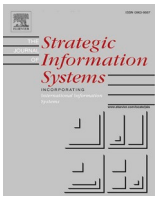
Journal of Strategic Information Systems 32 (2023) 101776

Contents lists available at ScienceDirect

Journal of Strategic Information Systems

journal homepage: www.elsevier.com/locate/jsis



Business-IT alignment as a coevolution process: An empirical study

Fabrizio Amarilli [a], Bart van den Hooff [b,*], Mario van Vliet [c]

[a] Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133 Milano, Italy
[b] Vrije Universiteit Amsterdam, School of Business and Economics, KIN Center for Digital Innovation, De Boelelaan 1105, 1081 HV Amsterdam, the Netherlands
[c] Vrije Universiteit Amsterdam, School of Business and Economics, KIN Center for Digital Innovation, De Boelelaan 1105, 1081 HV Amsterdam, the Netherlands

ARTICLE INFO

Keywords:
Business-IT alignment
Coevolution theory
System dynamics
Socio-technical systems

ABSTRACT

In this paper, we provide a detailed insight into the complex coevolution dynamics that shape the alignment process by analyzing how different mechanisms and factors are mutually related in complex networks of feedback loops. We combine insights from the literature on alignment as a (coevolution) process with literature on alignment as a state to identify the different components of the organization's socio-technical system that influence alignment, the relationships between these components, and the role that different factors play. In our empirical analysis (based multiple case studies) we then focus on the actual interplay between relevant factors. Using a causal loop diagramming approach - based on system dynamics – we analyze how these factors mutually influence each other through various feedback loops and thus shape the alignment process. We extend previous literature on the alignment process by identifying the way that the complex interplay between different factors shapes this process. By identifying the feedback loops between relevant factors, we also provide more insight into the complex bottom-up and top-down dynamics that shape the process, and that provide explanations for why this process is characterized by transitions between alignment and misalignment. For practice, our paper provides a deeper understanding of the alignment process, which is a precondition for improving alignment practices in organisations.

Introduction

The question of how to align business and IT in organizations continues to challenge researchers and practitioners (Coltman, Tallon, Sharma & Queiroz, 2015; Kappelman et al., 2022). The topic of Business-IT alignment has been extensively investigated in the literature, due to the impact that alignment has been found to have on organizations' performance in terms of competitive advantage, profitability and agility (Hitt & Brynjolfsson, 1996; Johnson & Lederer, 2010; Oh & Pinsonneault, 2007; Raymond & Bergeron, 2008). As conceptualized by Henderson and Venkatraman (1993) in their seminal work, Business-IT alignment concerns the degree of fit and integration among business strategy, IT strategy, business infrastructure, and IT infrastructure. Thus, alignment is an issue that includes different levels (strategic and operational), as well as multiple dimensions: the intellectual dimension (consistency between

* Corresponding author.
E-mail addresses: fabrizio.amarilli@polimi.it (F. Amarilli), b.j.vanden.hooff@vu.nl (B. van den Hooff), m.vanvliet2@vu.nl (M. van Vliet).

https://doi.org/10.1016/j.jsis.2023.101776
Received 29 April 2022; Received in revised form 20 May 2023; Accepted 20 May 2023
Available online 6 June 2023

business and IT strategies), the social dimension (mutual understanding between business and IT executives and staff), and the structural dimension (the congruence of business and IT processes and infrastructures) (Chan & Reich, 2007; Liang, Wang, Xue & Ge, 2017; Reich & Benbasat, 2000).

Although alignment has often been conceptualized as a *state* in terms of a condition of congruence of business needs and IT capabilities (e.g.: Chan, Sabherwal & Thatcher, 2006; Preston & Karahanna, 2009; Reich & Benbasat, 2000), there is an increasing realization in the IS literature that alignment is an ongoing *process* that is shaped through different actions by different actors in organizations (e.g.: Karpovsky & Galliers 2015; Yeow, Soh & Hansen, 2018). In recent literature, this process has often been conceptualized as one of *coevolution* in terms of the continuous mutual adaptation between business and IT at various levels (Benbya & McKelvey, 2006; Peppard & Breu, 2003; Tanriverdi, Rai, & Venkatraman 2010; Vessey & Ward, 2013; Zhang, Chen & Lyytinen, 2021).

The literature that builds on this conceptualization of alignment as a process of coevolution has advanced our understanding of the complexities of alignment. When alignment is seen as a state, it is considered as an outcome, assuming a linear connection between different factors and alignment. This does not reflect the complexity of alignment as a phenomenon that emerges through the complex interactions between different factors over time, and where no stable "end state" is likely (Ciborra, 1997; Ciborra et al., 2000; Vermerris, Mocker & Van Heck, 2014). By recognizing that alignment is an ongoing process in which social and technical components are interconnected in digital infrastructures (Henfridsson & Bygstad, 2013), mutually influence each other at different levels (Baker & Singh, 2019; Benbya & McKelvey, 2006; Vessey & Ward, 2013), and lead to an ongoing transformation (Fischer & Baskerville, 2022), the coevolutionary conceptualization of alignment does more justice to this complexity.

However, research using the coevolution perspective tends to be mainly descriptive and conceptual (Burton-Jones, McLean & Monod, 2015), thereby leaving the generative mechanisms that explain the way the process unfolds understudied. Consequently, how alignment actually takes shape in organizations is still, to a large extent, unclear (Campbell, Kay & Avison, 2005; Ciborra et al., 2000; Coltman et al., 2015; Zhang, Chen & Lyytinen, 2019). Furthermore, there is a scarcity of empirical research that provides insight into how this process of coevolution unfolds in practice, and what factors are involved in this coevolution.

In this paper, we aim to contribute to this literature by focusing on the interplay between relevant factors involved in the alignment process, identifying the feedback loops between these factors through which this process is shaped. In order to do this, we first conceptualize this process as one of coevolution at different levels, identifying the mechanisms - i.e. the "causal structures that generate observable events" (Henfridsson & Bygstad, 2013, p. 911) - through which the process takes shape. We then turn to the literature on the state perspective, because it helps us identify the relevant factors that can play a role in the aligning process. Thus, we combine insights from both literatures to identify the different components of the organization's socio-technical system that influence alignment, the relationships between these components, and the role that different factors play in how these mechanisms shape the alignment process. In our empirical study (based on an in-depth analysis of the alignment process in four organizations) we then focus on the actual interplay between relevant factors. Using a causal loop diagramming approach - based on system dynamics – we analyze how these factors mutually influence each other through various feedback loops and thus shape the alignment process. Thus, we answer our main research question: *What are the factors that play a role in the alignment process, and how does the complex interplay between these factors shape this process in organizations*?

By identifying how the complex interplay between different factors shapes the alignment process, we extend prior research that mainly focused on a description of this process. Our perspective on alignment does justice to the complexity of the process by outlining how the different mechanisms and factors are mutually related in complex networks of feedback loops. By identifying the feedback loops between relevant factors, we also provide more insight into the complex bottom-up and top-down dynamics that shape the process, and that provide explanations for why there is movement between alignment and misalignment. Our findings also confirm the importance of social alignment, specifically shared domain knowledge, and add insights into the mechanisms through which this factor plays multiple roles in the alignment process.

The paper is organized as follows. The literature review discusses previous work on alignment as a (coevolution) process and identifies relevant factors and mechanisms in this process, providing the theoretical background of the study. The method section explains our case study design, data collection and data analysis. Then, our findings on alignment are presented in terms of the complex networks of feedback loops showing the interplay between relevant factors that shapes the alignment process in the four cases we studied. The discussion section comments on the findings, positions our results in the extant literature, and highlights the implications for theory and practice.

Theoretical background

The alignment process

In the literature on alignment as a process, there are a number of studies that conceptualize alignment as a *dynamic capability* (Baker et al., 2011; Yeow et al., 2018). Dynamic capabilities are defined as "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (Teece et al., 1997, p. 516). In this perspective, alignment is conceptualized as an enduring competency to re-combine technological, organizational and managerial resources that allows the organization to respond to the rapidly changing competitive environment (Baker et al., 2011).

This literature is valuable in providing insight into what this process looks like, for instance in terms of identifying phases in the process of alignment. Yeow et al. (2018) describe the alignment process as an iterative sequence of the Exploratory, Building, and Extending phases. The *Exploratory phase* concerns the identification of opportunities and actions to initiate the alignment process. In the *Building phase*, the organization focuses on the implementation of actions to recombine its resources. The *Extending phase* is related

to leveraging the new IT capabilities. These studies portray the alignment process as a sequence of phases, mutually connected, that reconfigure organizational resources and highlight the sources of misalignment that cause the initiation of subsequent phases.

To understand how this enduring competency is shaped in organizations, we turn to the literature that takes a *coevolution* perspective on the alignment process. This is an ongoing process of mutual adaptation between IT and business at different levels (Tallon, 2007; Vessey & Ward, 2013). In this conceptualization of the alignment process, the focus is on mutually interacting components of a socio-technical system, where the social component encompasses employees, their social capital, their knowledge bases, skills, and abilities (Ryan, Harrison & Schkade, 2002; Sarker et al., 2013), and the technical component includes the IT infrastructure, software, and databases (Nolan & Wetherbe, 1980; Sarker et al., 2013).

Alignment as coevolution at different levels

Building on Henderson and Venkatraman's (1993) conceptualization of alignment, our point of departure is that Business-IT alignment is an issue that concerns both the *external* and the *internal* level. At the external level, the main issue is the alignment between business and IT strategies, as well as their respective alignment with developments in the organization's environment. At the internal level, the focus is on the alignment between an organization's business and IT resources, in terms of the structures, processes, and people involved in both domains.

Recent IS literature points out that the embeddedness of IT throughout the organization means that business and IT strategies are increasingly integrated into *digital strategies* (Bharadwaj et al., 2013; Yeow et al., 2018). This means that there is a "blurring of the distinction between business and IT strategies" (Yeow et al., 2018, p. 43), which implies that aligning business and IT strategies may not be the most relevant focus in alignment research. In the coevolution conception of the aligning process, the focus at the external level should be on the coevolution of digital strategy (encompassing both business and IT) with business and IT resources in the organization – which brings us to the internal level.

At the internal level, our focus is on the coevolution between components in the social and the technical sub-systems in the organization (Vessey & Ward, 2013). This means that we follow the literature that conceptualizes alignment in terms of Complex Adaptive Systems (CAS) (Tanriverdi et al., 2010; Vessey & Ward, 2013; Zhang et al., 2021). CAS are systems composed of large numbers of components, that interact and adapt, undergoing constant change – both autonomously and in interaction with their environment (Holland, 2006). Based on this perspective, we focus on how the social and technical sub-systems mutually coevolve in response to changes in the digital business strategy – as well as how this coevolution, in turn, can also lead to changes in this strategy.

This means that there is also a process of coevolution *between* the external and the internal level, as the coevolution of the social and technical subsystems at the internal level coevolves with the digital business strategy. Strategy, after all, is not only deliberate (i.e., realized exactly as intended by those responsible for strategy formulation and implementation) but for a large part also emergent (i.e., shaped through patterned actions and practices that do not directly derive from top management's intentions) (Mintzberg & Waters, 1985; Mirabeau & Maguire, 2014). This is in line with the observation that in coevolution processes in organizations, the continuous interaction between components is not only due to top-down direction, but also subject to bottom-up emergent processes (Benbya & McKelvey, 2006). Alignment is both about the top-down processes initiated by executives, and the bottom-up processes initiated by users and managers (Baker & Singh, 2019; Yeow et al., 2018). Thus, understanding how the process of alignment is shaped in organizations requires an understanding of the series of actions that organizations undertake – both planned and emergent – and who the actors are that undertake these actions (Karpovsky & Galliers 2015).

All in all, these insights from the literature lead to our representation of the alignment process in Fig. 1. In this figure, we distinguish four generative mechanisms that shape the alignment process across the external and internal levels:

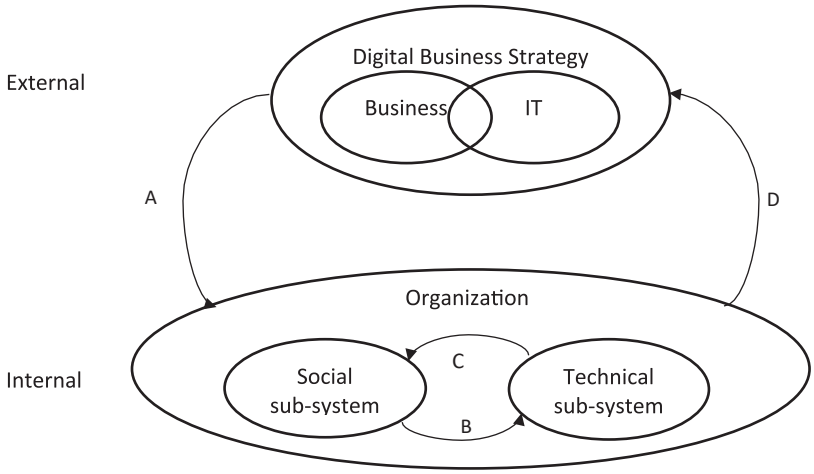


Fig. 1. Business-IT Alignment as a coevolution process.

(A) *Strategy-driven change*, where developments at the strategy level necessitate changes in the way both the social and technical sub-systems are shaped, and mutually influence each other;
(B) *IT redesign,* where the social sub-system (i.e., managers and staff in both business and IT) initiates changes in the technical sub-system to accommodate for the requirements that stem from the strategic changes;
(C) *IT-enabled change,* where changes in the technical sub-system (i.e., hardware, software, infrastructure, databases, etc.) enable or require changes in the social sub-system (such as new positions, roles, skills, collaborations, processes, etc.);
(D) *Strategy revision,* where the changes in the social and technical sub-systems enable or require a revision of the existing strategy (e.g., new business models, new markets, new ecosystems, etc.).

As shown in Fig. 1, this is an ongoing process of alignment between the different components at different levels, shaped through these four mechanisms. These mechanisms should not be confused with phases in a linear process. There are similarities to the phases in the alignment process as distinguished by Yeow et al. (2018) (e.g. mechanism (A) having similarities to the Exploratory phase, and mechanisms (B) and (C) to the Building phase), but the emphasis here is on mechanisms through which the coevolution between different subsystems and levels continuously shapes and reshapes the alignment process. Furthermore (as our findings will also show), alignment can also be initiated in a more bottom-up way (Baker & Singh, 2019; Zardini, Rossignoli & Ricciardi 2016).

In understanding this process of coevolution at different levels, it is important to note that complex systems such as CAS are "non-linear systems, composed of many (often heterogeneous) partially connected components that interact with each other through a diversity of feedback loops" (Merali, 2006, p. 219). In other words, for a detailed insight into how the process of coevolution takes shape, we would have to understand these feedback loops through which the different components interact. Although there is a limited number of studies that describe complex networks of feedback loops that influence alignment (Baker & Singh, 2019; Butler, 2022; Campbell et al., 2005), issues such as lack of theoretical foundations and limited or no evidence circumscribe our understanding of how the interplay between different factors actually shapes the alignment process.

In this paper, we first provide such a theoretical foundation by identifying the factors influencing alignment that were found in previous studies. Then, we provide an in-depth empirical exploration of the interplay between these factors based on four case studies.

Factors influencing the alignment process

The different dimensions of alignment have been the subject of various studies (Chan 2002; Gerow et al., 2016; Liang et al., 2017; Zhou et al. 2018), which typically investigate alignment as a *state*, i.e., an organizational property that can be measured at a certain point in time and that is influenced by different factors (Chan & Reich, 2007; Coltman, Tallon, Sharma & Queiroz, 2015; Luftman, Papp & Brier, 1999). In trying to organize the many factors identified in the literature, we build on the classifications proposed by Luftman (2000), De Haes and Van Grembergen (2009), and Reich and Benbasat (2000).

Based on these prior classifications, we organized the factors found in our literature study into six main categories (see Table 1): (i) Top management leadership and commitment; (ii) Communication structures, facilitating information exchange and coordination between business and IT executives; (iii) Relational mechanisms, shaping the collaborative relationship among business executives and IT management; (iv) Operational conditions: properties of the IT infrastructure, governance processes, and skills that facilitate decision-making, management of IT resources, and implementation of decisions; (v) Environmental factors, which relate to organizational characteristics such as general management style, culture, and previous IT project experience (Preston 2003), and; (vi) Shared

Table 1
Factors Influencing Alignment.

Type of factors	Factors	References
(i) Top management leadership and commitment	CEO leadership, CIO leadership, top management commitment, top management proactivity	De Haes & Van Grembergen (2009); Peppard & Ward (2004); Baker & Niederman (2014); Teo & Ang (1999).
(ii) Communication structures	CIO reporting to CEO, CIO on executive committee, IT strategy committee, IT involved in strategy decisions, connecting roles (e.g. liaison roles) between business and IT departments, locus of power	Luftman (2000); De Haes & Van Grembergen (2009); Chan (2002); Preston & Karahanna (2009).
(iii) Relational mechanisms	Mutual trust between CEO and CIO, IT project sponsors, informal meetings between business and IT management	De Haes & Van Grembergen (2009); Luftman & Brier (1999).
(iv) Operational conditions	(1) Infrastructure sophistication, infrastructure flexibility (connectivity, compatibility, modularity) (2) Governance processes, such as Strategic Information Systems Planning procedures, SLA (Service Level Agreement), Project portfolio management and prioritization, IT benchmarking (3) Personnel competences, IT operational skills, skills flexibility (4) External IT expertise	Hussin, King & Cragg (2002); Newkirk, Lederer & Johnson (2008); Van Oosterhout, Waarts & van Hillegersberg (2006); De Haes & Van Grembergen (2009); Sabherwal & Chan (2001); Sabherwal & Kirs (1994); Thong, Yap, & Raman (1996).
(v) Environmental factors	Organizational culture, management style, prior IT project success	Reich & Benbasat (2000); Ravishankar, Pan & Leidner (2011). Luftman (2000).
(vi) Shared domain knowledge	CEO knows about IT, CIO knows about business, mutual understanding of business and IT, IT personnel understands business domain; shared language	Chan & Reich (2007); Reich & Benbasat (2000); Preston & Karahanna (2009); Luftman & Brier (1999).

domain knowledge, which indicates a condition of mutual understanding between business and IT personnel about the other party's domain. As pointed out by Reich and Benbasat (2000), some of the factors overlap and are correlated.

With this, we have a basis for the kinds of factors we assume to play a role in the complex networks of feedback cycles that shape the alignment process through the mechanisms identified above. However, in order to get a more detailed overview of these factors, and of their interplay in this process, we need to explore this phenomenon more elaborately in an empirical setting.

Method

In order to investigate how the complex interplay of factors shapes the alignment process in organizations, we followed a multiple case study design. Our choice for this research design is guided by three key rationales. First, the literature on alignment as a complex coevolution process is still growing, and a case study design is useful for exploring emerging research topics, and for theory development (Lee, 1989; Yin, 1994). Second, a case study approach offers the opportunity to collect data from the social actors who contribute to the alignment process and therefore to gain deep insights into the process as enacted by these actors. Third, case studies have proven to be an effective and practical means of collecting data that covers extended periods of an organization's life. A multiple-

Table 2
Overview of the four case organizations.

Key data	Summary of the alignment process
Company 1 Industry: discrete manufacturing (heating and cooling systems, renewable energy technology). One production plant and a limited number of sub-contractors. Revenue: 80 million Euros (2017).	Company 1 had a period of stability until 2010, with a CIO who extended the IS landscape through customization and voiding innovation or optimization. However, when the competitive environment became more dynamic in 2010, the IS landscape was unable to respond to the changes. In 2012 the recently appointed CIO promoted an external analysis of the IS that convinced the CEO and top managers to initiate an IS renewal, which led to the implementation of a new IT governance model focused on demand management, design, and portfolio management. Despite initial resistance, the new IS proved to be aligned with the company's strategy, leading to an increase in market share and the development of new business models. However, the termination of the contract with the IT consultants in 2014 marked the transition to a new phase of alignment, during which the company faced problems such as continuous software customization and a lack of IT governance processes. The involvement of a new consulting firm which helped the company eliminate customizations and bring the applications to a standard configuration marked a new phase of improvement in the alignment process.
Company 2 Industry: discrete manufacturing (spray packaging solutions and filling equipment). Group composed of a parent company and 14 production factories. Revenue: 79 million Euros (parent company), around 200 million Euro (group) (2018).	Company 2 enjoyed a stable market with long-term agreements with key customers ensuring steady sales growth and profitability. However, their IS did not keep pace with the high degree of production automation in the factories. IS development was based on obsolete technology, and a package was connected to multiple heterogeneous systems. No IT governance mechanisms existed to manage user demand and IS planning. In 2017, new competitors entered the market, and top management was replaced. The new management had to address the rigidity of the IS in relation to supporting business activities and executing the growth strategy. A steering committee was established to design a new IS landscape, emphasizing integration, standardization, and simplification. However, implementation was challenging due to a lack of operational capacity and user resistance. Process reorganization was necessary to implement the new IS, which offered the opportunity to simplify operational processes by merging legal entities. At the time of the interviews, the process of renewing the IS was ongoing
Company 3 Industry: food and beverages (food nutrition and supplements). Two production plan and several subcontractors. The company is listed in the stock market. Revenue: 56 million Euros (2017).	Company 3 achieved business growth and market leadership at the national level. Its IS landscape, however, did not keep up with this growth, since management viewed this as a supportive asset. The IT department reported directly to top management, lacking a clear IT governance structure. The absence of a CIO resulted in key decisions being made by line managers. The company invested in new IS, but these systems were inadequate in supporting business processes and required costly customization and additional packages. Furthermore, the replacement of the ERP system was unsuccessful due to user resistance. In 2012, the company introduced a CIO who reported to the CEO and promoted the renewal of the IS landscape and the selection of a new ERP system. Structured governance processes were defined, resulting in a successful implementation. The new IS facilitated acquisitions and reorganization of the supply chain, though IT supplier support was limited, leading to delays and excessive costs. As a result, the company invested in internal operational IT resources.
Company 4 Industry: made-to-order manufacturing process (pasta equipment). One production plant. Revenue: 98 million Euros (2018).	Company 4 is a manufacturer that specializes in customized products and has attained a market leadership position due to its product uniqueness. The company operates within a family-owned group of firms, with IT management being handled by the CIO of a sister company, Company 1. Investments in IT have been limited, and the company has resorted to incremental improvements through customization of the IS landscape. Management responded to market pressures aimed at improving time to market by considering a revision of the IS to support automation, end-to-end process management, and enhance efficiency. The transformation process benefitted from external consultants, and internal support was provided by a reporting officer in the control department who streamlined communication from top management to end-users. However, after the reporting officer retired, a lack of direct communication between the CEO and CIO resulted in delays in IS transformation.

case study was chosen as it allows us to maximize the scope of what can be learned within the available period of study (Dubé & Paré, 2003).

The sampling strategy for the identification of the case studies was designed to ensure that the selected cases provide a rich and varied set of data for analyzing the research questions. Out of a set of companies where the authors had access to information on the alignment processes, four were selected based on their potential to provide comprehensive and diverse information on the alignment process. We used purposive sampling (Patton, 2002), which involves selecting cases based on specific criteria relevant to the research question. Beyond the accessibility to data, the sample selection criteria included the complexity of the alignment process, heterogeneity of the companies in terms of their production and manufacturing processes and structures, and the role and characteristics of the IT department in the organization structure.

Four companies were included in the study. All companies are firms that have gone through phases of alignment and misalignment and where the alignment process was influenced by several factors. In each organization, IT was instrumental in pursuing strategic objectives. The selected companies represented a range of different production processes (e.g., design to order and make to stock), had different numbers of production plants (e.g., one, multi, or none), and had varying IT department structures (e.g., mature, newly created, or outsourced). This approach allowed for a comprehensive analysis of the alignment process across a variety of contexts and organizational structures. Together, the cases offer an extensive knowledge base for the investigation of how various factors shape the alignment process. A summary of the organizations' background and their alignment stories is provided in Table 2. A second condition for selecting cases was the availability of top management and their willingness to grant access to information, through interviews to all key informants and to additional secondary sources, such as internal reports, meetings notes, suppliers' quotations, and financial data.

Data collection

Interviews with key actors in the alignment process constituted the primary data source for this study. In each organization, the Chief Information Officer (CIO) was interviewed first, to obtain an overview of the alignment story and to identify the key informants. As details on the alignment process emerged, additional interviews were organized. In total, 38 interviews were conducted between November 2015 and October 2018. The interviews were partly retrospective, as informants provided information on the evolution of the company's IS and its relationship with the business over a period of several years. The length of the data window varied depending on the experience of the informants. For instance, in Company 1, Company 3, and Company 4, the data collected began in 2011, while in Company 2, the investigation window started in 2016.

Given that we view alignment as a co-evolutionary process that is influenced by various actors in an organization, the unit of analysis for our study was the organization. We conducted interviews with all significant actors involved in the alignment process, which varied across cases. For instance, in Company 2, a group composed of different production firms, the managers involved in the alignment process were those at the headquarter level as well as managers of the different factories. In Company 1 and Company 2, consultants were also interviewed as they played a critical role in supporting the alignment process. Although consultants were also present in Company 4, their role was less central, and they were not included in the study. It is worth noting that Company 4 is associated with Company 1 as they belong to the same entrepreneurial group. Company 4 outsourced the management of its IT resources to Company 1, and the CIO of Company 1 also served as the CIO of Company 4. The administrative controlling officer of Company 4 acted as a liaison connecting the (external) CIO to the departments of Company 4. This administrative officer was also involved in the interviews.

In all cases data was collected about all key departments and processes of the organization that had an impact on the alignment process. In all cases, an initial interview with the CIO helped identify the informants. They included the CEO and the C-managers responsible for sales, finance and administration, operations, and IT. Based on the peculiarities of the companies, additional informants were identified. Where the design of the products was relevant for the IS, such as in Company 1 and Company 4, product design and R&D managers were interviewed. Some informants were interviewed more than once. For instance, Company 1 and Company 4 are linked companies as the CIO of Company 1 is also responsible for the IT in Company 4. Therefore, more interviews were organized with Company's 1 CIO and an interview was held with the controlling officer and IT support in Company 4, who was responsible for linking the (external) CIO to the company's business processes. In Company 1, the CEO was interviewed twice as he was also responsible for the company's sales. In Company 3 and Company 4, the president and the CEO respectively were also responsible for sales. Company 2 experienced a change in top management during the period of the interviews. The CEO and the CFO were interviewed both at the beginning of their mandate and during the evolution of the alignment process. As the role of the purchase and supply manager in this company was defined during our study, this manager was also interviewed. In this same company, IT is managed both at the level of the parent company and at the level of production firms. Hence, we also interviewed IT staff at the decentral level. Finally, IT consultants and IT suppliers played different roles in the alignment process of the companies. Where relevant, they have also been included in the informants' list. For instance, in Company 1 and Company 3, the IT consultants and suppliers gave a relevant contribution to revising the IT governance processes and in extending the operational skills of the IT departments.

In accordance with established best practices for case studies (Yin, 1994), a data collection protocol was developed for conducting interviews. The protocol consisted of a set of semi-structured questions that were designed to be sufficiently open-ended so as not to constrain the discussions. The questions covered a range of topics, including the informant's role and responsibilities, work history, their role in relation to IS, as well as their expectations and experiences during IS renewal activities. Throughout the interviews, participants were encouraged to provide examples of both alignment and misalignment, and to support their claims with evidence. The interview questions were tailored to each informant's background and position within the company, with interviews with CEOs

focusing on strategy and those with CIOs emphasizing the role of IS. The interviews were recorded and transcribed, although some line managers declined to be recorded. In these cases, extensive notes were made, which were later enriched with additional details. All interviews lasted between 30 and 90 min. Appendix A contains the full interview protocol utilized in the study.

Secondary data sources were also used, including documentation such as corporate procedures, process diagrams, technical documentation on the IS, meeting notes, requests for quotations, and quotations from IT suppliers, as well as financial data. In addition to this, financial magazines were consulted for all companies. While insights on the factors influencing the alignment process and their interplay were obtained from the interviews, secondary sources of data played a crucial role in verifying some of the claims made by the informants. For instance, in Company 1, the Head of Operations claimed that the investments made in IS renewal were not yielding the expected results. However, this claim was challenged by reports that demonstrated improvements in IS-related indicators, such as orders processed and lead time from order to production. The knowledge base of the study is described in Table 3.

Data analysis

We adopted the steps recommended by Atkinson (2002) and Paré (2004) to analyze our data. Drawing on the existing literature, we initially developed a theoretical framework to interpret the alignment process, which encompassed its fundamental mechanisms (as illustrated in Fig. 1) and influential factors (as presented in Table 1). We then identified a set of primary codes that reflected the theoretical concepts, including codes for the corporate strategy (external level), the organization (internal level), the mechanisms governing the interaction between different components, and the factors involved in these interactions. The primary codes were further classified into secondary codes: for corporate strategy, we specified codes associated with the business and IT aspects of the strategy, and for organization, we defined codes for the social and technical sub-systems. The factors were classified according to the alignment literature. In particular, secondary codes refer to the types of factors we identified in the literature (Table 1). These codes served as a preliminary step for analyzing the case studies. We then applied the codes to the empirical data collected from the cases. Not all the factors identified in the literature were observed in the cases.

Data collected through secondary sources was coded using the same approach. For instance, corporate communication and data from market and competition was useful to support the identification of the companies' strategy. Internal reports were useful to identify the organizational structures and therefore the social sub-system. Technical documentation from the companies or IT suppliers offered an overview of the technical sub-system. Analyzing secondary data contributed to the identification of the organization's systems and to corroborate claims by informants. Table 4 illustrates the set of codes that were used in the analysis.

Through the initial analysis enabled by the codes, we developed a narrative description of the cases, highlighting the mutual influence between the external and internal levels, and between the social and technical sub-systems. We then used a causal loop diagramming approach - based on system dynamics (Fang et al., 2018; Sterman, 2000) to visualize how the relevant factors mutually

Table 3
Data sources.

Companies and interviews	Secondary sources
Company 1:	- Data on market and competition
- CEO and sales manager (2 interviews)	- Financial data
- CFO	- Technical documentation on IS
- CIO (3 interviews)	- Survey on end users' satisfaction and proficiency in IS, conducted during the implementation of the IS
- Head of Operations	- Meeting memos (meetings of organisational bodies)
- R&D & Product Design manager	- Meeting memos
- IT suppliers and consultants	
Company 2:	- Reports on company activities and results
- CEO (3 interviews)	- Data on market and competition
- CFO (2 interviews)	- Financial reports
- CIO (3 interviews)	- Contracts with IT providers (request for quotation and offers)
- Operations manager	- Meeting memos (meetings of organizational bodies)
- Purchase and supply chain manager	
- Sales manager	
- IT personnel	
- IT suppliers and consultants	
Company 3:	- Corporate communications on products and market
- President and CEO	- Financial data
- CFO	- Balance sheets
- CIO (3 interviews)	- Requests for quotation used for software selection
- System Architect and IT help desk	- Financial data
- Head of production	- Data on market and competition
	- Meeting memos
Company 4: - CEO (2 interviews)	- Data on market and competition - Financial data
- CFO	- Technical documentation on application portfolio and IT resources
- Chief Operation Officer (COO)	- Internal reports on processes, business needs, IT application portfolio assessment
- Sales manager	- Meeting memos
- Controlling officer and IT support	
- Pre-sales engineer	
- Product designer	

Table 4
Coding scheme used in data analysis.

Primary codes	Secondary codes	Description
Strategy	Business aspects	Value proposition, key competitive differentials, business model, business plan, competitive environment.
	IT aspects	Services expected from IS, key performance indicators of IS.
Organization	Social sub-system	Personnel, organisational structure, skills, procedures, routines.
	Technical sub-system	IT artefacts, application portfolio, hardware, communication infrastructure, key IT performance indicators.
Mechanisms	Strategy-organization	Mututal influence of strategy and organization systems
	Social and technical sub-systems	Mututal influence of social and technical sub-systems
Factors	Top management leadership and commitment	See Table 1
	Communication structures	See Table 1
	Relational mechanisms	See Table 1
	Operational conditions	See Table 1
	Background antecedents	See Table 1
	Shared domain knowledge	See Table 1
	IT governance processes	See Table 1

influence each other through various feedback loops and thus shape the alignment process. As Fang et al. (2018) outline, this approach enables us to capture the reciprocal and temporal causal mechanisms that shape complex and dynamic systems, making it a very appropriate approach for our study. In these diagrams, each factor is linked to at least one other factor through an arrow that indicates the direction of the influence that one factor exerts on the other. A plus sign signifies that an increase in one factor leads to an increase in the connected factors, whereas a minus sign suggests that an increase in one factor leads to a decrease in the connected factors. This creates feedback loops that can either be self-reinforcing or self-correcting, depending on the configuration of the interconnections and the direction of the arrows (Sterman, 2000). We built our diagrams based on the factors we empirically observed (in interviews or secondary data) and the narratives we derived from our data on how these factors mutually influenced each other. Appendix B represents a summary of the alignment journey for each case organization, as well as a description of the different feedback loops found in the different stages in those journeys.

Findings

In this section, we present the findings derived from our case studies, cumulatively building the complex network of feedback loops shaping the alignment process. We start with the basic loops in which the alignment process is initiated, and then zoom in on the

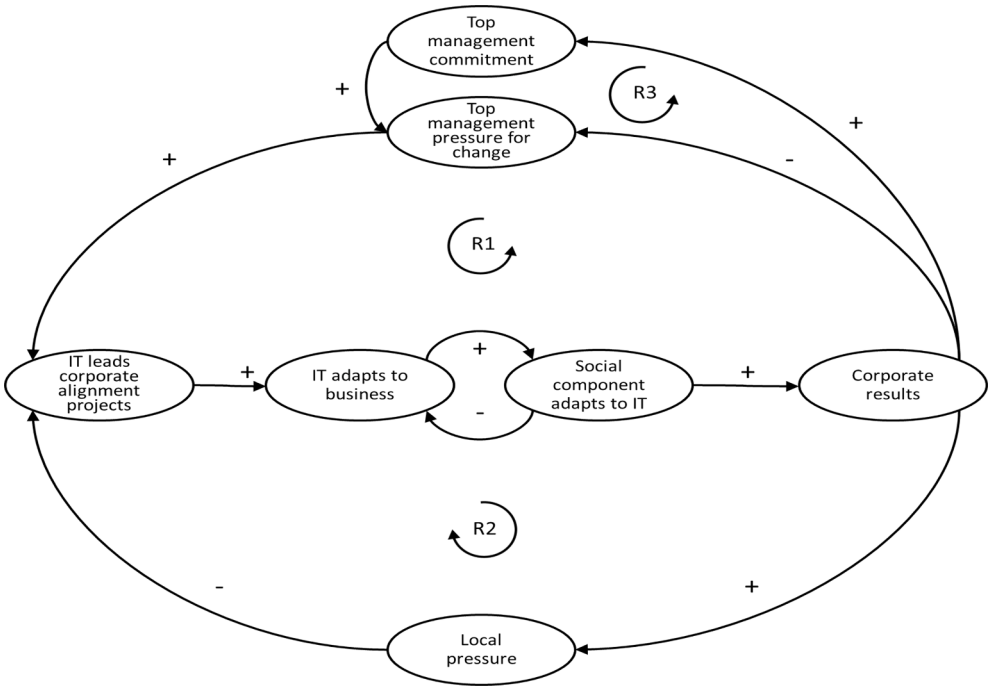


Fig. 2. Feedback loops governing the alignment process.

mutual adaptation between the technical and the social sub-systems. Subsequently, we identify specific feedback loops concerning the role of social alignment, and (governance of) the IT function.

Initiating alignment: top-down and bottom-up feedback loops.

Our findings show two feedback loops through which the mutual adaptation of the technical and social sub-systems is triggered. The first loop is initiated by the actions of top management, while the second is initiated by lower level managers (See Fig. 2).

The first feedback loop (R1 in Fig. 2) is initiated when top management exerts pressure on the IT function to undertake actions that contribute to aligning business and IT in line with strategic objectives. Here, we see mechanism (A) from Fig. 1 (strategy-driven change), as developments at the strategic level motivate top management to pressure for change. This pressure then initiates mechanisms (B) (IT redesign), as the IT function initiates projects to realize the required changes to the IS landscape, and (C) (IT-enabled change), as the social sub-system adapts to the renewed IS landscape. As the social and technical sub-systems mutually adapt, the pressure to further revise these sub-systems decreases.

Mutual adaptation between the technical and social sub-systems positively impacts corporate results, reducing the pressure on top management to initiate alignment initiatives. This shows mechanism (D), strategy revision, although as a negative feedback loop: positive results reduce the drive towards strategy revision. This feedback loop leads to an alternating pressure on the IT function. The perception of top management of a misalignment between business and IT affects top management's alignment pressure. Successful actions result in re-alignment, and a reduction in alignment pressure. In the long term, these dynamics can lead to a reduction in corporate performance. At a certain point, when performance drops below a critical level, top management re-initiates efforts to press for change – again showing mechanism (D), but now with a positive drive towards strategy revision.

In Company 1, for instance, the CIO looked back on the situation before he was appointed:

> *"The previous CIO's actions with regard to IS renewal were instrumental to guaranteeing that all processes of the organization were properly supported and positively contributed to corporate success. However, in the long term, the lack of pressure to revise the IS landscape led to a deeply customized IS, based on legacy technology… When he retired, I was the senior system administrator, and I was appointed as new CIO. I soon realized that the current application portfolio was not ready to cope with the business requirements. Nevertheless, the satisfaction of the CEO with applications and the corresponding lack of pressure were a relevant obstacle to me in initiating a further IS renewal."*

The CEO of Company 1 corroborated this statement by the CIO, saying:

> *"Why should I invest in a new IS? The IS we have worked properly for the last ten years, and we are now among the market leaders in the heating industry at national level."*

A similar pattern was observed in Company 2, which comprises of multiple production firms. The company enjoyed a period of market stability and leadership, before the resignation of the CEO. Upon the appointment of a new CEO, the organization was faced with the challenge of managing a group of factories that were individually well-supported by local systems, yet lacked effective interconnectivity and group-level applications. At the time of the appointment of the new CEO, the state of the company's information systems was attributed to a lack of emphasis on aligning business and IT objectives. The new CEO described the IS as the result of a lack of pressure on maintaining business and IT aligned:

> *When I was recalled [the manager had been the company's head of sales before leaving and founding a new company] to be appointed as CEO, I realized that there were two companies. One was composed of the production factories, where all was automated. We were the first company in the country to really implement what everybody calls Industry 4.0. The second company was the one where I'm in now and that has to manage the relationship with the market and coordinate the production at global level. And here, we have no means to understand how to optimize our production. We receive an order from a customer, and we choose the factory to produce the required component based on the experience of the managers and not on data. Simply because we have no data at group level."*

The effectiveness of the first feedback loop was consistently influenced by a second feedback loop in all cases (R2 in Fig. 2). In this second loop, local pressure originating from lower level managers was exerted on the IT function to initiate changes in the IS landscape to better fit local needs. These needs were often specific to individual departments, and fulfilling them sometimes conflicted with corporate-level goals. For instance, in Company 1, the heads of different departments reported that the evolution of the IS was a continuous negotiation process to ensure that their specific needs were satisfied. The CIO of the company confirmed this description of the IS landscape:

> *"Here the current mentality inherited by the previous CIO's approach is that the role of the IT function is to purchase the technology chosen by the departments. In some cases, my colleagues* [referring to the other managers] *come to me and just show the solution they need and ask me to negotiate with the supplier. In the end our IS is a suit tailored to the needs of the end users."*

In Company 2, our study revealed conflicting perspectives regarding the implementation of the corporate IS as reported by key decision-makers, including the CEO, CFO, and CIO, who advocated for the adoption of standardized and interoperable IS across all factories to enable seamless global data integration and reporting. In contrast, the operational managers responsible for the factories prioritized local requirements, resulting in the deployment of heterogeneous and disjointed IS solutions. These tensions were not effectively resolved before the initiation of an IS renovation initiative, leading to the continued dominance of local pressures and the persistence of non-standardized and non-interoperable IS. A statement reported by several informants in the interviews that was

attributed to the previous president and CEO when speaking about IT was: *"Let the factories work. Don't disturb them with IT, just provide them with what they ask for."*

In Company 3, before the company embarked on an organizational and technological transformation project, line managers were the ones choosing key enterprise applications. The new CIO, appointed after the failure of IT investments, said:

> *"Before my appointment, the corporate IS was a patchwork of disjointed and heterogeneous applications. All the problems originated when the company needed to update the systems. We are a manufacturing company, so they* [referring to the president and CEO] *considered it a natural choice to ask the head of the production department to select the system. The application that was chosen was in use by one of our competitors* [in a different country] *and worked well in managing production. But when the company had to manage administrative and financial issues, the needs of our country were not reflected in the system and therefore the CFO was invited to select a new application. As a result, we have now several applications, each of them working in a specific department, but no capacity to coordinate the whole company."*

In this bottom-up feedback loop, we see that local pressures lead to the initiation of locally oriented IT projects – instead of projects with a corporate focus. Although this may lead to some alignment at this local level, the ultimate effect on the alignment process at the corporate level is a negative one. Interestingly, this would then, over time, create a renewed urgency for top management to pressure for corporate alignment. On the whole, we find that these two intertwining feedback loops were responsible for the transformation of the IS in all cases.

Additionally, we found that top management's commitment to renewal of the IS landscape played a vital role in mitigating the conflicting impacts of the top-down and bottom-up feedback loops (R3 in Fig. 2). For instance, when the new CEO of Company 2 was appointed, the company was still in a condition of market leadership, which meant that IS renewal had low priority. However, the CEO was convinced of the potential of information technology to enable the organization to achieve its goals. Consequently, he directed investments towards new enterprise systems despite encountering difficulties and experiencing delays in generating tangible business outcomes. Despite complaints from managers who demanded departmental solutions to address the perceived inefficacy of the IT project, the CEO remained resolute and continued to press on. A similar scenario was observed in Company 4, where the CEO promoted the renovation of the IS even in a condition of market leadership and absence of indications for a change in corporate strategy or corresponding IS transformation. Beside pressing for the transformation of the IS, the CEO retained faith in IS renewal projects even when they did not appear to impact business results. During a meeting with company managers who expressed dissatisfaction with the significant investments in IT and the lack of performance improvements, the CEO made it clear that the project's objective was to align business and IT, and not necessarily cater to individual departmental needs: *"The aim of the project is beyond your individual needs."*

Mutual adaptation between the social and technical sub-systems

As outlined above, the process of mutual adaptation between the IT and social sub-systems takes shape through mechanisms (B)

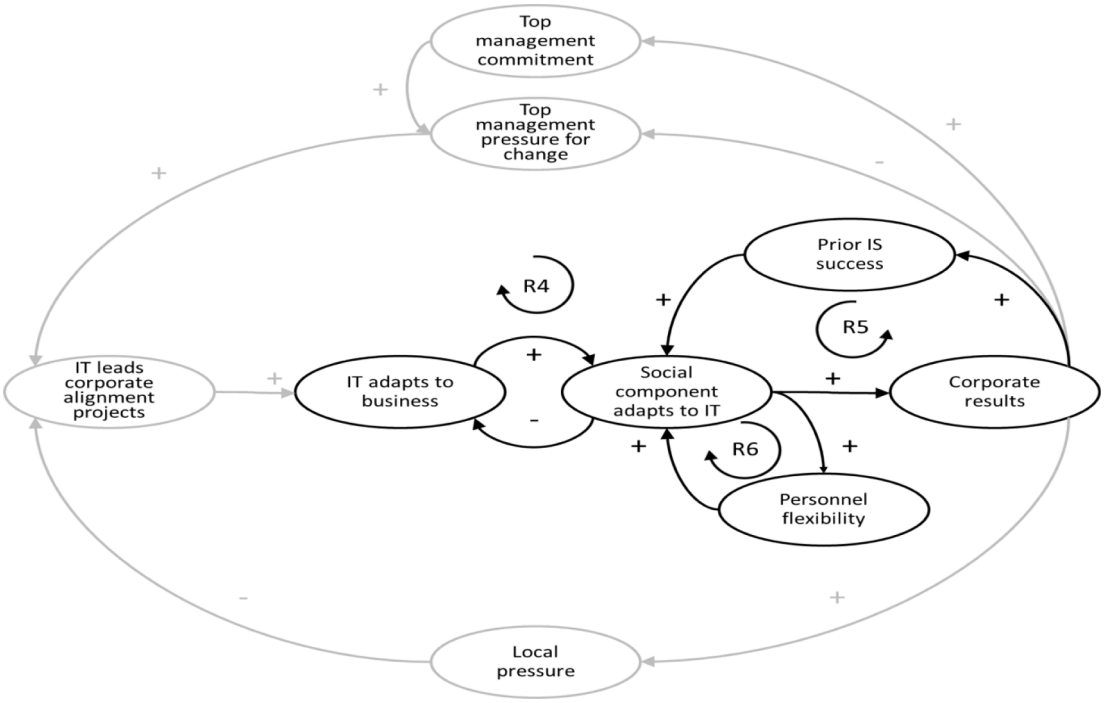


Fig. 3. Mutual adaptation between technical and social subsystems.

and (C), which create a fourth feedback loop (R4 in Fig. 3). The introduction of new technological solutions requires an adaptation of users' working procedures, skills, and organizational structure. In turn, these transformations of the social sub-system influence the further implementation and incorporation of new technologies.

In Company 2, for instance, the availability of an integrated system for scheduling production at the group level required a revision of the order management process, which was originally based on a geographical approach: the subsidiary receiving the order used to be responsible for the production and delivery. A new corporate-level production management system, enabling the collection of production data from each factory, facilitated a redesign of the production scheduling process to better serve customers and optimize the use of corporate resources. To enable this change, a new organizational structure was necessary. Before, each factory had their own head of production, a structure that did not facilitate integrated production. A new department for supply chain management and new procedures were introduced. The head of the new supply chain department confirmed:

> *"Now that we have the orders and production availability data from all factories, we intend to move from several and independent supply chains managed at local level to a unique supply chain managed at global level. This requires new organizational procedures at local and group level. We must work on people, processes, and technology."*

On the other hand, an inability of the social sub-system to adapt to and exploit new technologies was found to create a further need for adaptation of the IS landscape. In Company 1, for instance, the introduction of a new ERP system facilitated a redesign of the production scheduling process. Staff involved in production scheduling, however, resisted this redesign, instead pressuring the CIO to purchase a new scheduling system that would enable their existing processes.

Similarly, in Company 3, following the introduction of an order management system integrated with all the company's retailers, the CIO emphasized that in order to collect orders from shops, the organization continuously needed to push sales employees to revise their procedures and record information (orders) about customers in the central system.

These findings point towards the importance of staff flexibility in the alignment process. A lack of flexibility gives way to inertia, which negatively influences the adaptation of the social sub-system – indicated by feedback loop R5 in Fig. 3. In each case organization, employees often faced a phase of inertia during the IS renewal before potentially adapting to the new procedures enabled by the IS. This adaptation process was crucial for employees to acquire improved proficiency in using the IS. In Company 2, periodic surveys on employee satisfaction and independence in IS use revealed a self-reinforcing mechanism. This mechanism described how the adaptation to the new software led to the development of new skills, thereby aiding the employees' effective exploitation of the new IS possibilities. In Company 4, the COO reported that the main condition that facilitated the company's IS transformation was the flexible mentality of staff:

> *"We are quite used to novelties, at least in our department. We work on a project basis. Every piece of machinery we make is a new job. So, people are quite open to change and ready to call themselves into question."*

The CIO confirmed that the proficiency in using the new applications increased the employees' motivation to effectively utilize them.

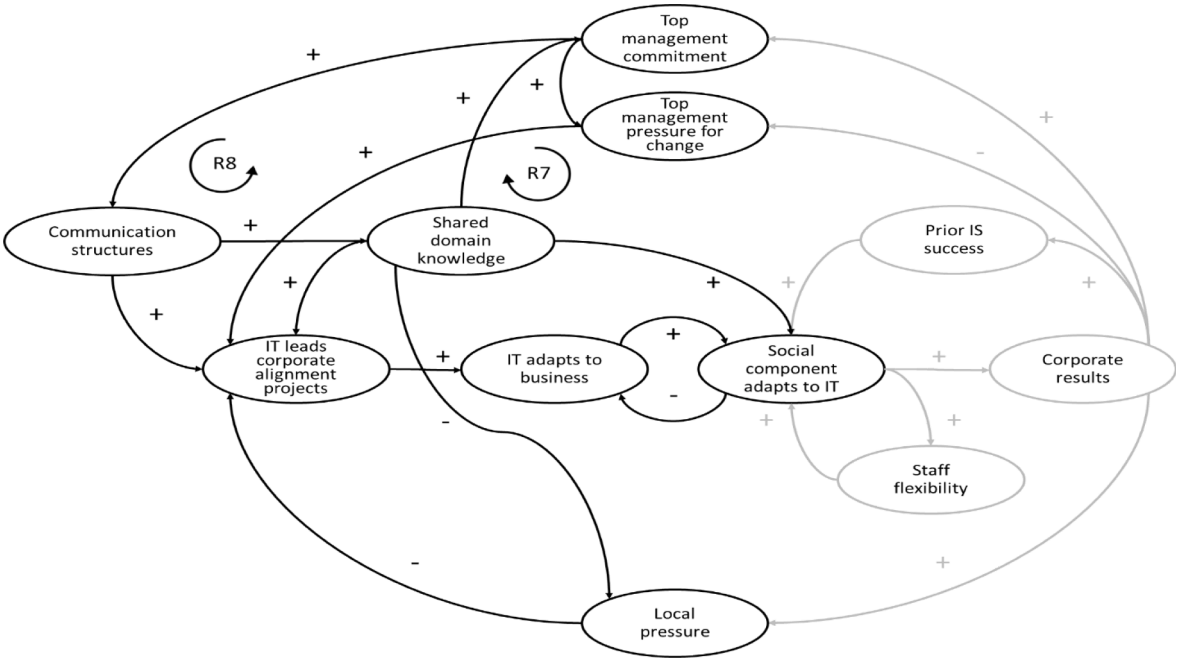


Fig. 4. The role of social alignment.

Another feedback loop that influenced the social sub-system's adaptation to the IT component points towards the importance of prior IS success (R6 in Fig. 3). In Company 3, for instance, the CFO described that, before the launch of the ambitious renewal of the IS landscape, employees in the administration department had a tendency to reject any IT-based change initiatives. It turned out that this resistance was mainly due to the memory of a previous IT failure. In an earlier ERP project, separate systems were selected for production and administrative processes. The lack of integration among these systems meant that the administrative staff encountered many problems in coordinating work with the production department. A similar pattern was found in Company 2, where the initial phase of the renewal of the IS landscape suffered delays and managers started complaining about the lack of impact on corporate results. The CFO underlined his disappointment:

> *"I attended several meetings with consultants. My department and myself dedicated time to the project. I understand that ours is a manufacturing company and production deserves more attention, but at a certain point we* [the administration department] *will need data to make decisions."*

After realizing that there was a decreasing commitment on the side of the employees to use the new solutions, the CIO and the consultants involved in the change project decided to organize regular events to share the progress of the project, and to highlight the contribution of the new applications to corporate activities. A periodic survey was organized to monitor the degree of satisfaction of the IS users and confidence in the use of the new solutions. Results of the survey exhibited a gradual increase of the users' commitment in all departments.

Social alignment: The role of shared domain knowledge and communication structures

Our analysis shows two feedback loops that point towards an important role of shared domain knowledge and communication for both the top-down and bottom-up feedback loops. Although not explicitly identified in Fig. 4 (as it is implied in the other factors), the alignment factor "relational mechanisms" also plays a role here, as these mechanisms are enabled by communication structures and facilitate the creation of shared domain knowledge. These variables represent social alignment between business and IT, as they relate to mutual understanding and collaboration between the two domains.

The activities of Company 2's CEO illustrate feedback loop R7. He expressed his expertise in the IS domain in Fig. 4: In Company 2, the new CEO expressed his expertise in the IS domain (which was also acknowledged by the CIO and IT staff). Despite initial project delays and unsatisfactory outcomes, this shared domain knowledge helped maintain his commitment to the IS landscape renewal. He managed to invoke trust in the technology among employees, motivating them to adopt new solutions, and mitigated other managers' departmental requests. This is something we saw across different cases: establishing shared domain knowledge at the corporate level reduces the local pressures for tailored IT projects.

The activities of Company 2′s CEO also illustrate feedback loop R8 in Fig. 4: he initiated the creation of a project steering committee comprising of C-level managers, consultants, and key IT staff involved in the IS renewal. This committee convened regularly to share project progress, fostering a deeper understanding of both the business and IT requirements of the project among all managers. In

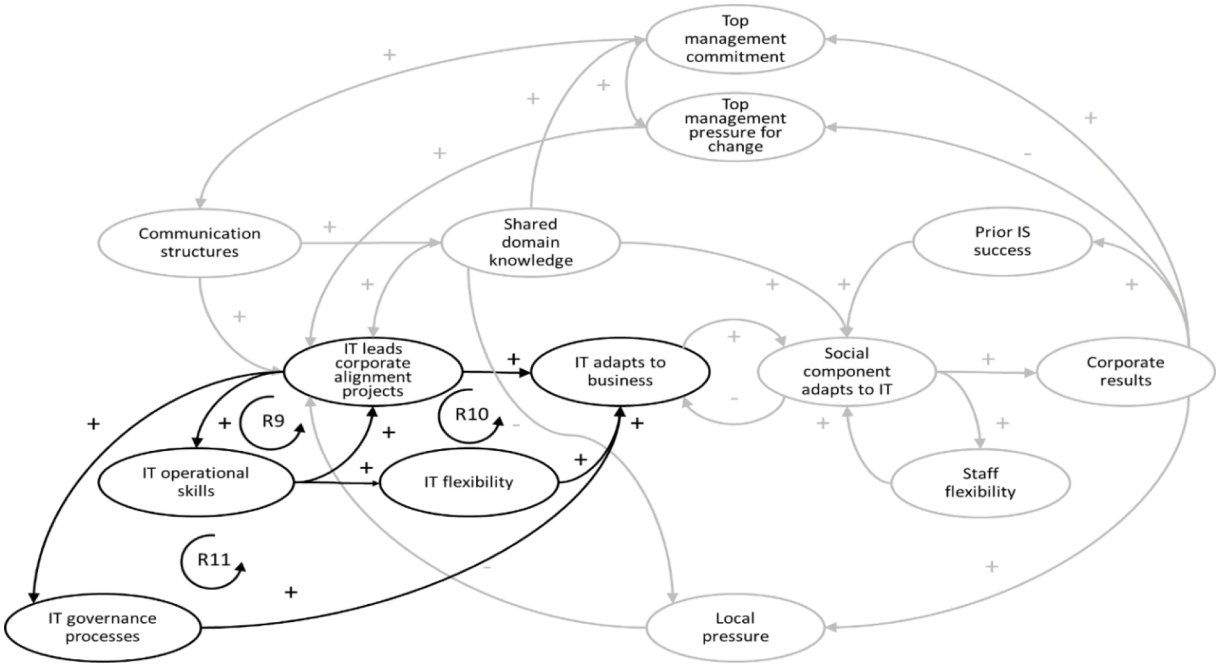


Fig. 5. Role of the IT function in the alignment process.

Company 4, a liaison role was established to connect business needs and technology. The administrative controlling officer was entrusted with the task of analyzing business needs and transforming them into requirements for the IS renewal. The officer's extensive knowledge of corporate processes and technology, as well as his close relationship with the CEO, were pivotal in developing a shared domain knowledge. In all cases, the existence of an organizational body that promoted communication, enabling relational mechanisms and shared domain knowledge, facilitated the IT function's understanding of business needs and ensured consistent focus on IT alignment initiatives.

In Company 1 and Company 3, the CIO championed the establishment of communication structures that facilitated the cultivation of shared domain knowledge. The presence of these communication structures were essential in compensating for the lack of commitment from top management. Sharing information on IT opportunities and constraints fostered the development of a shared domain knowledge, which ultimately enabled top management to recognize the potential contribution of IT to corporate strategy. In Company 1, for instance, IT consultants organized regular meetings with business and IT managers to discuss the state of the IS. The consultants confirmed that it was only after sharing the IS problems and the risks associated with a lack of investment in its renovation that the CEO and other business executives began promoting the IS renewal.

The role of the IT function

Finally, our findings show the role of (governance of) the IT function in shaping the alignment process. We found three relevant feedback loops that had an impact on the IT function's ability to properly manage alignment initiatives. In all cases, it was clear that having a high level of IT operating skills in the IT function was crucial in enabling IT to lead alignment initiatives (R9 in Fig. 5). The CIO of Company 3 attested to this. The company embarked on an IS renewal initiative which involved the replacement of several enterprise applications. After the completion of the first activities, the IT function lacked sufficient internal IT resources and heavily relied on external IT suppliers for development and customization tasks. These suppliers gradually became a barrier in the process, due to their internal procedures for managing requests - and their high costs. The alignment process benefitted from the introduction of new skilled resources in the IT function. The CIO commented on the impact of the choice:

> *"Things changed when we hired experienced developers. Rather than asking consultants to develop new functionalities and wait for their long procedures, we could quickly realize them internally. This enabled us to adopt a trial-and-error approach and promptly test new solutions as they became available. Moreover, the availability of IT operational skills also helped me reduce the time dedicated to managing and negotiating with consultants and focus on the analysis of business needs and the coordination of the projects."*

A similar situation was observed in Company 2. Upon recruitment of new IT staff, skilled in data infrastructure management and software development, the IT function had the opportunity to focus on the key alignment activities for the firms of the group.

An increase in IT operational skills was found to enhance IT flexibility through the selection of more flexible and modular technologies. This, in turn facilitated the adaptation of the IS to business needs (R10 in Fig. 5). In Company 2, for instance, the employment of new developers was crucial in the development and implementation of a new IS landscape that was based on a combination of standardization and modularization. This landscape was much more appropriate for coping with the dynamic business requests than the old landscape. In Company 1, the CIO described how, after an initial phase of effective IS renewal led to a new standardized IS landscape, the pressures for customization at department level prevailed. This, in turn, led to an inflexible system landscape. Due to the introduction of new internal developers and external consultants, skilled in the new IS technology, the customization process was stopped. The CIO commented:

> *"We are now dismantling all the customizations. The effect of this return to the standard became evident. As the warehouse management required new functionalities for managing bar codes, we could implement them easily, without the constraints of a legacy system."*

During the process of aligning business and IT, implementing structured governance processes had a positive impact on the adaptation of IT to business needs (R11 in Fig. 5). Examples of such processes are formal processes for collecting business requirements, project portfolio management procedures, and project prioritization. Company 1 and Company 2 received support from consulting firms in the IS renewal activities, which resulted in an improved adaptability of the companies' IS landscapes to changing business requirements. For example, Company 1 introduced a structured process for collecting and analyzing business requirements and implemented a procedure to reduce non-standard technologies. This facilitated the development of an IS landscape that better reflected business needs. In Company 3, the CIO established an IT project management office that was responsible for selecting and prioritizing business requirements. As a result, the IS was better equipped to respond to key business requirements, while non-priority requests were postponed, and system transformation was accelerated.

Alignment as a complex process of coevolution

Our findings show that, across the four case organizations, the alignment process was shaped through several feedback loops involving the interplay between various alignment factors. An integrative view of these feedback loops shows that the alignment process is indeed found to be a complex process of coevolution, where minor variations in some factors influenced the prevalence of one feedback loop over the others. For example, in Company 3, limited commitment from top management towards IT created conditions where local pressures prevailed, leading to a general deterioration of the alignment process. The situation was further exacerbated by unsuccessful IT projects, which prompted top management to hire a new CIO, who facilitated the establishment of a communication committee, which analyzed the business strategy and strengthened the linkage between the IT function and the

business. These choices resulted in a virtuous circle, where top management was better informed about the constraints and opportunities of the IS, which improved their commitment and maintained pressure on IS renewal.

As another example: in Company 2, after initial delays in and unsatisfactory results from the alignment activities performed by the IT function, the process was facilitated by the introduction of IT governance processes, the acquisition of new personnel skills, and the sharing of project results among end users. These choices led to improvements in the mutual adaptation of the IT and social subsystems, resulting in enhanced results that convinced top management to maintain pressure on IT renewal initiatives, despite the pressures exerted by managers of the group firms.

Finally, in Company 1, the crucial role of the alignment factors and their associated feedback loops in shaping the alignment process was apparent when the company discontinued collaboration with the consulting firm that facilitated communication between top management and the IT function and supported the implementation of governance processes. Through the feedback loops associated with these factors, top management commitment quickly eroded, paving the way for local pressures to override alignment actions. This led to customization of the IS landscape, and increasing misalignments at the corporate level.

Discussion

With our study, we provide insight into the interplay between relevant factors that shapes the alignment process in organizations. Our analysis of four cases shows that the four generative mechanisms identified in Fig. 1 indeed all play a role in shaping the alignment process. Alignment is found to emerge through several feedback loops, that mutually interact in complex ways. We find that many different factors identified in previous studies play a role in shaping the process, and that the interplay between these factors (and the way they shape the process) depends on which of the feedback loops becomes dominant at a certain point in time.

Our study shows a fundamental dynamic between two core feedback loops. The first one has a top-down nature, and is initiated by top management exerting pressure on the organization to make changes in the IS landscape. This engenders coevolving change processes in both the technical and the social sub-systems, ultimately affecting corporate results. The second core feedback loop is a bottom-up one. Here, change is initiated by managers at the BU or department level, pursuing changes in the IS landscape that meet their local interests. The dynamic between these feedback loops is one of contradictory forces: where the top-down feedback loop positively influences corporate results (at least in the short term), the bottom-up one tends to negatively affect those results as it prioritizes local interests over corporate ones. The predominance of one loop over the other is influenced by various factors in a non-linear way. For instance, a slight intervention in establishing shared domain knowledge may move the organization from a situation where feedback loop R1 is dominant (which in the long term leads to a reduced alignment process and alternate dynamics), to dominance of feedback loop R3 (which will reinforce the alignment process). Similarly, actions to share prior IS success help streamline the adaptation of the social sub-system. This is a typical trait of complex systems, where small perturbations may alter the behavior of the whole system in a relevant form.

Finally, our findings shed light on the role that time plays in the alignment process. Together, the feedback loops shape a complex process of coevolution. This is not a linear and sequential process, and not all the feedback cycles in the process have the same timescale – some have a higher or lower tempo than others, may occur more or less frequently, et cetera. For instance, top management pressure has a short term impact on IT leading corporate alignment projects – such pressure is likely to motivate the IT function to take direct action to respond to these pressures. However, corporate results have a longer term effect on top management pressure: it takes time for the mutual adaptation between the technical and the social sub-system to affect corporate results, and for top management to become aware of these effects. Similar observations can be made for all the other feedback loops, and their interplay, as well.

Theoretical implications

With these conclusions, our study provides three main contributions to the literature. First, we extend prior research on alignment as a process that describes the phases of the evolution of the process, by unveiling the underpinning complexity of this process. Our analysis does justice to the complexity of the reality of the alignment process by acknowledging that there is an intricate interplay between several factors at work here, and that these factors play different roles in different mechanisms in the process, mutually influence each other, and ultimately shape the coevolution process of aligning.

Our study thus contributes to a coevolution theory of the Business-IT alignment process by outlining how the different mechanisms and factors are mutually related in complex networks of feedback loops – providing a more detailed insight into the complex coevolution dynamics that shape the alignment process. The different factors that play a role in the process represent the *what* of the theory, i.e. "part of the explanation of the social or individual phenomena of interest" (Whetten, 1989, p.490). Through the identification of the interplay between these factors that shape the alignment process, we also provide the *how* of our theory, i.e. the patterns of evolution of the phenomena (Whetten, 1989). In the coevolution description of the process in the organizations, we incorporate the top-down and bottom-up relationships between digital business strategy and the mutual adaptation between the social and technical sub-systems. This logic underlying our model is the *why* of a theory (Whetten 1989).

Our contribution to this theory is in identifying the mutually interacting components of the socio-technical system, the generative mechanisms that shape the interaction between them, and the way these interactions shape the larger alignment process. The insight that the feedback loops in which these interactions take place are complex, often unpredictable, strongly interrelated, and operate at different time scales, provides a picture of the alignment process that helps us understand why this process often oscillates between alignment and misalignment. It also makes clear that alignment is not a stable "state" that any organization is likely to reach, as the factors and their interplay are subject to continuous change, and the consequences of such changes are extremely difficult to predict.

With the insights into the fundamental dynamics between top-down and bottom-up feedback cycles, our study also provides a contribution to the literature by extending previous work on these dynamics, such as Benbya and McKelvey (2006), Baker and Singh (2019), Vessey and Ward (2013), and Yeow et al. (2018). Where such previous work has acknowledged that both top-down and bottom-up processes play a role in the coevolution of relevant components shaping alignment, our detailed analysis extends this insight by showing the fundamentally contradictory nature of the top-down and bottom-up feedback loops: where the top-down loop (R1) provides a positive dynamic in the process of of aligning at the corporate level, the bottom-up one (R2) contributes to deterioration of the process by prioritizing local interests over corporate ones. We also show that the top-down feedback loop itself has a balancing tendency (regardless of the influence of the bottom-up loop): as the alignment process is more successful, it will weaken the pressure for top-down driven change. Together, this constellation of feedback loops provides further insight into why alignment is so difficult to achieve and maintain, and into the crucial role of top management commitment in keeping the process going.

Finally, we contribute to the literature on alignment by unpacking the role of social alignment in the process, especially shared domain knowledge. This factor has been identified as a relevant influence on alignment in quite a number of previous studies (e.g. Kearns & Sabherwal, 2006; Luftman & Brier, 1999; Preston and Karahanna, 2009; Reich & Benbasat, 2000), which our study confirms. Our study extends this previous work by providing a detailed insight into the mechanisms through which this factor plays multiple roles in the alignment process. Shared domain knowledge positively influences the alignment process by increasing top management commitment and by reducing local pressures, as a shared understanding of the (corporate-level) requirements and possibilities of IS helps in initiating activities that contribute to alignment at this level. At the same time, shared domain knowledge also directly influences the mutual adaptation between the technical and social sub-systems, further contributing to the alignment process. In this respect, it is not wrong to say that shared domain knowledge is an antecedent of alignment (Reich and Benbasat 2000), but our findings indicate that its role is more complex than that, as this factor is embedded in a complex network of relations. For instance, increasing shared domain knowledge without taking relevant actions on prior IS success may result in very low impact on alignment.

Practical implications

By outlining which alignment mechanisms can be activated by organizations, how they are mutually related, and which factors play a role in this process, we provide a managerial framework that can be used by decision makers to monitor or guide the alignment process in organizations.

For instance, the contradicting pressures exerted by the top-down and bottom-up feedback loops imply that management must continuously be aware of the ongoing dynamic between alignment and misalignment. The dynamics between the feedback loops R1, R2 and R3 mean that there is a risk of complacency: when results are positive, the drive to keep the alignment process going is reduced. The crucial role of top management commitment provides clear guidance here: top management must maintain its commitment to alignment, and develop structures and processes that help in spotting tendencies towards misalignment in the organization. Signs of impending misalignment can for instance be a rise in IT costs, a tendency towards fragmentation of the IS landscape, or increasing levels of technical debt. The risk of misalignment is particularly highlighted in the case of organizations with conglomerate structures, such as group-affiliated companies, where the alignment pressures at local level may clash with those at the overarching level. Top management should continuously be aware that there will be local pressures on the IT function. It is crucial to continuously monitor the state of the IS landscape, and intervene proactively when such tendencies towards misalignment are found.

Furthermore, our findings emphasize the importance of social alignment between Business and IT. A practical implication here is that it is crucial to set up communication structures that enable the interaction between both domains, facilitating relational values like mutual trust and identification, and enabling the creation of shared domain knowledge. What effective communication structures are available will differ per organization, so it is important to analyze which structures (such as committees, liaison roles, knowledge sharing sessions, etc.) optimally fit with the characteristics of the organization and the people involved in the alignment process. Our findings, for instance, show the importance of achieving shared domain knowledge at the C-level (through steering committees for instance) in generating high-level commitment to alignment, which then needs to be shared at the more operational level (through various relational mechanisms). Another example is the specific role of the liaison officer in Company 4, whose important role in translating between business requirements and IT possibilities signficantly contributed to aligning the two domains at the operational level.

Coming back to our observation on the role of time: this condition can be exploited in two positive ways. When the IT function launches a project and top management is waiting for the results, this may present a “window” where the IT department is free to undertake all the necessary actions. When the first positive results appear, dashboards can help monitor performance and quickly bring the positive results to the attention of top management and staff, with a positive impact on top management commitment and reducing staff inertia. This is in line with the conclusion of Cumps et al. (2009) about the role of time, but our study provides evidence and extends the understanding of the role of time in the process. Specifically, our results provide a more detailed picture of how these processes interact over time, and thus how such synchronization can actually be realized.

Limitations and further research

Our research is based on four case studies, which necessarily provided only a partial view of the reality of alignment. Despite the number of informants interviewed and the data collected, we cannot claim that we provide a complete insight into all the factors that play a role in the alignment process – or in their interplay. In the research design phase, we purposely selected companies characterized by a rich alignment process trajectory. However, the cases exhibit some similarities in their dimensions (mid-sized companies) and

business models (manufacturing firms). This design choice reinforced the reliability of our results, but restricts their applicability to other companies at a more general level. On the other hand, our study did not aim to come up with a generalizable model of the alignment process – rather, we wanted to provide insight into the complex nature of this coevolutionary process by identifying relevant factors and the networks of feedback loops involving their interplay. Our claim is not that our conclusions are exhaustive in this respect, but that they do provide insight into the relevant factors, what kind of feedback loops can be distinguished, and how all this shapes this complex process of coevolution.

Future research directions are directly derived from the contribution and limitations of the present study. Additional investigation involving additional cases is needed in order to further validate and enrich our results. Such additional studies can lead to the identification of other factors and feedback loops, and a specification of the contextual variables that influence the way in which the interplay between specific factors can play a role in the alignment process in different kinds of organizations and industries.

Finally, a quantitative approach to modelling and studying alignment could yield additional insights into the alignment process. The explanation of alignment as a co-evolution process and the identification of the feedback loops that shape this process, paves the way to the application of new methodological tools in the investigation of the alignment process. Co-evolution theory research tools such as agent-based simulation, mathematical modelling, and quantitative system dynamics have been applied to several domains of research, allowing researchers to identify and explain unexpected phenomena, such as emergence of properties, bifurcations, and complex behaviors (McBride, 2005; Benbya & McKelvey, 2006). The identification of the mechanisms, of the influencing factors, and the way their interplay in various feedback loops shapes the alignment process, is instrumental in the elaboration of mathematical models and the application of quantitative approaches towards system dynamics in the alignment process. These tools can contribute to a better understanding of the complex alignment dynamics, explaining for instance the sensitivity to initial conditions, the type and stability of alignment equilibrium states (i.e. under which conditions alignment is a stable equilibrium point), and the conditions that make the alignment process proceed incrementally or through punctuated periods of sudden, revolutionary, turbulent changes. Some recently published work (Benbya et al, 2020; Pentland et al., 2020; Zhang et al., 2019) approach alignment through methods and analytical tools based on complexity science (such as agent-based modeling and network simulations). Such studies confirm the potential of these research methodologies in the domain of alignment.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A

Interview protocol

Questions are open-ended and must be presented to stimulate the discussion with the informants.

1. (In the case of company owner or top managers) Can you please introduce the company highlighting the products and services offered to the market and the competitive landscape?

- Can you tell us the entrepreneurial story of the company?
- What products and/or services does it offer to the market?
- Are you among the leaders of the market?
- What are your key competitive differentials?
- What are the company's key strategic objectives?
- Can you describe the competitive environment, in terms of key actors, dynamicity, volumes?

2. Role and responsibility

- Please introduce yourself and your role in the company.
- What are your duties and main activities?

3. Personal background

- Please describe your background, highlight your experience in the company. Describe your employment history.
- In case of recent hire, what were your previous experiences?

4. How would you describe your link with the company's information System?

- How would you describe your role in connection with the IS (operational user, decision makers who uses data provided by the IS, provide requirements, technician and developer, "sponsor", etc.).
- Pease describe your activities connected to the IS.

– What applications (or in general digital technologies) do you use?
– Who are the users of the IS in your department? Which technologies do they use?

5. (For the technical informants) Can you provide a picture of the current IS?

– What are the key applications of the IS?
– Can you describe the IT architecture underpinning the IS?
– What is the role of the IS in relation to the company's business strategy?
– How did the application portfolio and the architecture evolve over the years?
– What drivers pushed the transformation of the IS?

5. What are your expectations from the IS?

– What is working in the current IS?
– What is not working in the current IS?
– What performance would you suggest focusing on to improve the IS? What does improve mean for you?
– What drivers pushed the transformation of the IS?
– What was your role during the transformation of the IS?

6. How would you describe the alignment of the IS to business?

– Why is it aligned? Please provide some examples.
– Why is it not aligned? Please provide some examples.
– Did the alignment change of the time?
– Did business requirements change over time?
– Who are the actors that mainly contributed to the alignment or misalignment?

7. Did you experience specific cases of alignment or misalignment between business and IT?

– Can you tell us the "story" of the alignment/misalignment?
– What was the evidence that an alignment or a misalignment existed?
– Which elements of the IS, social and technical, contribute to the alignment.
– What factors [e.g., shared domain knowledge, top management commitment, prior IT success, etc.] influenced the evolution of the IS and led to alignment or misalignment?

Appendix B

Alignment journeys and feedback loops

The following tables offer a detailed overview of the evolution of the alignment journeys for the four companies in the present study, highlighting the contribution of the different feedback loops in shaping the alignment process.

Company 1

Steps in the evolution of the alignment process	Feedback loops' role in shaping alignment
Company 1 enjoyed a long period of stability until 2010, during which time the IS department was overseen by an experienced CIO who reported directly to the CEO. The CIO took a reactive approach to address business needs as communicated by the CEO, despite occasional pressure from departmental managers. Due to the CIO's access to information regarding the company's strategy, as well as his experience and trustworthiness in the eyes of the CEO, he was able to exercise a degree of independence in rejecting requests for departmental services. However, the alignment between the IS function and the company's overall strategy and the lack of CEO's commitment to IT reduced the pressure to renovate the IS landscape. Consequently, the IS landscape was incrementally extended through customization, with limited emphasis on innovation or optimization.	R1 is the dominant feedback loop. Top management pressure for changing the IS and align it to business gradually decreased as a consequence of positive corporate performance. Pressure from departments' managers (R2) was mitigated by the CIO who reports to the CEO and has access to information on corporate strategy. Positive results gradually reduced the pressure for change of the top management.
After the retirement of the previous CIO, the lack of commitment to IT from the CEO was reflected in the appointment of a new CIO with a technical background. Additionally, the organizational structure was revised so that	R2 becomes the dominant feedback loop. Departmental managers exerted pressure on the CIO for local solutions. This pressure, combined with the lack of access to corporate strategy and of a

(*continued on next page*)

(*continued*)

Steps in the evolution of the alignment process	Feedback loops' role in shaping alignment
the CIO reported to the CFO. The increasing competition faced by the company resulted in departmental managers demanding local solutions. The new CIO lacked a shared domain knowledge and access to corporate strategy information, making it difficult to align the IS with the overall company strategy. As a result, the process of customizing the IS to match departmental needs and the introduction of local departmental solutions became dominant, extending the misalignment between corporate strategy and IS.	shared knowledge and with the reduction of top management pressure for alignment, led to local optimization and increase of the gap between the IS and the overall strategy of the company.
As the environment became excessively competitive, the IS landscape did not enable the organization to respond to this development. An assessment of the IS by external consultants in 2012 convinced the CEO and the other top managers to initiate a comprehensive IS renewal. With support from the consultants, a new IT governance model was designed and implemented, with a focus on structured processes of demand management, design, and portfolio management. Additionally, an executive board including the CEO, other top managers, and the CIO was established to facilitate communication and alignment on corporate strategy and on the IS redesign's progress. While the IS transformation faced resistance from end-users and experienced delays in generating impact on company performance, the increased commitment and perception of IS importance by top management enabled sustained pressure on the IT department to complete the IS transformation and ensure its alignment with the corporate strategy. In the IT department, additional personnel, increasing the operational capacity of the department and the IS flexibility.	At corporate level, R3 emerges as the dominant feedback loop as the consequence of the interplay of different factors. The presence of a communication channel (executive board) reinforced the efficacy of the top management in promoting overall alignment against pressures from the departmental managers (R8). The shared domain knowledge had a twofold effect: it reinforced top management commitment and reduced pressures at departments' level (R7). In the IT department, the additional personnel contributed to increasing operational skills (R9) and the flexibility of the IS (R10). The presence of IT governance processes, defined by the external consultants, improved the capacity of the IT department to revise the IS in line with business needs (R11).
The termination of the contract with the external consultants, in 2014, marked the transition to a new phase in the alignment journey. The launch of the new IS encountered problems such as continuous software customizations to compensate the inability of the end users to adapt to new solutions and the lack of IT governance processes. The inadequacy of technological choices made during this implementation phase became evident, showing an inability to keep up with evolving business needs.	Degradation of the role and efficacy of the communication structure and of the shared domain knowledge negatively impacted on the capacity of the IT department to successfully carry out alignment projects (compromising R8). Personnel memory of failures in previous IT projects reduced the capacity of the end-users to adapt to the new IS (compromising R6), who consequently increasingly required customization of the IS (compromising R4).
The involvement of a new consulting firm extended the IT operational skills and helped eliminate customizations, increasing IS flexibility. On the other hand, the IT department undertook actions to share the successful progress in IS transformation among end users and its contribution to business among the top managers, reinforcing their capacity to adapt to IS changes.	The actions by the consulting firm re-activates the feedback loops involving top management commitment (R3), shared domain knowledge (R7), and Prior IS success (R6).

Company 2

Steps in the evolution of the alignment process	Feedback loops' role in shaping alignment
Company 2, a group composed of several production factories coordinated by a holding company, operated in a stable market, with long-term agreements with key customers, which guaranteed sales growth and profitability. Sales and production were organised to address regional demand. Each factory IS was optimised to serve the requests and match the peculiarities of the local markets. The company lacked a CIO and decisions on IT were made by the purchase manager. The president and CEO of the group lacked a shared domain knowledge and accepted that IS was managed at the factory level, leading to a collection of regional IS, well supported by automation, but heterogeneous, deeply customized, and disconnected with the IS of the parent company. Despite being in a position of market leadership, the group gradually experienced the rigidity of the regional IS to cope with changing market needs and competition and the inability of the top management to make informed decisions, caused by a lack of communication between subsidiaries and parent company.	The lack of pressure from the top management to promote alignment at group level and the pressure from local factories shaped the IS which was composed of several well automated, but heterogeneous and disconnected IS, making the R2 feedback loop dominant.
Following a relevant increase in market competition and dynamicity, company top management was entirely replaced leading to a new phase in the evolution of the IS. The novel CEO and most managers were characterized by commitment to IT and shared domain knowledge. A CIO, reporting to the CEO, was appointed and an ambitious renovation project of the group IS was initiated with the aim of improving homogeneity of the regional IS, promoting interoperability, and providing information and tools to the top management at the parent company level to make informed and optimal decisions. A project steering committee was established to liaison business strategy and IT actions. The implementation of the IS renovation project was hindered by the lack of IT operational skills and the limited staff flexibility to adapt to new technologies and new processes.	The company experienced difficulties in the transformation of the IS due to lack of operational skills and end users' rigidity, hindering R11 and R5 feedback loops, respectively. However, deeply committed top management maintained pressure on the IT department to undertake alignment actions at group level, despite difficulties and delays in improvement in corporate performance, making R3 feedback loop dominant. This feedback loop was reinforced by the presence of a communication structure (the steering committee) and shared domain knowledge (reinforcing R8 and R7 feedback loops).
As the company experienced positive results from the transformation of the IS, the CIO, supported by the CEO, gradually reorganised the IT department improving operational skills (new developers and a data expert were hired)	The dominant feedback loop of the top management commitment influencing pressure for alignment at corporate level (R3) was reinforced by the presence of IT operational skills (R9) and IT flexibility (R10). Top management

(*continued on next page*)

(*continued*)

Steps in the evolution of the alignment process	Feedback loops' role in shaping alignment
and IT flexibility. A consulting firm was involved to support the change management phase, promoting results of the transformation among end-users and coaching personnel to adapt to the new processes enabled by the IS. Availability of an IS characterized by homogeneity and interoperability across the different subsidiaries allowed the top management to undertake transformation actions at group level, introducing a new corporate department to manage supply chain, procurement, and production at group level and a new policy for the definition of product prices.	commitment also allowed to appreciate the positive contribution of the IS to corporate performance and maintain pressure on IS renovation (hindering R1). Actions aimed at sharing IS success and improving staff flexibility reinforced the capacity of the personnel to adapt to the IS and effectively exploit its potential (reinforcing feedback loops R6 and R5 respectively). The joint effect of the feedback loops allowed top management to undertake business transformation actions (supply chain management and prices revision).

Company 3

Steps in the evolution of the alignment process	Feedback loops' role in shaping alignment
Company 3 achieved significant business growth as a result of its national market leadership position. However, the organization's IS landscape did not keep pace with this growth, as top management viewed it solely as a supporting asset. The IT department reported to top management and lacked clear IT governance, with decision-making primarily driven by line managers rather than a CIO. Although substantial investments were made in new IS, these systems proved ineffective in supporting business processes and required expensive customizations and additional packages. Efforts to replace the ERP system were unsuccessful, as end-users rejected the new system.	The lack of top management commitment and a weak pressure on alignment actions (R1) combined with requests for customized services and packages from line managers made R2 feedback loop dominant. This feedback loop was a self-reinforcing one, as the dissatisfactory choices on the IS contributed to generate disappointment of the end users, who rejected additional changes in the IS (hindering R6).
In 2012, the company introduced a CIO who reported directly to the CEO and, thanks to a shared domain knowledge on business and IT, prioritized the renewal of the organization's IS landscape and selection of a new ERP, making the IS more aligned to corporate strategy. This effort also involved defining structured communication processes with the top management (regular meetings and interviews were organized by the CIO with the president and the CEO, to comprehend corporate strategy, and with line managers, to collect business requirements), which promoted shared domain knowledge, and ultimately led to a successful implementation of the new IS.	The presence of a CIO with business and IT knowledge was instrumental to transform the feedback loops in the company. The introduction of communication structures between the IT department and the top management and the promotion of a shared domain knowledge contributed to both aligning requests from line managers to corporate strategy (hindering R2) and furthering top management commitment (R3) which manifested in additional funding available for the IT department to undertake alignment actions. The introduction of IT governance processes to effectively collect business requirements reinforced the capacity of the IT department to lead alignment actions (R11).
The new IS has facilitated acquisitions and reorganization of the supply chain, but limited support was received from IT suppliers, resulting in delays and excessive costs. To mitigate these issues, the company invested in internal operational IT resources (new developers were hired).	During the transformation of the IS, results on corporate performance were hindered by the lack of internal IT operational skills and corresponding increasing dependency on IT suppliers (hindering R9). This lock-in condition led to delays in activities by the supplier and excessive IT costs. Availability of internal operational skills to compensate delays of IT suppliers re-activated R9 and contributed to realizing a flexible configuration of the IS (R10).

Company 4

Steps in the evolution of the alignment process	Feedback loops' role in shaping alignment
Despite top management committed to IT, product uniqueness and market leadership hindered pressures for improvements in the IS, whose role was limited to implementing operational tasks with no support to decision making processes. The lack of pressure on alignment actions was evident in the choice of the top management to outsource the coordination of the IT department, which was supervised by the CIO of a sister company (Company 1). As a consequence, investments in IT were limited and the IS was gradually customized based on the requests of the line managers. Liaison role between CIO (belonging to Company 1) and Company's 2 top management was played by a controlling officer, who had deep knowledge of the company's processes and was also proficient in IT.	The lack of top management pressure on IT department (limited R1) allowed pressures from department managers to slightly be prevailing and make R2 feedback loop dominant. Additionally, despite the presence of a liaison role, the connection between corporate strategy expressed by the CEO and the (external) CIO was weak, generating a drift in the capacity of the IS to support business and enable its transformation.
Market pressure for improving time to market led the top management to consider revising the IS with the aim of supporting automation, end-to-end management of processes, and efficacy improvement. Internal support was provided by the reporting officer in the control department whose liaison role was extended and streamlined communication at all levels of the organization (connecting company's top management, end users, and the external CIO). A communication structure linking CEO, CIO, the controlling officer, and the company's top management was established. Transformation was favoured by the flexibility of the personnel staff, who was used to work on a project base and didn't reject or compromised IT projects.	Slumps in corporate performance due to increased market competition triggered the top management to undertake transformation of the IS to re-align it to business requirements. The role of the reporting officer was extended and a clear communication structure to interconnect all managers was defined. As a consequence, feedback loop R1 was re-activated and the presence of top management commitment allowed the company to compensate the reduction in top management pressure caused by improved performance and make R3 feedback loop dominant. Staff flexibility favoured the transformation of internal processes to better exploit the new IS (R5), favouring impact on corporate results.
After the reporting officer retired, lack of direct communication between CEO and CIO caused misunderstanding of business requirements and delays in IT projects implementation.	An apparently minor event, the retirement of the reporting officer, whose liaison role was not replaced, marked a transformation in the dynamics of the feedback loops: the communication between the company's top management and the external CIO was compromised, hindering the efficacy of R3 feedback loop which was gradually replaced by R2.

References

Atkinson, J., 2002. Four steps to analyse data from a case study method. *ACIS 2002 Proceedings*, 38.

Baker, J., Jones, D.R., Cao, Q., Song, J., 2011. Conceptualizing the Dynamic Strategic Alignment Competency. J. Assoc. Inf. Syst. 12 (4), 299–322.

Baker, E.W., Niederman, F., 2014. Integrating the IS functions after mergers and acquisitions: Analyzing business-IT alignment. J. Strateg. Inf. Syst. 23 (2), 112–127.

Baker, J., Singh, H., 2019. The roots of misalignment: Insights on strategy implementation from a system dynamics perspective. J. Strateg. Inf. Syst. 28 (4), 101576.

Benbya, H., McKelvey, B., 2006. Using Coevolutionary and Complexity Theories to Improve IS Alignment: A Multi-Level Approach. J. Inf. Technol. 21 (4), 284–298.

Benbya, H., Nan, N., Tanriverdi, H., Yoo, Y., 2020. Complexity and information systems research in the emerging digital world. Mis Quarterly 44 (1), 1–17.

Bharadwaj, A., El Sawy, O.A., Pavlou, P.A., Venkatraman, N., 2013. Digital business strategy: toward a next generation of insights. MIS Q. 37 (2), 471–482.

Burton-Jones, A., McLean, E.R., Monod, E., 2015. Theoretical perspectives in IS research: from variance and process to conceptual latitude and conceptual fit. Eur. J. Inf. Syst. 24, 664–679.

Butler, M.J., 2022. A qualitative system dynamics perspective on the contribution of information technology credibility towards business and information technology alignment. South African J. Business Manage. 53 (1), 12.

Campbell, B., Kay, R., Avison, D., 2005. Strategic alignment: a practitioner's perspective. J. Enterp. Inf. Manag. 18 (6), 653–664.

Chan, Y.E., 2002. Why Haven't We Mastered Alignment? The Importance of the Informal Organization Structure. MIS Q. Exec. 1 (2), 97–112.

Chan, Y.E., Reich, B.H., 2007. IT Alignment: What Have We Learned? J. Inf. Technol. 22 (4), 297–315.

Chan, Y.E., Sabherwal, R., Thatcher, J.B., 2006. Antecedents and outcomes of strategic IS alignment: an empirical investigation. IEEE Trans. Eng. Manag. 53 (1), 27–47.

Ciborra, C.U., 1997. De profundis? Deconstructing the concept of strategic alignment. Scand. J. Inf. Syst. 9 (1), 2.

Ciborra, C., Braa, K., Cordella, A., Dahlbom, B., Hepsø, V., Failla, A., Hanseth, O., 2000. From control to drift: the dynamics of corporate information infastructures. Oxford University Press.

Coltman, T., Tallon, P., Sharma, R., Queiroz, M., 2015. Strategic IT Alignment: Twenty-five Years On. J. Inf. Technol. 30 (2), 91–100.

Cumps, B., Martens, D., De Backer, M., Haesen, R., et al., 2009. Inferring comprehensible business/ICT alignment rules. Inf. Manag. 46 (2), 116–124.

De Haes, S., Van Grembergen, W., 2009. An Exploratory Study into IT Governance Implementations and its Impact on Business/IT Alignment. Inf. Syst. Manag. 26 (2), 123–137.

Dubé, L., Paré, G., 2003. Rigor in Information Systems positivist case research: current practices, trends, and recommendations. MIS Q. 27 (4), 597–636.

Fang, Y., Lim, K.H., Qian, Y., Feng, B., 2018. System Dynamics Modeling for Information Systems Research: Theory of Development and Practical Application. MIS Q. 42 (4), 1303–1329.

Fischer, L.H., Baskerville, R., 2022. Explaining sociotechnical change: an unstable equilibrium perspective. Eur. J. Inf. Syst. 1–19.

Gerow, J.E., Grover, V., Thatcher, J., 2016. Alignment's Nomological Network: Theory and Evaluation. Inf. Manag. 53 (5), 541–553.

Henderson, J., Venkatraman, N., 1993. Strategic Alignment: Leveraging Information Technology for Transforming Organizations. IBM Syst. J. 32 (1), 4–16.

Henfridsson, O., Bygstad, B., 2013. The Generative Mechanisms of Digital Infrastructure Evolution. MIS Q. 37 (3), 896–931.

Hitt, L., Brynjolfsson, E., 1996. " Productivity, Business Profitability, and Consumer Surplus: Three Different Measures of Information Technology Value. MIS Q. 20 (2), 1.

Holland, J.H., 2006. Studying complex adaptive systems. J. Syst. Sci. Complex. 19 (1), 1–8.

Hussin, H., King, M., Cragg, P., 2002. IT Alignment in Small Firms. Eur. J. Inf. Syst. 11 (2), 108–127.

Johnson, A.M., Lederer, A.L., 2010. CEO/CIO mutual understanding, strategic alignment, and the contribution of IS to the organization. Inf. Manag. 47 (3), 138–149.

Kappelman, L., Torres, R., McLean, E.R., Maurer, C., Johnson, V.L., Snyder, M., Guerra, K., 2022. The 2021 SIM IT Issues and Trends Study. MIS Q. Exec. 21 (1).

Karpovsky, A., Galliers, R.D., 2015. Aligning in Practice: from Current Cases to a New Agenda. J. Inf. Technol. 30 (2), 136–160.

Kearns, G.S., Sabherwal, R., 2006. Strategic alignment between business and information technology: a knowledge-based view of behaviors, outcome, and consequences. J. Manag. Inf. Syst. 23 (3), 129–162.

Lee, A.S., 1989. A scientific methodology for MIS case studies. MIS Q. 13 (1), 33–50.

Liang, H., Wang, N., Xue, Y., Ge, S., 2017. Unraveling the Alignment Paradox: How Does Business-IT Alignment Shape Organizational Agility? Inf. Syst. Res. 28 (4), 863–879.

Luftman, J., 2000. Assessing Business-IT Alignment Maturity. Communications of the AIS 14 (4), 1–51.

Luftman, J., Brier, T., 1999. Achieving and Sustaining Business-IT Alignment. Calif. Manage. Rev. 42 (1), 109–122.

Luftman, J., Papp, R., Brier, T., 1999. Enablers and Inhibitors of Business-IT Alignment. Commun. AIS 1 (1), 11.

McBride, N., 2005. Chaos Theory as a Model for Interpreting Information Systems in Organizations. Inf. Syst. J. 15 (3), 233–254.

Merali, Y., 2006. Complexity and Information Systems: The Emergent Domain. J. Inf. Technol. 21 (4), 216–228.

Mintzberg, H., Waters, J.A., 1985. Of strategies, deliberate and emergent. Strateg. Manag. J. 6 (3), 257–272.

Mirabeau, L., Maguire, S., 2014. From autonomous strategic behavior to emergent strategy. Strateg. Manag. J. 35 (8), 1202–1229.

Newkirk, H.E., Lederer, A.L., Johnson, A.M., 2008. Rapid business and IT change: drivers for strategic information systems planning? Eur. J. Inf. Syst. 17 (3), 198–218.

Nolan, R.L., Wetherbe, J.C., 1980. Toward a comprehensive framework for MIS research. MIS Q. 4 (2), 1–19.

Oh, W., Pinsonneault, A., 2007. On the assessment of the strategic value of information technologies: conceptual and analytical approaches. MIS Q. 31 (2), 239–265.

Paré, G., 2004. Investigating information systems with positivist case research. Commun. Assoc. Inf. Syst. 13 (1), 18.

Patton, M.Q., 2002. Qualitative research and evaluation methods. Integrating theory and practice. Sage, London.

Pentland, B., Liu, P., Kremser, W., Hærem, T., 2020. The Dynamics of Drift in Digitized Processes. MIS Q. 44 (1), 19–47.

Peppard, J., Breu, K., 2003. Beyond Alignment: A Coevolutionary View of the Information Systems Strategy Process. In: *ICIS 2003 Proceedings*, 61.

Peppard, J., Ward, J., 2004. Beyond Strategic Information Systems: Towards an IS Capability. J. Strateg. Inf. Syst. 13 (2), 167–194.

Preston, D.S., Karahanna, E., 2009. Antecedents of IS Strategic Alignment: A Nomological Network. Inf. Syst. Res. 20 (2), 159–179.

Preston, D.S., 2003. Shared mental models between the CIO and CEO: Towards information systems strategic alignment. In: *Proceedings of the 2003 Americas Conference on Information Systems (AMCIS 2003)*, 452.

Ravishankar, M.N., Pan, S.L., Leidner, D.E., 2011. Examining the strategic alignment and implementation success of a KMS: A subculture-based multilevel analysis. Inf. Syst. Res. 22 (1), 39–59.

Raymond, L., Bergeron, F., 2008. Project management information systems: An empirical study of their impact on project managers and project success. Int. J. Proj. Manag. 26 (2), 213–220.

Reich, B.H., Benbasat, I., 2000. Factors that Influence the Social Dimension of Alignment between Business and Information Technology Objectives. MIS Q. 24 (1), 81–113.

Ryan, S.D., Harrison, D.A., Schkade, L.L., 2002. Information-technology investment decisions: when do costs and benefits in the social subsystem matter? J. Manag. Inf. Syst. 19 (2), 85–127.

Sabherwal, R., Chan, Y.E., 2001. Alignment between Business and IS Strategies: A Study of Prospectors, Analyzers, and Defenders. Inf. Syst. Res. 12 (1), 11–33.

Sabherwal, R., Kirs, P., 1994. The alignment between organizational critical success factors and information technology capability in academic institutions. Decis. Sci. 25 (2), 301–330.

Sarker, S., Chatterjee, S., Xiao, X., 2013. How" Sociotechnical" is our IS Research?: An Assessment and Possible Ways Forward. In *Proceedings of the 34th International Conference on Information Systems. ICIS 2013* (p. 1185).

Sterman, J.D., 2000. Business Dynamics: Systems Thinking and Modeling for a Complex World. Irwin/McGraw-Hill, Boston.

Tallon, P.P., 2007. A process-oriented perspective on the alignment of information technology and business strategy. J. Manag. Inf. Syst. 24 (3), 227–268.

Tanriverdi, H., Rai, A., Venkatraman, N., 2010. Research commentary—reframing the dominant quests of information systems strategy research for complex adaptive business systems. Inf. Syst. Res. 21 (4), 822–834.

Teece, D.J., Pisano, G., Shuen, A., 1997. Dynamic capabilities and strategic management. Strateg. Manag. J. 18 (7), 509–533.
Teo, T.S., Ang, J.S., 1999. Critical Success Factors in the Alignment of IS Plans with Business Plans. Int. J. Inf. Manag. 19 (2), 173–185.
Thong, J.Y., Yap, C.S., Raman, K.S., 1996. Top management support, external expertise and information systems implementation in small businesses. Inf. Syst. Res. 7 (2), 248–267.
Van Oosterhout, M., Waarts, E., van Hillegersberg, J., 2006. Change Factors Requiring Agility and Implications for IT. Eur. J. Inf. Syst. 15 (2), 132–145.
Vermerris, A., Mocker, M., Van Heck, E., 2014. No time to waste: the role of timing and complementarity of alignment practices in creating business value in IT projects. Eur. J. Inf. Syst. 23 (6), 629–654.
Vessey, I., Ward, K., 2013. The Dynamics of Sustainable IS Alignment: The Case for IS Adaptivity. J. Assoc. Inf. Syst. 14 (6), 283–301.
Whetten, D.A., 1989. What Constitutes a Theoretical Contribution? Acad. Manag. Rev. 14 (4), 490–495.
Yeow, A., Soh, C., Hansen, R., 2018. Aligning with new digital strategy: A dynamic capabilities approach. J. Strateg. Inf. Syst. 27 (1), 43–58.
Yin, R.K., 1994. Case Study Research: Design and Methods, 2nd Ed. Sage Publications, Thousand Oaks, CA.
Zardini, A., Rossignoli, C., Ricciardi, F., 2016. A bottom-up path for IT management success: From infrastructure quality to competitive excellence. J. Bus. Res. 69 (5), 1747–1752.
Zhang, M., Chen, H., Lyytinen, K., 2019. Principles of organizational co-evolution of business and IT: a complexity perspective. ECIS Proceedings.
Zhang, M., Chen, H., Lyytinen, K., 2021. Validating the coevolutionary principles of business and IS alignment via agent-based modeling. Eur. J. Inf. Syst. 30 (5), 496–511.
Zhou, J., Bi, G., Liu, H., Fang, Y., Hua, Z., 2018. Understanding employee competence, operational IS alignment, and organizational agility–An ambidexterity perspective. Inf. Manag. 55 (6), 695–708.