Jentsch & Beimborn, 2014, 2016). High SU can enable alignment, but the two are not interchangeable. Misalignment may persist despite shared cognition (e.g., due to organizational frictions), and formal alignment may remain superficial in the absence of deeper mutual understanding. Recognizing this distinction clarifies SU's unique role in fostering responsiveness and effective IT adaptation.

Recent discussions suggest a shift from alignment to strategy fusion, where business and IT are no longer seen as separate domains (Bharadwaj et al., 2013; Teubner & Stockhinger, 2020). Yet even here, SU remains foundational. Merging strategic domains does not eliminate the need for shared understanding (Holotiuk & Beimborn, 2017). On the contrary, it may even increase its importance in ensuring coherent action across roles and units. Moreover, the organizational integration of business and IT remains aspirational in most incumbent organizations, where traditional boundaries persist or are even reintroduced in response to shifting priorities such as cost efficiency over agility. This tension is also reflected in longitudinal studies like the SIM survey (Johnson et al., 2024), where alignment continues to rank among the top executive concerns, alternating only with cybersecurity.

To understand SU, we turn to how individuals interpret knowledge. Gobet and Simon (1996) emphasize that perception is shaped by internal cognitive templates—individual mental models grounded in beliefs, assumptions, and interpretive categories (Clark, 2002; Kelly, 1955). These templates allow individuals to structure complexity. In modular systems, where complexity is decomposed into subsystems, such structuring becomes easier and more uniform, fostering shared meaning across actors.

To analyze SU across organizational contexts, we adopt work system theory (Alter, 1999). This framework distinguishes between artefacts within a work system—such as processes, activities, and technologies—and those external to it, such as strategies, infrastructure, or environment. These categories provide a consistent lens for differentiating levels of understanding. This distinction is illustrated in

Figure 1, which maps SU onto the work system framework and highlights how operational and strategic artefacts serve as focal points for cognitive alignment.

We emphasize, however, that these domains (strategic and operational) refer to areas of understanding—not to specific actor groups. Business and IT stakeholders are jointly involved in both, and SU emerges when their mental models overlap across these domains. Empirical work supports this structure. Jentsch et al. (2014) propose a measurement model that differentiates SU along three dimensions: understanding of business strategy (strategic), understanding of processes and technologies (operational), and clarity about roles (interactional). These correspond closely to the internal/external logic of work system theory, with roles mediating between both levels. Their instrument reinforces the notion that SU is a multidimensional construct that spans both strategic and operational domains.

The dynamic nature of SU becomes particularly evident in agile environments, where teams must coordinate continuously under uncertainty. Bittner and Leimeister (2014) show how agile teams iteratively develop SU through structured communication rituals such as stand-ups and retrospectives. Their findings highlight that SU is not only a cognitive state but also a processual outcome of communication and coordination—particularly crucial in contexts of rapid IT change.

Prior literature mirrors this dual perspective. SU about internal artefacts—such as roles, tasks, and technologies—has been linked to operational alignment (Nelson & Cooprider, 1996; Wagner et al., 2014). SU about external artefacts—such as strategies and markets—has been studied in the context of strategic alignment (Chan et al., 2006; Preston & Karahanna, 2009).

We define SU as the overlap of mental models between business and IT stakeholders, particularly as these models pertain to both strategic and operational domains of the work system. These mental models are shaped by stakeholders' experience, roles, and exposure to domain-specific knowledge, allowing them to structure complexity in consistent ways. This conceptualization reflects both theory and measurement and serves as the foundation for our research model, which examines how modular architectures support SU and thereby enable effective IT adaptation.

### Modularity

Complex systems are ubiquitous today. Even seemingly simple artifacts often contain such high levels of complexity that no single individual can fully design or understand them. Modularity provides a set of design rules that have proven useful in many contexts for managing this complexity (Baldwin & Clark, 2000). The principles of modularity have been discussed since the 1960s (Alexander, 1964; Simon, 1962). At its core, modularity is a design approach that divides a complex system into smaller subsystems of reduced complexity, which together still fulfill the functions of the original system (Baldwin & Clark, 2000). These smaller subsystems—called modules—are designed to be interchangeable and recombinable in different configurations. Baldwin and Clark (2000) define a module as "a unit whose structural elements are powerfully connected among themselves and relatively weakly connected to elements in other units. Clearly, there are degrees of connection, thus there are gradations of modularity" (p. 63).

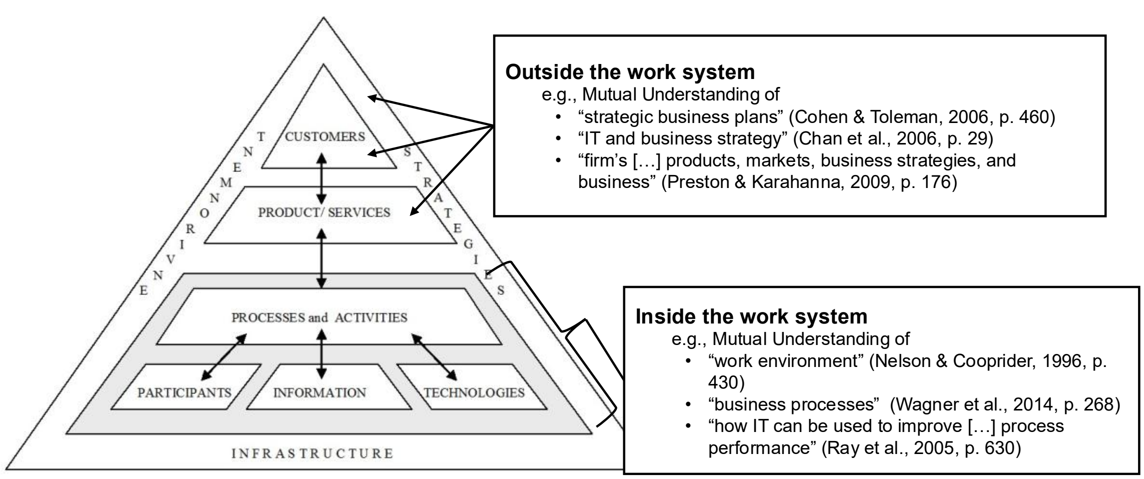



**Figure 1. Relationship Between Shared Understanding Concept and Work System Framework (Based on Alter, 2006)**

Two fundamental principles underlie modularity: (1) interdependence within, and independence across, modules; and (2) abstraction, information hiding, and interfaces (Baldwin & Clark, 2000). The first principle highlights that although modules are designed to be independent, they must still function together coherently. Modularity is therefore often conceptualized alongside integration, which refers to combining modules into a unified whole so that they interact seamlessly and achieve system-level objectives (Nazir & Pinsonneault, 2021).

The second principle emphasizes that modules encapsulate internal complexity behind well-defined boundaries, providing conceptual abstraction. A modular system can thus be seen as a hierarchy of loosely coupled components rather than a monolithic whole. Interaction occurs through standardized interfaces, which allow modules to communicate while remaining independent. Such interfaces enable loose coupling, ensuring that changes to one module have minimal impact on others (Fowler, 2001; Nambisan, 2002). Well-designed modules can be understood and tested independently, without requiring knowledge of their internal workings (Langlois, 2002). Acting as black boxes, modules reveal only the information necessary for interaction (Parnas, 1972), while the quality of interfaces determines the degree of coupling (Schilling, 2000).

Because of its broad applicability, modularity has been studied across multiple domains (Frandsen, 2017; Parslov & Mortensen, 2015). Its origins lie in product design (Ernst & Kamrad, 2000; Momme et al., 2000), but the concept has since been applied in management, information systems, and organizational research. Scholars have examined modularity in product manufacturing alignment (Doran & Hill, 2009), product architectures (Henfridsson et al., 2014; Hoetker, 2006; Langlois, 2002), and embedded coordination in design (Langlois, 2002; Sanchez & Mahoney, 1996; Ulrich, 1995). This embedded coordination has been shown to support outsourcing and large-scale projects (Kude et al., 2023; Mishra & Sinha, 2016). Other strands of research address modularity in processes (Sanchez & Mahoney, 1996; Tanriverdi et al., 2007), organizations (Soyer et al., 2018), services (Hsuan & Mahnke, 2011; Müller & Lubarski, 2016), platforms (Yoo et al., 2010a), and sustainable design (Sonego et al., 2018). The concept has also shaped new paradigms such as modular layered architectures (Hylving & Schultze, 2020), building on the notion of layered modularity in digital innovation (Yoo et al., 2010b). This perspective has more recently been extended to the level of ecosystems and industries, where modular design rules shape interorganizational structures (Baldwin, 2018).

Modularity is relevant to business contexts because firms themselves are highly complex systems. Enterprise architectures are typically conceptualized as layered structures, distinguishing between business and IT domains to enable alignment (Beese et al., 2023; Haki et al., 2020). In these models, IT systems support or execute business processes. In the following, we explain how both business processes and IT architectures can be organized in modular ways.

Business processes are structured sequences of tasks aimed at achieving business outcomes (Davenport & Short, 1990). If modularized, processes can be decomposed into sub-processes (Basu & Blanning, 2003). Tanriverdi et al. (2007) define business process modularity as “the extent to which a business process is loosely coupled, mature, and standardized enough to be separated from a firm’s other business processes, executed independently, and recombined without loss of functionality” (p. 283). In this view, a modularized process consists of activities that represent independent modules, which can be recombined with others with minimal loss of functionality (Schilling & Steensma, 2001). Moreover, entire processes—such as granting and managing real-estate loans—can themselves act as modules, loosely coupled to other business processes (Sanchez & Mahoney, 1996; Tanriverdi et al., 2007). While modularity increases adaptability, it can also introduce coordination trade-offs and performance risks (Ethiraj & Levinthal, 2004).

The IT layer comprises applications and their subsystems, including middleware and supporting technologies (Byrd & Turner, 2000). IT architecture modularity is defined as “the degree of decomposition of an organization’s IT portfolio into loosely coupled subsystems that communicate through standardized interfaces” (Tiwana & Konsynski, 2010, p. 290). Applications may act as modules themselves, or they may consist of sub-modules that encapsulate information and interact only via interfaces. This design ensures that changes to one application affect others only minimally (Fowler, 2001; Nambisan, 2002). A modular IT architecture with stable interfaces enables organizations to integrate new components, develop or replace existing ones, and improve communication with suppliers (Ceci et al., 2019). This reflects the observation of Conway (1968) that system architectures often mirror the communication structures of the organizations that design them. Even in modular IT systems, organizations must often retain more knowledge than they directly employ (Brusoni & Prencipe, 2001).

## Research Model and Hypotheses

This research aims to determine whether and to what degree modularity supports SU between business and

IT units and thus contributes to IT's ability to fulfill the agility needs of the business. Figure 2 visualizes the research model developed in the following. As previously stated, we distinguish between SU of business processes (SU inside the work system) and SU of business strategies (SU outside the work system). Our antecedents include two types of modularity: business process modularity and IT modularity.

Focusing on the meaning of organizational agility in the context of our study, earlier research indicates that a high level of business/IT shared understanding enables the IT unit to react quickly and flexibly in addressing upcoming business needs in the sense of organizational agility (Wagner et al., 2014).

An optimal IT infrastructure is designed to support organizational knowledge creation, which, in turn, results in an increased organizational agility to stay competitive in changing markets (Queiroz et al., 2018). Similarly, Chen et al. (2014) found that strong alignment of an IT architecture to the business environment significantly contributes to the level of business process agility, in terms of changeability and effectiveness. Furthermore, a closely aligned business/IT architecture will be achieved through a high level of SU (Reich & Benbasat, 2000), while Ray et al. (2005) found that SU of business processes mediates the positive effects of IT spending on process performance. Other research focusing on the strategic alignment between business and IT argues that SU about the business strategies helps the IT unit to deploy appropriate IT architecture to support the realization of these strategies (Chan et al., 2006; Cohen & Toleman, 2006; Preston & Karahanna, 2009). Thus, it is not the IT architecture itself which helps improve strategic IT performance, but rather IT's understanding of how to leverage and improve this flexible IT architecture to optimally support the work and processes of the business unit.

Therefore, we hypothesize it is not (just) the modular IT architecture itself that helps improve agility, but in addition IT's understanding of how to leverage and improve this modular IT architecture to optimally support the work and processes of the business unit:

> Hypothesis 1a (H1a): Shared understanding of business processes facilitates IT change effectiveness.

> Hypothesis 1b (H1b): Shared understanding of business strategy facilitates IT change effectiveness.

Research shows that business process modularity improves the structure of, and between, processes, and uncovers redundancies and inefficiencies (Basu & Blanning, 2003). Especially in research on IT projects, scholars generally agree that "well-designed modules and interfaces benefit team coordination by economizing on the need to communicate and the need to develop a deep, shared common ground" (Kudaravalli et al., 2017, p. 48). Mani et al. (2010) argue that modular structured business processes enable knowledge transfer between individuals because the information that needs to be processed has likewise become modular. This enables structured "piece-by-piece" information processing. Based on these ideas of modularity, we argue that reduced complexity and the potential of piece-by-piece information processing facilitate the development of individuals' understanding of the business process.

In our research domain, the involved individuals are members of the business or IT unit. In referring to the work system theory, the main work domain (i.e., "inside the work system") of business professionals is the business process itself, and IT professionals interpret the business process through the lens of the IT architecture. We argue that IT professionals possess a larger set of personal templates (Gobet & Simon, 1996) about the IT domain than about the business domain, which they are less familiar with.

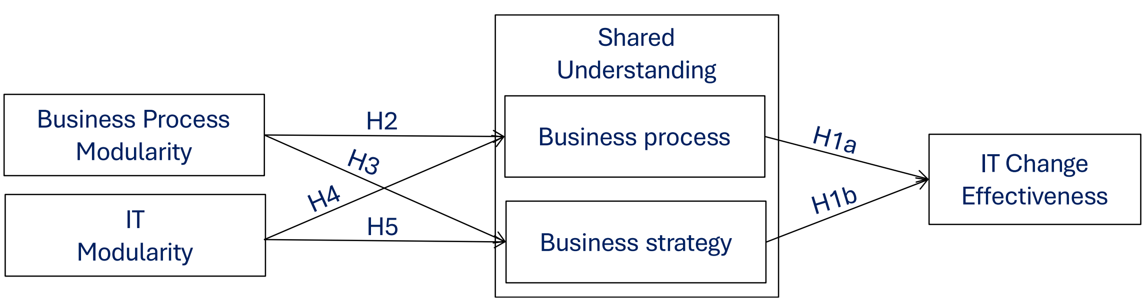



**Figure 2. Research Framework**

Nevertheless, since modularity is a very common concept in the IT domain—e.g., in software engineering (Booch et al., 2005, 2007) or IT architecture (Joachim et al., 2013)—many IT professionals are experienced with the concepts of modularity as such and may therefore find it easier to understand the business side if the business processes are organized in a modular way. If the processes are detachable from their infrastructure and other business processes, it allows them to effectively understand which parts of "their" IT domain are connected to which parts of the "foreign" business domain. This effectively models the relationship between a business task and its corresponding IT function. Standardization of interfaces and this explicit modeling enable IT personnel to get a better understanding of the architecture and function of the business. They can now map the business process to their own cognitive model of intertwined IT functions. This helps to bring them into a structured flow that corresponds to the business function, which in turn helps them align IT to business. We classify this type as inside-in work knowledge perspective since the knowledge for "inside the work system" (here: business process knowledge) is being enabled by specification from inside the work system (here: modular business process). Thus, our next hypothesis is:

> Hypothesis 2 (H2): Modular business processes are associated with a higher level of shared understanding of business processes between business and IT professionals (inside-in perspective).

The concept of hierarchical encapsulation in modular systems facilitates a "scrolling" through multiple levels of abstraction. A set of modules can together form one concrete system, while this system can be a module in a higher-level system. By applying the modularity concept to our understanding of how knowledge is created, as explained by personal templates, we can argue that a person uses various cognitive templates to make sense of his or her surroundings. About the perceived (set of) environmental modules, the individual uses various hierarchical templates to interpret those modules. This enables him or her to do a cognitive hierarchical scrolling through the different levels of abstraction, which maps to the modularity concept. Our argument is supported by Henfridsson et al. (2014), who describe the different levels of abstraction as patterns that are combined to form a network of patterns, which can be flexibly adjusted to a changing environment. Thus, an individual applies multiple hierarchical templates to abstract a general understanding of a business system (network of patterns) from a concrete step in a business process (pattern).

Again, based on the work system theory, we argue that individuals experienced in abstracting perceptions of single work systems (inside the work system) to a larger network of work systems are able to interpret the strategy of the network of business systems (outside the work system). We call this inside-out work knowledge. Initial evidence for this assumption has been provided by Malhotra et al. (2005), who found that modular business processes across different units enable strategic knowledge exchange among the collaboration partners. Recently, Chatterjee et al. (2021) have shown that innovation and the management of organizational processes can be eased up by different factors, including strategic modularization of IT systems, while Zhou et al. (2023) found that modularized architectures are an enabler for information sharing, shared knowledge, and shared understanding across boundaries. Based on these findings, we argue that structuring single business elements in a modular way improves the understanding of the intent (or strategy) of a larger business system. Accordingly, we state our hypothesis as follows:

> Hypothesis 3 (H3): Modular business processes are associated with a higher level of shared understanding of business strategies among business and IT professionals (inside-out perspective).

As discussed above, we posit that an IT module can only realize its full potential when it is integrated within a larger enterprise architecture. IT modularity enables a flexible IT architecture (Byrd & Turner, 2000; Chanopas et al., 2006). Combining IT professionals' experience with IT modularity, we argue that an IT architecture that flexibly supports the modular structure of the firm's business processes especially facilitates business understanding among IT professionals. From a theoretical perspective, this means that IT professionals adopt personal templates from outside the current work system to make sense of the inside work system (outside-in work knowledge perspective). Malhotra et al. (2005) found that modular structures of two or more collaborating organizations enable the exchange of knowledge and improved joint operational performance. Likewise, by enabling knowledge exchange within business/IT collaboration, IT professionals gain a better understanding of the business process while aligning the IT architecture with the business process. This, in turn, contributes to greater SU of the business process between business and IT professionals. This assumption is supported by previous studies showing that individuals working together in a team achieve a higher level of shared understanding when their environment is organized in a modular structure (Kudaravalli et al., 2017). Thus, we hypothesize:

> Hypothesis 4 (H4): IT modularity is associated with a higher level of shared understanding of business processes among business and IT professionals (outside-in perspective).

Analogously to the previous argumentation (cf. Hypothesis 2), we assume that IT people interpret business processes through the lens of IT architecture (outside-in work knowledge). If an organization has a modular IT architecture in place (as a system of IT modules) which does flexibly support the business process system, the IT staff will be able to create an understanding of what the strategic business intent is in a much easier way than if the IT architecture was non-modular (e.g., monolithic or silo-oriented with spaghetti-like point-to-point linkages between the different components). This assumption leads us to an outside-out work knowledge perspective, which provides the reasoning for the final hypothesis:

> Hypothesis 5 (H5): IT modularity is associated with a higher level of shared understanding regarding the business strategies among business and IT professionals (outside-out perspective).

## Methodology

We tested our research model using data collected in a survey-based process-level study in the banking industry.

### Data Collection

We surveyed participants from the banking industry in Germany, Austria, and Switzerland (only German-speaking regions). We investigated two core processes: granting and managing SME investment loans and private real estate loans. We deliberately chose a process-level approach. Measuring at the firm level would blend the net effects of our antecedent variables on performance. Firms often have strong processes in some areas but weaker ones in others, which at the aggregate level would obscure the effects we aim to capture (Wagner et al., 2014). However, together, these processes cover key profit-generating segments of both commercial and retail banking.

As a first step, we identified the 1,000 largest banks by their total assets and the two managers responsible for the two credit handling processes in question. The managers were identified with a multi-step approach. First, we reviewed the website for leads. We contacted each firm by phone and asked for the responsible manager. We then tried to speak personally to them and invited them to participate in our study; as a benefit, we offered to provide an anonymized benchmark report. This way, we contacted 1,868 senior managers by phone. If the person agreed to participate in the study, we sent out the questionnaire. After ten and 20 days, we sent out reminder emails and then called each manager who had not yet replied. In total, we received 202 questionnaires (response rate of 10.8 percent).

### Survey Development and Measures

We involved three researchers and four consultants from the banking industry in the development of the survey. In addition, we pre-tested the final questionnaire with three banking managers. Our questionnaire starts with a brief introduction that describes the business process (credit handling process) in the focus of the survey. As outlined above, we targeted the process owner, thus taking a key informant approach, ensuring that we had the most appropriate responses to evaluate the related business environment. Since we focused on single business processes, we were able to ensure that key informants were very knowledgeable about the interaction between business and IT units regarding that particular process (Schlosser et al., 2015).

One concern might be that our items for IT-related constructs should have been measured at the firm level (e.g., IT change effectiveness) rather than at the process level. We want to highlight that the IT units, because of the complex and large structures of the banking IT systems, are organized in teams that provide services and applications to “their” business unit (e.g., the loans departments). Accordingly, responses from process owners reflect the services delivered by the corresponding IT unit, but not those of the overall IT organization. In our survey (including the introductory explanations to the overall questionnaire and to the single sections of questions), we made it very clear that the focus of the respondent should be on the process, on the IT system supporting this process, and on the IT unit delivering this IT system. In our pretests and expert discussions during the development of the questionnaire, we never perceived any other (broader, firm-level) perception of our measurement items.

While IT units in banks are structurally organized in teams serving respective business units, this does not imply modular IT architectures. A team may still operate on monolithic, tightly coupled systems with low modularity, while others work on highly modular systems composed of separable, recombinable components. Our construct of IT modularity therefore captures the architectural property of IT systems—i.e., the degree to which IT components are designed to be self-contained, interoperable, and flexibly recombinable—rather than their organizational assignment. This distinction ensures that our measurement of IT modularity reflects differences in architectural design choices, not simply team structures.

The measures used in our survey were adopted from previous empirical studies. All constructs were measured with reflective questionnaire items. Minor adaptations based on the insights from pre-tests and interviews were made to reflect the banking domain and the particularities of loan processes. To measure business process modularity and IT detachability (a control for modular interdependence between IT and business, introduced in the next paragraph), we adapted the items provided by Tanriverdi et al. (2007). The items for measuring IT modularity have been adapted from Tiwana and Konsynski (2010). Shared understanding was operationalized using items that had been used in multiple other studies (e.g., Cohen & Toleman, 2006; Preston & Karahanna, 2009; Wagner et al., 2014). Finally, IT change effectiveness was operationalized by measuring the quality and change responsiveness of the IT unit in building IT solutions for the business unit (Wagner et al., 2014). To tailor this construct to our study, we refined these measures, which allowed us to ensure conceptual consistency with Tiwana and Kim (2015) while drawing on Wagner et al. (2014) to provide the specificity needed to analyze how modular architectures affect the speed and quality of IT adaptation. The items and original sources are listed in Appendix B.

In addition, we included several control variables: process type (type of credit), country, firm size (log of balance sheet total), bank sector (commercial banks, cooperatives, public savings banks), and respondent age as a proxy for experience. The descriptive statistics for the controls are listed in Table 1. Additional descriptive statistics on the measurement items are in Appendix A. In addition, we included IT detachability (Tanriverdi et al., 2007) as a control variable. While modularity captures an architectural design choice—the structuring of processes and IT into separable modules—detachability reflects the realized degree of technical decoupling between business processes and IT infrastructure. In this sense, detachability is not equivalent to modularity but a related property that shapes coordination requirements. By controlling for detachability, we ensure that the effects we attribute to modularity are not simply driven by the technical separability of processes from their supporting IT systems. Tanriverdi et al. (2007) define IT process detachability as "…the extent to which the process and its underlying IT infrastructure are loosely coupled to allow separation, independent execution of the process on another IT infrastructure, and recombination without loss of functionality" (p. 285). IT detachability has been shown to reduce coordination costs and influence the contract type in sourcing decisions (Ge et al., 2021). IT detachability, therefore, captures the essence of modularity between the two subsystem layers.

### Validating the Measures

As we tried to measure different types of modularity with the same survey, we ensured that the items were distinct enough. To ensure content validity, we conducted a card-sorting experiment. Seven pairs of IT architects and process owners served as the jury. In the experiment, they were presented with the items and had to categorize them into a construct. The experiment explicitly allowed the assignment of an item to more than one or no category at all. We calculated Fleiss's Kappa (.806). Because of the high value (> .65), we only conducted a single round of sorting (Moore & Benbasat, 1991).

**Table 1. Descriptive Statistics**

| **Sector** | | **Country** | | **Balance sheet total in Mio €** | |
|---|---|---|---|---|---|
| Private | 13.37% | Germany | 83.17% | 612-772 | 10.39% |
| Public | 26.73% | Austria | 6.93% | 772-948 | 10.39% |
| Cooperative | 59.90% | Switzerland | 9.90% | 948-1,120 | 10.89% |
| **Process Type** | | **Age (in years)** | | 1,120-1,320 | 10.89% |
| Real estate loans | 55.94% | < 35 | 8.37% | 1,320-1,590 | 9.90% |
| SME loans | 44.06% | 35-44 | 36.95% | 1,590-2,780 | 9.90% |
| | | 45-54 | 29.56% | 2,180-2,780 | 9.90% |
| | | >= 55 | 8.37% | 2,780-4,600 | 9.90% |
| | | N/A | 16.75% | 4,600-8,060 | 9.90% |
| | | | | 8,060-365,000 | 8.91% |

To address the concern that process owners cannot give a sufficient response regarding IT modularity, we conducted another small experiment with 23 pairs of process owners and their corresponding IT architects. 18 pairs of them were asked to fill out the survey simultaneously without any communication between them. The other five pairs were asked to fill out the questionnaire based on a scenario that we created from a textbook. In both cases, the answers were highly correlated, so we are certain that process owners can act as proxies for IT architects in this case (.743).

### Missing Value Treatment

Of the 202 received surveys, 90 had missing values. As our sample is relatively small, with some variables having missing values above 5 percent, we chose not to use mean replacement or case-wise deletion as missing data technique. This would have resulted in biased results and less statistical power (Reitz, 2025; van Buuren, 2018; Wang et al., 2022). Based on the analysis of the dataset and the test rounds with the experts' comments, we are quite certain that data are missing at random. For this scenario, multiple imputation or maximum-likelihood perform best (Graham & Coffman, 2012; Reitz, 2025). Cleaning the dataset as suggested by Hair et al. (2014), e.g., removing datasets with complete constructs missing, we ended up with 171 treatable datasets. We chose multiple imputations by fully conditional specification (FCS-MI), which allows the imputation of categorical and continuous variables using a set of conditional densities to create a multivariate imputation model for every missing variable (van Buuren, 2007). This makes it especially powerful when no fitting multivariate distribution exists and thus shows to be a perfect complement to PLS-SEM. The approach creates multiple datasets in which the missing values are replaced by different estimates. We used the R statistics software for this treatment. To impute the data, we used the reference implementation "mice" (van Buuren, 2007), following the suggestions to generate 25 datasets in 50 iterations and using predictive mean matching (Morris et al., 2014). Finally, we pooled the obtained estimates using Rubin's rules (Barnard & Rubin, 1999).

### Data Analysis

We evaluated the research model using PLS-SEM, which is the preferred method when the primary goal is to explain the variance of the dependent variables, rather than test an overall model fit (Petter, 2018). PLS-SEM is non-parametric and requires no assumptions on distributions. PLS-SEM is the method of choice for exploratory research, while covariance-based approaches (CB-SEM) are better for verifying theories (Dash & Paul, 2021). We, therefore, also validated our model using CB-SEM and found equivalent results. We used the software package SEMinR (Ray et al., 2023) and cSEM (Rademaker & Schuberth, 2020) to create and test all our models, using the recommended 10,000 bootstrap iterations (Hair et al., 2021). Instead of using the often-cited rule of thumb for the required sample size (Hair et al., 2011), we used the inverse square root method (Kock & Hadaya, 2018). This method evaluates the probability that the ratio of a path coefficient to its standard error exceeds the significance threshold of a test statistic at a specified significance level. Consequently, the results are contingent on a single path coefficient and are not influenced by the complexity of regressions within the models or the overall model size. According to the pre-generated tables of Hair et al. (2021), for a significance level of 5 percent, a minimum effect size of .2, and a common power level of 80 percent, a minimum sample size of 155 is necessary. We meet this with our sample size of 171.

## Results

### Measurement Model Assessment

#### *Internal Consistency and Validity*

We assessed internal consistency, discriminant, and convergent validity of the constructs. To assess internal consistency, we checked the loadings of the constructs. We dropped items with loadings lower than the suggested acceptable value of .7 which did not lead to higher $R^2$ values. All other loadings of the indicators to their constructs were well above the suggested threshold of .7 (Hair et al., 2021). The composite reliability values are all above .8, the average variances extracted (AVEs) are well above .5, and the discriminant statistics show that the inter-construct correlations are always lower than the square root of the respective construct's AVE (Fornell & Larcker, 1981). More detailed results (indicator loadings, indicator cross-loadings, and results of the HTMT analysis) are presented in Appendix D through Appendix G.

#### *Non-Response Bias*

To ensure that our data does not suffer from non-response bias, we compared the answers provided by individuals responding immediately with those who had answered after one or more reminders. We did this as suggested by Armstrong and Overton (1977), who argue that the answers given by individuals after being reminded share properties with those who did not respond at all. Since indicators revealed no significant difference, we do not expect non-response bias to present a major problem.

***Common Method Bias***

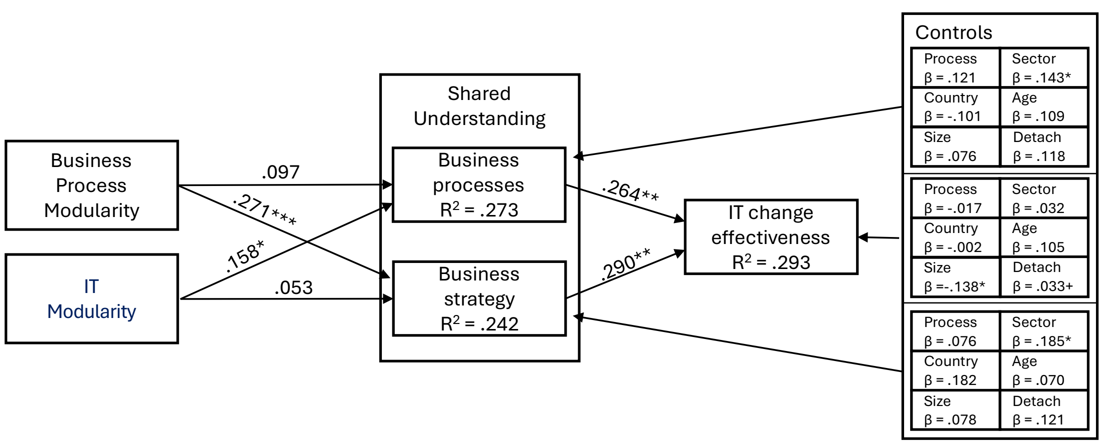
Another potential issue threatening the validity of the survey-based empirical results is common method bias (CMB). Following the suggestion of Podsakoff et al. (2003), we used concise and clear items. After collecting data, we applied three procedures to uncover indications of potential CMB. First, we applied the Harman single-factor test, which did not uncover a single component explaining the majority of overall variance (the largest component explained 36.5 percent) (Harman, 1976). Further, as a post-hoc analysis (Malhotra et al., 2006), we included a theoretically unrelated marker variable ("Competition in our loans market is very strong") in our model that was linked to each construct of the original model (Lindell & Whitney, 2001). The resulting model test results did not show any structural differences in the levels and significance of path coefficients or the level of R2 of the dependent variables. As a third method to assess the CMB, we did a collinearity diagnostic of the outer model as suggested by Kock (2015) and Hair et al. (2021). Our highest factor-level variance inflation factor (VIF) is 1.585. Therefore, all our factors are below the suggested threshold of 3.3 and 3.0, respectively, which indicates that our data does not suffer from CMB. The results of this check are in Appendix H.

**Structural Model Assessment**

Before checking the effects, we did another collinearity diagnostic of the inner VIFs of the model. With a spike maximum of 2.907 and 2.205 on average, all values are below the critical value of five (Hair et al., 2017). We, therefore, conclude that the level of collinearity is not critical among the constructs of our structural model. The VIF values are presented in Appendix C. The results of testing our research model are presented in Figure 3.

The findings show a strong relationship between business process modularity and shared understanding of business strategy (β=.271, p=.001), as well as between IT modularity and shared understanding of business processes (β=.158, p=.026). Accordingly, H3 and H4 are supported, while H2 and H5 have to be rejected. Finally, the two dimensions of shared understanding—inside (i.e., business processes) and outside (i.e., business strategy) the work system—are both strongly related to IT change effectiveness (β=.264, p=.002 for SU of the business process and β=.290, p=.003 for SU of business strategy). Accordingly, H1a and H1b are supported.

A potential threat of such studies might be the existence of type-II errors in rejected hypotheses due to insufficient statistical power. Although the path coefficients of .097 and .053 are so small that the threat of a type-II error is highly unlikely, we ran a post-hoc power analysis for H2 and H5, which, given the sample size of n=171, showed the likelihood of a type-II error to be about .007 for H2 and .012 for H5, i.e., we can quite safely falsify H2 and H5. A full report with all details is presented in Appendix I (with all additional details, like confidence intervals, as suggested by Hair et al. (2019, 2021)).




(standardized path coefficients with sig. levels, $R^2$)

Notes: N=171; ***: p <.001; **: p <.01; *: p <.05; +: p<.1. One-sided t-tests, based on 10,000 bootstraps.

**Figure 3. Estimation Results**

### Model Variation Analysis

To gain a more complete picture, we tested and compared further model variants (cf. Table 2): a controls-only model, a direct model without shared understanding, and a partially mediated model which adds direct paths from the modularity constructs to IT change effectiveness to the original model and thus allows us to test for mediation effects (cf. Table 3). Finally, we controlled for interaction effects (cf. Table 4 and Table 5).

The controls-only model allowed us to identify the additional variance resolution provided by our explanatory variables. This showed that the R2 of IT change effectiveness increased from .076 to .293 through the inclusion of our model variables.

Next, testing the direct model but only including the direct paths from modularity to IT change effectiveness, we find a significant effect of IT modularity on IT change effectiveness (β=.391, p=.000), while business process modularity has no direct effect (β=.092, p=.124).

We tested a mediation model with added direct paths from modularity to IT change effectiveness, to control for an effect of business process and IT modularity on IT change effectiveness which is not mediated by shared understanding. For example, technological IT modularity was identified as a possible antecedent of agility (Tallon et al., 2019), and other contributions of modularity aside from contributing to SU are highly likeable as modularity increases the reusability potential of software components, which allows IT to implement changes in a faster and more effective way (reusing modules instead of developing from scratch) (e.g., Henfridsson et al., 2014; Karim, 2006; Tiwana & Konsynski, 2010). The importance of IT modularity is demonstrated by the strength of the path that runs directly from IT modularity to IT change effectiveness in all analyses (partial mediation model: β=.205, p=.010; direct model: β=.319, p=.000) and by the increase of R2 from .293 to .334 when this direct path is added. In the results, we see that IT modularity is the foundation for high IT change effectiveness, demonstrated by the strength of the path that runs directly from IT modularity to IT change effectiveness, while there is no such effect for business process modularity.

In addition, we conducted an extended multiple mediation to further investigate the mediating effects (results in Table 3). We used the recommendation from Hair et al. (2021), who suggest using the approach from Zhao et al. (2010), based on the works from Preacher and Hayes (2004). This procedure allows testing for multiple mediations in PLS-SEM using the path significance of the direct links and the significance of the indirect links.

**Table 2. Model Test Results**

| Model | | Full mediation model *(=original model, cf. Figure 3)* | | | Direct model | Controls-only |
|---|---|---|---|---|---|---|
| Independent variable \ Dependent variable | | IT change effectiveness | SU of business processes | SU of business strategy | IT change effectiveness | IT change effectiveness |
| SU of business processes | | **.264 (.002)** | | | | |
| SU of business strategy | | **.290 (.003)** | | | | |
| Business process modularity | | | .097 (.138) | **.271 (.001)** | .092 (.124) | |
| IT modularity | | | **.158 (.026)** | .053 (.302) | **.319 (.000)** | |
| Controls | Country | -.002 (.484) | .101 (.072) | **.182 (.002)** | .072 (.145) | .064 (.185) |
| | Firm size | **-.138 (.019)** | .076 (.173) | .078 (.166) | -.061 (.221) | -.112 (.091) |
| | Sector | .032 (.323) | .143 (.036) | **.185 (.008)** | .119 (.057) | .119 (.077) |
| | Process type | -.017 (.446) | .121 (.186) | .076 (.284) | .078 (.269) | .021 (.442) |
| | Work experience | .105 (.068) | .109 (.085) | .070 (.180) | **.149 (.023)** | **.170 (.017)** |
| | IT detachability | .033 (.328) | .118 (.088) | .121 (.054) | .054 (.296) | .150 (.083) |
| $R^2$ | | .293 | .273 | .244 | .106 | .076 |

(standardized path coefficients with sig. levels, $R^2$)

Notes: N=171, one-sided t-tests, based on 10,000 bootstraps. The p-values are given in parentheses.

While there is no mediating relationship between IT modularity (ITMod) and IT change effectiveness (ITCEff) via shared understanding of business strategy (SUbs), the test confirms a complementary mediated relationship between IT modularity (ITMod) and IT change effectiveness (ITCEff) via shared understanding of business processes (SUbp). For business process modularity (BPMod), the test confirms an indirect-only (i.e., fully mediated) relationship of BPMod on ITCEff via SUbs, while there is no such effect via SUbp. We can therefore concur that both dimensions of shared understanding contribute significantly to explaining why the respective modularity dimensions positively contribute to IT change effectiveness. This effect is small for SUbs medium (f2 = .024), while it is medium for SUbp (f2 = .117). 26.1 percent of the variance of IT efficiency (ITCEff) is explained by BPMod and 73.9 percent by ITMod. Of BPMod's effect (26.1 percent), 8.8 percent is attributed to an increase of and mediation through SUbp, 51.9 percent to an increase of and mediation through SUbs, and 39.2 percent to other factors, resembled by the direct effect. Similarly, for ITMod, its share (73.9 percent) is explained by 19.7 percent from an increase of SUbp in its mediator role, 9.3 percent from an increase of SUbs, and 70.9 percent from other factors.[1]

**Table 3. Mediation Analysis**

| | Relationship | Bootstrapping results | 95% Confidence interval |
|---|---|---|---|
| Step 1: Indirect paths a*b (t-test of indirect effects) | BPMod→SUbp→ITEff | .009 (.328) | [-.026, .040] |
| | BPMod→SUbs→ITEff | **.053 (.031)** | [.015, .125] |
| | ITMod→SUbp→ITEff | **.057 (.034)** | [.013, .114] |
| | ITMod→SUbs→ITEff | .027 (.192) | [-.011, .089] |
| Step 2: Direct paths c (t-test of β co-efficient) | BPMod→ ITEff | .040 (.315) | [-.092, .183] |
| | ITMod→ ITEff | **.205 (.010)** | [.064, .350] |

Notes: N=171, one-sided t-tests, based on 10,000 bootstraps. The p-values are given in parentheses.

**Table 4. Interaction Analysis**

| | IT Change Effectiveness | SUbp | SUbs |
|---|---|---|---|
| SUbp | **.249 (.002)** | | |
| SUbs | **.287 (.003)** | | |
| BPMod | .106 (.078) | .092 (.141) | **.259 (.001)** |
| ITMod | .088 (.134) | **.151 (.030)** | .042 (.327) |
| IT detachability | -.004 (.477) | .116 (.099) | .118 (.052) |
| IT detachability * ITMod | **.160 (.011)** | -.053 (.298) | **-.152 (.035)** |
| IT detachability * BPMod | -.004 (.475) | -.006 (.471) | .091 (.085) |

Notes: N=171, one-sided t-tests, based on 10,000 bootstraps. The p-values are given in parentheses.

**Table 5. Effect Sizes ($f^2$)**

| | IT Change Effectiveness | SUbp | Subs |
|---|---|---|---|
| IT detachability * ITMod | .139 | .015 | .004 |
| IT detachability * BPMod | .030 | .066 | .073 |

Notes: N=171, based on 10,000 bootstraps.

Finally, we tested for interaction effects. Although our model did not hypothesize an interaction effect between the different types of modularity (IT, business process, and IT detachability as control), we performed a test to empirically control for the existence of such a relationship. Specifically, we wanted to check if IT detachability, which essentially captures the dependence between business processes and IT applications, impacts the effect of modularity on shared understanding. We used the two-stage approach from Chin et al. (2003), as suggested by Hair et al. (2021). We used IT detachability as moderator of all paths toward the two dimensions of shared understanding and IT change effectiveness. The results are presented in Table 4 and Table 5. The interaction effect of IT modularity * IT detachability on IT change effectiveness was positive and significant with a path coefficient of .160 (p=.011). This is backed by the effect size (f2) of .139, indicating a medium (Cohen, 1988), respectively large (Kenny, 2016) effect (Table 5). By contrast, the interaction of IT modularity * IT detachability had a negative significant impact of -.152 on SU of business strategy (p=.035). All other effects were non-significant. The slope analysis for those two significant effects is presented in Appendix E; it shows that in both cases the direction of the main effect gets turned around by the moderator. So, while IT detachability strengthens the effect of IT modularity on IT change effectiveness, it dampens the effect of IT modularity on shared understanding of business strategy. It seems that IT detachability captures some of the aspects of IT modularity and therefore partially substitutes the effects of IT modularity.

## Discussion

Our empirical results demonstrate that companies can become more agile by fostering a greater shared understanding of business processes and strategies. Furthermore, they show that firms can achieve higher levels of SU when their business processes are structured in a modular way and supported by a modular IT architecture. Consistent with prior work, modularity is positively associated with agility and alignment outcomes (e.g., Ko et al., 2005; Mani et al., 2010). However, our results also clarify and, in some respects, challenge traditional assumptions about how modularity shapes SU and alignment.

Contrary to the view that modularity reduces interdependencies and thereby diminishes the need for SU (Reijers & Mendling, 2008; Schilling, 2000), our evidence shows that SU remains critical even in modular contexts. Rather than lowering SU requirements, modularity redistributes them: business process modularity primarily facilitates strategic SU, while IT modularity enables operational SU. This indicates that modularity changes the locus rather than the importance of SU, highlighting SU as a persistent and indispensable key mechanism of IT/business alignment.

Research on business process management often implies that process modularity primarily strengthens shared understanding of processes and workflows (Cappelli et al., 2010). In contrast, our results show that business process modularity has little effect on process-level SU but significantly promotes strategic SU. This runs counter to the dominant process-centric expectation and suggests that modular processes provide a platform for developing common views of goals and priorities, rather than primarily aligning detailed workflows.

Prior work on service and process modularity has further argued that alignment follows almost automatically from the architectural matching of modular components (Bask et al., 2010, 2011). Our results challenge this assumption by showing that modular structures alone are insufficient. Instead, their contribution to alignment is mediated by the specific forms of SU they enable. Modularity thus functions less as a structural guarantee of alignment but more as a cognitive enabler, shaping distinct dimensions of SU that operate differently across levels of analysis.

Overall, a modular IT architecture exerts a stronger influence on agility because it enables technical flexibility and reduces complexity, facilitating quicker and effective change implementation. Business process modularity, however, is more important in the context of SU's effect on agility. While IT modularity inherently provides mechanisms for faster change implementation, SU amplifies its effectiveness by aligning business processes with IT capabilities and strategic objectives. Therefore, although IT modularity is important for IT change effectiveness, SU enhances the synergy between business processes and IT, playing a pivotal role especially in the context of business process modularity. Interestingly, while the effect of modular IT architecture on IT change effectiveness is strengthened by IT detachability, the effect of IT modularity on SU of business strategy is dampened. It seems that although IT detachability facilitates loose coupling between business processes and supporting IT, thereby enhancing agility, it also complicates SU between business and IT.

### Theory-Driven Interpretation of the Results

For interpreting the results, in the following, we use the work system theory as introduced above.

Modularity of a business process contributes to the development of SU of business strategy but does not contribute to SU of business processes. As presented in the theoretical background, individuals apply different cognitive templates to interpret their surroundings. Concerning business process modularity, the single modules can either be interpreted within the respective business process (i.e., inside the work system; the business process consists of several modules) or across different business processes (i.e., outside the work system; a module is represented by a business process in a larger system of business processes). In a modularized business process environment, our results indicate that individuals apply similar interpretation schemes with respect to the overall business strategy (i.e., H3 supported) but not with respect to a specific business process (i.e., H2 rejected). According to the work system theory, in a modularized system, each business unit (e.g., procurement, production, sales) can be interpreted as a single work system itself. The IT unit, however, is typically part of a more global work system that supports all the business units in the larger organization. For the IT unit (which is not necessarily directly involved in a work system such as procurement, production, or sales), it is much easier to develop an understanding of their own work system on a higher abstraction level (like the purpose of the module "customer relationship management" within the system "sales") than in a more specialized system (like the purpose of the module "risk evaluation" in the system "crediting process"). If the IT unit's work system supports all business units, business process modularity helps structure the big picture. Business process modularity does not imply that the shared understanding of every business process in the system will increase because not every business process is part of the joint work system of business and IT professionals.

This interpretation also helps explain the findings for IT modularity, where we found a positive impact on SU of business processes (H4 supported), but not on SU of the business strategy (H5 rejected). Since the IT architecture, which flexibly supports the modular business processes, is part of the IT unit's work system, the business process itself becomes a critical component in IT's work system. However, this does not automatically imply that the IT professionals' understanding of the business strategy on a global level will also increase. The reason can again be found in different hierarchical work systems. Focusing on the modular IT architecture, the work system is the respective business process which is supported by the modular IT architecture, but not the entirety of business processes of the overall organization (i.e., H5 rejected).

### Theoretical Contributions

Our study contributes to research on modularity and IT/business alignment by clarifying and nuancing several long-standing assumptions. While prior work has emphasized that modular systems increase flexibility and support coordinated change, we extend this understanding by showing that modularity does not merely reduce complexity but also shapes the development of distinct forms of shared understanding.

First, our findings extend modularity theory (Schilling, 2000) by challenging the assumption that modularity reduces interdependencies and thereby lowers the need for SU. Instead, we show that SU remains critical in modular contexts, but its locus shifts: business process modularity enhances strategic SU, while IT modularity strengthens operational SU. This reconceptualization positions SU as a persistent microfoundation of alignment, even in modular environments.

Second, our results refine the business process management literature by contradicting the expectation that process modularity primarily fosters process-level understanding (Cappelli et al., 2010). In contrast, we demonstrate that process modularity contributes little to process SU but significantly to strategic SU. This finding challenges the dominant process-centric view and highlights modular processes as a platform for developing shared views of business goals and priorities.

Third, our study questions the idea that modularity alone guarantees alignment through architectural matching (Bask et al., 2010, 2011). Our evidence shows that alignment does not follow automatically from modular structures. Instead, modularity contributes indirectly by enabling distinct forms of SU at different levels. This reframes modularity from a purely structural mechanism to a cognitive enabler that conditions how IT and business units achieve alignment.

Taken together, these contributions reposition SU at the center of the modularity–alignment relationship. By demonstrating that modularity shapes not whether but how SU develops, we advance theory by highlighting SU as a microfoundation that links modular architectures to IT/business alignment, agility, and change effectiveness.

### Managerial Implications

From a practical perspective, our study shows that business process modularization supports SU between business and IT professionals about strategic aspects of the organization, but it does not automatically increase the SU of business processes. This SU of operational processes can be achieved if the IT unit builds a flexible IT architecture to support the respective business processes. Where business process modularity is lacking, the IT unit can develop SU of business processes but has limited chances to develop SU of strategic aspects of the organization.

We can confirm that modularization contributes to shared understanding. Modularization is an adequate instrument to manage organizational complexity because every module only draws on certain information. Further implementation-related information, which makes the information more complex, is not included in the module (Henfridsson et al., 2014), so the amount of information that needs to be transferred among collaboration partners decreases significantly (Mani et al., 2010). Thus, research assumes that there is a difference between complex and non-complex systems regarding governance structures such as knowledge transfer mechanisms (Blomquist & Müller, 2006). Indeed, practitioners might design knowledge transfer mechanisms as a gradual sequence of trainings per module. The potentials of this piece-by-piece approach are supported by the idea of cognitive templates (Gobet & Simon, 1996), which suggests that individuals start the learning process by making sense of single modules in their environment. When they proceed, they start cognitively combining different modules and building a cognitive template of the work system.

This leads to the following practical recommendations. First, management should understand modularization (and integration) of the business and IT environment as a tool to increase shared understanding and enable IT to react quickly to changing business needs. Only when both environments are structured in a modular sense can the full potential for enabling knowledge sharing be achieved.

Second, management can support the process of knowledge sharing by implementing knowledge transfer mechanisms aligned with the modular structure of the organizational environment. Training sessions, documentation, and other forms of knowledge transfer should, whenever possible, focus on single modules. By transferring the concept of encapsulation to knowledge transfer mechanisms, a set of training or a handbook of documentation can therefore comprise knowledge transfer mechanisms for a whole business process, which consists of several modules. The positive effects of this piece-by-piece knowledge transfer design enable scrolling through different hierarchical templates and making sense of the whole work system (inside and outside).

Third, with regard to work system theory, our findings also suggest that management should invest in training and related mechanisms that enable knowledge sharing in a joint work environment. The benefit of training offered to a larger set of merely potential stakeholders is unlikely to be as great.

## Limitations and Future Research Directions

A first limitation might be the potential for reversed causality. However, the argument of reversed causality, i.e., shared understanding driving modularity instead of the originally hypothesized effect, is highly unlikely in our case, as most of the banks use standardized banking IT architectures or application suites, often provided and operated by external vendors, which they can only customize to a certain degree. Thus, large parts of the modularity in the processes and the IT architecture are externally pre-determined. Nonetheless, we have to differentiate between the development and operations of IT systems. While the systems are often commonly developed by external providers, the operations of the systems, on the other hand, are not static at all. Changes and adjustments to these systems happen on a permanent basis via change requests from the business side. Thus, these changes are not pre-determined externally, but the foundational modular architecture of the systems is.

Advancing on this, organizational forms that have merged IT and business people into joint arrangements (such as BizDevOps teams) and therefore do not need explicit alignment and shared understanding “between business and IT” are less likely in the incumbent financial industry setup that we have examined. Our research is therefore confined to organizations that, as mentioned earlier, segregate business and IT functions. Furthermore, in other setups (e.g., Fintechs), we still do not believe that shared understanding is automatically generated through a joint BizDevOps-style setup (Teubner & Stockhinger, 2020) and that modularity will still play a role. Yet, in contrast, shared understanding may play a different role, and issues like “group think” and the exclusion of diverse perspectives could arise (Sabherwal et al., 2019). Therefore, it would be highly interesting to systematically examine our research question in different environments (such as a joint setup) to ascertain their impact.

Another potential limitation might be that we did not include the perceptions of the IT unit in our study but solely focused on the owners of the credit processes as respondents of our survey. However, our research design makes the business managers the most suitable respondents. As already outlined above, we argue that only process owners as key informants can determine how well the structure of the IT architecture fits the business processes. Finally, the generalizability of the study is limited since the model was tested with data from one industry only. While we have no reason to assume that the results cannot be generalized to—at least—comparable processes of other service industries, replicating studies in other contexts will be necessary to allow for the statistical generalizability of our findings. Chiasson and Davidson (2005) do, however, advise focusing on a single industry to reduce further contingency effects that are not in the interest of one's study.

An area of future research that might be interesting is the incorporation of generative AI (GAI) into the picture. While GAI is not expected to change the importance of modularity in handling complexity and building, maintaining, and changing software (Li et al., 2024), more and more software coding is done by GAI and will increasingly be initiated by businesspeople themselves (e.g., through low-code environments). In such contexts, the meaning of SU might shift but not diminish since now either the business side might need more knowledge than before to "prompt" the creation of sound software solutions, or the IT side might need even more SU about the business requirements and contexts to proactively take care of solutions that otherwise might appear and run "in the shadow," i.e., outside the sight and control of IT.

We can conclude that profound shared understanding is facilitated by business process modularity only in combination with a flexible IT architecture. For future research, the findings provide a more differentiated perspective on modularity as an antecedent of shared understanding.

## Conclusion

In our study, we combined two research streams to examine how modularity in business processes and IT architectures shapes shared understanding and, in turn, IT change effectiveness. While prior research often assumed that modularity reduces the need for shared understanding (Schilling, 2000), fosters primarily process-level comprehension (Cappelli et al., 2010), or ensures alignment through structural matching (Bask et al., 2010, 2011), our findings show otherwise. We demonstrate that modularity reshapes the locus of SU: business process modularity fosters strategic SU, whereas IT modularity fosters process-level SU. This refinement positions SU as a key mechanism linking modular architectures to IT/business alignment and agility.

Drawing on work system theory (Alter, 1999), we explain these differentiated effects by distinguishing between artefacts inside and outside the work system. This perspective clarifies why process modularity affects strategic rather than operational SU. Overall, our results show that modular architectures matter not because they eliminate the need for understanding, but because they enable specific forms of it—making shared understanding a vital condition for agility in digital business.

## Note

[1] These ratios can be calculated from Table 3. For example: The mediation of BPmod through SUbp is 8.8% = $\frac{.009}{.009+.053+.040}$

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## Appendix A

**Table A.1. Descriptive Statistics**

| Item | Mean | Median | Min | Max | SD |
|---|---|---|---|---|---|
| BPMod1 | 4.025 | 4 | 1 | 5 | 1.064 |
| BPMod2 | 3.245 | 3 | 1 | 5 | 1.196 |
| BPMod3 | 3.308 | 3 | 1 | 5 | 1.171 |
| ITMod1 | 3.566 | 4 | 1 | 5 | 1.096 |
| ITMod2 | 3.824 | 4 | 1 | 5 | 1.043 |
| ITMod3 | 3.371 | 4 | 1 | 5 | 1.277 |
| ITMod4 | 3.447 | 4 | 1 | 5 | 1.344 |
| SUbp1 | 2.907 | 3 | 1 | 5 | 1.136 |
| SUbp2 | 2.523 | 2 | 1 | 5 | 1.072 |
| SUbp3 | 3.240 | 3 | 1 | 5 | 1.031 |
| SUbs1 | 3.135 | 3 | 1 | 5 | 1.026 |
| SUbs2 | 3.217 | 3 | 1 | 5 | .997 |
| SUbs3 | 3.105 | 3 | 1 | 5 | 1.008 |
| ITEff1 | 3.131 | 3 | 1 | 5 | .984 |
| ITEff2 | 2.788 | 3 | 1 | 5 | .923 |
| ITEff3 | 2.970 | 3 | 1 | 5 | .961 |
| Detach1 | 2.962 | 3 | 1 | 5 | 1.487 |
| Detach2 | 3.686 | 4 | 1 | 5 | 1.182 |
| Detach3 | 3.377 | 3 | 1 | 5 | 1.185 |
| Size* | 9090.2 | 1590.7 | 612.3 | 364625.4 | 37004.7 |

## Appendix B

**Table B.1. Survey Items**

| Construct | Loading (all sig. at p<.001) | Item | Description | Adapted from |
|---|---|---|---|---|
| SBK of business processes | .912 | SUbp1 | Our IT unit understands the business operations of the business unit. | Ray et al. (2005) |
| | .902 | SUbp2 | Our IT unit understands the requirement to optimize our business processes. | |
| | .896 | SUbp3 | Our IT unit has a good level of understanding of the work environment (business-related problems, tasks, etc.) of the business. | Nelson & Cooprider (1996) |
| SBK of business strategy | .849 | SUbs1 | Our IT unit has a good level of understanding of strategic business plans. | Preston & Karahanna (2009) |
| | .919 | SUbs2 | Our IT unit understands the direction in the financial market we are attempting to follow in the coming years. | |
| | .874 | SUbs3 | The IT unit understands what support we need to realize our business plans. | |
| Business process modularity | .878 | BPMod1 | It is very easy to detach this business process from our other processes. | Tanriverdi et al. (2007) |
| | .886 | BPMod2 | This business process has very well-defined interfaces with our other processes. | |
| | .846 | BPMod3 | Changing this business process does not affect our other processes. | |
| IT modularity | .773 | ITMod1 | The design of the business process and IT architecture are designed based on a common reference model. | Tiwana & Konsynski (2010) |
| | .778 | ITMod2 | Our system is built in a modular way, so that implemented functionalities can be re-used in other processes. | |
| | .792 | ITMod3 | Our IT system is built from reusable components. | |
| | .786 | ITMod4 | Legacy applications do not hinder the development and usage of new applications. | |
| IT detachability | .734 | ITD1 | This business process can be easily transferred and implemented across IT platforms of outsourcing vendors. | Tanriverdi et al. (2007) |
| | .834 | ITD2 | This business process and the supporting IT infrastructure are tightly coupled (reverse coded). | |
| | .875 | ITD3 | The supporting IT infrastructure is highly customized to the needs of this business process (reverse coded). | |
| IT change effectiveness | .890 | ITEff1 | The IT unit is able to quickly implement the business requirements. | Wagner et al. (2014) |
| | .832 | ITEff2 | The IT unit is always able to meet the requirements of the business units. | |
| | .896 | ITEff3 | The IT unit reacts flexibly to change requests specified by the business side. | |

## Appendix C

**Table C.1. Collinearity Check (Inner VIF Values)**

| | SU of business processes | SU of business strategy | IT change effectiveness |
|---|---|---|---|
| Business process modularity | 1.207 | 1.207 | 1.309 |
| IT modularity | 1.248 | 1.248 | 1.365 |
| SU of business processes | | | 1.845 |
| SU of business strategy | | | 1.802 |
| IT detachability | 1.092 | 1.092 | 1.129 |
| Country | 1.103 | 1.103 | 1.127 |
| Experience | 1.212 | 1.212 | 1.274 |
| Firm size | 1.547 | 1.547 | 1.561 |
| Process type | 1.063 | 1.063 | 1.072 |
| Sector | 1.485 | 1.485 | 1.532 |

## Appendix D

**Table D.1. Discriminant Analysis: Cross-Item Correlations**

| | IT modularity | Business process modularity | IT detachability | SU of business processes | SU of business strategy | IT change effectiveness |
|---|---|---|---|---|---|---|
| ITMod1 | .759 | .397 | .335 | .122 | .098 | .333 |
| ITMod2 | .728 | .234 | .196 | .189 | .026 | .106 |
| ITMod3 | .824 | .136 | .360 | .336 | .252 | .292 |
| ITMod4 | .832 | .312 | .446 | .349 | .366 | .348 |
| BPMod1 | .255 | .764 | .345 | .049 | .144 | .013 |
| BPMod2 | .112 | .887 | .326 | .121 | .267 | .054 |
| BPMod3 | .440 | .932 | .468 | .177 | .292 | .215 |
| ITD1 | .387 | .298 | .874 | .361 | .336 | .234 |
| ITD2 | .437 | .364 | .752 | .070 | .155 | .058 |
| ITD3 | .363 | .487 | .839 | .238 | .297 | .170 |
| SUbp1 | .289 | .152 | .275 | .929 | .620 | .367 |
| SUbp2 | .309 | .058 | .269 | .916 | .567 | .410 |
| SUbp3 | .359 | .200 | .338 | .912 | .686 | .462 |
| SUbs1 | .270 | .243 | .287 | .691 | .865 | .329 |
| SUbs2 | .269 | .374 | .337 | .532 | .915 | .349 |
| SUbs3 | .256 | .156 | .312 | .632 | .911 | .291 |
| ITEff1 | .370 | .110 | .165 | .415 | .327 | .903 |
| ITEff2 | .300 | .079 | .181 | .375 | .230 | .886 |
| ITEff3 | .342 | .186 | .243 | .436 | .416 | .923 |

## Appendix E

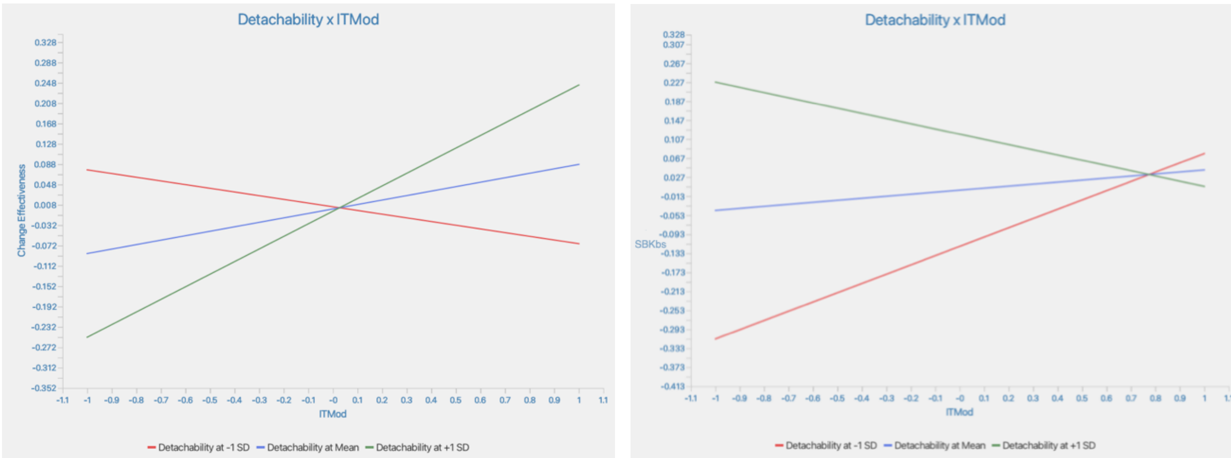


**Figure E.1. Interaction Slope Analysis**

## Appendix F

**Table F.1. Discriminant Analysis: HTMT Ratios**

| | IT change effectiveness | IT modularity | SU of business processes | SU of business strategy | Business process modularity |
|---|---|---|---|---|---|
| IT modularity | .400 | | | | |
| SU of business processes | .500 | .362 | | | |
| SU of business strategy | .406 | .278 | .766 | | |
| Business process modularity | .135 | .390 | .163 | .308 | |
| IT detachability | .219 | .553 | .312 | .377 | .537 |

## Appendix G

**Table G.1. Construct-Based Quality Criteria**

| Latent variable | rho_c | Cronbach's Alpha | AVE |
|---|---|---|---|
| IT change effectiveness | .909 | .851 | .770 |
| IT modularity | .850 | .769 | .587 |
| SU of business processes | .931 | .890 | .819 |
| SU of business strategy | .915 | .860 | .782 |
| Business process modularity | .905 | .844 | .761 |
| IT detachability | .852 | .748 | .659 |

## Appendix H

**Table H.1. Outer VIF Values**

| VIF (independent) | |
|---|---|
| BPMod1 | 1.781 |
| BPMod2 | 2.163 |
| BPMod3 | 2.189 |
| ITMod1 | 1.653 |
| ITMod2 | 1.734 |
| ITMod3 | 1.788 |
| ITMod4 | 1.506 |
| ITD1 | 1.407 |
| ITD2 | 1.947 |
| ITD3 | 1.962 |

| VIF (dependent) | |
|---|---|
| SUbs1 | 3.658 |
| SUbs2 | 3.302 |
| SUbs3 | 2.553 |
| SUbp1 | 2.079 |
| SUbp2 | 2.719 |
| SUbp3 | 2.759 |
| ITEff1 | 2.653 |
| ITEff2 | 2.294 |
| ITEff3 | 3.003 |

## Appendix I

**Table I.1. Path Coefficients with Confidence Intervals**

| | | | Original sample | Sample mean | 5.0% | 95.0% |
|---|---|---|---|---|---|---|
| IT modularity | | IT change effectiveness | .074 | .080 | -.055 | .213 |
| IT modularity | | SU of business processes | .156 | .168 | .030 | .304 |
| IT modularity | | SU of business strategy | .046 | .057 | -.110 | .220 |
| SU of business processes | | IT change effectiveness | .253 | .248 | .093 | .398 |
| SU of business strategy | | IT change effectiveness | .258 | .261 | .083 | .436 |
| Business process modularity | | IT change effectiveness | .098 | .101 | -.025 | .224 |
| Business process modularity | | SU of business processes | .097 | .096 | -.049 | .242 |
| Business process modularity | | SU of business strategy | .272 | .273 | .130 | .410 |
| Controls | Country | IT change effectiveness | .015 | .014 | -.086 | .117 |
| | Country | SU of business processes | .100 | .099 | -.018 | .211 |
| | Country | SU of business strategy | .182 | .179 | .071 | .286 |
| | IT detachability | IT change effectiveness | -.004 | -.001 | -.129 | .122 |
| | IT detachability | SU of business processes | .117 | .125 | -.017 | .253 |
| | IT detachability | SU of business strategy | .121 | .125 | .001 | .246 |
| | Experience | IT change effectiveness | .097 | .096 | -.024 | .213 |
| | Experience | SU of business processes | .110 | .109 | -.020 | .240 |
| | Experience | SU of business strategy | .071 | .073 | -.053 | .200 |
| | Firm size | IT change effectiveness | -.120 | -.119 | -.231 | -.006 |
| | Firm size | SU of business processes | .076 | .077 | -.055 | .210 |
| | Firm size | SU of business strategy | .077 | .078 | -.057 | .210 |
| | Process type | IT change effectiveness | .003 | .008 | -.199 | .219 |
| | Process type | SU of business processes | .121 | .126 | -.097 | .350 |
| | Process type | SU of business strategy | .077 | .082 | -.141 | .302 |
| | Sector | IT change effectiveness | .041 | .041 | -.070 | .153 |
| | Sector | SU of business processes | .144 | .144 | .012 | .274 |
| | Sector | SU of business strategy | .185 | .182 | .053 | .307 |