Aligning Business and IT as a Coevolution Process: From Principles to Practices

ABSTRACT

Despite an extensive body of research on Business-IT alignment, insight into the practices through which alignment can be realized in organizations is still relatively scarce. The interpretation of alignment as a coevolution process provides insight into the principles through which a persistent aligning of business and IT may be achieved. However, the incorporation of these principles into corporate practice is still limited. In this paper, we address this gap, by combining insights from the literature with the empirical findings from five case studies. We identify four principles of coevolution, and 14 alignment practices through which these principles are operationalized. We also discuss how these principles and practices are interconnected. This paper contributes to filling the gap between theoretical alignment principles and operational practices that exists in literature. Identification of principles and practices and understanding their connection provides operational guidance for organizations to successfully shape the process of aligning business and IT.

Keywords: business IT alignment, co-evolution theory, principles and practices.

1. INTRODUCTION

Aligning business and IT has been a concern for academics and practitioners for three decades (Chan & Reich, 2007). The motivation for this enduring interest in the topic lies in the link, investigated by several authors, between alignment and corporate performance (Kearns & Lederer, 2000; Luftman, Lyytinen, & Zvi, 2017; Wu et al., 2015). However, despite an extensive body of research that has identified and investigated the different factors influencing alignment, its application to corporate practice is still lagging and the topic constantly ranks as a top priority for corporate executives and IT professionals (Kappelman et al., 2021).

The interpretation of alignment as a coevolution process is a promising approach to understanding how a persistent aligning of business and IT can be achieved (Merali, 2006; Vessey & Ward6 2013). Central to this approach is the conceptualization of alignment as a continuous process of mutual adaptation and change between IT and business resources at different levels in the organization (Benbya & McKelvey, 2006a; Chan & Reich, 2007; Peppard & Breu, 2003). Coevolution literature offers alignment researchers several principles that have the potential to guide alignment actions in organizations (Nassim & Robert, 2010; Zhang, Chen & Lyytinen ,2019). However, the incorporation of these principles in corporate practice is still limited: "What has been ignored is that alignment ultimately has to result from actions on a micro-level of day-to-day operations" (Vermerris, Mocker, & Van Heck, 2014: 630). Coevolutionary alignment principles are valuable as they can inspire and guide organizations, but in order to contribute to alignment, they must be practical enough to be applied to real cases (Zhang et al., 2019). Understanding the process of alignment requires investigating the practices that organizations engage in to align IS with business (El-Masri et al., 2015; Karpowsky & Galliers, 2015).

In literature on alignment, such practices - defined as "what managers and other organizational actors do in their day-to-day activities to achieve alignment" (Karpovsky & Galliers, 2015: 137)

- are consistently conceived of as actions that leverage various factors that contribute to the alignment process (Chan, Sabherwal, & Thatcher, 2006; Teo & Ang, 1999). In spite of the attention that previous literature has paid to these practices, the translation of this knowledge into practical guidance for an effective process of aligning has remained limited. The present study addresses the gap existing between the identification of alignment principles and their operationalization through effective alignment practices by addressing the following research question:

How can coevolution principles be operationalized and successfully applied by organizations to contribute to the process of aligning business and IT?

By answering this question, we extend previous research on alignment and contribute both to theory and to practice. The development of a framework that interconnects principles and practices contributes to filling the gap between theoretical alignment principles and operational practices that exists in literature. By identifying the role and the complementarity of practices in implementing alignment principles, we contribute to reducing the somewhat fragmented character of the alignment literature on practices. Identification of principles and practices and understanding their connection provides operational guidance for organizations to optimally shape the process of aligning business and IT.

The remainder of the paper is organized as follows. Section two provides the theoretical background of the study and highlights the gaps in extant literature concerning the application of alignment studies to practice. Section three provides details of the case study method used in our empirical study. Next, the empirical findings of our study are discussed. Results are organized into four principles and corresponding practices. Prominent quotations and events are presented to support the role of principles and the part that practices play in their implementation. In the final section of this paper, results are discussed and the contribution to theory and practice, as well as the limitations of the study, are highlighted.

2. THEORETICAL BACKGROUND

2.1 Coevolution-based Alignment Principles

The coevolution conceptualization of business-IT alignment is rooted in the idea that organizations are complex socio-technical systems where alignment arises from the ongoing mutual adaptation between different components (social and technical) at different levels of the organization (Benbya & McKelvey, 2006a; Jacucci et al., 2006; Kim & Kaplan, 2006; Lee, Kim, Paulson, & Park, 2008; Merali, 2006; Vessey & Ward, 2013). Even though coevolution theory does not provide a clearly defined set of properties of complex coevolving systems, such systems do exhibit some common characteristics (Merali & McKelvey, 2006):

- Structural and dynamic complexity. Systems that coevolve are composed of several interconnected components, with a variety of interactions between these components (Allen & Varga, 2006; Vessey & Ward, 2013), and thus typically are complex systems (Simon 1962). Structural complexity refers to the arrangement of components in the system (Widjaja & Gregory, 2020), while dynamic complexity is the – often counterintuitive – system behavior that arises from the interactions of the components over time (Sterman, 2001; Widjaja & Gregory, 2020).
- Feedback loops. The mutual interactions between different components are recursive and result in interdependencies and chains of interconnections. Feedback loops are positive when the interactions among the components generate a self-reinforcing chain of actions. They are negative when the actions tend to compensate for each other and stabilize the systems (Merali, 2007; Morel & Ramanujam, 1999).
- Non-linearity. In the interaction between components, the effect of an action is not proportional to the intensity of the action, leading to unanticipated results (Merali, 2007).

- Multi-level effects and emergence. A system's components may interact at different levels of the system. As a result, the system's properties and behavior at higher levels emerge from the interaction between components at lower levels (Benbya & McKelvey, 2006a; Merali, 2007; Morel & Ramanujam, 1999).
- Path dependency. The temporal sequence of interactions among the components that coevolve influences the properties and behavior of the system. In a system that coevolves, the same combinations of actions occurring in a different sequence or distributed in time in a different way can generate different results (Merali, 2007; Sydow, Schreyögg, & Koch, 2009).

These properties of complex coevolving systems can be used to identify specific principles for the process of aligining business and IT. In the IS literature, various coevolution principles have been identified. Benbya and McKelvey (2006b), for instance, propose a set of seven principles for improving the IS development process in organizations: adaptive tension, requisite complexity, change rate, modular design, positive feedback, causal intricacy, and coordination rhythm. Zhang et al. (2019) elicit ten alignment principles that help organizations maintain an evolutionary change rate aligned with the dynamicity of the competitive environment. Vessey and Ward (2013) identify and explore the contribution of three key principles (matching coevolutionary change rates, optimizing self-organization, and synchronizing exploitation and exploration) to achieving a sustainable alignment process. In a study on open source systems, Nassim and Robert (2010) propose three principles (adaptive tensions, change rates, and modular design) to reconcile top-down and bottom-up interactions in the alignment process.

The alignment principles proposed in the literature differ significantly in their scope; that is, in terms of the organizational levels or the alignment dimensions that are considered. For instance, the principle of requisite complexity addresses the technological and the social (organizational) components at different levels, from a single software package to enterprise applications, from

individual departments to different branches and plants of the company. Furthermore, some of the principles investigated in the literature do not exhibit a clear connection with the properties of a coevolution system identified above. We conceive of alignment as a coevolution process that addresses the whole company at the different levels and embraces all dimensions of alignment (from strategic to operational, from structural to social, etc.). Consequently, in our investigation, we selected principles that were clearly connected to coevolution properties and sufficiently extensive in scope, excluding principles addressing one organizational level and/or one single alignment dimension. Table 1 shows the alignment principles that resulted from our analysis of the literature. We provide a description of each principle, how it links to the properties of coevolution systems identified above, and list the studies in which this principle was identified.

Insert Table 1 about Coevolution

Principles for Alignment.

Despite the promise of coevolution principles to guide the alignment process in organizations, their potential has been largely unexploited. Principles are "often used to explain the concept of business IT alignment, but rarely treated as guidelines for controlling alignment in practice" (Zhang et al., 2019: 3). Operationalizations of principles are lacking, and even though the connection between principles and alignment practices has been suggested in the literature (Ciriello et al., 2017; Weeger and Ulrich 2016), few studies explicitly link them (El-Masri et al., 2015). A notable example is represented by the system dynamics models developed by Zhang et al. (2019) to describe how formal control and informal adaptation contribute to alignment implementation. These models incorporate several alignment factors, such as communication, relationships, mutual trust, and learning. However, their applicability to

predicting organizations' behavior and providing suggestions useful for alignment is not developed and corroborated by empirical cases. The models are primarily oriented towards explaining the dynamics of alignment, rather than suggesting how to practically shape the process.

2.2. Alignment Practices

In this paper, we consider practices to be actions performed by organizational actors pursuing alignment and exploiting alignment factors (Karpovsky & Galliers, 2015). Alignment literature has intensively investigated various factors related to business-IT alignment, highlighting their different roles in the alignment process. Factors can be antecedents when their presence is linked to the occurrence of an alignment process (Chan et al., 2006; Preston & Karahanna, 2009). They play a role as pre-conditions if they are mandatory conditions to triggering the alignment process (Reich & Benbasat, 2000). They are enablers or inhibitors if they positively or negatively influence the process outcome (Luftman, Papp, & Brier, 1999). Alignment barriers represent obstacles in the implementation of the process (Alaceva & Rusu, 2015). Based on this, we conceptualize alignment practices as actions aimed at introducing alignment antecedents, preconditions, and enablers, and removing inhibitors and barriers, in order to successfully shape the proces of alignment.

Based on extant literature, organizations can rely on several factors to define alignment practices. For instance, Luftman et al. (1999) identify the following factors as being crucial in aligning IT plans and business plans: senior executive support to IT, the involvement of IT personnel in strategy development, shared domain knowledge between business and IT executives, prioritization of IT projects, and proven leadership of the IT function. In order to impact the social dimension of alignment, organizations can promote shared domain knowledge, develop connections and promote communication between business and IT personnel, and leverage a priori success in IT projects (Reich & Benbasat, 2000). The CEO's

commitment to IT, the level of IT sophistication, and the engagement of external IT expertise are instrumental to aligning IT investments to business strategy and improving corporate performance (Cragg et al., 2002). Additionally, several IT governance practices were found contribute to the alignment process (De Haes & Van Grembergen, 2009; Schlosser, Beimborn & Weitzel, 2015).

Despite an extensive literature investigating the factors influencing alignment, the translation of this knowledge into practical guidance for an effective process of aligning has been hindered by a mechanistic view of the link between factors and alignment (Zhang et al., 2019). The role of different factors in relation to alignment has typically been studied independently, underestimating their mutual influence and complementarity (Baker & Singh, 2019; Karpovsky & Galliers, 2015). Investing in only one alignment practice is not likely to improve business IT alignment (Cumps et al., 2009). The role of time, that is, when and in which order the alignment practices prove effective, has also received only limited attention in the extant literature: "While we did learn from these studies [i.e. prior literature] that certain practices and their complementarity are important for alignment, we did not learn as much about when to apply which practice" (Vermerris et al., 2014: 630). Practices have been studied as isolated actions, and their mutual influences and complementarity during the process of alignment have been under-investigated.

Furthermore, while the practice lens – focusing on what people do – calls for "close empirical observation of how technologies are really used, sensitive to all the adaptations and improvisations of practical life" (Whittington et al., 2014: 88), there is a dearth of in-depth empirical explorations of the alignment process. Our empirical study employed a multiple case study design to further explore the practices that organizations apply in shaping the process of aligning business and IT, and how these practices are related to the coevolution-based principles we identified above.

3. RESEARCH SETTING AND METHODOLOGY

3.1 Research Design

In our study we adopted a longitudinal, multiple-case study design, based on four arguments. First, understanding how coevolution principles can be operationalized by organizations requires an understanding of the mechanisms underpinning the alignment process. A case study is appropriate when "how" questions are investigated, thanks to its capacity to unfold and deepen the mechanisms governing real-life phenomena (Yin, 1994). Second, the literature addressing the application of coevolution-based concepts to organizational practice is still growing and case studies represent a useful technique for exploring and validating emerging concepts (Yin, 1994). Third, case study designs have proven to be a valid approach to investigate the alignment process and have already been applied in other research (Eisenhardt, 1989; Wang et al., 2011). Finally, multiple-case study is useful when research is aimed at understanding how a particular phenomenon varier across different contexts. Cross-case analysis enabled by the study of multiple cases studies provide a more comprehensive understanding of a phenomenon and can help increase the generalizability of the findings (Dubé & Paré, 2003).

3.2 Case Organizations and Data Collection

In line with our research question, the unit of analysis in our case study was the alignment process in organizations. An initial set of 36 organizations was identified by the authors among the firms where they had access to key informants and where relevant secondary sources of information were available. Organizations were contacted for a preliminary collection of data, and cases were selected based on the following criteria: the organization undertook actions aimed at aligning business and IT, evidence of the success or failure of the alignment activities was available, and selected organizations were sufficiently heterogeneous in terms of size,

business model, and industry. Ultimately, five organizations were selected, as shown in Table 2.

In total, 26 interviews were conducted. In addition, the first author of the study directly contributed – as a consultant and as an auditor – to the assessment of the IS and to the execution of the alignment process in Company 1 and Company 2, so additional insights on the alignment processes were available. Company 3, Company 4, and Company 5 all have transparency obligations, so, alongside the interviews, detailed information on financial and operational performance was publicly available. Table 2 provides details of the data sources for the five cases.

Insert Table 2. Case organizations and data sources.

We conducted field research over a period of 30 months from April 2017 to September 2019. Key informants were selected among the corporate C and C-1 executives who contributed to the alignment process. In one case (Company 5) an IT consultant was selected as well, due to his contribution to the definition of the company's IT governance. In some cases, key informants were interviewed twice. For all the organizations, additional information was collected through secondary sources, such as internal documentation, financial reports, proposals received from IT suppliers, and news published in journals and magazines. A semi-structured interview protocol was prepared. Questions covered aspects such as the company's strategy and competitive context, corporate performance (financial and operational), the actors (e.g., managers, key people, stakeholders) involved in alignment actions, the actions implemented and their efficacy, and the variables that influenced the process.

We selected cases that exhibited a sufficiently high variety and 'richness' of case histories, in terms of alignment practices applied by the organizations and organizations' characteristics

(size, business model, and industry). The organizations applied different groups of practices in different periods. This allowed us to observe the effect of different combinations of practices on the alignment process, as well as the way practices mutually influenced one another.

3.3 Data Analysis

Alignment literature provided the key factors that contribute to the alignment process and the corresponding practices for the implementation of the alignment principles. A coding procedure was applied to the data collected from interviews and secondary sources. The codes used reflected the principles, the alignment factors, and their role in and contribution to the alignment process.

During the data collection process, informants were invited to provide a narrative description of the alignment actions undertaken. Following a processual analysis approach (Pettigrew, 1997), data on the actions performed by the organizations, the factors that played a role, and the corresponding contribution to the alignment process were observed. In all cases, data on alignment actions was clearly highlighted by the informants, while the contribution to the alignment process was either directly expressed by the informants or derived from contextual data (e.g., increase in corporate performances, launch of new products; penetration of new geographical markets). For all cases, triangulation of interview data with secondary sources of information was conducted to validate the data collected.

We classified the factors identified and the corresponding practices and linked them to coevolution principles, assessing their contribution to the alignment process. We used a visual mapping strategy (Langley, 1999) in which practices were identified in the organizations' behaviors and connected to principles, and the impact on the alignment process was evaluated.

In our analysis of the contribution of the practices to the alignment process, we adopted a longitudinal approach, i.e. "a repeated observation of the same unit on the *same outcomes* over

a certain amount of *time*" (Kehr & Kovatsch, 2015: 2), where the impact of one practice on the alignment process was observed over time. By comparing the different cases, that applied the same practice, we could identify the contribution of the practice to the process. The evaluation of a positive or negative contribution to alignment was either directly indicated by the informants or derived from key events (e.g., increase in end users' satisfaction, successful launch of a new product line enabled by a revision of the application portfolio, improvement of decision process enabled by availability of data).

In our analysis, we iterated between theory and findings. For instance, the identification of some of the practices applied by the organizations suggested a need for a reinvestigation of the literature to deepen principles. Similarly, to understand which practices were necessary for the operationalization of one particular principle, we clustered practices into groups. In doing so, we returned to literature on coevolution theory in order to identify the appropriate clustering criteria. Once practices were observed in the cases and linked to principles, we carried out a cross-case analysis to compare the contribution practices made to principles in the different cases and under different conditions.

4. FINDINGS

First, we provide a short description of the alignment process for each of the five organizations in our study, to clarify the context of our analysis.

Company 1: After a long period of enterprise software customization, the IS landscape was found to be too rigid to face to the increasing dynamicity of the environment. Therefore, the company invested in a fundamental renovation of the landscape. The involvement of external consultants streamlined the transformation process by clarifying risks of maintaining the existing systems, and by effectively shaping IT governance. Despite initial improvements in alignment, the company tended to maintain the status quo and replicate existing processes in

the new IS. This approach exhibited limitations when the company faced challenges in its increasingly competitive environment (e.g., new competitors). Furthermore, when consultant involvement was gradually reduced, the company failed to keep the alignment process active.

Company 2: In order to compete with large competitors in its extremely dynamic ennvironment, the company focused on product customization and agility. Revision of the IS landscape and the software development process was necessary. The change was supported by external consultants, specialized in Agile, who helped make the new software development procedures part of the company's standard procedures. The revision tackled all phases of corporate activity, from software development to customer management. The contribution that the new way of working made to corporate performance was assessed.

Company 3: The company is part of a dynamic competitive environment. It grew at a national level and developed an IS to match local needs. When it became part of an international group, it had to balance local pressure for customized IS services with the need for standard and compliant systems in all countries. Despite the use of state-of-the-art solutions in the group's companies, limitations in communication and integration were evident. Inter-company committees (e.g., CIO committees) were created to support the IS design and evolution process at the group level and coordinate IS activities in different countries.

Company 4: This company faced an internationalization process, through an M&A, which required the renovation of IS and of organizational procedures. Different systems were created and partially integrated in the different countries. IT governance was defined with diverging procedures and responsibilities in different countries. The company started experiencing IS dissatisfaction from top management and initiated a process to realign business and IT. Renovation of top management (CEO) favored change, while staff resistance and inertia and lack of homogeneous IT governance hindered the transformation.

Company 5: This is a large group of companies in a dynamic environment. To overcome the difficulties of several companies with specific needs and requiring specific individual systems, the group selected state-of-the-art technologies and developed an effective process for managing IS development and maintaining alignment based on a Proof of Concepts (POC) approach. The IS development process was based on IT suppliers at global level for POCs and on a network of regional suppliers for local implementation. This approach guarantees scalability and replicability of the solutions developed through the POCs.

4.1 Principles and Practices

In our analysis of the case studies, we identified 14 alignment practices that contribute to the operationalization of the four coevolution principles identified before. We also observed that the implementation of a principle does not require the application of all practices linked to that principle. For some principles, categories of practices sharing a common contribution to the operationalization of the principles were identified. The operationalization of these principles requires the application of at least one practice per category. Table 3 presents the results of our analysis in terms of coevolution principles, the (categories of) practices and their contribution to the operationalization of the principles.

In the cases, we observed that the presence of practices related to each of the first three principles – adaptive tensions, requisite complexity, and interaction-dominant dynamics – was essential for the alignment process to be initiated and to proceed. The absence or interruption of one of the principles resulted in the interruption of the process. The fourth principle, learning and consolidation, was instrumental to guaranteeing the sustainability of the alignment process. Organizations that applied only the first three principles were successful in shaping their alignment process, but only temporarily. Organizations that fostered a learning process to identify and select the appropriate combination of alignment practices and subsequently

embedded these into their standard procedures kept the alignment process active over time. We will now discuss the practices we found, organized per principle.

Adaptive tensions

In all cases, an alignment process could only be initiated when organizations perceived a business pressure that originated from a disequilibrium between the IS landscape on the one hand, and the business strategy or context on the other. This pressure generated tensions within the organization, for example between departments or between business and IT executives, triggering actions aimed at aligning the different components. Organizations adopted different practices to detect a disequilibrium condition and to raise awareness among staff. We found that two groups of practices were necessary for a successful application of this principle: practices aimed at nurturing inter-organization pressure and practices aimed at nurturing intra-organization tensions.

To foster inter-organization pressure, organizations applied practices such as setting up governance structures involving external experts (e.g., committees combining internal and external experts, supervisory boards), the introduction of external expertise, and initiatives to promote assessment or benchmarking. In Company 1, for instance, an executive committee involving the CEO, CFO, CIO, and external independent auditors was set up and an assessment was performed to compare the IS landscape with competitors. The assessment revealed a potential risk of loss of market share due to an inability to serve customers as quickly as competitors. These actions were instrumental in convincing management of the urgency of change. With regard to the CEO's changing perception of the need to revise the IS (the CEO was initially reluctant to pursue any IT projects), the CIO commented:

> *The day when the results of the study were presented to our executive committee marked the change in the CEO's perception of the urgency of change. Even though, in several*

meetings, I stated the need to invest in renovating our systems, my requests always went unheard. The message coming from external independent experts proved effective.

Table 3. Principles and practices observed in the cases.

Company 4 originated at a local level, with the evolution of the IS following a gradual improvement and customization process to match local needs. Consequently, the IS landscape gradually became obsolete and lost the capacity to respond to new business requirements. When the company became part of an international group composed of subsidiaries in different countries, managers from different subsidiaries exchanged information that revealed misalignments and transformation pressures. In addition, a CEO with international experience was appointed. He described the vision and the transformation pressure he brought to the company:

After several years serving large companies, the company's president invited me to come back as CEO to support the company's transformation from a national player to an international group. I quickly realized that our procedures and technologies were not ready to support us at the international level. A thorough renovation of both our technology and our organizational procedures for managing information systems was required. The first action I undertook was a set of meetings with line managers to motivate the need for change.

In order to transform inter-organizational pressure into intra-organizational transformation tensions, organizations adopted practices such as the establishment of governance structures promoting communication between business and IT (e.g., Board of Directors involving business and IT representatives, liaison roles) or governance processes facilitating

communication between business and IT executives (e.g., joint coordination of IT and business plans, reporting between business and IT, CIO involved in strategic planning, job rotation). In Company 1, the CEO's perception of a gap with the competitive environment was shared during executive board meetings and became a source of internal tension. The CEO described the way he shared his concerns with the line managers:

> *During a management board meeting I acknowledged the business risk connected to our legacy systems. I said that I welcomed the requests from IT that complained about the rigidities of our system and that I sponsored a relevant investment to renew our system. But, at the same event, I told all managers that they now had no excuse not to excel.*

In the same company, due to the complexity of the IS, reports on sales were produced by the IT department via queries on the system. When the system was renovated, an employee from the sales department moved to the IT department temporarily to learn how to perform business intelligence analysis and create customized reports. When the employee returned to the sales department, he started developing queries and reports independently of the IT department. This initiative pushed the sales department to make better use of the IS, and challenged IT to revise its internal procedures. The Head of Sales commented:

> *The IT department has always complained about the complexity of the reports we were asking for. When we became able to develop them independently, our IT colleagues realized that they were losing their role in the organization. They then revised their procedures for providing services to the departments and became much swifter and more responsive to our business requests.*

In order to improve the development process of its IS, Company 5 created an internal committee, including managers from different departments. Confrontation among managers enabled practices that were successfully used in one department to be applied in the IT

department. The head of the purchasing department, who was a member of the committee, commented:

> *The Proof of Concepts approach commonly applied in the identification of technical solutions to produce our products was shared during our meetings, and the contribution to speeding up the production process and reducing time to market was highlighted. The IT department then adopted a similar approach to the design and development of new applications.*

An alignment process could only be initiated when both practices for nurturing inter-organizational pressure and intra-organizational tensions were applied. In Company 1, following the successful implementation of the new IS landscape, the company gradually reduced the involvement of the external consultants who performed the assessment and benchmarking analyses. The lack of comparison with competitors resulted in a diminished internal pressure for change. As a consequence, the IS renovation process to meet the emerging needs expressed by managers and end users suffered delays and never reached mature completion.

Requisite complexity

Our findings show that organizations adopted practices to establish a level of complexity that matched the business context's requirements. An appropriate level of structural complexity was required to realize adequate support for business needs, while meeting requirements in terms of dynamic complexity guaranteed that the organization was capable of swiftly adapting to changing business requirements. Organizations adopted practices such as the modularization of the IT architecture and IT governance, the selection of flexible internal resources (IT components, personnel skills, processes), and the arrangement of a flexible IT ecosystem to improve structural and dynamic complexity.

Modularity provides the possibility to reconfigure a system by adding, changing, and integrating its components without affecting the system as a whole. Modularity can be a design principle for both the IT architecture (loosely coupled components that interact through standard interfaces) and the IT governance structure (decentralized decision-making) (Tiwana and Konsynski 2010). In Company 1, before introducing an up-to-date ERP system, the company's legacy system had been extended and deeply customized for a long time. Peculiarities of the company's processes were coded into the system, which exhibited rigidity and an inability to support new requirements. After the introduction of a modern and modular ERP system, the company experienced a period of improving alignment, and the capacity to support all business needs (structural complexity) and match emerging requirements (dynamic complexity). For instance, when the company introduced a new post-sales department, the department's activities were easily and promptly supported through the introduction of a new module for the ERP. The CIO described the previous system:

> *Our system was stuck in old processes and old technologies. Every time business managers asked us to develop some new functionalities, I had to explain that huge amounts of money and time were needed due to the rigidities of our system. And it wasn't easy for them to understand why a system customized for over 20 years was no longer working.*

Company 3 grew from a national operator in the B2B automotive industry to a global firm, as part of an international group. During the integration, differences emerged between regional IS, which had been developed and selected to match local needs. The company undertook a harmonization process that addressed technology choices and IT governance: branches selected the processes to support, but technology decisions had to be made centrally. The CEO described the new organizational configuration:

Our objective now is to create a system that is modular, with a core at central level and interconnected, standard systems at the local level. Each branch has the right to identify which processes need support, but the technology is decided centrally, and all branches must comply with this choice.

The organizations that were successful in aligning business and IT selected flexible internal resources, either in the IT architecture or in their organizational processes. Company 1, for instance, selected an IS based on up-to-date and customizable technology, which proved to be valuable when the company revised its commercial strategy to focus on new target countries. The need to deal with data and produce documents in a new language could be easily addressed through simple interventions in the software and in the database. The CIO commented on this possibility offered by the new IS:

When previously our sales manager proposed to manage data in non-European languages, we had to explain that this meant that databases had to be fully revised, and interfaces had to be redesigned. In our current system, dealing with the Chinese language required a simple reconfiguration of the database and an easy modification of the software interfaces through an administration tool.

In order to improve its capacity to react to market requests, Company 2 invested in an agile demand management and software development process. The CEO who promoted this choice described the benefits of these new software development procedures:

At a certain point we had many IT projects running, but none completed on time. With an agile approach we can now deliver solutions, or at least prototypes, quickly and match users' requests when they are expressed.

The arrangement of a flexible ecosystem of IT suppliers was instrumental to achieving an appropriate level of structural and dynamic complexity. For example, Company 3 defined IT

implementation policies that guided the selection of the technologies and the development process in a way that would mitigate potential problems in the event that IT suppliers were replaced. The CIO of one of the branches of Company 3 commented on the identification of a local IT supplier:

> *Our group IT gave clear indications of how to select and develop software. They also suggested an IT supplier for the whole group. However, when we deal with local administrative processes, we prefer to rely on a national IT supplier who is more familiar with national administrative regulation and, due to its small size, is nimbler and more reactive to our requests. All branches are following a similar approach, where the corporate supplier takes care of common modules and local suppliers implement vertical modules, and this doesn't prevent the systems being effective, open, and interoperable.*

Interaction-dominant dynamics

Our findings show that organizations that were capable of assessing and monitoring the efficacy of the feedback loops affecting alignment were also capable of revising the chains of interactions, either by removing existing connections or by introducing new connections, ultimately improving the alignment process. In Company 1, for instance, the lack of feedback between the administrative and IT departments was responsible for the reduction of funds for IT investments. During the interviews, the CFO reported the lack of information on how funds were used by IT and the CIO's inability to demonstrate the returns on IT expenses. Consequently, the funds for IT projects were cut, which resulted in deterioration of the IS's performance. During the renovation of the IS, assessment of the connection between CFO and CIO revealed this condition. A business performance scorecard was prepared to identify business priorities expressed by C-level managers, link IT projects to priorities, and assess the contribution of the IS. The introduction of this feedback loop unveiled the business value of the

IS to the administrative department and created a self-reinforcing mechanism that made a positive contribution to the alignment process.

Company 4 has structured IT governance processes, including a defined IT budget formulation plan that entails that IT collects end user requirements and prepares a proposal for IT investments to be submitted for approval to the CEO. The lack of line management involvement in the demand management process resulted in IT investment plans that were focused on solving operational issues, rather than on initiatives relevant for the business as a whole, ultimately increasing the gap between business and IT. An assessment initiated by the recently-appointed CEO unveiled this limitation. A new demand management process was set up involving line managers, enabling the CIO to formulate IT investment plans that were more aligned with business priorities. The CIO commented on the revision of the demand management process:

> *The needs requirements collection process was ineffective. We [the IT department] collected complaints from the end users and the resulting IT plan was no more than a continuous bug-fixing process. Relevant business needs emerged only by chance.*

Fostering learning and consolidation

Organizations that are successful in aligning business and IT select the appropriate degree of complexity and the effective configuration network of feedback loops. Alignment is pursued in a sustainable form when the selection process is carried out promptly and when choices are coded into the standard processes of the organizations. We observed two types of practices that successfully contributed to making the coevolution process sustainable: practices aimed at fostering the learning process and practices aimed at consolidating the choices. Organizations were found to adopt practices such as an agile development process, exploiting Proof of Concepts (POC) approaches, or best practice replication to foster the learning process. Company 5 adopted a POC approach to the identification of IT applications that better matched

business needs. The head of HR described the process that led to the introduction of new software packages to process CVs, replacing activities performed by individuals and streamlining the hiring process:

> *A POC is useful also when it comes to understanding what works. […] One example is the use of automation in CV analysis. We receive 5,000 CVs per year and it's not feasible to read them all. We launched a POC to develop an AI-based solution for classifying CVs and make suggestions to the HR department according to keywords. We tested the software for months and it turned out that the candidates that the software suggested had the same probability of matching our needs as those identified by HR department personnel through manual screening of CVs.*

Company 4 traditionally had a conservative approach to innovation, until the arrival of a new CEO who welcomed innovation based on replication of best practices. The CIO described the case of the selection of a document management system:

> *We are a pharmaceutical company; without a document management system we cannot work. In 2011 I invited IT consultants to carry out an investigation on best solutions adopted in our industry, but the CEO halted the initiative. Now we have a new CEO who's much more open to innovation. We picked up the selection of solutions based on best practices again.*

Once the learning process had delivered positive results, organizations that managed to embed results into standard practice were also successful in keeping the alignment process active. Practices such as coaching or formalization through coded procedures or process manuals were applied.

In Company 2, the lack of experience in the capacity to design and deploy new solutions quickly to keep up with the pace of change in the competitive environment was compensated by the

experience of experts who introduced an agile software development approach. The experts coached the company through a number of projects before it became autonomous and independent.

Identifying effective solutions is not a sufficient condition to maintain a successful alignment process. In Company 1, during the IS renovation project, the company tested formal procedures for demand management and IT projects prioritization with the help of external consultants. These IT governance procedures helped the company maintain a focus on business objectives. However, the new procedures were not coded into corporate practice and did not become part of the company's standard *modus operandi*.

Both Company 4, a pharmaceutical company with strict procedures, and Company 5, a stock-market- listed multinational group with compliant requirements coded the successful governance models once these were identified. The CIO of Company 4 commented on the role of coded procedures:

> *Once management identified a successful governance model, they pushed to formalize it and make it part of our coded processes. We even engaged a consulting firm to provide a formal description of our processes.*

4.2 Complementarity of the Role of Principles in the Alignment Process

The implementation of the principles of adaptive tensions, requisite complexity, and interaction-dominant dynamics through the practices we identified, made a positive contribution to the alignment processes in the cases analyzed. Shortcomings in the application of one principle resulted in the alignment process being unable to start or in the alignment process being interrupted. In Company 3, for instance, during the phase of growth at regional level, the company developed an appropriate degree of structural and dynamic complexity, and connected to an up-to-date ERP system and to skilled personnel. However, the lack of

information on competing companies and of the corresponding business pressure, and therefore the absence of adaptive tensions, inhibited the initiation of the alignment process. It was only once the company became part of an international group that the differences and delay in the IS's development in comparison to sister companies emerged and an alignment process could start.

The application of the fourth principle of learning and consolidation determined the sustainability of the process. Company 1, Company 2, and Company 4 all successfully adopted practices for the implementation of the first three principles and were initially rather successful at aligning business and IT. However, while Company 2 and Company 4 successfully implemented learning and consolidating principles, through coaching from external consultants or through the formalization of processes into manuals, Company 1 failed to maintain the solutions once identified. Despite the evident benefits following the introduction of new operating modalities for business needs identification and IT governance processes, the firm ended the contract with the consultants who had designed the new working procedures, resulting in an interruption of the alignment process. Business needs were not systematically collected and analyzed, leading to ineffective technological choices or delays to the implementation of the necessary solutions.

5. DISCUSSION

In this study, we conceptualize business-IT alignment as a process of coevolution between social and technical components in an organization. We identified four principles of coevolution, and in our empirical analysis found 14 alignment practices through which these principle are operationalized. Principles and practices are positioned in a framework. In order to be triggered, the coevolution process in a company requires adaptive tensions that are created only when the company adopts practices aimed at identifying and sharing a gap existing between the IS landscape and the business contex or between the IS landscape and the planned

strategy (*principle of adaptive tension*). Succesfully shaping the alignment process requires the adoption of an appropriate degree of structural and dynamic complexity to support all business processes in an integrated form and cope with the dynamicity of the competitive environment (*principle of requisite complexity*). The emergent nature of coevolving systems requires that organizations identify and revise feedback loops that exist among the different organizational actors, in order to reinforce or introduce those loops that make a positive contribution to alignment (*principle of interaction-dominant dynamics*). Finally, organizations establish sustainability of the alignment process through a learning process that fosters the identification of the appropriate degree of complexity and of the effective network of connections and through a consolidation activity to incorporate lessons learned into the standard company's processes (*principle of learning and consolidation*).

Our study is positioned in the stream of research that addresses alignment as a coevolution process. The importance of the link between principles and practices lies in the possibility of moving from theoretical coevolution principles to operationalized ones that organizations can apply, and to a better understanding of the relationships between, and complementarities of, alignment practices. These results extend prior alignment literature in several respects and contribute to theory and to practice.

5.1 Theoretical Implications

The present study offers three major contributions to theory. First, the alignment principles suggested in the literature that conceptualizes alignment as a coevolution process have been operationalized through the identification of operational practices. Coevolution principles have been observed in organizations pursuing alignment, and operational practices have been identified and linked to the principles. Our framework connecting principles to practices extends prior alignment literature that lacks an investigation of the operationalization of principles (Zhang et al., 2019; Vermerris et al., 2014) and where the several alignment practices

have been investigated independently, without taking their complementarities into account (Cumps et al., 2009; Karpovsky & Galliers, 2015; Vermerris et al., 2014). The aggregation of practices into principles therefore has the potential to improve their efficacy in contributing to the alignment process.

Second, our findings show the complementarity of alignment practices by identifying complementary principles and categories of practices sharing a common contribution to the implementation of these principles. For example, practices such as the introduction of committees involving external experts, the involvement of novel personnel, and the exposure to external ideas all serve a similar objective: generating an inter-organization pressure. While their joint adoption is likely to increase the inter-organization pressure, in the absence of practices belonging to the complementary cluster of intra-organization tensions the implementation of the principle of adaptive tensions will be inhibited. Similarly, the adoption of practices to implement the principle of adaptive tensions without the implementation of practices to guarantee appropriate structural and dynamic complexity for the company will hinder the execution of the entire alignment process. This contribution extends prior literature on alignment practices that typically addressed these practices independently and under the assumption of a cause-effect relationship with alignment (Baker & Singh, 2019; Chan & Reich, 2007; Cumps et al., 2009; Karpovsky & Galliers, 2015; Weeger & Ulrich, 2016).

Third, the distinction between the role of the principles of adaptive tensions, requisite complexity and interaction-dominant dynamics on the one hand, and the role of the principle of learning and consolidation on the other, contributes to providing a time perspective on the adoption of alignment practices. The role of time, i.e. what actions are required and when, is crucial to the alignment process. The adoption of practices for learning (such as agile development or POCs), and for consolidating (such as coaching or coding procedures), is mandatory for keeping the alignment process active. This suggests that these practices should

follow, in a time perspective, the implementation of practices related to the first three principles. This interpretation of the roles of the principles in the alignment process contributes to extending prior literature that under-investigated the role of timing in the adoption of practices (Boddy & Paton, 2005; Levy, Powell, & Yetton, 2009; Sabherwal et al., 2001; Vermerris et al., 2014) and adds insights to the literature on sustainable alignment (Vessey & Ward, 2013).

5.2 Practical Implications

The list of operational alignment practices and their connections with coevolution principles (Table 3) represents a framework that can support managers in the design of their alignment roadmaps or in the assessment of current alignment initiatives in order to improve their efficacy. For example, a company where business and IT are misaligned in a way that this hinders its competitive position, might define an alignment roadmap that incorporates practices implementing the four principles investigated in our study. The company might then assess the practices implemented and invest in those capable of triggering the alignment process. A company suffering unsatisfactory results in an alignment process might use our list of principles and practices to check for the presence of all the necessary practices.

Although not exhaustive, our list of practices grouped into categories gives organizations the option of optimizing investments in alignment initiatives. Practices belonging to the same category are expected to contribute to the implementation of similar principles. Business executives might, for instance, save funds by not implementing practices belonging to the same category and instead concentrating resources on practices addressing all the principles. Organizations may also choose to cherry-pick the practices that better fit the company's characteristics or that are more easily accessible.

Finally, our study is based on a field analysis. Principles have been derived from literature, but their application and the corresponding operational practices have been observed in an

empirical setting. Even though the case study methodology does not allow for generalization of our findings, our empirical investigation does suggest that these ideas have broader applicability in practice.

5.3 Limitations and Directions for Future Research

Our study suffers several limitations, which also represent opportunities for future research. Our list of principles represents one set of possible principles guiding alignment. Based on the assumption that alignment is a coevolution process that addresses the whole organization and that tackles different alignment dimensions, we selected to investigate principles that incorporated coevolution properties and addressed multiple alignment dimensions. Our research approach, which links practices to principles and investigates the complementarities of principles and practices, could be applied also to principles addressing specific alignment dimensions or touching specific organizational levels.

In our study we witnessed 14 practices, which is a limited number compared to the several alignment factors and practices identified in the literature (Chan & Reich, 2007). Our list of practices is the result of the joint effect of the limited number of cases analyzed, and the identification of the sole practices that operationalized our selected principles. Practices identified in previous literature, such as IT sophistication or IT project prioritization, were not reported - either because they were not found in the cases or because they were applied by organizations but could not be linked to any specific alignment principles. An increase in the number of cases analyzed is likely to increase the number of alignment practices. Furthermore, a more extensive dataset would improve the robustness of the claims regarding the complementarity of principles and practices.

Finally, by interpreting alignment as a coevolution process that incorporates characteristics and properties of complex processes such as non-linearity and emergence, we acknowledge that the

investigation of the topic is complex too. As a result, our study – based on a multiple-case study where practices were recorded and linked to principles – could benefit from novel approaches to investigation, more typical of complex domains, such as system dynamics, system modeling and analysis, and agent-based simulation (Amaral & Uzzi, 2007; Benbya, Nan, Tanriverdi, & Yoo, 2020; Merali & McKelvey, 2006).

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TABLE 1

Coevolution Principles for Alignment

Principle	Description	Coevolution properties	Sources
Adaptive tensions	Disequilibrium beween coevolution system components generates pressures: adaptive tensions. Perceived misalignment between IT and business generates internal adaptive tensions that are translated into alignment actions.	• Feedback loops • Multi-level effect and emergence	Benbya and McKelvey (2006b); Nassim and Robert (2010).
Requisite complexity	To function effectively, a system needs to exhibit the same degree of complexity as its environment. This involves both the structural dimension of the system (number of components and interactions) and the dynamic dimension (rate of change in the system's architecture).	• Structural complexity • Dynamic complexity • Non-linearity	Ashby (1956); Boisot and McKelvey (2010); Benbya and McKelvey (2006b).
Interaction-dominant dynamics	The behavior of a coevolving system emerges from the interaction between its components at different levels. Components interact though chains of connections that generate positive or negative feedback loops.	• Feedback loops • Non-linearity • Multi-level effect and emergence	Benbya and McKelvey (2006b); Nassim and Robert (2010); Vessey and Ward (2013).
Learning and consolidation	To pursue coevolution in a sustainable way, a system has to quickly identify and select the most effective behaviors and consolidate them into its code of conduct. Through coevolution, systems can marshal an extensive set of behaviors. However, despite this potential, systems tend to implement a limited number of behaviors selected from those that proved to be more effective.	• Multi-level effect and emergence • Path dependency	Zhang et al. (2019); Benbya and McKelvey (2006a); Hanseth and Lyytinen (2010).

TABLE 2

Case organizations and data sources

Organization	Interviews	Secondary sources
Company 1: family-owned manufacturing SME producing systems for heating, climate control, and industrial and process applications. €90 million in revenue (2018)	CEO (2 interviews), CIO (2 interviews), Head of Operations Department, Head of R&D Department, Sales Manager.	Internal reports, news available on financial magazines, documents prepared by consulting firms.
Company 2: start-up delivering digital products and services in the health industry €4 million in revenue (2018)	CEO (2 interviews), Head of Sales, R&D Manager, CIO.	Financial documents, magazine news, technical reports.
Company 3: large enterprise, reselling automobile products and spare parts. €350 million in revenue (2018)	CEO, CIO (2 interviews), Sales Manager, COO (2 interviews).	Financial reports, internal technical documents.
Company 4: large pharmaceutical company €700 million in revenue (2018)	CEO, CFO, CIO (2 interviews).	Technical reports, internal technical documents, assessment and audit documents.
Company 5: large manufacturing firm in electronics components for automobile industry. Size: €7 billion in revenue (2018)	Head of Purchase Department, HR Manager, CIO, IT consultant (responsible for IT governance).	Financial reports, internal technical documents.

TABLE 3

Principles and practices observed in the cases

Categories of practices per principle	Alignment practices
Adaptive tensions	
Practices that **nurture inter-organization pressure,** contributing to the identification of a disequilibrium between the IS and the planned business strategy or the requirements posed by the competitive environment.	• Governance structures involving external experts (e.g., committees combining internal and external experts, supervisory boards). • Introduction of external expertise • Initiatives to promote information exchange and comparison with external environment (e.g., assessment activities, benchmarking)
Practices that **nurture intra-organization tensions,** enabling the adaptive tensions to be shared within the organization, in order to trigger alignment actions.	• Governance structures promoting business-IT communication (e.g., Board of Directors with business and IT representatives, liaison roles). • Governance processes promoting business-IT communication and shared domain knowledge (e.g., joint coordination of IT and business plans, job rotation).
Requisite complexity	
Practices that **improve the organization's capacity** to support all business requirements in an integrated way (structural complexity) and to cope with changing requirements (dynamic complexity)	• Modularity of IS architecture and IT governance. • Flexibility of resources (IT components, personnel skills, processes). • Flexibility of the IT ecosystem.
Interaction-dominant dynamics	
Practices that contribute to the **connections among different organizational components** (e.g., business units, IT departments) reinforcing or removing feedback loops influencing organizational behavior and alignment.	• Identification and assessment of efficacy of feedback loops. • Revision of feedback loops (e.g., reinforcement of existing loops, removal or introduction of connections).
Learning and consolidation	
Practices fostering the **learning process** increase the system's capacity to explore different alternatives and identify those better matching alignment.	• Agile development of solutions (e.g. agile software processes, Proof of Concepts (POC), pilots. • Best practice replication.
Practices aimed at **consolidation** allow the system to embed new solutions into its standard code of conduct and standard procedures.	• Coaching, work shadowing. • Formalization (e.g., coded procedures, process manuals.