Aligning through complexity

A co-evolutionary information systems alignment approach to address complex environments in the pursuit of business-IT alignment

Pien Walraven

Open Universiteit

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PREFACE

The title of this dissertation, ***Aligning through complexity,*** represents the content of my research in two important ways. On the one hand, it refers to the continuous efforts to pursue business-IT alignment, ***straight through the complexity*** that many contemporary organizations face nowadays.

On the other hand, it refers to actually ***making use of complexity*** in doing so, through this dissertation's theoretical foundation of complex adaptive systems theory.

However, complexity is not present just in the pursuit of business-IT alignment. Over the course of the past five years, I have learned that complexity is definitely also characteristic of pursuing a PhD. Working straight through this complexity, while making use of it as well as possible, was challenging at times, but a great learning experience overall. I could not have done it without the tremendous support of several people.

I would like to start by thanking my daily supervisor Rogier van de Wetering, for giving me space and trust to carve my own path in this PhD journey, while always being there to guide me in the right direction. I would also like to thank my main supervisor Remko Helms, for his great advice over the course of this trajectory, at times accompanied by a good cup of coffee in Utrecht. Thank you to my supervisor Marjolein Caniëls, for her refreshing perspectives and advice, and for her endless positivity and encouragement. I also thank my supervisor Johan Versendaal for his enthusiasm and ideas, and for welcoming me in the community of (aspiring) PhD students at Utrecht University of Applied Sciences. The discussions there have been inspiring and enlightening. Thank you to everyone involved there, too!

I would like to thank my colleagues at the information science department of the Open University, and Montserrat Pratz López in particular, for her engagement and informal mentoring from the very beginning of my PhD. Thank you to the people of the OU Graduate School and the OU Green Office, for broadening my perspective during my PhD.

I thank everyone who has taken the time to participate in my research. To all the masters' students I supervised in writing their thesis as part of the BPMIT program: you helped me to further shape and refine my research. Thanks!

Of course, I would also like to thank all my friends and family that have supported me through the past few years. In particular, I thank my sister Marit, I could have never done it without you.

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1

INTRODUCTION

1.1 THE CHALLENGE OF BUSINESS-IT ALIGNMENT IN COMPLEX ENVIRONMENTS

The promise of IT-based organizational innovation is a much-researched topic (Brynjolfsson & Hitt, 2000; Devaraj & Kohli, 2003; Jonathan et al., 2020; Vial, 2019). Both practitioners and scholars point towards the potential digital transformation of organizations, for example through recent technological developments like big data, artificial intelligence, internet of things, robotics process automation and blockchain (Vial, 2019). However, making the promise of digital technologies come true is not easy, as several scholars have been underlining in the past few decades (Brynjolfsson, 1993; Henderson & Venkatraman, 1993; Kahre et al., 2017; Luftman & Kempaiah, 2007).

In line with this notion, early research on the actual effects of IT investments on organizational performance has showed mixed results (Brynjolfsson, 1993). Later works have suggested that these mixed results can be explained through the need to put in place adequate organizational complements to leverage IT in practice (Brynjolfsson & Hitt, 2000). For example, organizations need new business processes, skills and capabilities to realize the promise of IT, and to do so strategically (Brynjolfsson & Hitt, 2000; Kahre et al., 2017; van de Wetering & Versendaal, 2021; Vial, 2019).

In line with this potential explanation, many scholars have addressed the challenge of strategically applying IT using a business-IT alignment (BITA) lens (Chan et al., 1997; Gerow et al., 2014; Henderson & Venkatraman, 1993; Leonard & Seddon, 2012; Luftman et al., 1999; Luftman & Brier, 1999). BITA involves *"[…] applying IT in an appropriate and timely way and in harmony with business strategies, goals and needs"* (Luftman & Brier, 1999, p. 109). Several mature frameworks have emerged from this line of research, however since the beginning of the millennium, scholars have started to point out the limitations of existing BITA approaches in complex, turbulent environments (Benbya et al., 2019, 2020; Benbya & McKelvey, 2006b). These complex environments are created by two particular circumstances faced by many contemporary organizations.

Firstly, organizations nowadays face rapid change, not only on a technological level but also in terms of societal and legislative changes (Hafseld et al., 2021; Marschollek & Beck, 2012; Pang et al., 2014). Secondly, organizations are expected to consider the interests of many different internal and external stakeholders who all have their views on how the organization should best benefit from technological developments (Freeman, 2010; Murphy et al., 2017). These stakeholders include for example different types of employees; customers; IT suppliers and governmental institutes (Lapointe et al., 2011).

Given these complex circumstances, the more traditional, widely used, mature BITA frameworks have some important limitations that need to be addressed (Benbya et al., 2020).

1.2 THE LIMITATIONS OF TRADITIONAL BITA APPROACHES IN LIGHT OF COMPLEXITY

It is clear that BITA has been a topic of research for decades now, with some of the most popular frameworks dating from the 1990s (Chan et al., 1997; Henderson & Venkatraman, 1993; Reich & Benbasat, 1996). However, many of these frameworks have two important limitations preventing them from effectively addressing the complex environments many contemporary organizations face.

Firstly, these frameworks do not explicitly consider the plethora of IS stakeholders involved in alignment challenges. Instead, they are often limited to the dichotomy of business on the one hand, and IT on the other hand. In some cases, this dichotomy is further divided into strategic and operational levels (Chan et al., 1997; Henderson & Venkatraman, 1993). In other cases, scholars distinguish between social and intellectual dimensions of alignment (Reich & Benbasat, 1996).

Intellectual alignment in this case refers to the fit between actual business- and IT plans, for example looking into strategic IT orientations that fit particular strategic business orientations (Chan et al., 1997). Social alignment refers to the degree to which there is a common understanding of objectives and plans between business and IT managers (Reich & Benbasat, 1996). Later, scholars recognized the importance of the social dimension of alignment on operational levels as well and incorporated this in their studies. In these efforts, operational social alignment is viewed as a composite of social capital between business and IT personnel (i.e., their interpersonal relations) and

IT personnel's business understanding as the results of this social capital (H.-T. Wagner et al., 2014).

However, the implicit assumption that remained in all these studies is that of the dichotomy of business and IT. Specifically, this dichotomy implies that both business and IT are homogeneous and already have, at least among themselves, a common interpretation and implementation of how IT should be applied in a specific organizational context. Already in 1997, scholars confirmed this limitation and argued that alignment may be pursued more effectively with *"An enlarged notion of alignment within a hybrid network of semi-autonomous actors"* (Ciborra, 1997, p. 79). As later described by Leonard (2008, p. 567):

> "The alignment of an organisation's information systems to its needs should be characterized by identifying the specific groups of people and the specific technologies, involved in any organisational change."

The second important limitation of more traditional approaches to business-IT alignment is their limited ability to effectively address rapid and unpredictable change because of their focus on top-down management. Within these traditional alignment studies, two important schools of thought of approaching BITA can be distinguished, i.e., alignment as an end-state and alignment as a process (Chan & Reich, 2007b).

An often applied line of thought in conceptualizing alignment as an end-state is that of strategic profiles (e.g. Sabherwal and Chan (2001)), where strategic fit of IT is viewed in relation to strategic business profiles including the defender, the analyzer, and the prospector business strategies (Miles et al., 1978). While this way of thinking is useful to reflect at a certain moment in time on the best way to strategize in relation to technology, it is not helpful to sustainably maintain alignment in complex and changing environments. For example, Sabherwal et al. (2001) have shown that the strategic IS profile of an organization evolves and changes over time, and that these changes are rarely intentionally designed by the initiative of top management only. Instead, external pressure (e.g., through legislation or societal developments such as the COVID-19 pandemic) and internal changes (e.g, through personnel changes) are often catalyzers of these changes. This suggests that the quest on how to best organize alignment is not a one-time effort but instead requires continuous attention. Thus, the school of thought that addresses alignment as a continuous process seems more promising to effectively address the alignment challenge in complex environments.

However, the traditional BITA conceptualizations of alignment as a process also assume relative stability and predictability of both strategic and operational organizational levels through their focus on top-down control. For example, Henderson and Venkatraman's well-known strategic alignment model (SAM) (1993) is explicitly positioned as a process-based model.These authors distinguish the business- and IT domains on operational and strategic levels and subsequently identify four ways that the process of pursuing business-IT alignment can manifest (Figure 1.1). The first approach is technology transformation, i.e., initiated from the business strategy, aligning with the IT strategy and then adapting the IT operations accordingly. The second alignment approach identified in SAM is called competitive potential, where IT on a strategic level identifies technological opportunities that then change the business strategy and subsequently the business operations. The third approach is strategy execution, where a clear business strategy is translated to business operations which is subsequently aligned to IT operations. The last alignment approach as part of SAM is called service level, where the IT strategy is executed in IT operations, which then influences business operations.

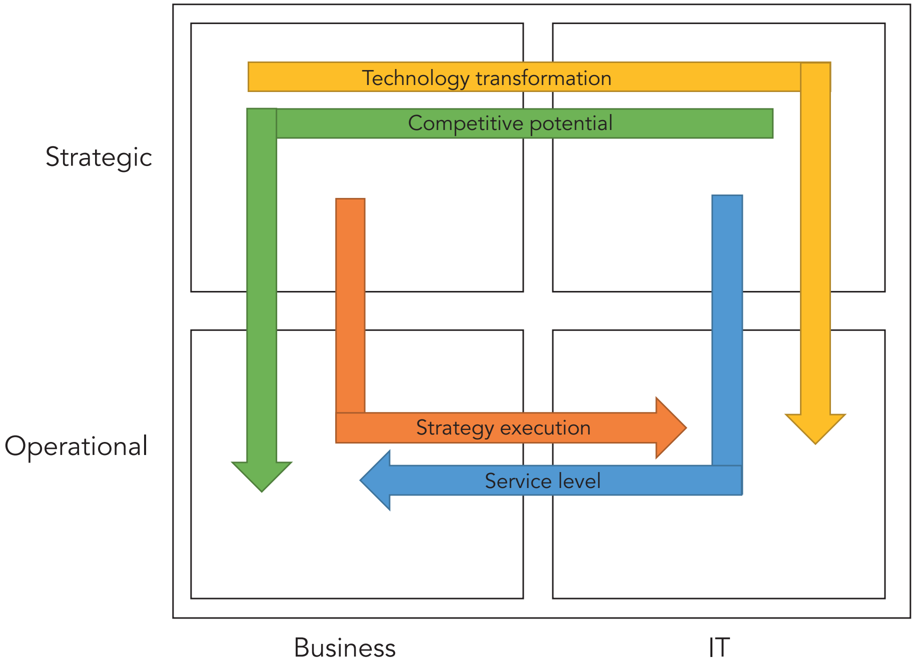


Figure 1.1. Alignment perspectives as part of the Strategic Alignment Model (SAM) (Henderson & Venkatraman, 1993)

Notably, each of these four alignment processes is triggered on the strategic level of either the business or the IT domain, underlining the previously mentioned top-down focus. However, in unpredictable environments, efforts to align IT better to an organization's needs often start on operational levels. Namely, both misalignments and opportunities for improvement are often noticed first on operational levels in conditions of rapid change, leading to emergent strategy and organizational learning (Baker & Singh, 2019; Cunha et al., 2011; Leidner et al., 2017; H.-T. Wagner et al., 2014; Weeger et al., 2015). Hence, while the SAM framework may be useful in moderately dynamic environments in pursuing BITA, in highly turbulent and unpredictable conditions its potential is not as obvious.

1.3 THE PROMISE OF COMPLEXITY SCIENCE-BASED APPROACHES FOR BITA IN COMPLEX ENVIRONMENTS

To address these challenges, several scholars have pointed to the potential of complexity science (Benbya et al., 2020; Merali, 2004; Merali & McKelvey, 2006). Specifically, many refer to the principle of requisite complexity, based on Ashby's law of complexity ("*[…] only variety can destroy variety*") (Ashby, 1956, p. 207). This principle states that "*[…] in order to remain viable, a system needs to generate the same degree of internal complexity as the external complexity it faces in its environment*" (Benbya & McKelvey, 2006b, p. 290). This idea to remain viable in complex environments by adding internal complexity has been adopted by many scholars in management science to improve firm performance in turbulent environments (O'Reilly III & Tushman, 2013). Additionally, IS research recognizes this potential of complexity as well (Benbya et al., 2020; Benbya & McKelvey, 2006a; Merali, 2004; Merali & McKelvey, 2006).

Following this proposition, organizations that are successful in complex, dynamic environments would presumably show characteristics of complex adaptive systems (CAS), a concept originated in complexity science, which can be defined as *"Open, non-linear systems, composed of many (often heterogeneous), partially connected components that interact with each other through a diversity of feedback loops"* (Merali et al., 2012, p. 133).

Anderson (1999) elaborated on the adoption of complexity theory in organization science and identified several characteristics of CAS theory applied to the context of organizations. For example, he explains that CAS consists of many individual agents acting by relatively simple rules in order to achieve their goals. Furthermore, he argues that CAS are self-organizing systems that survive by the input of energy and that they evolve to a dynamic state at the edge of chaos. Onix, Fielt, and Gable (2017b) integrated CAS concepts from Anderson (1999) with those of several other scholars. In doing so, they added emergence, fitness landscapes, dynamism, non-linearity and adaptation to the characterization by Anderson (1999) as being distinctive to CAS theory (Dooley, 1997; Gell-Mann, 1994; Holland, 1995; Morel & Ramanujam, 1999).

Since the beginning of this millennium, the first studies started to appear that applied complexity thinking to the business-IT alignment challenge. Amarilli et al. (2016) performed a literature review on 124 business-IT alignment studies using complexity science as a theoretical lens. These authors distinguish four approaches of using complexity science in business-IT alignment studies, depending on two dimensions including the degree of formalization of complexity methods and tools, and the underlying conceptualization of alignment (table 1.1).

The first dimension considers the degree of formalization, referring to the extent to which *"[…] the structure, characteristics, properties, and behaviour of the Information System viewed as a complex system can be coded through formal descriptions"* (Amarilli et al., 2016, p. 7). An un-codified approach implies a relatively low level of formalization, while a codified approach implies a highly formalized description of system components and -dynamics.

Table 1.1. Approaches to applying complexity science to business-IT alignment (Amarilli et al., 2016)

		Alignment conceptualization	
		State	**Process**
Degree of formalization	Un-codified	Metaphors	Co-evolutionary models
	Codified	Functional complexity models	Complexity dynamics models

The second dimension, i.e., alignment conceptualization, distinguishes two types of alignment conceptualizations, including alignment as a state and alignment as a process. Studies that view alignment as a state aim to measure alignment at a certain point in time, oftentimes in correlation with other variables such as organizational performance (Chan & Reich, 2007b). Studies that view alignment as a process aim to understand the dynamics behind alignment efforts, and how these can be developed and influenced.

The combination of these dimensions leads to four different ways of applying complexity thinking to alignment studies, including (a) metaphors; (b) functional complexity models (within the conceptualization of alignment as a state); (c) complexity dynamics models and (d) co-evolutionary models. (Amarilli et al., 2016).

The first approach, i.e., metaphors, uses concepts and ideas from complexity science to explain practical phenomena and to stimulate a complexity-based way of thinking (Amarilli et al., 2016). The butterfly effect is a good example of such a metaphor: *"The 'butterfly effect' became popular to explain with an effective and intuitive image the problems caused by the sensitivity to initial conditions in a complex system"* (Amarilli et al., 2016, p. 7).

The second approach, which is focused on functional complexity models, is based on a relatively codified degree of formalization and takes the idea of emergence as a starting point. As explained by Amarilli et al. (2016, p. 8): "*In a complex system, the state and properties of higher levels depend on the characteristics of lower levels. These relationships can, in some cases, be expressed through mathematical models, formulated in the form of payoff functions that link specific properties of the whole system to structural characteristics or properties of the components"*. A given example that applies this way of thinking to alignment includes an article that studies the correlation between social alignment (on an individual level) and intellectual and operational alignment (on an organizational level, emerging from the lower-level characteristics of social alignment) (Gerow et al., 2016)

Complexity dynamics models are the third approach of applying complexity science to alignment studies. These models are highly codified and use mathematical descriptions through algorithms to capture and predict the dynamics of a complex system. Agent-based modelling is an important avenue in which these models have been developed, also in the field of business-IT alignment. For example, Zhang et al. (2020, 2021) developed an agent-based model to simulate co-evolution between business and IT, based on rules around communication, knowledge sharing and action reporting and commanding among business and IS agents. However, an important limitation of this work is that there is no explicit attention for the nature of relationships between agents within the organization (e.g., synergistic or conflicting) (Zhang et al., 2020). This limitation is underlined by Kurtz and Snowden (2003), who put forward several limitations of agent-based simulation of human behavior:

Firstly, they argue that humans inherently have multiple roles and thus their identity and hence their behavior cannot be clearly defined and predicted. For example, a person can be a parent, sibling, spouse, friend, or colleague and they may show different behaviors depending on which role they take on. In addition, on a community level a person's behavior may differ depending on the situation: For example, a teacher in a demonstration for better salaries may in that moment in time identify strongly with the community of teachers, but while at work in a meeting, the same person may strongly disagree with their fellow teachers and display completely different behavior towards the community.

Secondly, agent-based models work with the assumption that individual agents act based on their observations in their immediate local environment. For example, a bird within a flock of birds only looks at the birds flying directly around them to decide what to do next. However, this is not necessarily true for human behavior, as explained by Kurz and Snowden (Kurtz & Snowden, 2003, p. 465):

> "People have a high capacity for awareness of large-scale patterns because of their ability to communicate abstract concepts through language, and, more recently, because of the social and technological infrastructure that enables them to respond immediately to events half a world away. This means that to simulate human interaction, all scales of awareness must be considered simultaneously rather than choosing one circle of influence for each agent".

Co-evolutionary models, which are the fourth and last approach as described by Amarilli et al. (2016), are better suited to address these limitations through an un-codified degree of formalization. These models study *"[…] the evolution of a complex system based on the interaction of the constituting elements. Their focus is on the evolution of IS, identifying causes, inhibitors, influencing factors, and rules of interaction"* (Amarilli et al., 2016, p. 8). In this viewpoint, co-evolutionary processes shape alignment over time through coevolutionary principles (Zhang et al., 2021).

This approach is less reductionistic in nature than complexity dynamics models, and focuses on creating the right boundary conditions for a complex system to function optimally (Benbya & McKelvey, 2006b; Mitleton-Kelly, 2003). In doing so, it allows more room for individual and context-dependent characteristics of complex organizations and their constituting actors. Moreover, these models can serve as a useful lens to guide empirical studies. In this effort, they create the potential to further develop and test these models in real-life contexts and to address the earlier mentioned limitations of traditional alignment frameworks: *"Awareness of the mechanisms that govern the relationships between the parameters guides management in the implementation of alignment actions, overcoming a linear and deterministic representation of IS evolution"* (Amarilli et al., 2016, p. 8).

Therefore, the main focus of the application of complexity science in this dissertation will be on co-evolutionary approaches to business-IT alignment. In particular, it will investigate the potential of such an approach for business-IT alignment in complex environments.

1.4 THE CURRENT STATE OF CO-EVOLUTIONARY ALIGNMENT STUDIES

Several studies have applied this co-evolutionary approach to business-IT alignment in the past decade (P. Allen & Varga, 2006; Benbya & McKelvey, 2006b; Vessey & Ward, 2013). For example, the work by Allen and Varga (2006) fits well into this perspective and discusses information systems and their alignment as emergent phenomena resulting from co-evolutionary interactions between individual actors. These scholars start at the microlevel of these individual actors and distinguish between actors' personal ontology, their personal axiology and their personal epistemology. Herein, ontology refers to an individual's personal view of reality, axiology refers to someone's values, interests, aims and goals, and epistemology refers to someone's understanding and knowledge of a certain situation. This latter term of epistemology is viewed as synonymous to information systems (IS), where IS are conceptualized explicitly as broader than just technological information systems. These three aspects of each agent relate to each other differently, as illustrated in figure 1.2.

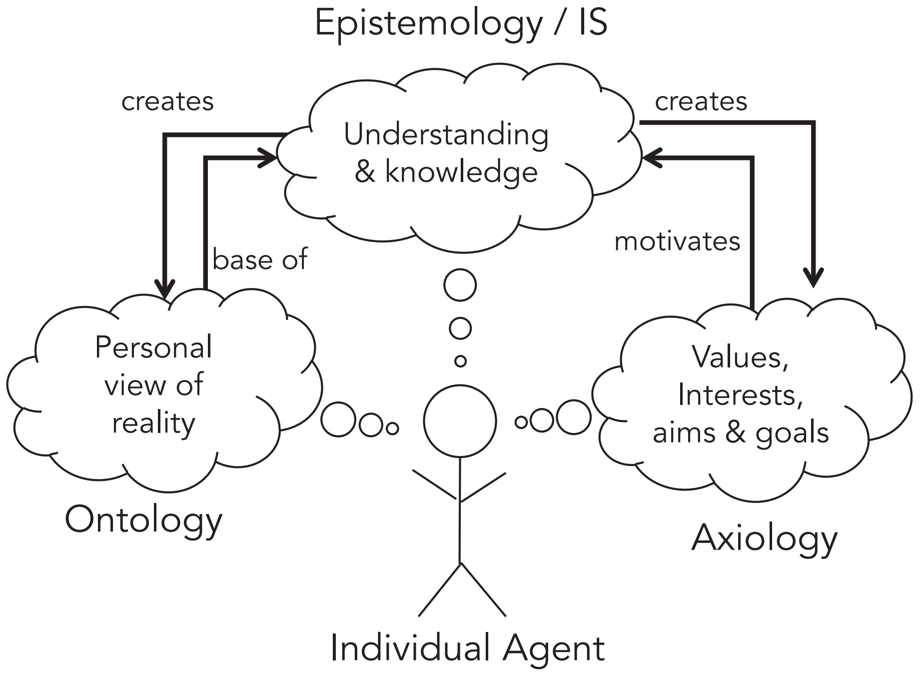


Figure 1.2. Ontology, axiology and epistemology in individual agents (based on Allen and Varga (2006))

Allen and Varga (2006) then argue that information systems evolve co-evolutionarily through interactions between different individual agents, as illustrated in figure 1.3. Finally, IT systems, which should be aligned with organizations' strategies, goals and needs from the perspective of business-IT alignment, play a particular role in this co-evolutionary whole of interactions that is the organization according to these authors:

"[…] IT systems represent a consolidated sub-set of agents' ontologies. IT systems consist of those items that organizational agents agree exist in reality and are necessary for the completion of organizational tasks. IT systems represent emergence at the organizational, macro-level. As agents' ontologies evolve, upgrades and revisions of IT systems follow". (P. Allen & Varga, 2006, p. 233).

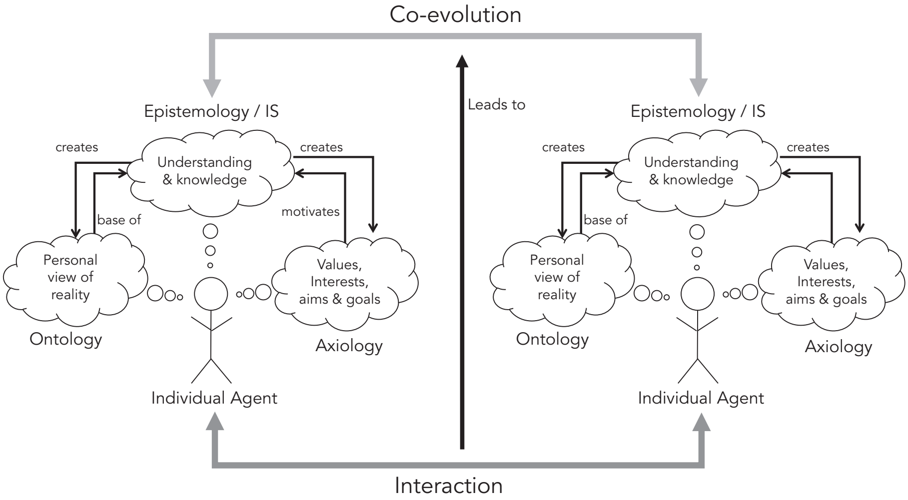


Figure 1.3. Co-evolutionary interactions between individual agents (based on Allen and Varga (2006))

This co-evolutionary view on information systems is a promising avenue for the challenge of business-IT alignment in complex environments. Namely, it resonates very well with the challenge of multiple stakeholders and goals in complex organizations. It also transcends the idea that top-down management is the only way to organize alignment: Namely, to align IT systems to the organization as a whole, ontologies, axiologies and epistemologies of *all* stakeholders of information systems, and their co-evolution, must be considered.

However, although promising, the IS conceptualization of Allen and Varga (2006) is still limited in several ways. Firstly, it views IT systems almost as a mere repository of structured information that agents agree on are existing and relevant. However, contemporary systems have much more advanced opportunities and functionalities that should be considered in answering the question how to *"[…] apply IT in an appropriate and timely way, in harmony with business strategies, goals and needs"*. It is not only about the information itself, but also about what to do with the information stored in these IT systems. For example, ethical considerations are not addressed by Allen and Varga (2006) in their work but are in fact proven to be very important (Mingers & Walsham, 2010).

Related to this first limitation, another issue is that these authors do not make the explicit link between IT systems on the one hand and organizational goals and strategies on the other hand. While from a complex systems perspective, these organizational strategies in themselves are co-evolutionarily developed and emergent in nature, from the perspective of business-IT alignment it is relevant to take them into account more explicitly (Luftman & Kempaiah, 2007). After all, the challenge is to pursue information systems in such a way that they are applied appropriately, in line with an organization's strategies, goals and needs.

Several authors worked towards this goal using co-evolutiory thinking as a theoretical foundation. One of the first of these works was by Benyba and McKelvey (2006b). These authors take a co-evolutionary viewpoint and conceptualize business-IT alignment as *"[…] a continuous coevolutionary process that reconciles top-down 'rational designs' and bottom-up 'emergent processes' of consciously and coherently interrelating all components of the Business/IS relationship at three levels of analysis (strategic, operational and individual) in order to contribute to an organization's performance over time"* (Benbya & McKelvey, 2006b, p. 284). Hence, they take a holistic, multi-level view on alignment and move beyond the dominant idea of top-down approaches of alignment, while explicitly addressing the organizational perspective. However, their work remains conceptual and does not provide operationalizable ways to assess co-evolutionary alignment and it, again, focuses mainly on the dichotomy of business and IT.

Vessey and Ward (2013) add to these two works by specifically addressing the role of management in CAS-based co-evolutionary alignment, recognizing the importance of both bottom-up and top-down processes in aligning information systems in organizational contexts. Their main argument is that organizations can never be fully considered as CAS,as they describe organizations to be inherently bureaucratic. In other words, they argue that no actor within an organizational context is able to act purely based on their perceptions of the environment. These authors define alignment as follows: *"an organization and its IS are aligned when the organization's IS support the organization's goals. Hence, an organization's IS need to adapt over time to remain in alignment with the constantly-changing (evolving) organizational goals"* (Vessey & Ward, 2013, p. 288). Following, they propose that sustainable IS alignment requires three types of IS management, including adaptive IS management; enabling IS management and administrative IS management, underlining the balance between CAS dynamics and bureaucracy and control. They then go on to conceptually discuss the application of these management types in the context of IT implementation and Enterprise Architecture management, thus considering a fairly holistic view of alignment. However, their ideas still remain conceptual and not empirically validated. Moreover, while these authors do not consider business and IT as a dichotomy per se, the role of different stakeholders and their alignment is not explicitly taken into account.

Amarilli et al. (2017) also take a co-evolutionary approach to alignment. These authors go a little bit beyond the dichotomy of business and IT through the distinction of the business (*"the products and services realized and the business model of the company"* (Amarilli et al., 2017, p. 7)), the employees within the organization and the IT systems themselves. They then distinguish four alignment mechanisms and three types of influencing factors and demonstrate them through an empirical study among two private sector companies. The alignment mechanisms include (a) Business influence on the organization; (b) Transformation of business needs into IT projects and implementation; (c) Adjustments in the organization and (d) Transformation in the business. The influencing factors include enablers, dynamic actors and controlling parameters. While more concrete and applicable in empirical settings, this conceptualization of co-evolutionary alignment is still limited in its ability to address pluralistic organizations consisting of many different stakeholders. Namely, it combines products and services with a business model at the heart of co-evolutionary interactions. However, in contemporary organizations facing complex environments, business models represent only in part the complex decision-making around IT. For example, in public organizations where complex environments are omnipresent, stakeholder values play a much more prominent part.

Summarizing, although existing works on co-evolutionary alignment add to the knowledge base of the potential value of a co-evolutionary notion of business-IT alignment, none of them manages to cover all aspects needed to effectively address environmental complexity in the challenge to apply IT in an appropriate and timely way, in harmony with strategies, goals and needs of the organization. Namely, they either focus on a specific level of alignment (e.g., strategic alignment), they do not consider the breadth of involved stakeholders by sticking to the business-IT dichotomy, or they are very theoretical in nature and do not provide practitioners with concrete tools to address alignment in complex environments. In conclusion, the necessary characteristics that address these limitations and that should enable an effective co-evolutionary conceptualization of alignment are threefold:

1. Conceptualize alignment holistically in organizational settings, beyond top-down approaches, with individual interactions among diverse actors as its microfoundations.
2. Account for different, possibly conflicting stakeholder perspectives on alignment, broader than just the business-IT dichotomy
3. Provide an instrument to assess the new co-evolutionary alignment conceptualization in organizations in practice

1.5 SCOPE OF THIS RESEARCH

As described, there are a number of studies that focus on co-evolutionary, CAS-based conceptualizations of business-IT alignment. To date, none of these studies manages to take a holistic view on alignment, while accounting for the many different stakeholders within and around the organization, and providing organizations in practice with tools to better deal with complex environments. However, despite these limitations of existing co-evolutionary alignment approaches, the literature on complexity science in information systems still suggests that a co-evolutionary perspective on alignment does in fact have the potential to effectively address complex environments (Benbya et al., 2020; Zhang, Chen, Lyytinen, et al., 2019). Hence, the focus of this dissertation will be to further explore this research challenge.

In line with the abovedescribed aim, this dissertation aims to answer the following main research question:

What is the potential of a co-evolutionary approach to business-IT alignment for organizations to address complex environments?

1.5.1 Three steps towards the potential of a co-evolutionary approach to business-IT alignment

This dissertation is divided into three parts, each answering a corresponding sub research question that contributes to answering the main research question.

Part 1: Exploring the key components of COISA

The first part of this dissertation explores the key components of co-evolutionary information systems alignment (COISA). In doing so, this first part addresses the limitations of existing approaches as best as possible by using a holistic approach and acknowledging that COISA's microfoundations comprise individual interactions among heterogeneous actors. The corresponding first sub-research question is:

> **RQ1.** What are the key components of COISA?

Part 2: Measuring and shaping COISA as an organizational capability
The second part of this dissertation investigates the practical assessment and application of the COISA components developed in part 1, synthesizing them in terms of COISA as an organizational capability. Thereby, the theoretical nature of existing works on co-evolutionary approaches to business-IT alignment is addressed and practitioners are provided with concrete tools to build a COISA capability in their organization. This is done from a cross-sectional perspective to give organizations insight into their current state in COISA. Furthermore, specific attention is paid to shaping the COISA capability's evolution over time. Namely, one of the implications of complexity for IS research is the need for specific attention to evolution over time:
"In making claims to new knowledge in studies of complex sociotechnical systems, IS researchers should report how frequently the system might be going through state changes and how durable the newly discovered knowledge might be." (Benbya et al., 2020, p. 8).

The corresponding second research question is:

> **RQ2.** How can COISA be assessed cross-sectionally and shaped over time as an organizational capability?

Part 3: The value of a COISA capability in addressing complex environments
The third and last part of this dissertation focuses on assessment of the value of the newly developed conceptualization in addressing complex environments. After all, this is what eventually defines the true potential of a co-evolutionary approach to business-IT alignment. In particular, this last part assesses the correlation between the COISA capability and an organization's capability to deal with complex environments. The latter is conceptualized in terms of dynamic capabilities, i.e., an organization's capacity to (1) sense and shape opportunities and threats; (2) seize opportunities and (3) enhance, combine, protect and reconfigure a firm's assets to remain successful in highly turbulent environments (Teece, 2007). This theoretical lens is fitting because dynamic capabilities look at patterns instead of events, thereby addressing the implication of complexity for IS research in terms of predicting behavior of complex systems (Benbya et al., 2020, p. 8):

"Prediction efforts of IS research should focus not on the ability to foresee specific, well-defined system events in space and time (i.e., paths), but on the ability to anticipate the range of possible behaviors the system might adopt (i.e., patterns)".

Furthermore, dynamic capabilities on the organizational level should manifest at a higher level than co-evolutionary alignment activities. Therefore, this relationship fits into the functional complexity model approach. This approach was described as one of the ways to apply complexity science to the business-IT alignment challenge by Amarilli et al. (2016), hence, it provides a suitable approach to address this problem from a theoretically consistent perspective.

In addition to just looking into the relationship between COISA and dynamic capabilities, this last part gives insight in the particular configurations of COISA elements that are sufficient or even necessary to effectively address complex environments. In doing so, it considers the implications of complexity for IS research related to the nature of causality in complex systems (Benbya et al., 2020). Specifically, by looking into configurations of elements, this third part regards the features of conjunction, i.e. *"[…] outcomes rarely have a single cause but rather result from the interdependence of multiple conditions"* (Benbya et al., 2020, p. 8) and equifinality, i.e. *"[…] more than one pathway from an input to an outcome"* (Benbya et al., 2020, p. 8). The corresponding third research question is:

> **RQ3.** How and to what degree does a COISA capability help organizations to address complex environments?

1.5.2 Empirical context: Electronic Medical Records in hospitals

As explained in the introduction, the complex environments mentioned in the main research question refer to the combination of quickly changing environments, and many different stakeholder perspectives. An exemplary context where these complex environments prevail is that of Electronic Medical Records (EMR) implementations and -operations in hospitals, which will therefore be the main context for the empirical studies presented as part of this dissertation.

EMR traditionally consist of patient records, kept over time (Kohli & Tan, 2016). However, more advanced EMR systems that have been implemented in the past decade also include many additional functionalities including for example information integration across and outside the hospital, the availability of patient portals and the support for complex medical- and research processes (van Eekeren & Polman, 2016). This makes that an increasing number of stakeholders is involved in these EMR.

In addition, hospitals face quickly changing, sometimes difficult to predict, environments. These environments consider organizational and societal levels, e.g., changing legislations such as GDPR, the aging society, and the recent COVID-19 pandemic (Mohrman & Shani, 2014; Sutherland et al., 2020). Moreover, this unpredictability is also visible on operational levels, with patients having concurrent, interacting illnesses, with some patient groups expecting the same digital services as in the private sector (van der Vaart et al., 2022), and with personnel shortages forcing healthcare professionals to take care of more patients with less time (Rao & Singh, 2021). Hence, EMR alignment, i.e., working towards a common interpretation and implementation, across stakeholder groups, of what it means to apply EMR appropriately, is very challenging.

1.6 RESEARCH METHODOLOGY

This section describes the research methodologies applied in each of the three parts of this dissertation. Overall, the dissertation applies a multi-MAP (methods, approaches, perspectives) approach (Levallet et al., 2020). This is suiting because of the breadth of this dissertation's research scope and the corresponding research questions. Namely, each of the three sub research questions can best be answered using different methodologies, perspectives and corresponding analytical approaches (table 1.2).

Furthermore, through the complementarity of the chosen methods and analytical approaches, a more comprehensive answer can finally be formulated on the main research question (Levallet et al., 2020). The remainder of this paragraph will further elaborate on the specific decisions made for the research as part of this dissertation, for each sub research question.

1.6.1 Research question 1: What are the key components of COISA?

To answer the first research question, existing theoretical insights are combined with new empirical data in the context of hospital EMR.

Table 1.2. Methods used in this dissertation to answer this dissertation's research questions

Methodological approaches / activities	Research question / Applied methods / tools	RQ1	RQ2	RQ3
Systematic Literature Review	Search protocol through keywords and selection criteria	■		
Multiple case study	Literature review	■		
	Semi-structured interviews	■		
	Desk research	■		
Expert focus groups	Literature review	■		
	Focus group protocols	■		
Scale development for COISA measurement	Literature review		■	
	Card sorting		■	
	Expert survey		■	
Longitudinal multiple case study	Literature review		■	
	Semi-structured interviews		■	
	Desk research		■	
Cross-sectional surveys	Literature review			■
	Survey analyzed using partial least squares structural equation modeling (PLS-SEM)			■
	Survey analyzed using necessary condition analysis (NCA)			■
	Survey analyzed using fuzzy set qualitative comparative analysis (FsQCA)			■

In doing so, a systematic literature review was first conducted on co-evolutionary approaches to business-IT alignment, following the approach by Okoli and Schabram (2010). Specifically, this study focused on the business processes in which co-evolutionary alignment activities occur, as a first step to make the COISA conceptualization more practically applicable. This resulted in a conceptual model including the specific business processes that can be empirically assessed when studying co-evolutionary alignment in practice.

Next, a multiple case study was conducted, in three Dutch hospitals that implemented an EMR, to empirically validate and refine the SLR findings. In doing so, semi-structured interviews and document analyses were conducted in line with the recommendations by Yin (2018). Furthermore, the cases were selected based on literal replications, meaning that all cases have comparable outcomes. In this particular study, each hospital's EMR implementation was successful in terms of planning, scope and costs. The outcomes of this multiple case study confirm the manifestation of co-evolutionary interactions among stakeholders within the alignment processes as identified in the SLR, although in different degrees for each hospital and each alignment process.

However, manifestation of co-evolutionary interactions in alignment processes is no guarantee for the efficacy of these interactions in their pursuit of alignment. Therefore, another study was done, focusing on the facilitators of efficacious COISA interactions. This study was conducted using a single case study on another EMR implementation, combined with expert focus groups with experienced EMR consultants. The single case study consisted of semi-structured interviews following the recommendations by Yin (2018). For the focus groups, theoretically informed focus group protocols were developed based on several key works on this topic (Merton et al., 1990; Morgan, 1996; Stewart & Shamdasani, 2014). This study resulted in four categories of alignment facilitators for efficacious co-evolutionary interactions in alignment processes.

1.6.2 Research question 2: How can COISA be assessed cross-sectionally and shaped over time as an organizational capability?

The second research question can be divided into two perspectives, i.e., measuring the current state of the COISA components within an organization (from a cross-sectional viewpoint), and shaping COISA over time (from a longitudinal viewpoint). To capture both perspectives, corresponding research methodologies were selected.

To enable cross-sectional assessment of COISA, a study was done following the specific steps for scale development as recommended by MacKenzie et al. (2011). As part of these steps, insights from the studies as part of the first research question were synthesized with additional literature to come to an initial set of constructs and corresponding survey items. Then, those items were assessed and further developed using a three-staged approach including a combination of two card sorting sessions with experts (Moore & Benbasat, 1991) and a content validation survey among experts based on the recommendations by Schriesheim et al. (1999a). This resulted in a renewed conceptualization viewing COISA as an organizational capability consisting of alignment competencies (based on alignment processes) on the one hand and alignment facilitators on the other hand. This conceptualization was then explicated in a content validated survey instrument suitable for cross-sectional assessment.

To look into the shaping of the evolution of this COISA capability over time, a longitudinal multiple case study was performed in three hospitals that each recently implemented an EMR. In this effort, semi-structured interviews were conducted and the evolution of the COISA capability in each of the three case hospitals was studied during the implementation phase of the EMR and after go-live of the system. This approach is in line with the before-and-after logic for longitudinal research (Yin, 2018), where data collection is done in two phases. The first phase occurs before a critical event and the second one after a critical event. In this study, this critical event entails the go-live of the EMR. To get more insight into how to shape this evolution, the evolution's drivers were also studied. These efforts resulted in several evolutionary paths in which the COISA capability may evolve over time and a set of categories of drivers of these evolutionary paths.

1.6.3 Research question 3: How and to what degree does a COISA capability help organizations to address complex environments?

This third and last research question is best answered using a quantitative method, with its focus on assessing hypotheses about the relationship between COISA and organizations' dynamic capabilities (Edmondson & McManus, 2007). Furthermore, this third research question aimed to assess external validity of the empirical findings from the hospital EMR context to other organizations facing complex conditions. However, the research question does imply multiple perspectives and corresponding analytical approaches (Levallet et al., 2020). Namely, it firstly refers to a variance-based perspective based on correlation between variables (in this case, COISA and dynamic capabilities). However, the *how* part of this question also implies a more configurational perspective, looking into which particular configurations of COISA elements may be effective in creating organizational dynamic capabilities. Therefore, two surveys were conducted using a combination of analytical approaches to answer both perspectives implied in this research question.

The first survey was conducted in the Dutch healthcare sector among 95 healthcare organizations and used a combination of Partial Least Squares Structural Equation Modelling (PLS-SEM) (Hair et al., 2016) and Necessary Condition Analysis (NCA) (Dul, 2019) analysis approaches. The second survey was a broader survey in the Dutch public sector, filled in by 210 strategic or tactical IT decision-makers in public sector organizations. In this case, Fuzzy set Qualitative Comparative Analysis (FsQCA) (Ragin, 2009; Vis & Dul, 2018) was added to the applied analysis approaches, making it possible to draw conclusions on the different configurations of COISA elements that help in addressing complexity.

This resulted in a demonstration of the value of COISA using empirical data, and in several configurations in which the different alignment competencies may improve an organization's dynamic capabilities.

1.7 DISSERTATION OUTLINE

The outline of this dissertation corresponds with the three parts presented as the scope of this research (figure 1.4).

The first part of this dissertation covers chapters 2-4.

Chapter 2 discusses the systematic literature review uncovering the practical contexts in which co-evolutionary interactions towards alignment manifest. This research is published as a full research paper in the proceedings of the Mediterranean Conference on Information Systems 2018.

Chapter 3 empirically validates and refines the outcomes of the SLR through a multiple case study covering three EMR implementations in Dutch hospitals. This research is published as a full research paper in the proceedings of the European Conference on Information Systems 2019.

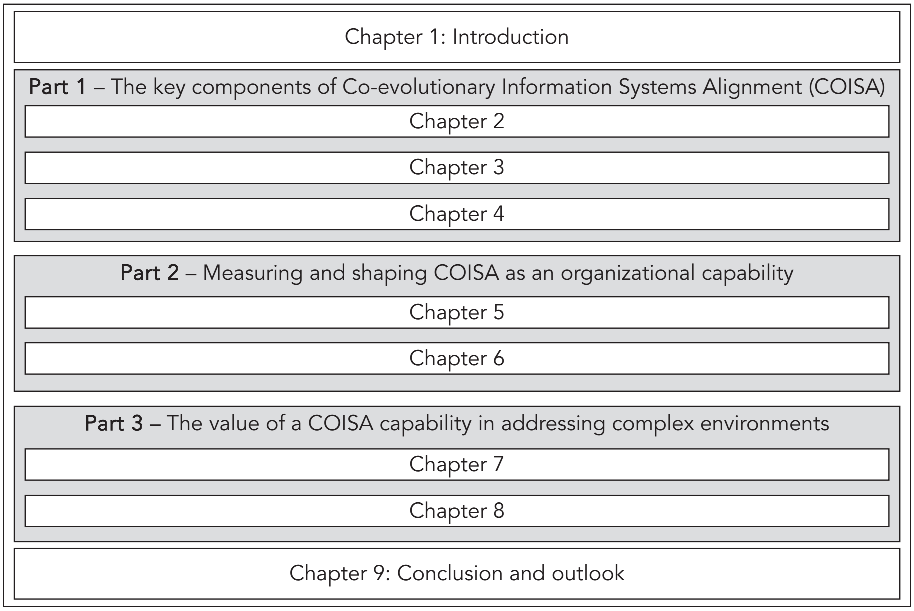


Figure 1.4. Dissertation outline

Chapter 4 dives deeper into the facilitators that are needed to make the co-evolutionary interactions towards alignment efficacious in nature, i.e., to ensure as well as possible that they work *towards* alignment and not away from it. This research is published as a full research paper in the proceedings of the European Conference on Information Systems 2020.

The second part of this dissertation covers chapters 5 and 6.
Chapter 5 covers the development of a survey instrument to assess COISA cross-sectionally. This research is published as a full research paper in the proceedings of the Hawaiian International Conference on System Sciences 2021.

Chapter 6 focuses on the ways that the COISA capability itself evolves over time and on the drivers behind these evolutionary paths. Specifically, three EMR implementations are assessed, comparing the COISA capability evolution before- and after go-live. This research is published in the Journal of Health Organization and Management.

The third part of this dissertation covers chapters 7 and 8.

Chapter 7 investigates the correlation between COISA, dynamic capabilities and organizational performance in the Dutch healthcare sector. This research is published as a full research paper in the proceedings of the European Conference on Information Systems 2022.

Chapter 8 further broadens the research context, looking into the correlation between COISA, dynamic capabilities and organizational performance in the Dutch public sector as a whole. Furthermore, chapter 8 also takes on a configurational perspective looking into the different configurations of COISA elements that may be effective in addressing public sector complexity. This research is submitted as a full research paper to an academic journal.

INTRODUCTION

1

PART 1

EXPLORING THE KEY COMPONENTS OF CO-EVOLUTIONARY INFORMATION SYSTEMS ALIGNMENT

2

CO-EVOLUTIONARY IS-ALIGNMENT: A COMPLEX ADAPTIVE SYSTEMS PERSPECTIVE

The results presented in this chapter have been published as a full research paper in the proceedings of the Mediterranean Conference on Information Systems 2018.

ABSTRACT

Many studies have investigated the effects of information technology (IT) in achieving organizational performance. However, despite substantial IT investments, organizations often fail to improve organizational performance using IT. This failure could be the result of a lack of Business-IT alignment. Recently, scholars and practitioners have adopted a complexity science approach to better address the many interwoven IT, organizational and environmental turbulence challenges. These efforts resulted in the emergence of the complexity-based concept of co-evolutionary IS/IT-alignment (COISA). COISA involves "the series of coevolutionary moves that makes IT aligned over time." However, the notion of COISA remains conceptual, and further operationalization in preparation for more empirical evidence seems appropriate. Therefore, this study aims to provide further clarification on the conceptualization of COISA in turbulent environments. We conducted a structured literature review using a theoretical foundation of Complex Adaptive Systems theory. In this effort, we developed a COISA model composed of five continuous alignment processes characterized by co-evolutionary moves toward alignment, situated in two organizational contexts. This model provides a basis for further empirical research on COISA.

Keywords: Business-IT alignment; Complex Adaptive Systems; Co-evolutionary IS-alignment; Alignment processes

2.1 INTRODUCTION

Many scholars have argued that investments in information technology (IT), along with structural adoption and use, can lead to multi-factorial advantages for organizations (Gerow et al., 2014; van de Wetering, Mikalef, et al., 2018) These benefits include for example more efficient processes, reduction of costs, better deals with business partners, advanced creativity and ideation processes, and augmented reputation (Devaraj & Kohli, 2003; Kearns & Lederer, 2003; Mûller & Ulrich, 2013). Therefore, organizations invest large proportions of their budgets on IT, aiming to improve their overall performance. Despite these substantial investments, organizations in practice often fail to enhance organizational performance using IT. In general, this 'productivity paradox' has been argued to be caused by the lack of fit or alignment between business strategy and internal resources including IT (Brynjolfsson & Hitt, 2000), in other words, the lack of Business-IT alignment (BITA). BITA aims to apply IT in an appropriate and timely way, in harmony with business strategies, goals, and needs (Luftman & Kempaiah, 2007) and has been a significant concern for business executives and IT practitioners for decades (Kahre et al., 2017).

Scholars have investigated BITA for decades, because of its relevance. In their extensive literature research in this field, Chan and Reich (2007a) underline the distinction between two different overarching perspectives on alignment. Namely, on the one hand, there is the perspective of alignment as a process *"[…] which requires specific IT management capabilities, encompasses specific actions and reactions and has discernable patterns over time"* (Chan & Reich, 2007b, p. 310). On the other hand, there is the perspective of alignment as a goal or an end state, *"[…] which focuses on the antecedents, measures, and outcomes of alignment"* (Chan & Reich, 2007b, p. 310). However, recent literature points out that existing IS theories, including those addressing BITA, do not sufficiently account for the environmental turbulence and organizational complexity faced by contemporary organizations (Merali et al., 2012; Merali & McKelvey, 2006). These challenges are driven by for example increasing customer demands, changing collaborations and technological development itself (Jansen et al., 2006).

To better address the organizational challenge of environmental turbulence, scholars increasingly adopt complexity theory and related complex adaptive systems (CAS) principles (Merali et al., 2012; Onix et al., 2017a). They do so because complexity theory is often pointed out to provide potential solutions to the organizational challenges of complex, highly dynamic environments. For example, Benbya and McKelvey (2006b, p. 290) formulate the law of requisite complexity: *"[…] in order to remain viable, a system needs to generate the same degree of internal complexity as the external complexity it faces in its environment"*, which was based on Ashby's law of requisite variety: "*[…] only variety can destroy variety*" (Ashby, 1956, p. 207). By these principles, contemporary organizations should exhibit complex characteristics to remain successful in turbulent environments. Herein, maintaining critical complexity is essential, i.e., between the edge of catastrophe (leading to a deterministic system) and the edge of chaos (leading to a chaotic system) (McKelvey, 2002).

By these recent developments, the IS community, too, adopts and uses complexity- and CAS principles as a basis for better suited BITA theories (Merali et al., 2012; Onix et al., 2017a). These efforts resulted among others in the emergence of the CAS-based concept of co-evolutionary IS/IT-alignment (COISA) (Amarilli et al., 2017; Benbya & McKelvey, 2006b), or the *"[…] series of co-evolutionary moves that makes IS aligned over time"* (Benbya & McKelvey, 2006b, p. 288), emphasizing a two-way evolution of both business and IT domains. Indeed, this view subscribes to the view of alignment as a process as opposed to an end-state. However, the concept of COISA remains vague: Specifically, the unique business processes that incorporate these co-evolutionary moves toward alignment have been left implicit until now. For example, the model by Benbya and McKelvey (2006b) distinguishes strategic, operational and individual alignment, while emphasizing co-evolution between business and IT domains taking place. However, these scholars did not explicitly specify the business processes where these dynamics manifest in practice. Moreover, CAS-inspired case studies of alignment (e.g., Amarilli et al. (2017), Montealegre et al., (2014)) naturally study one or more business processes in practice as their unit(s) of analysis to understand the phenomenon of alignment. However, none of these studies *explicitly* identifies these processes as alignment processes or takes a holistic account of *all* processes that play a role in COISA. In other words, the knowledge we are looking for is available in the existing literature. However, it is left implicit. The lack of an explicit connection between business processes in practice and the notion of alignment as a process makes it difficult to assess COISA empirically, in a holistic fashion. Further operationalization in preparation for more empirical evidence thus seems appropriate.

This current study thus aims to provide further clarification on the conceptualization of COISA for organizations in turbulent environments, drawing from existing CAS-inspired alignment research using a structured literature review (SLR). Given the law of requisite complexity, we argue that taking a CAS perspective on organizations is a promising avenue to better understand and address alignment in turbulent environments. Specifically, we identify business processes in which co-evolutionary alignment activities take place, developing a solid basis for empirical research in this area. In other words, this current paper aims to clarify the unit(s) of analysis that should be taken into account when assessing COISA holistically. Given the above, we formulate the following research question:

RQ: In which business processes do co-evolutionary alignment activities take place?

In the remainder of this paper, we will first specify our theoretical framework. Then, we will explain our approach in conducting the SLR, and finally, we will present our findings and conclusions.

2.2 THEORETICAL FRAMEWORK

In this research, we utilize the definition of BITA as given by Luftman et al. (1999, p. 3) : *"[…] applying IT in an appropriate and timely way, in harmony with business strategies, goals and needs"*. In line with our CAS perspective, herein BITA is not an end-state because the mentioned strategies, goals and needs are in constant change due to environmental turbulence. Instead, the nature of BITA in turbulent environments can be compared to the higher-level aim of many natural CASs: survival. This aim also needs to be worked on continuously and thus cannot be considered an end-state. COISA extends this notion of BITA by focusing on the co-evolutionary alignment activities, viewing the organization in which these moves manifest as a CAS. Two theoretical building blocks explain this extension, i.e., I). alignment as continuous processes and II). emergent alignment. Table 2.1 presents a summary of these building blocks and their CAS characteristics. We now elaborate on their theoretical foundation, by first broadly introducing CAS theory, and then explaining the building blocks that form the basis of our conceptualization of COISA.

Table 2.1. Theoretical building blocks and supporting CAS characteristics

Theoretical building blocks	Description	Supporting CAS characteristics
Alignment through continuous processes	COISA manifests through continuous alignment processes, involving feedback loops between business domains, IT domains and external actors	Dynamism; interdependence; co-evolution; adaptation; connectivity; flow; nonlinearity; self-organization
Emergent alignment	COISA is an emergent phenomenon resulting from interactions between individuals in different contexts and should be approached holistically to be thoroughly assessed and understood	Emergence; aggregation

2.2.1 Complex Adaptive Systems Theory

CAS theory stems from scientific fields of physics and evolutionary biology, and it is part of Systems science, which "*[…] transcends technological problems, reflecting a reorientation that has become necessary in all sciences, from physics and biology to the behavioral and social sciences, emphasizing relationships between parts.*" (Hammond, 2010, p. 105). In other words, systems theory emphasizes interactions between individual, heterogeneous parts, leading to aggregated wholes, where the sum is more than its parts (Hammond, 2010). CAS theory as applied to human systems can be distinguished from general systems theory by the behavior of CASs individual agents, adapting to environmental conditions, based on their perception of reality. Dooley (1997, p. 76) explains that, in a CAS, "*[…] agents scan the environment and adapt accordingly […], using schema to interpret reality and context, and trigger decisions and actions […], while competing with other agents for resources and information.*" Furthermore, Anderson (1999, p. 219) emphasizes that the essence of taking a CAS perspective on organizations is that "*[…] at any level of analysis, order is an emergent property of individual interactions at a lower level of aggregation*". These insights can be summarized in several indicators characteristic to CAS, i.e., dynamism; interdependence; adaptation; connectivity; flow; nonlinearity; self-organization; co-evolution; emergence and aggregation (Anderson, 1999; Holland, 1995; Onix et al., 2017a).

Given the heterogeneous nature of agents acting within a human CAS, it is crucial to acknowledge the existence of different organizational contexts: Indeed, alignment may be perceived differently in each context. Essentially, an organizational context may be seen as a subsystem of the CAS that is the organization as a whole. As a comparison, we consider a coral reef, an excellent example of a CAS, given its heterogeneous actors (e.g., coral, fish, divers, predators), and co-evolutionary interactions. In this coral reef, there are different "contexts" in place, interacting with each other while all are having their perspective on the CAS as a whole and its parts. Examples of these contexts include the fish living in the coral reef, the coral itself, and tourists diving to observe its beauty. When a larger fish swims into the coral reef, this is terrible news for the small fish's context, since they risk to be eaten. In other words, the introduction of the large fish into the coral reef is not well aligned with the goals and needs of the small fish, i.e., survival. However, for the tourist diver's context, it might be a fantastic event because it might be a beautiful, rare fish. In other words, the large fish being present in the coral reef is very well aligned with the goals and needs of the tourist diver, i.e., spotting as many beautiful and rare creatures as possible. Comparably, organizations have different contexts which all have their view of the organization and how it should go forward. An IT solution can, just like the larger fish swimming into the coral reef, be very well aligned with the goals and needs of one organizational context, but not necessarily with another.

For this current study, we distinguish two organizational contexts which are based on the classic Strategic Alignment Model, namely I) The strategic context and II) The operational context (Henderson & Venkatraman, 1993). After all, it is not self-evident that employees working in the operational context agree with strategic objectives, as becomes clear from existing literature on organizational change management (Ford et al., 2008; Rajagopalan & Spreitzer, 1997). These different perspectives are no different concerning organizationally embedded IT (Aladwani, 2001), potentially leading to alignment being assessed as high within the strategic context, but low within the operational context, or vice versa.

2.2.2 CAS foundation of COISA

As mentioned earlier in the theoretical framework, we base COISA on two theoretical building blocks, namely I) alignment as continuous processes and II) emergent alignment.

We base our first building block, i.e., alignment as continuous processes, on CAS characteristics of dynamism, interdependence, adaptation, connectivity, flow, non-linearity, self-organization and co-evolution (Anderson, 1999; Holland, 1995; Onix et al., 2017a). These characteristics imply that complex organizations are highly dynamic. This means that the diverse agents (i.e., actors involved in alignment processes, e.g., CIO, IT and business management, software developers, users) within the organization are continually adapting and co-evolving. These continuous adaptations cause changes to occur frequently in both the business and IT domain of the organization, in accordance to changes in other parts of the organization, the environment (Anderson, 1999) or by the very implementation and use of IT (P. Allen & Varga, 2006; Nan, 2011). Moreover, seemingly small changes in one domain can lead to substantial effects elsewhere in the organization, due to the nonlinearity of CAS behavior (Anderson, 1999). From an executive management perspective, the system self-organizes because many decisions are made locally to enable quick responses to changes.

These inevitable changes and adaptations cause any equilibrium state of alignment to be unstable, giving rise to the need for continuous alignment processes. In these alignment processes, business employees, IT employees and external actors such as customers, software suppliers, or consultants, communicate and collaborate, pursuing alignment. These interactions lead to interdependence, connectivity, and flow between the involved actors and consequently, co-evolution manifests between business employees, IT employees and external actors.

This co-evolution is triggered by events involving organizational embedding of IT, such as I). IT adaptation (e.g., software, hardware, development methods and strategic plans that change), II). business adaptation (e.g., operational processes, products, and strategic plans that change), III). new opportunities that are driven by external actors (e.g., new technologies or partnerships that emerge and evolve) and IV). changing requirements from external actors (e.g., new regulations or customer demands). Note that co-evolution can also manifest *within* the business domain or the IT domain: For example, business employees from different departments might hold differentiated views or ways of working with a specific type of software, and these can co-evolve by interacting or collaborating. The same goes for IT employees, for example when different expertises collaborate in developing a new IT solution (e.g., a business intelligence developer and a solution architect). Co-evolution between external actors may exist, but this is not within scope since we focus on COISA within organizations. In summary, our first theoretical building block is that COISA manifests as continuous alignment processes, characterized by co-evolution between business employees, IT employees and external actors.

Our second primary theoretical building block, i.e., emergent alignment, is based on CAS characteristics of emergence and aggregation, which emphasize that order is an emergent property of aggregated individual interactions on a lower level (Anderson, 1999). In line with this statement, we argue that alignment in CAS contexts should also be viewed as an emergent phenomenon, acknowledging that alignment is a specific manifestation of order. In the same line of reasoning, alignment is a phenomenon emerging from interactions between actors (e.g., people operating in teams) involved in business processes that pursue BITA in different organizational contexts (P. Allen & Varga, 2006; Burton-Jones & Gallivan, 2007). Therefore, to fully grasp COISA, taking a CAS viewpoint on organizations advocates a holistic perspective of alignment, while acknowledging its foundation of individual interactions (Amarilli et al., 2016; Anderson, 1999; Benbya & McKelvey, 2006b).

To proceed with these statements, we need to identify the business processes that we can label as co-evolutionary alignment processes in both the strategic and the operational organizational contexts. In doing so, we define alignment processes as business processes where co-evolutionary interactions toward alignment take place between business employees, IT employees and external actors.

2.3 METHODOLOGY

To answer our research question, we conducted a structured literature review (SLR), following the guidelines by Okoli and Schabram (2010). The reason we chose to do an SLR, is because a considerable amount of CAS-founded studies on aligning business with IT has been done in the past decade, both empirically and conceptually. However, as far as our knowledge reaches, no research has been done to explicate the specific business processes underlying these alignment efforts. As mentioned in our theoretical framework, we view co-evolutionary IS alignment as an emergent phenomenon resulting from interactions between individual business employees, IT employees and external actors from different organizational contexts, jointly pursuing BITA. In correspondence with this perspective, three types of studies can potentially provide answers to our research question. These types of studies include firstly articles focusing on BITA from a CAS perspective; secondly, articles focusing on IT adaptations based on business needs from a CAS perspective; and finally, business adaptations as a result of IT adaptations from a CAS perspective. By incorporating these three types of research, this current study aims to give a holistic overview of the business processes in which alignment interactions take place.

2.3.1 Search protocol

While finding literature relevant to our research question, we limited our scope to articles that were published in the top basket of eight IS Journals as acknowledged by AIS (*Senior Scholars' Basket of Journals*, n.d.). In doing so, we assured that all articles included in our review were high-quality and peer-reviewed. Additionally, we only included articles published between 2007 and 2017, to get an up-to-date overview of business processes that can be identified as alignment processes. Moreover, we added full research papers that were part of proceedings of AIS-supported conferences from the past three years (2015-2017). After all, the most recent insights in the field cannot yet have been published in top journals, due to the timeline of this research and the subsequent publishing process. We looked for articles using the AIS online library, Google Scholar, and Web of Science to get a broad overview of the available literature. To assure that alignment and CAS were a primary focus of the found articles, we limited our search areas within articles to titles, abstracts and/or keywords whenever possible. Specifically, we searched in titles and abstracts in the AIS online library, and in Web of Science, we limited our search to article topics. As an exception, while using Google Scholar, we *did* search in the full text of the articles, as Google Scholar's search options were too limited to specify search areas within articles further.

2.3.2 Keywords

The keywords used to find relevant articles revolved around two main topics. These topics are alignment on the one hand and CAS theory on the other hand, given that the main purpose of our SLR is to explicate further the business processes underlying COISA, based on CAS principles. In doing so, we assure that the business processes that we identify indeed contribute to alignment, and show co-evolution and/or interaction between the actors involved. For the topic of CAS, we included the search term "c*omplex adaptive systems,"* as well as search terms relating to complexity science in a more general sense, including "*complexity theory,"* "*complexity science"* and "*complex systems."* Furthermore, we included "*co-evolution"* as well as "*co-evolutionary"* to make sure that we include articles that actually use co-evolutionary alignment in their primary terminology.

For the topic of alignment, we used the search terms "*alignment*" and its frequently used synonym *"fit."* However, we realized that using only these keywords might exclude articles focusing on IT-induced organizational change and IT adaptation caused by organizational needs. However, as explained earlier in this chapter, these are in fact very relevant to our research question as they do focus on co-evolution between business domains, IT domains and external actors. Therefore, we also took into account the more general keywords of "*information systems*" and "*information technology.*"

We subsequently applied every possible keyword combination, using one keyword from each of the two lists in every query. To optimize replicability of our research, we kept track of a log specifying each of our searches, as well as a list of found articles, with for each article its corresponding search query and source. This log is available on request.

2.3.3 Quality- and practical screen

Our search efforts led to a total of 245 articles. These articles all fulfilled our quality screen criteria since this was addressed by only including articles published in one of the eight top IS journals or presented at AIS-supported peer-reviewed conferences. We then developed practical screen criteria to filter out the articles that were not relevant to our research question. These practical screen criteria aimed to reassure that the articles included in our final analysis indeed focused on alignment and that they indeed used CAS principles. We decided to screen the articles based on their abstracts since these generally give a good overview of the articles' focus.

Early on in our screening process, we discovered that many of the found articles did not explicitly state in their abstract to use CAS theory but instead mentioned several properties that are characteristic to CAS. Therefore, our practical screen criterion considering CAS as a theoretical basis could be fulfilled in two ways:

- The abstract mentions that it uses CAS theory/principles as a theoretical foundation
- The abstract mentions at least two of the properties that are characteristic to CAS. These properties include aggregation, nonlinearity, flows, diversity, emergence, co-evolution, self-organization, connectivity, interdependence, dynamism, and adaptation (Anderson, 1999; Holland, 1995; Onix et al., 2017a).

We developed the following three statements to decide whether alignment was a main focus or not. Articles had to correspond to one of these statements to fulfill the criterion of focusing on alignment.

- The abstract explicitly mentions focusing on alignment or fit
- The abstract mentions focusing on IT-induced organizational adaptation
- The abstract mentions focusing on organizationally induced IT adaptation

A total of 18 articles were considered to be relevant for our research after applying these practical screen criteria. Later in the process, two additional articles on Enterprise Architecture Management (EAM) from a CAS perspective were added by replacing the keywords considering alignment with "Enterprise Architecture Management." The reason to do so is that EAM did show up in our first sample as an alignment process, however mainly in theoretical and conceptual papers. By doing an additional search, we found two articles that provide additional empirical support for EAM as being a co-evolutionary alignment process (Rolland et al., 2015; Schilling et al., 2017), thus strengthening our results. The total amount of articles that we considered for this study is therefore 20.

2.3.4 Coding, analysis, and synthesis

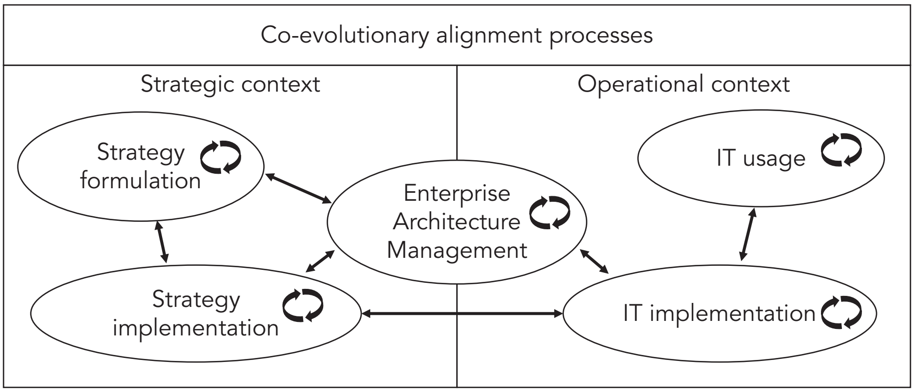
We coded the articles with NVivo software, using two complementary coding techniques based on Saldaña (2015), namely in vivo coding and descriptive coding. In vivo coding implies that codes are taken from the text in the qualitative data. We used this technique for articles that explicitly address different alignment processes. The second coding technique we adopted is descriptive coding. The primary purpose of this coding technique is to infer the primary topic of a text passage (Saldaña, 2015). We used this technique for studies that provided information on alignment processes, without explicitly naming them. Articles that we analyzed following this procedure included for example case studies on specific IS implementations or organizational transformations. In our analysis, we used a hybrid coding approach: We used open coding to identify the business processes showing co-evolutionary moves toward alignment, but we categorized these codes into the pre-defined strategic and operational contexts. The codes we used in our descriptive coding were taken from the codes that emerged from our in-vivo analysis.

We subsequently synthesized the results of our coding into a conceptual model, integrating the organizational contexts and corresponding alignment processes. In doing so, we only included alignment processes supported by at least one empirical study (i.e., not only by conceptual papers). Alignment processes were labeled as "supported" when at least two articles either used them as a unit of analysis or if they were described in empirical data. This step ensures that the alignment processes, that we incorporate, actually manifest in practice. By also taking into account conceptual and theoretical papers, we strengthened the theoretical CAS foundation of the final conceptualization.

2.4 RESULTS

We identified five alignment processes based on our analysis and synthesis of the included studies. Two are part of the strategic context, i.e., I) strategy formulation and II) strategy implementation, one bridges the strategic context and the operational context, i.e., III) Enterprise Architecture Management, and two are part of the operational context, i.e., IV) IT implementation and V) IT usage. Interestingly, we also identified co-evolutionary interactions to take place *between* some of these alignment processes, i.e., between EAM and strategy formulation, between EAM and Strategy implementation, between EAM and IT implementation, between Strategy Formulation and Strategy Implementation, between Strategy implementation and IT implementation and between IT implementation and IT usage. We visualize the results in figure 2.1.

Figure 2.1. Conceptual model of COISA



This COISA model fits the CAS perspective very well. The model focuses on alignment processes wherein and between which interactions between business actors, IT actors and external actors prevail. Furthermore, these individual interactions lead to emergent alignment in different contexts, i.e., a hallmark of the CAS perspective. Because the goals, needs, and strategies of organizations in turbulent environments change quickly and may differ among the involved actors, so does their alignment with IT. Therefore, the interactions between actors operating in and between alignment processes should be continuous, making the pursuit of emergent alignment an ongoing process.

The appendix shows an overview of all articles, with for each article the supported alignment processes, and the way in which each alignment process was incorporated in the article at hand. We now elaborate on the main findings.

2.4.1 Co-evolutionary alignment processes in the strategic context

In the strategic context, we identified two different alignment processes, i.e., Strategy formulation, and Strategy implementation.

The alignment process of *strategy formulation* is supported by Liang et al. (2017), who did a survey study on the relationship between BITA and organizational agility. In doing so, they subscribe to our CAS viewpoint on organizations by acknowledging the emergent and interdependent nature of strategic alignment processes, i.e., Strategy formulation and Strategy implementation. They underline that executive managers (both business- and IT-oriented) are responsible for both processes in strategic alignment efforts. Therefore, they address both in their survey design. Yeow et al. (2017) take the same viewpoint, stressing the importance of responding to environmental turbulence in their explanation of the process of strategy formulation. In doing so, the authors emphasize the emergent nature of strategy and strategic alignment, taking a dynamic capabilities approach to the problem at hand. However, they do not explicitly take the process of strategy formulation into account in their empirical analysis, so support comes mainly from the theoretical discussion. Additionally, Tanriverdi et al. (2010) mention that co-evolutionary development of IS strategy, corporate strategy, and competitive strategy is essential in turbulent environments. In this article, too support comes from the theoretical discussion in the paper. Baker et al. (2011) agree with this viewpoint, reinforcing the importance of co-evolution of business- and IT strategies in highly dynamic conditions. They, however, do focus on the process, thus, in this case, it is the unit of analysis.

The second alignment process, i.e., *strategy implementation*, is also acknowledged by Liang et al. (2017), who, as discussed above, explicitly address both strategy formulation and strategy implementation and thus use it as part of their unit of analysis. Additionally, by acknowledging the interdependent and emergent nature of these processes, the article by Liang et al. (2017) also provides support for co-evolution taking place *between* these processes, as is visible in figure 2.1.

Case study findings on strategy implementation in CAS contexts appear to lean on emergent initiatives that are driven by simple, strategically defined axioms. For example, Busquets (2015) focus on *discovery paths*, explaining *"[…] the firm's evolution by sets of variations in the strategic interaction between the organization and technology"* (Busquets, 2015, p. 1). Their explanation of strategy implementation involves how the strategically defined customer-centricity axiom found its way throughout the studied organization by using customer-centric data. This concrete example of strategic objectives directly influencing IT implementation subsequently provides support for co-evolution taking place between Strategy Implementation and IT implementation, as the use of the customer-centric data took place within IT implementation processes. Comparably, Grisot et al. (2014) describe the evolution of a hospital's information infrastructure, *"[…] characterized by nonlinear evolutionary dynamics"* (Grisot et al., 2014, p. 197). The instance of strategy implementation described by these scholars addresses how the strategically defined patient-centricity principle was intrinsic to a new initiative from a team at a hospital's IT department. Again, this provides support for both the process of strategy implementation as well as its co-evolution with IT implementation. Montealegre et al. (2014) take a co-evolutionary view on information services development and in doing so, they seem to address strategy implementation as well: They underline that alignment between vision, strategy, governance, and resources *enable* operational alignment processes. Unfortunately, they do not address further how this enabling process of strategy implementation manifests in practice. In other words, they do not provide sufficient support to draw further conclusions on co-evolution taking place between specific alignment processes.

2.4.2 Co-evolutionary alignment processes in the operational context

We found two alignment processes in the operational context, i.e., IT implementation, and IT usage.

IT implementation refers to all activities that are part of embedding IT within an organization. These include for example quality design and implementation of requirements, but also dimensions such as prioritization, and change management. Additionally, IT implementation can take place both in- or outside of a project context (E. L. Wagner et al., 2010). Several articles support this viewpoint:

Two articles discuss IS development as situated socio-technical change, emphasizing its emergent nature (Lyytinen & Newman, 2008; McLeod & Doolin, 2012), based on results from their case study considering the implementation of a reporting tool. Vessey and Ward (2013) address in their conceptual paper among others how to manage IS development projects in co-evolutionary contexts, providing further theoretical support for these projects to show co-evolution. Furthermore, Amarilli et al. (2017) illustrate co-evolutionary dynamics taking place within IT implementations, by doing a multiple case study. Additionally, Grisot et al. (2014) describe in their case study how the project initiated by a small team from a hospital's IT department went by in defining requirements, taking a learning approach while implementing the system. In doing so, the authors underline the evolutionary, emergent nature of this process. Montealegre et al. (2014) take a co-evolutionary view on information services development in their case study, stressing the importance of modular information services design to enable dynamic adaptation in accordance with environmental turbulence.

Four different articles support the process of IT usage as a co-evolutionary alignment process. Firstly, Allen et al. (2013) describe how unintended changes emerged in the work system of a healthcare environment after implementing two different IT systems through interactions between business employees using the systems. Apart from co-evolution within the IT usage process, the study, additionally, provides support for co-evolution taking place between the IT usage and the IT implementation processes. Wagner et al. (2010, p. 276) focus on large-scale, off-the-shelf software (Enterprise Systems), specifically on the "*turnaround process by which a troubled project at go-live becomes a working information system*". Therein, they introduce the notion of negotiated practice, which aims to address emergent misalignments between best practices that are characteristic to off-the-shelf software, and existing practices within the organization. The co-evolutionary interactions that they address in their case study focus mainly on the process of IT usage. However, they also touch upon co-evolution between the IT usage process and the IT implementation process, by discussing changes made to the system based on user feedback, *after* its go-live, providing additional support for co-evolution between these processes. Goh et al. (2011) look at the effects of an implementation of a computerized documentation system in the work system within a hospital setting, from an adaptive structuration theory perspective (characterized by co-evolution and adaptation). They explain changing routines caused by system implementation through three stages: The pre-implementation stage, "*[…] when users form initial symbolic expressions about the new system and plan for the changes to existing routines*" (Goh et al., 2011, p. 582), the transition stage, "*[…] focused on restoring the essential functions of routines*" (Goh et al., 2011, p. 582) and the refinement stage, focusing on "*[…] fine-tuning and exploring new capabilities*" (Goh et al., 2011, p. 582). Apart from these empirical papers, REF address IT use conceptually, from a multi-level, agent-based perspective and therein provide additional theoretical support for the alignment process of IT usage.

2.4.3 Enterprise Architecture Management

The alignment process of *enterprise architecture management* (EAM) bridges the strategic context (addressing questions of 'what' and 'why') with the operational context (addressing questions of 'how') (Ahlemann et al., 2012). Several studies show evidence for EAM to be part of COISA:

Vessey and Ward (2013) view the transition from current to target EAs as co-evolution between business- and IT-domains. They apply adaptive management principles as defined by Vidgen and Wang (2009) to EA maturity stages, aiming to address co-evolutionary alignment throughout the organization instead of only within IS development projects. This supports EAM as a COISA process from a theoretical viewpoint. Schilling et al. (2017) address IS architecture as a socio-technical phenomenon in their survey study, emphasizing that *"[…] IS architecture can be considered as a continuous effort to keep changing organizational aspects aligned with changing technological aspects"* (Schilling et al., 2017, p. 3). The scholars show that evolutionary change of the architecture itself has a positive relationship to the Architecture outcomes, thus providing solid support for EAM as a co-evolutionary alignment process. Furthermore, they discuss how EAM coevolved with strategy, thus providing support for co-evolution between the processes of EAM and strategy implementation, and between EAM and strategy formulation: *"[…] as part of a strategy for increased global growth and collaboration across locations, a new Information System […] was developed in 2009"* (Rolland et al., 2015, p. 5). Rolland et al. (2015) show that EAM, or *Enterprise Architecting*, as they call it, is a continuous, evolutionary process that should focus on realizing the transitions from as-is EAs to target EAs. This process should address not only the target state of the architecture but also the current architecture and the path dependencies that come along with decisions made in the past. In their case study, the authors describe the co-evolution not only within the EAM process but also between the EAM process and the IT implementation process. Finally, Weeger and Ulrich (2016) did a longitudinal case study of co-evolving business- and IT domains. Their primary focus is on misalignment in the activity systems of and between both business and IT domains. The authors stress the role of ITs shift of focus, from local tools to organization-wide optimization (characteristic to EAM), to address these misalignments successfully. This is a clear example of the process of IT implementation coevolving with the process of EAM.

2.5 DISCUSSION AND CONCLUSION

We identified five different co-evolutionary alignment processes, manifesting in and between the operational and the strategic contexts. These processes include I) Strategy Formulation (strategic context), II) Strategy Implementation (strategic context), III) Enterprise Architecture Management (bridging the strategic and the operational context), IV) IT implementation (operational context) and V) IT usage (operational context). In these processes, business actors, IT actors and external actors communicate and collaborate through co-evolutionary interactions, continuously pursuing alignment. Our study additionally revealed that co-evolution also manifests *between* different alignment processes.

Interestingly, our literature study did not show co-evolutionary interactions between *all* alignment processes, as is visible in figure 2.1. Specifically, for the alignment process *IT usage*, our study only showed evidence for co-evolution with the alignment process IT implementation. We found no evidence for direct co-evolution with any of the other alignment processes. The absence of this particular relationship may be explained by the sheer complexity and diversity of IT usage processes, as these occur in every organizational context making use of IT. However, IT usage may simultaneously be the most interesting process to influence the alignment processes in the strategic context, as it *is* the process where outcomes of alignment efforts first emerge. We see good potential for co-evolution between IT usage and strategic co-evolutionary alignment processes in the CAS-based approach of quantified self-interpreted micro-narratives (Snowden, 2011). This potential is clearly explained by Snowden (2011, p. 220): *"We are dealing in complex systems with human motivations and attitudes, and […] these are best revealed through an understanding of the day-to-day micro-narratives of existence"*. Fitness landscapes can then represent these large-scale collected micro-narratives, allowing actors in strategic COISA processes *"[…] to sense the evolutionary* *possibilities (and impossibilities) of the present along with risk assessment. It also allows monitoring of the impact of safe-fail experiments, permitting more rapid, effective, and lower-cost interventions."* (Snowden, 2011, p. 221).

Apart from the process of IT usage, we also found no direct interactions between the alignment processes IT implementation and Strategy formulation. Instead, we only found indirect co-evolution through the processes of Enterprise Architecture Management and Strategy implementation. The relatively small sample of our study may explain this outcome, suggesting that interaction between those processes, in fact, *does* take place in practice. However, it may also indicate that the absence of interactions between some of the processes is in fact quite useful: Indeed, this absence limits the alignment processes' complexity. Therefore, it may just prevent the organization to fall into a state of chaos. Further research should aim to provide clarification on this matter.

Our model is a valuable addition to the existing knowledge base for two reasons: First, our findings consolidate COISA's foundation on CAS theory. They do so, by using theoretically founded building blocks to identify the relevant alignment processes.

Second, our study takes the first step toward operationalizing COISA, by specifying the business processes that should be taken into account when assessing COISA empirically.

This step builds upon existing work on COISA by, e.g., Benbya and McKelvey (2006b) and takes a process-view of COISA as a key foundation. Our process perspective does not mean, however, that we dismiss literature approaching alignment as an end-state altogether. Instead, we bring some nuance in the notion of BITA in turbulent environments specifically. We do so, by subscribing to the definition given by Luftman and Kempaiah (2007), who focus on the goals, needs, and strategies of the business with which IT needs to align. Given environmental turbulence, these goals, needs, and strategies are in constant change. Moreover, most complex organizations have multiple organizational contexts (i.e., strategic and operational) which, as we have argued, are likely to have different or even contradictory goals and needs. These different contexts within one organization add to the challenge of alignment and the constant need for change. The fact of constant change thus gives us reason to conceptualize BITA not as an end-state, but as a general aim of the CAS that is COISA within organizations, comparable to the general aim of survival of many natural CASs (e.g., a coral reef).

Both survival and BITA—given environmental turbulence—indeed are aims, but explicitly not end-states, since they may be interpreted differently depending on the organizational context, and are in constant change due to environmental turbulence. In other words, they are not end-states because they need continuous work and effort to be pursued.

Additionally, our model could also have practical relevance as it can be applied as a useful checklist for organizations to identify COISA improvement areas.

Despite the value of our contribution, there are several limitations that future work must seek to address. First, we conceptualize a model of COISA based on an exploratory SLR. Complementary empirical evidence is needed to validate our model and its claims. Moreover, a substantial limitation of our model is that in assessing COISA empirically, it is not enough to merely measure whether an organization applies the identified alignment processes or not. After all, this does not guarantee co-evolutionary moves toward alignment to take place within and between the processes. Thus, the model should be extended with indicators of these co-evolutionary interactions.

Furthermore, future research should expand the scope and reach of COISA and also compare results across industries, contributing to the generalizability of our findings. An interesting direction would be to apply a configurational approach (Meyer et al., 1993; van de Wetering et al., 2017); through which groups and (sub)segments can be analyzed in detail. This approach aligns well the complexity paradigm to capture the complex entanglement of strategic and operational IT and business operations in practice. For example, the model could be adapted for different types of organizations (e.g., public or private sector, small- or large-scale) or different types of IT solutions (e.g., large-scale systems versus small, innovative solutions). The notion of organizational contexts can be a good starting point to do this: By first identifying the specific organizational contexts that should be taken into account in a specific (type of) organization, a more reliable, holistic assessment of the degree of alignment within these organizations can be made. For example, in universities, each faculty might be its own organizational context and might have differentiated views on how IT should be leveraged to support business goals.

Lastly, our model's application to organizations facing turbulent environments is only based on the principle of requisite complexity. To strengthen its applicability in turbulent environments, we will further develop and test the model in the context of hospitals. Namely, almost every environmental aspect that hospitals face (Social, Technological, Economic, Environmental, Political, Legal and Ethical, see also Kew and Stredwick (2017)) evolves in a high pace, making it a very suitable domain for our aims.

To conclude, we further clarified COISA by identifying specific alignment processes in different organizational contexts, therein taking the first steps toward an actionable operationalization of COISA. Our model specifies the conceptualization of COISA for organizations facing environmental turbulence and is designed for further empirical research. By using theoretically founded building blocks, its CAS theory basis is reinforced.

APPENDIX
MATRIX OF ARTICLES INCLUDED IN SLR

Table 2.2. Matrix of articles included in SLR

#	Article	Methodology	Alignment process	Integration in article
1	Liang et al. (2017)	Survey	Strategy formulation	Unit of analysis
			Strategy implementation	Unit of analysis
2	Yeow et al. (2017)	Case study	Strategy formulation	Theoretical discussion
3	Tanriverdi et al. (2010)	Research commentary	Strategy formulation	Theoretical discussion
4	Baker et al. (2011)	Conceptual paper	Strategy formulation	Unit of analysis
5	Busquets (2015)	Case study	Strategy implementation	Described as part of case study
			IT implementation	Unit of analysis
6	Grisot et al. (2014)	Case study	Strategy implementation	Described as part of case study
			IT implementation	Unit of analysis
7	Montealegre et al. (2014)	Case study	Strategy implementation	Theoretical discussion
			IT implementation	Theoretical discussion
8	Schilling et al. (2017)	Survey	EAM	Unit of analysis
9	Rolland et al. (2015)	Case study	EAM	Unit of analysis
10	Weeger and Haase (2016)	Case study	EAM	Described as part of case study
11	Vessey and Ward (2013)	Conceptual paper	EAM	Unit of analysis
			IT implementation	Unit of analysis
12	McLeod and Doolin (2012)	Case study	IT implementation	Unit of analysis
13	Lyytinen and Newman (2008)	Theoretical paper	IT implementation	Unit of analysis
14	Allen et al. (2013)	Multiple case study	IT usage	Unit of analysis
15	Wagner et al. (2010)	Case study	IT implementation	Unit of analysis
			IT usage	Unit of analysis
16	Goh et al. (2011)	Case study	IT usage	Unit of analysis
17	Burton-Jones and Gallivan (2007)	Conceptual paper	IT usage	Unit of analysis
18	Nan (2011)	Agent-based modelling	IT usage	Unit of analysis
19	Vidgen and Wang (2009)	Multiple case study	IT implementation	Unit of analysis
20	Amarilli and van den Hooff (2017)	Multiple case study	IT implementation	Unit of analysis

3

USING A CO-EVOLUTIONARY IS-ALIGNMENT APPROACH TO UNDERSTAND EMR IMPLEMENTATIONS

The results presented in this chapter have been published as a full research paper in the proceedings of the European Conference on Information Systems 2019.

ABSTRACT

Electronic Medical Records (EMRs) are repositories of electronic medical histories of patients, maintained over time. Hospital operations and EMRs typically become interdependent, due to the inclusion of medical workflow- and administrative process support as core functionalities. Hence, it is profoundly challenging to effectively enable complex, multi-stakeholder clinical processes, enhance patient care, and align EMRs with hospital strategies, goals, and needs. In this study, we build upon co-evolutionary IS-alignment (COISA) theories and argue that current approaches to business-IT alignment in hospitals should be reconceptualized, particularly regarding modern EMR implementations. In this effort, we respond to the call for more empirical research on business-IT co-evolution. We unfold how COISA manifests during EMR implementations using a multiple case study method. This method allows us to get a rich understanding of the complex social phenomena that emerge during EMR implementations. Outcomes show that COISA manifests in all three cases, involving different stakeholder groups, but in different localities and intensities. These findings suggest that COISA is a suitable framework to describe and understand EMR implementations and that different configurations of interaction patterns can lead to comparable results. This understanding enables EMR practitioners to more effectively identify improvement areas in dealing with internal and external complexity.

Keywords: Co-evolutionary IS-alignment (COISA), complexity science, Electronic medical records (EMR), hospitals

3.1 INTRODUCTION

The effects of digitization are becoming widespread in modern societies. Technological change takes place at unprecedented speed, and ordinary lives have become part of collaborative and social networks. These impactful developments also hold for the healthcare sector, and hospitals in particular, as the future of medical practice is evolving due to new exponential and digital technologies (van de Wetering, Versendaal, et al., 2018). Also, emerging technologies in mobile health drastically alter healthcare delivery processes and how patient value is delivered across the healthcare ecosystem (Sako et al., 2017). Consequently, patients and governments have high expectations from the hospital's (digital) services (Engelen, 2018; C. Liang et al., 2017). This shift in expectations causes hospitals to strategize toward delivering patient-centered care, i.e., care that is both respectful of, and responsive to, individual patients' needs and values[1]

The shift to patient-centered care has a direct impact on the organization of hospital IT: *"Today, many hospitals are dominated by systems that are organised in isolated silo structures, which are result of IT systems implemented to support specialised clinical needs. Supporting clinical needs is of course functional from the clinician's perspective, but the typical patient follows a path across organizational boundaries and require different IT systems"* (Bygstad & Bergquist, 2018, p. 3170). Consequently, hospital employees who used to work in silos should now intensively collaborate and work integrally (Sherer et al., 2017).

This study focuses on implementations of a specific digital technology where the challenge of integrality is evident, i.e., Electronic Medical Records (EMRs). EMRs can be defined as repositories of electronic medical histories of patients, maintained over time (Kohli & Tan, 2016). The newest generations of EMRs provide integrated information and medical records from different specialists and stakeholders, in line with the principle of patient-centered care. Therefore, multiple stakeholders throughout the hospital have to be involved for an extended period of time. Furthermore, hospital operations become interdependent with the EMR due to the inclusion of complex healthcare process support in these EMRs (Raghupathi & Tan, 2008; Sulaiman & Wickramasinghe, 2014; van Eekeren & Polman, 2016). Hence, the EMR is subject to both strategic and operational objectives from many different stakeholders. Therefore, the quest to effectively enable medical processes, enhance patient care, and 'align' EMRs with hospital strategy, goals, and needs, becomes a profound challenge.

[1] We follow the definition of the IOM (Institute of Medicine).

This particular process of applying IS/IT in an appropriate and timely way, in line with strategies, goals, and needs is prominently referred to in the literature as Business/ IT alignment (BITA) (Luftman & Kempaiah, 2007). However, in a hospital context, strategies, goals, and needs may change quickly due to the rapid changes in the hospitals' networked ecosystem. Additionally, the many relevant internal and external stakeholders may in their turn have their own (possibly conflicting) strategies, goals, and needs (Currie & Guah, 2007; Kizito & Kahiigi, 2018; Pouloudi et al., 2016).

The extant scholarship on BITA in a healthcare setting typically studies specific groups of stakeholders, e.g., physicians (Gewald & Gewald, 2018) or nurses (Nguyen et al., 2017). Sulaiman and Wickramasinghe (2014) are an exception, addressing multiple stakeholder groups in their single case study on hospital IT (HIT) assimilation. However, these scholars do not clarify possible interrelations with strategic alignment processes and outcomes. Comparably, Weeger, Ohmayer and Gewald (2015) take a process-view on alignment in a healthcare setting. In doing so, they underline the importance of collaboration between business- and IT stakeholders, but only in an operational alignment setting.

We argue that an understanding of the interrelations between different stakeholder perspectives and between strategic and operational alignment processes is critical in the pursuit of better alignment of EMRs with hospitals' strategies, goals, and needs. Namely, such an approach may point toward integral solutions to the challenges of both internal and external complexity in an EMR implementations context. However, there is no current research holistically addressing these interrelations.

A stream of research that seems promising in this matter addresses the alignment problem from a coevolutionary IS-alignment (COISA) perspective (P. Allen & Varga, 2006; Amarilli et al., 2016, 2017; Benbya & McKelvey, 2006b; Walraven et al., 2018). COISA implies that alignment is a continuous process including two-way interactions between business, IT and external parties and between strategic and operational alignment processes. Therefore, COISA may provide a holistic understanding of interrelations between different stakeholder groups and strategic and operational alignment processes. As argued, this holistic understanding is critical for HIT practitioners to integrally address internal and external complexity in pursuit of better alignment of EMRs with hospitals' strategies, goals, and needs. However, until now, COISA has only scarcely been applied in empirical studies and to the best of our knowledge, never in a healthcare setting.

Hence, the objective of this study is twofold: First, we aim to assess the application of COISA to achieve a better understanding of the alignment dynamics in hospitals by applying this theory to EMR implementations. Second, we aim to refine and validate COISA theory for organizations facing complex conditions, such as hospitals. We thus add to the scientific knowledge base on COISA, where empirical research is still sparse and explicitly called for (Zhang, Chen, Lyytinen, et al., 2019). Our research question is as follows:

> **RQ:** How does co-evolutionary IS-alignment manifest in EMR-implementations?

We address our research question using a multiple case study method. This method is suitable because we aim to derive a holistic understanding of the complex social phenomenon that is COISA and to elucidate its theoretical model using empirical evidence (Yin, 2018). This study proceeds as follows. First, we elaborate on the theoretical foundations of this study. We will then discuss our research approach, followed by the results. We will end with our contributions and future research opportunities.

3.2 THEORETICAL FOUNDATION

3.2.1 Co-evolutionary IS-alignment

To proceed, we first need to outline our conceptualization of COISA in this current study. COISA research generally presents complexity-based conceptualizations of alignment, which are especially suitable for organizations facing highly turbulent environments and complex internal structures (P. Allen & Varga, 2006; Amarilli et al., 2016, 2017; Benbya & McKelvey, 2006b; Walraven et al., 2018). As explained in the introduction, COISA theories emphasize that alignment is a continuous process including two-way interactions between business, IT and external parties and between strategic and operational alignment processes. Furthermore, this school of thought takes a Complex Adaptive Systems (CAS) viewpoint on organizations as a foundation, implying that *"[…] at any level of analysis, order is an emergent property of individual interactions at a lower level of aggregation"* (Anderson, 1999, p. 219). There are several conceptual models available that explicate the building blocks of COISA and could thus be possible theoretical foundations of our research (Amarilli et al., 2016). However, not all are well-suited for the aims of this current study given the holistic viewpoint we are looking to apply.

Namely, many existing studies addressing co-evolutionary aspects of alignment focus on only one context of alignment, i.e., strategic, operational or individual, and thus do not fit the complex, multi-stakeholder, multi-context challenge of EMR implementations sufficiently. For example, Liang et al. (2017) emphasize the importance of social alignment involving two-way interactions between CIOs and CEOs on the strategic level in order to achieve emergent coordination of operational aspects. While these authors address the interaction between strategic and operational alignment processes, they do not cover co-evolutionary interactions taking place within the operational context of the organization, but instead, handle this as a black box. Contrastingly, Allen and Varga (2006) focus on individual co-evolutionary interactions leading to IS-alignment, explaining the mechanisms underlying these processes within individuals. However, these scholars do not embed individual interactions within strategic and operational organizational contexts. Therefore, although valuable, these articles do not provide the holistic viewpoint we are looking for in this current study.

We identified three existing articles that do address both strategic and operational COISA, i.e., our model (Walraven et al., 2018), Benbya and McKelvey (2006b) and Amarilli, Van Vliet and Van den Hooff (2017). Benbya and McKelvey (2006b) distinguish different three levels of alignment, i.e., individual alignment, operational alignment, and strategic alignment. The model aims to provide a different understanding of alignment using co-evolutionary theories. Stakeholders are not explicitly part of the model in itself. However, the authors do underline the importance of stakeholder perspectives in their theoretical explanation, where they emphasize that different stakeholder groups aim to embed their own views in the IS (Benbya & McKelvey, 2006b). Nonetheless, we found the model to have an insufficient degree of operationalization to enable empirical measurement, as it is difficult to clearly relate the role of these stakeholders to the conceptual model. On the other hand, the model by Amarilli, Van Vliet, and Van den Hooff (2017) does provide a solid basis for empirical studies. This is well illustrated by the considered article itself, applying the model directly for empirical measurement in a multiple case study of co-evolutionary alignment mechanisms. The building blocks of this model consist of four alignment mechanisms, i.e., 1) the business challenges the personnel to innovate the IS; 2) the social component of the organization acts on the IS…; 3) …and adapts to its changes; 4) the business can leverage and take advantage of the IS to be transformed. However, again, no explicit attention is paid to different stakeholders, making the model insufficient for our purposes.

Our model (Walraven et al., 2018) as depicted in figure 3.1, builds upon the insights of the aforementioned scholars. The study where this model was first developed consists of a structured literature review (SLR), aiming to unveil the specific business processes in which co-evolutionary alignment activities among business actors, IT actors and external actors take place (Walraven et al., 2018). In this effort, we drew from existing studies addressing business-IT alignment from a Complex Adaptive Systems perspective. The resulting model includes five different alignment processes in two organizational contexts, i.e., strategy formulation and strategy implementation in the strategic context, IT implementation and IT usage in the operational context, and enterprise architecture management (EAM) bridging the two contexts. Additionally, indications for co-evolution *between* some of the alignment processes were found in this SLR.

The model explicitly aims to provide an operationalisation for empirical measurement in complex conditions, suiting the goals of this current article very well. Furthermore, the model pays explicit attention to different stakeholder groups by incorporating not just business- and IT-actors, but also external actors playing a role in the alignment processes. Lastly, in our conceptualisation of organizational contexts, we underline differing goals and needs to exist within organizational boundaries, in line with our multiple stakeholder perspective: "*most complex* organization *have multiple* organizational *contexts […] which, as we have argued, are likely to have different or even contradictory goals and needs. These different contexts within one* organization *add to the challenge of alignment and the constant need for change."* (Walraven et al., 2018, p. 12). Therefore, we will use this model as our theoretical basis for further empirical analysis.

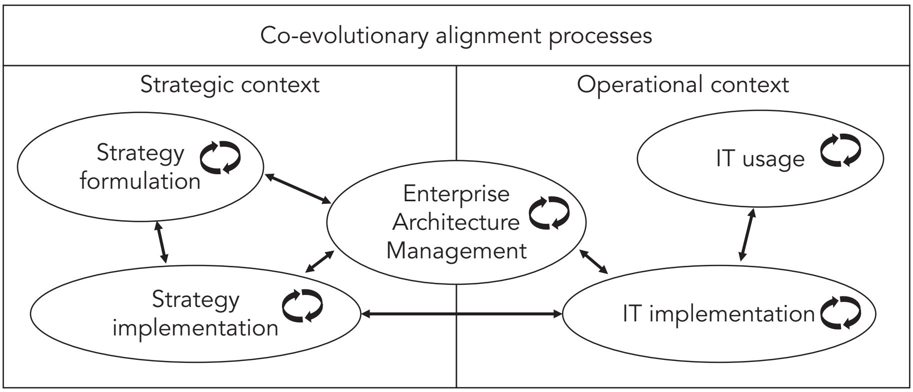


Figure 3.1. Conceptual model of COISA

To further improve structured analysis and to ensure the replicability of our study, we explicated definitions of the indicated alignment processes. To achieve this, we used the article where this model was first developed (Walraven et al., 2018) combined with insights from literature underlying that article. For EAM, some additional sources were added to achieve sufficient refinement for our analysis. Table 3.1 summarizes the working definitions that we applied in this current study.

Apart from the alignment processes that are central in COISA, we define several guidelines to identify co-evolution taking place within or between these processes. Our model is built upon the foundations of CAS theory, which states that emergent properties, such as alignment, are the result of individual interactions at a lower level of aggregation (P. Allen & Varga, 2006; Anderson, 1999). Furthermore, extant research has defined COISA as co-evolutionary moves making IT aligned (Benbya & McKelvey, 2006b). Thus, co-evolution of these IT-related moves and stakeholders' (support for) strategies, goals and needs should also be assessed at the level of interaction among stakeholders within and between the mentioned alignment processes. Furthermore, the term co-evolution implies a *two-way* interaction (Benbya & McKelvey, 2006b). Therefore, we outline co-evolution to take place when in an alignment process, the involved stakeholders and/or technology have a *mutual* influence on IT-related

Table 3.1. Working definitions of alignment processes in COISA

Alignment process	Working definition
Strategy formulation	The process of defining strategic objectives that the organisation wants to achieve (H. Liang et al., 2017; Walraven et al., 2018)
Strategy implementation	The process of setting up and maintaining structures to ensure that strategic objectives are realised in the operational context of the organisation (H. Liang et al., 2017; Walraven et al., 2018)
Enterprise Architecture Management	The process of managing an organisation's architecture (Ahlemann et al., 2012, p. 20)
IT implementation	The process of embedding an IT solution within an organisation (Walraven et al., 2018)
IT usage	The process of employing a system to perform a task (Burton-Jones & Gallivan, 2007, p. 659; Walraven et al., 2018)

moves, or on stakeholders' (support for) strategies, goals, and needs. Of course, these interactions may cross the boundaries of alignment processes, making co-evolution of stakeholders' (support for) strategies, goals and needs, and IT-related moves also possible *between* different alignment processes.

3.2.2 Stakeholders in EMR implementations

Because of the importance of involving different stakeholders in EMR implementations, in this current study, we aim to look for relevant stakeholders playing a part in the co-evolutionary interactions within and between the identified alignment processes. Information systems stakeholders can be defined as "*the individuals, groups,* organizations*, or institutions who can affect or be affected by an information system*" (Pouloudi et al., 2016, p. 6). Operationalizing this definition to our COISA conceptualization, we can distinguish at least three different stakeholders as a starting point for our analysis, namely business actors, IT actors and external actors (Walraven et al., 2018). Enriched with the literature on conflicting institutional logics within hospitals (Currie & Guah, 2007; Kizito & Kahiigi, 2018), the list can be further specified by distinguishing management, and medical staff on the business side of the hospital. Palvia, Jacks and Brown (2015) focus on EMR implementations specifically from a stakeholder perspective, distinguishing between vendors and medical providers, adding vendors as a more specific stakeholder in the group of "external actors" indicated in our model (Walraven et al., 2018). Lastly, a group of stakeholders that is particularly important to be included in the group of external actors in an EMR context consists of patients. This provides the following initial list of relevant stakeholders, i.e., the starting point of our analysis: 1) IT actors, 2) Medical staff, 3) Management, 4) EMR vendors, 5) Patients and 5) other external actors. Furthermore, stakeholders are assessed as being involved in an alignment process when they have an executing function within the process.

3.3 STUDY DESIGN AND APPROACH

3.3.1 Multiple case study approach

In investigating how COISA manifests in EMR implementations, we apply a multiple-case study approach. The multiple case study approach is well-suited for our exploratory study to investigate organizational issues (Benbasat et al., 1987) and allows to present rich evidence and a clear statement of theoretical arguments (Eisenhardt & Graebner, 2007). Hence, this approach enables us to explore similarities and differences within and between cases and to gain a better understanding of the phenomena at hand (Baxter & Jack, 2008). As argued by Yin (2018), a multiple case study design should follow a replication logic as applied to experimental research (Barlow & Nock, 2009) instead of a sampling logic as applied to quantitative research. This is very clearly explained by Yin (2018, p. 55): *"[…] upon uncovering a significant finding from a single experiment, an ensuing and pressing priority would be to replicate this finding by conducting a second, third, and even more experiments. Some of the replications might attempt to duplicate the exact conditions of the original experiment. Other replications might alter one or two experimental conditions considered challenges to the original finding, to see whether the finding can still be duplicated."*.

In this current study, we use literal replications, meaning that all case studies have comparable outcomes, *"[…] with the multiple-case inquiry focusing on how and why the exemplary outcomes might have occurred and hoping for literal (or direct) replications of these conditions from case to case"* (Yin, 2018, p. 59). In particular, we only include successful EMR implementations in this current study. This approach is comparable to the multiple case study by Olsson et al. (2008), who studied two comparable cases that implemented two-stage offshoring bridge models, aiming to understand similarities and differences between the approach of both case companies.

3.3.2 Sample selection: EMR implementation cases

To select our case hospitals, we first made a shortlist based on an investigation which hospitals implemented a new EMR between 2015 and 2018 (van Eekeren & van Zuilen, 2018). We limited our scope to hospitals in the Netherlands to improve the odds of success in data collection and to minimize possible inter-case cultural differences. We then selected from this shortlist potential cases based on the EMR- and hospital type. We ensured that the implemented EMRs were indeed modern, integrated EMRs providing more functionalities than just patient records (e.g., workflow support, administrative process support). Furthermore, we selected only hospitals that provide complex care as opposed to just basic care, to ensure internal complexity and to improve cross-case comparability. Following, we contacted several consultancy companies specialized in healthcare IT because these organizations were involved in many of the shortlisted EMR implementations. Based on their knowledge of the implemented EMRs and their expectation of hospitals being willing to cooperate in this research, we were able to incorporate three EMR implementations in three different Dutch hospitals in this current study.

3.3.3 Data collection and analyses

Data collection was done through retrospective interviews with different stakeholder groups. Additionally, we collected project documentation to enable triangulation in our final analysis and to improve construct validity (Yin, 2018).

The interviewees were selected so that we had an optimal representation of each identified stakeholder group, based on the recommendation by Pouloudi, Currie and Whitley (2016). These stakeholder groups include IT, medical, management and external. Furthermore, we aimed to select participants that had a broad overview of the implementation process and the developments therein. We were able to apply this principle because all of the identified implementations had several project leaders and program managers with a background in one of the relevant stakeholder groups in a hospital context. An additional advantage of this second criterion is that we were able to identify interactions between strategic and operational contexts. Namely, the roles of these people are often situated between the strategic and operational levels.

This current study did not capture the patients' perspective because, in all of our case hospitals, there were no representatives of this stakeholder group that fulfilled the criterion of having a broad overview of the EMR implementation. Furthermore, we were able to interview a vendor representative only in Hospital B, because the vendor of the system implemented in Hospital A and C was not willing to cooperate in this study. Table 3.2 gives an overview of the interviewed roles for each hospital, along with the corresponding stakeholder groups they represent.

Interview questions were developed based on our two theoretical pillars as out-lined in the theoretical framework, i.e., COISA (Walraven et al., 2018) and the stakeholde perspective (Palvia et al., 2015). All interviews were recorded, fully transcribed and coded in NVivo. Coding of alignment processes was done through themati analysis (Saldaña, 2015, p. 139), using a deductive approach with pre-defined codes for the COISA processes from our conceptual model. We consecutively applied both deductive and inductive coding to identify stakeholder groups involved in these COISA processes. We used deductive coding when a stakeholder group as identified in our theoretical framework was involved. However, in some instances, we encountered stakeholder groups that did not fit any of the pre-defined stakeholder groups. In other instances, we found that more specific groups within our pre-defined codes should be distinguished. This is where we added codes based on our empirical findings, i.e., an inductive approach. As stated in section 2.2.2, we deem a stakeholder to be involved

Table 3.2. Interviewed roles for each case hospital

Case / Stakeholder group	Hospital A	Hospital B	Hospital C
IT	ICT manager Project leader	ICT architect	Project leader_1 Project leader_2
External	Project leader	Program manager Vendor representative	Program manager Project leader_1 Project leader_2
Management	Project leader	Project leader	Project leader
Medical	Project leader	Information Manager	Information Manager

when they play an executing role in the alignment process at hand. Furthermore, we coded text passages indicating co-evolution taking place between two or more stakeholder groups within the regarded process. To identify potential influence or co-evolution *between* two alignment processes, we made use of NVivo's functionality of *relations*, enabling us to relate two COISA processes and their corresponding stakeholders with each other. These relations also indicated whether they could be indicated as one- or two-way.

To ensure the reliability of our coding approach, we selected two random interview transcripts, and had these coded both by ourselves and reviewed by an independent researcher. This is comparable to the approach of Anandarajan and Simmers (2005). We retrieved inter-coder agreement of > 90% on these transcripts, providing us with sufficient confidence in our analysis (Boudreau et al., 2001). Finally, we cross-checked our findings from the interviews with project documentation for each hospital. For example, we compared formally documented formal program structures with their descriptions given during the interviews.

3.4 FINDINGS

We studied three different hospitals (A, B and C) that recently implemented a new, integrated EMR. Hospital A and C both implemented a system from one vendor, which we will refer to as System 1. Hospital B implemented an EMR from another vendor, which we will refer to as System 2. We characterize both systems as integrated EMRs, including a broad range of functionalities (e.g., workflow support, decision support) apart from just integrated patient records. However, there is an essential difference between the systems: namely, System 1 is highly configurable, leaving many decisions on process design and system configuration to the hospital. System 2, on the other hand, is highly standardized. Notably, System 2 still has parts to configure and choose from, but to a considerably lesser extent than System 1. The three hospitals provide complex care in addition to standard care, and two of the three hospitals implemented the new EMR parallel to a merger with one or more other hospitals in the region. Table 3.3 summarizes the cases and provides relevant contextual information. In the remainder of this chapter, we will discuss the most notable findings for each of the three cases.

3.4.1 Stakeholder involvement in Hospitals A, B and C

Table 3.4 shows the involved stakeholders for each alignment process in Hospital A, B, and C. A few results stand out in this overview. First, representatives from both doctors and nurses played an executing role in almost all processes, in all three hospitals. The only exception is that there were no nurse representatives in the strategy formulation and strategy implementation processes in Hospital C. An important side note to the comprehensive representation of doctors and nurses in alignment processes, is that in EAM, this involvement was mainly visible in the process architecture. Furthermore, in none of the hospitals, patient- or external healthcare provider representatives were involved in strategic alignment processes. However, these stakeholders were involved in IT implementation and IT usage, although this involvement only considered the EMR's portals for these specific stakeholders.

Moreover, Hospital C used many external project employees in IT implementation, compared to Hospital A and B. Lastly, in the IT usage process, in all hospitals, apart from

Table 3.3. Hospital case overview

	Hospital A	Hospital B	Hospital C
Size	750-1000 beds	500-750 beds	>1000 beds
No. employees	5000-7500	2500-5000	10000-12500
Simultaneous merger?	Yes	Yes	No
Go-live year	2018	2018	2017
EMR vendor	System 1	System 2	System 1

end users, the software vendor was also involved. In all three cases, this involvement entailed on-floor support by employees of the software supplier in the first weeks after go-live, as an addition to in-house trained key users.

3.4.2 Co-evolution in Hospital A

Hospital A is a merger of two hospitals, whom both had their own EMR. The old EMRs of the formerly separate hospitals were outdated and very complex, making its management and governance near to impossible. Therefore, Hospital A decided to implement a new EMR, aiming to harmonize the processes of both hospitals, while putting more focus on patients. Hospital A chose to implement System 1. Figure 3.2 depicts our findings in terms of co-evolution in Hospital A.

Co-evolution within Hospital A's alignment processes

We found that Hospital A showed indications for co-evolution in all alignment processes, with a concentration in EAM. This relatively high amount of co-evolution lies in process

Table 3.4. Stakeholder involvement in alignment processes in each hospital

COISA process	Strategy formulation			Strategy implementation			EAM			IT Implementation			IT usage		
Stakeholder / Hospital	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Doctors	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Nurses	■	■		■	■		■	■	■	■	■	■	■	■	■
Administrative staff		■		■	■		■	■	■	■	■	■	■	■	■
Apothecary & Laboratory							■	■		■	■	■	■	■	■
Finance & Control		■					■	■		■	■	■	■	■	■
Internal ICT employees							■	■	■	■	■	■			
Executive management	■	■	■	■	■										
Finance management	■	■		■	■										
IT management	■	■	■	■	■	■	■	■	■						
Middle management	■	■		■	■	■	■	■		■	■	■			
Program management			■	■	■	■	■	■	■						
Software vendor				■	■		■	■	■	■	■	■	■	■	■
Consultancy		■	■	■	■		■	■		■	■	■			
Patients										■	■	■	■	■	■
Ext. healthcare providers										■	■	■	■	■	■
Ext. project employees												■			

harmonization and –definition. Namely, Hospital A created two types of teams for this task. Firstly, they had eight teams working on processes to be harmonized throughout the hospital, including for example medical processes, medication processes, and financial processes. In all of these teams, staff with know-how on the process at hand had an executing role in these teams to come to harmonized processes collaboratively. For example, in the team that considered the medication process, there were two physicians, an apothecary, a nurse, an operational IT employee and several types of assistants, both medical and administrative. These hospital-wide focused teams would then provide guidelines and rules for the second type of teams, i.e., specialism-specific teams. Each of the 34 specialisms had their own team, where also a broad set of role representatives of the specialism at hand was included. Co-evolution was clearest between these specialism-specific teams and hospital-wide teams in the pursuit of adherence to-, or agreed-upon deviation of hospital-wide process guidelines. This was a continuous process during the entire implementation, also providing structures for co-evolution in IT implementation and IT usage processes.

The strategy implementation process in Hospital A showed some indications for co-evolution, although not as frequently as in EAM. The program structure and -approach was a hybrid combination of insights of three crucial stakeholder groups, i.e., the

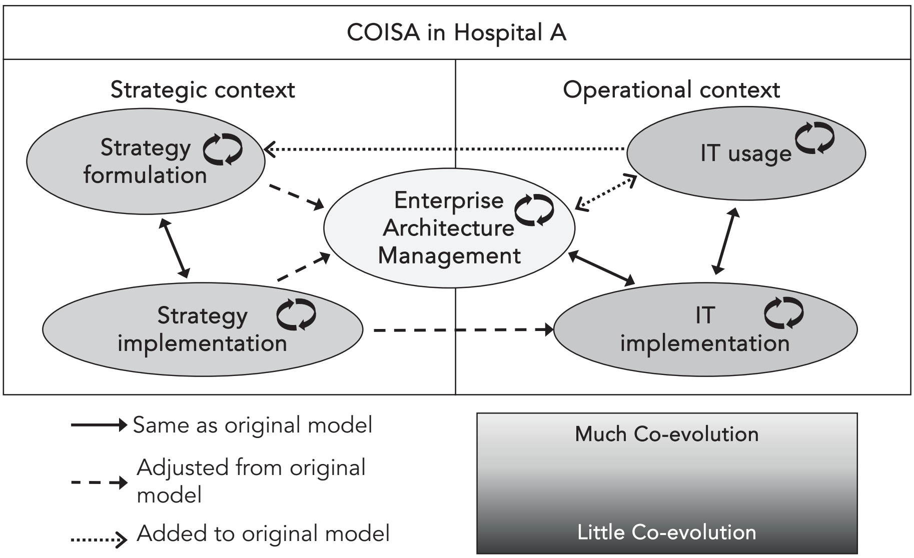


Figure 3.2. COISA in Hospital A

software vendor, internal program management of the hospital, and a consultancy firm. The structure regarding project planning and milestones was derived from the standard approach of the software vendor, while the program organization structure was developed by internal program management in collaboration with a consultancy firm. The abovementioned process-focused teams came from internal pro-gram management: One quote of an external consultant illustrates the influence of the hospital's program management herein: I had never seen it that way. In the beginning, I had my doubts because I thought, those are many meetings with many different people. But in practice, it works because everyone has their own share and the hospital-wide guidelines provided a basis for discussions.". Furthermore, the internal project manager who, among others, came up with the project structure, explains that some persuasion was needed toward the vendor, too: "*You have to be well-prepared because this vendor works mainly around applications, while we had deliberately set up our end-user teams around processes. In the beginning, this really was a struggle to keep it that way. But we believed in what we were doing: we felt like we knew why we did it that way. But we had to justify ourselves*"

Co-evolution between Hospital A's alignment processes
We found several indicators of co-evolution taking place between Hospital A's alignment processes. First of all, we found co-evolution between strategy formulation and strategy implementation. Strategy formulation was initially done by a committee consisting of executive management, doctors, middle management and IT management, as a basis for the EMR vendor selection. Nurses were represented by a member of middle management who was highly knowledge-able of nursing related processes. However, when the EMR implementation formally started, the newly formed project group did another iteration on the strategic principles, refining them. Nurses also participated in this project group. Because the formation of the project group was part of the strategy implementation process and the strategic principles were slightly adapted, this provides evidence for co-evolution between strategy formulation and strategy implementation processes.

Between strategy implementation and EAM and between strategy implementation and IT implementation, only one-way interactions could be identified, contrary to our original model: Namely, the earlier described project structure that enabled EAM on a processual level, evidently, directly influenced the EAM process. However, from our analysis, we could not identify and extract interactions in EAM that directly influenced strategy implementation. The same goes for IT implementation. Strategy implementation influenced IT implementation, i.e., the program planning and organizational structure applied in IT implementation were, of course, the result of the strategy implementation process. However, in maintaining the structures to implement strategic principles, influence from the strategy implementation process was also clearly visible: Namely, every meeting on the process- and system configurations in IT implementation was started with the core strategic principles to provide guidelines for the decisions to be taken. IT usage influenced strategy formulation, EAM and IT implementation processes, because end users were in-volved in each of these processes, bringing along their earlier experiences. The other way around, EAM and IT implementation had a direct influence on the IT usage process because these determined the work processes and corresponding system configurations, respectively.

3.4.3 Co-evolution in Hospital B

The EMR implementation in Hospital B was, like Hospital A, the result of a merger between two separate hospitals, who wanted to join forces and collaborate in providing better healthcare in the region. Hospital B chose to implement System 2. Figure 3.3 presents an overview of the co-evolution we found within and between the alignment processes during the EMR implementation in Hospital B.

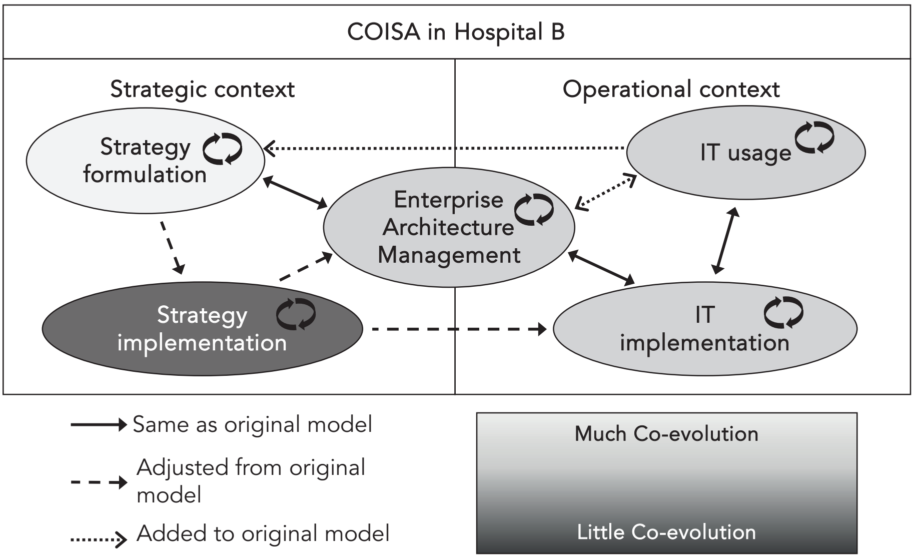


Figure 3.3. COISA in Hospital

Co-evolution within Hospital B's alignment processes

The first notable finding is that in Hospital B, we found indications for high levels of co-evolution taking place in strategy formulation. Namely, before the vendor selection, interviews and workshops with many different stakeholder groups were organized by the consultancy company involved in the selection. The insights from these interviews and workshops, combined with market insights and the overall hospital strategy formed the basis of the strategic principles underlying the vendor selection. Thus, in Hospital B, strategy formulation was a co-evolutionary process between executive management, consultancy and medical, administrative and IT staff of Hospital B. The latter three groups were involved in the abovementioned interviews and workshops.

The strategy implementation process in Hospital B had minimal indications for co-evolution. Namely, the project structure and approach was the standard approach of the vendor of System 2. As explained by the external program manager: *"The approach was proven, they* [the software vendor] *did this more often, so there was no discussion. It enables us to explain it to the hospital: this is how we will do it"*. The only possible indication of co-evolution in the strategy implementation process, is that the program plan was written by the external program manager, with input from several colleague consultants and one IT project manager in Hospital B. Consequently, the expertise and insights from the consultancy company probably directly influenced the final structures forming the basis of strategy implementation.

In the EAM process, there was co-evolution. In the more technical areas, this co-evolution took place between the software vendor and an internal ICT architect. However, co-evolution was more clearly visible on the level of process architecture, where two expert groups, i.e., one consisting of doctors and one consisting of nurses, jointly were responsible for hospital-wide processual decisions. In doing so, the expert groups received input from domains and underlying project groups responsible for department-specific process definition and corresponding IT implementation. The same structures provided the basis for co-evolution taking place in IT implementation. Within the IT usage process, there was co-evolution as well. This co-evolution mainly took place by colleagues training each other and by doing so, improving employees' system understanding and attitudes toward the new EMR.

Co-evolution between Hospital B's alignment processes

In Hospital B, EAM and strategy formulation processes showed co-evolution because, on the one hand, the ICT architect was directly involved in strategy formulation, while on the other hand, strategic principles following from the strategy formulation process, provided guidelines for the EAM process. EAM and IT implementation also showed co-evolution: namely, on the one hand, processual decisions stemming from EAM provided guidelines in IT implementation, while IT implementation sometimes influenced EAM, as there were examples where Hospital B would consciously deviate from architectural principles due to other circumstances. Co-evolution between EAM and IT usage took place because IT users were directly involved in the harmonization and redefinition of organizational processes, which in their turn constrained how the EMR could be used in practice. Comparable mechanisms were at play in the co-evolution between IT usage and IT implementation: IT users were directly involved in IT implementation processes, while the decisions regarding system configurations constrained EMR use in practice.

We also found indications for one-way interactions between processes. For example, IT users had a direct influence on the strategy formulation process. However, our analysis did not show indications of the strategy formulation process directly influencing IT usage. The same holds for strategy formulation and strategy implementation: as far as our knowledge goes, strategic principles were not changed due to interactions in the strategy implementation process. However, strategic principles did provide a basis for strategy implementation, providing evidence for a one-way interaction from strategy formulation to strategy implementation. In the same vein, strategy implementation provided guidelines for EAM and IT implementation, but the other way around, we could not identify any indicators of direct influence.

3.4.4 Co-evolution in Hospital C

Hospital C is a large hospital that decided to implement a new EMR because their old EMR was end-of-life. The hospital had a rigorous timeline to achieve its goals as the support of their old EMR would end soon. Figure 3.4 depicts the co-evolution in Hospital C.

Co-evolution within Hospital C's alignment processes

The first thing that stands out in figure 3.4 is the relatively low levels of co-evolution in strategy formulation and strategy implementation processes. The vision that formed the basis of the EMR implementation was formulated by a group of two doctors, two internal IT project leaders, and the external program manager. Two communication experts supported this group, and the hospital-wide strategy formed the basis of this vision. Results were presented to the board of directors and operational employee representatives. However, these presentations did not change the content of the strategy, so that no co-evolution could be demonstrated there, apart from possible co-evolution within the team responsible for the vision. In the strategy implementation process, there also was minimal co-evolution. The program structure was almost entirely set up by the external program manager, and the software vendor defined the program approach.

For EAM, comparable to Hospital A and B, in the more technical areas, co-evolution would only take place between internal IT employees and the software vendors. Moreover, again, most co-evolution within this particular alignment process could be found on the process level of EAM. Herein, Hospital C had an approach very similar to Hospital A: they appointed three core teams, i.e., one medical core team, one nursing core team, and one administrative core team. These teams were responsible to take decisions on hospital-wide processes. The core teams received input from the project teams, responsible for the configuration of the EMR. Furthermore, there were departmental teams, which were created to decide on specialism-specific system configurations. However, Hospital C had, contrary to Hospital A, no employees entirely dedicated to coordinating these departmental and hospital-wide teams.

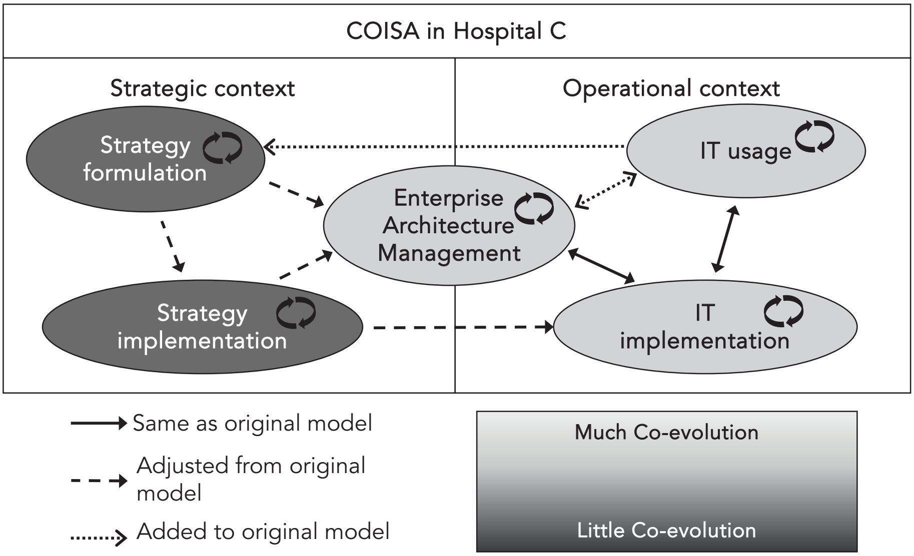


Figure 3.4. COISA in Hospital C

In IT implementation, the structures essential for EAM on a process level also ensured co-evolution to manifest between the employees configuring the system and the end-users in the departmental teams and core teams. However, an important side note, in this case, is that this went considerably better for the modules that served only one department, for example, the team responsible for the radiology module of the EMR. Some project teams had to communicate with all 45 specialist departments. Indeed, communication with departmental teams was a more significant challenge for two reasons: Firstly, it simply costs a lot more time to align decisions with 45 departments instead of one or two, and the team did not have enough resources to do this as intensively as they would have wanted. Secondly, as said, there were no people fully dedicated to the coordination among departmental teams, and between departmental and hospital-wide teams.

Co-evolution between Hospital C's alignment processes
We only found co-evolution between alignment processes in the operational context of this hospital. Co-evolution between IT usage and IT implementation occurred because end users were directly consulted and actively influenced decisions considering the configuration of the EMR in the IT implementation process. The other way around, this EMR configuration directly influences the way the EMR is used in practice. Furthermore, co-evolution between IT implementation and EAM occurred in two ways: First, the processual decisions made in the EAM process were reflected in the configurations of the EMR itself, and second, the processual decisions were constrained or enabled by (im)possibilities of the system. Lastly, we found co-evolution between IT usage and EAM, because end users were actively involved in the process redefinition within Hospital C. Between all other alignment processes, we only found one-way interactions: strategy formulation set the guidelines for EAM and strategy implementation, while strategy implementation set up the structures for EAM and IT implementation. Furthermore, there was a one-way interaction from IT usage to strategy formulation because doctors (i.e., end users) were involved in the strategy formulation process and took along their IT usage.

3.5 DISCUSSION, CONCLUSION, AND LIMITATIONS

This study shows that our COISA model is suitable to demonstrate and visualize alignment process interactions during EMR implementations and provides an insight into the interrelations between strategic and operational alignment and co-evolution between stakeholders. Following our rigorous analyses, we found that many different stakeholders take part in COISA processes, in both strategic and operational contexts. Moreover, we found that co-evolution takes place within all processes in all three hospitals. We also found evidence for interrelations between the different alignment processes. However, the degrees of co-evolution and the processes in which co-evolution prevailed differed from case to case.

A commonality across all cases is that the co-evolution within the EAM process especially played a substantial role in aligning the EMR configuration with strategies stemming from the strategy formulation process. The prevailing co-evolution between EAM and IT implementation in each of the hospitals might be a possible explanation for this finding. Another commonality found across all cases is the involvement of medical staff in all alignment processes. In all hospitals, doctors and in most cases, nurses, had an executing role in every process. This particular involvement might have contributed to the levels of support among other medical staff in the hospital and thus to successful EMR implementations. These particular outcomes are in line with previous findings on EMR alignment (Gewald & Gewald, 2018; Nguyen et al., 2017; Weeger et al., 2015).

Furthermore, it is notable that, even though all three case hospitals have patient centrality as one of their strategic principles, patient involvement in alignment processes is not very prominent and limited to discussions on patient portals in IT implementation, where they are represented as end users.

Differences between our case hospitals lie mostly in the locality of co-evolution. For example, in Hospital B, co-evolution seems to be concentrated more in the strategic context, while in Hospital C, this seems to be the case in the operational context. Hospital A falls right in between these hospitals by having its concentration of co-evolution in EAM, right between strategic and operational contexts.

This current study provides several notable contributions. Firstly, using COISA as a theoretical framework, we show that in all three of our cases, different stakeholder perspectives were represented in all alignment processes and interrelations also existed between strategic and operational contexts. In this effort, we provide a new theoretical lens to explain and understand the complex, multi-stakeholder alignment interactions that play a part in EMR implementations.

In particular, this new lens combines insights of interrelations between strategic and operational alignment contexts with interrelations between different stakeholder perspectives. This understanding enables practitioners to target improvement areas in integrally addressing internal and external complexity faced by hospitals, as both perspectives are crucial in the challenge of aligning EMRs with hospitals' strategies, goals, and needs. Furthermore, we refine and empirically validate our COISA model in an EMR implementation context, providing a solid basis for further operationalization of this theoretical concept. In doing so, we add to the knowledge base of BITA generally and COISA specifically.

Our study has several limitations that should be addressed by further research. Firstly, our study only focuses on EMR implementations and thus does not take into account the interactions that are at play during EMR operations. A more in-depth investigation of COISA during EMR operation builds upon the research by Sulaiman and Wickramasinghe (2014), who identified a gap to exist between HIT implementation- and operations phases. Another limitation of our study is that we used a retrospective interview technique, which might have slightly altered the perceptions of real-life experiences of our respondents. Future research could aim to use a more longitudinal approach, adding observations as a research method to get a more comprehensive view of the studied phenomena. Moreover, we did not take into account the patient perspective in this current study, which would be especially interesting in the operations phase, as this is the phase where patients should be confronted with the EMR's effects and benefits. Lastly, we currently only focused on three cases, which all considered successful implementations. Future research could investigate a more substantial amount of hospital cases, possibly including failed implementations, to validate and compare findings, or even apply a more quantitative approach to get additional insights into the manifestation of COISA in a healthcare setting. Another line of thought that future research could address is to focus on the different enablers and inhibitors of these and other EMR implementations and to discover whether these manifested in our cases and thus could explain the successful go-live, despite or, possibly, thanks to their differences in terms of COISA.

4

ALIGNING EFFECTIVELY:
THE CASE OF ELECTRONIC MEDICAL RECORDS

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ABSTRACT

Co-evolutionary IS-alignment (COISA) is a relatively new approach to understanding business-IT alignment (BITA) in complex environments. It is defined as continuously exercised alignment processes, characterized by co-evolutionary interactions between different IS stakeholders, in pursuit of a common interpretation and implementation of what it means to apply IT in an appropriate and timely way, in harmony with strategies, goals, and needs. This concept is well applicable in hospitals, given their many different stakeholders and quickly changing environments. For example, although hospitals heavily invest in advanced Electronic Medical Records (EMR), it remains unclear how EMR should align with the strategies, goals, and needs of hospitals and its stakeholders. Earlier work has shown that COISA may be a useful lens in revealing the manifestation of stakeholder interactions behind alignment during EMR implementations. However, it is insufficient only to assess the manifestation of COISA interactions, as this is no guarantee that these interactions are effective in pursuing alignment. Our study reveals facilitators of efficacious COISA interactions during EMR implementations, using theoretical insights on BITA, COISA and efficacious dynamics in complex organizations and empirical insights from a single case study and three focus groups. Our findings reconcile and complement existing knowledge, specifically for EMR implementations.

Keywords: Co-evolutionary IS-alignment, Electronic Medical Records, Business-IT alignment, Complex Adaptive Systems.

4.1 INTRODUCTION

In the past decade, contemporary hospitals have been implementing advanced, integrated Electronic Medical Records (EMR) at an unprecedented speed (Chang & Gupta, 2015; van Poelgeest et al., 2017). EMR consist of electronic repositories of medical histories of patients, which are maintained over time (Kohli & Tan, 2016). However, advanced EMR also provide additional functionalities, such as information integration across medical departments, complex healthcare process support, administrative support, and research support (Raghupathi & Tan, 2008; Sulaiman & Wickramasinghe, 2014; Walraven et al., 2019). This expansion of the reach and influence of EMR causes these EMR systems to be increasingly vital for a growing set of stakeholders. Moreover, hospitals face a complex environment due to quick technical developments in e-health, increasing patient expectations, and changing legislation (H. Liang et al., 2017; Miller & Tucker, 2009; van de Wetering, Versendaal, et al., 2018). Existing EMR implementation studies confirm that different stakeholder groups have different needs to leverage the benefits they experience from EMR (Goo et al., 2015; Sulaiman & Wickramasinghe, 2014; Walraven et al., 2019). However, the specific facilitators that are needed to reconcile these stakeholder needs into one single EMR as well as possible, are scarcely studied and do not explicitly focus on the complex and dynamic context surrounding these systems. Thus, the quest for alignment of EMR with strategies, goals, and needs of the hospital and its stakeholders is an increasingly complex, but crucial challenge that may benefit from novel approaches specifically designed for complexity (Benbya & McKelvey, 2006b; Goo et al., 2015; Merali & McKelvey, 2006).

More general studies into business-IT alignment, or to apply IT in an appropriate and timely way (Ghosh & Scott, 2014; Heier et al., 2012; Li & Tan, 2013; Luftman & Kempaiah, 2007) have long recognized the need for a different approach to the alignment challenge given rapid change, unpredictability and blurring boundaries between business- and IS functions (as also seen in EMR implementations) (Benbya & McKelvey, 2006b; Merali & McKelvey, 2006). These issues have led to calls for reconceptualization of alignment given complex conditions, including Ciborra (1997, p. 79), who argued for *"An enlarged notion of alignment within a hybrid network of semi-autonomous actors"* and Leonard (Leonard, 2008, p. 567), underlining that, given a continuous perspective on alignment, *"the alignment of an organisation's information systems to its needs should be characterized by identifying the specific groups of people and the specific technologies, involved in any organisational change."*

A stream of IS research that addresses these issues, is the complex adaptive systems (CAS)-based notion of co-evolutionary IS-alignment (COISA) (P. Allen & Varga, 2006; Amarilli et al., 2016; Benbya & McKelvey, 2006b; Leonard, 2008; Walraven et al., 2018). In this research, alignment can be viewed as an interpretation and implementation, shared across different IS stakeholders, of what it means to apply IT in an appropriate and timely way. This interpretation and implementation, in its turn, emerges from co-evolutionary interactions between IS stakeholders within and between strategic, operational, and individual levels of the organization (Benbya & McKelvey, 2006b). Furthermore, the notion of COISA is based on the viewpoint that organizations facing complex conditions have to respond with a critical degree of internal complexity to remain viable, i.e., the principle of requisite complexity (Benbya & McKelvey, 2006b, p. 290). Specifically, organizations facing complex conditions may benefit from the application of certain CAS principles in the orchestration of stakeholders (Benbya & McKelvey, 2006b; Zhang, Chen, Lyytinen, et al., 2019).

Recently, a multiple case study on three successful hospital EMR implementations has shown that a CAS-based co-evolutionary perspective on alignment may indeed be a practical approach in understanding stakeholder interactions behind alignment during EMR system implementations (Walraven et al., 2019). In particular, this study takes a conceptual lens of COISA as interactions between IS stakeholders within and between alignment processes to illustrate how and where these interactions manifest in practice. An essential limitation of this particular work is that it is insufficient only to assess the manifestation of co-evolutionary interactions between stakeholders to comprehensively explore the value of COISA in the context of hospital EMR. Specifically, creating a two-way dialogue between different stakeholders in pursuit of a common interpretation an implementation of what it means to apply the EMR system in an appropriate and timely way, does not necessarily imply that this common interpretation is, indeed, reached and maintained. In other words, it does not guarantee the manifestation of *efficacious* co-evolutionary interactions toward IS-alignment.

Based on the above, the present study aims to go beyond current COISA applications in healthcare and looks to explore efficacious co-evolutionary interactions between stakeholders toward alignment during EMR implementations. In doing so, we explore particular aspects that health IT practitioners could consider when striving for alignment and add to the knowledge base on co-evolutionary perspectives on business-IT alignment. Furthermore, we add to the knowledge base on effective EMR implementations by adding a new theoretical perspective that focuses on complex conditions to the existing insights in this particular field (Chen et al., 2019). Our work and line of reasoning are moreover congruent with the recent call for more case study research on business-IT co-evolution (Zhang, Chen, Lyytinen, et al., 2019) and with the call for unraveling the process of IS business value generation (Schryen, 2013). Our research question is as follows:

RQ: How can efficacious co-evolutionary interactions toward alignment be facilitated during Electronic Medical Records implementations in hospitals?

To answer this question, we integrate existing conceptual insights on co-evolutionary (alignment) interactions to form a sound theoretical basis. Following, we conducted an interview-based single case study on an EMR implementation in a Dutch hospital. Finally, we performed three focus groups to deepen our case study findings and gain some additional perspectives: one focus group in another hospital that recently implemented a new EMR, and two focus groups with consultants specialized in healthcare IT and EMR implementations. In the remainder of this paper, we will first outline our theoretical framework. Then, we will explain our research methods, and finally, we will discuss our results, conclusions and make some suggestions for possible future research.

4.2 THEORETICAL FRAMEWORK

4.2.1 Complex Adaptive Systems and Co-evolutionary IS-alignment

As explained, the theoretical basis of COISA lies in CAS conceptualizations. A CAS can be viewed as a "co-evolving multilayer network" (Thurner et al., 2018). Core characteristics include that CASs exist of many different interacting elements and that the interactions between these elements in a CAS may change over time (Holland, 1995). Anderson (1999, p. 219) was among the first to apply CAS thinking to socio-technical organizations and stressed that the essence of this perspective is that *"[…] at any level of analysis, order is an emergent property of individual interactions at a lower level of aggregation"*. Other characteristics that are in line with these ideas and often mentioned in existing literature include dynamism, interdependence, adaptation, connectivity, flow, non-linearity, self-organization, and co-evolution (Anderson, 1999; Holland, 1995; Onix et al., 2017a).

Built upon this theoretical perspective, COISA is a relatively new approach to understanding and pursuing business-IT alignment (Amarilli et al., 2016; Zhang, Chen, Lyytinen, et al., 2019). The work by Walraven et al. (2018) builds upon the insights of earlier co-evolutionary alignment studies (Amarilli et al., 2016, 2017; Benbya & McKelvey, 2006b). This particular study identifies five different COISA processes in a structured literature review on alignment studies with a CAS perspective. Within and between these processes, heterogeneous IS stakeholders interact in co-evolutionary ways, pursuing alignment. We continue to use this perspective as a theoretical basis as it is developed specifically for complex conditions and has been empirically applied in an EMR context before (Walraven et al., 2019).

The alignment processes as mentioned above are visualized in figure 4.1 and include Strategy formulation, Strategy Implementation, Enterprise Architecture Management (EAM), IT implementation, and IT usage. We base our definitions of the alignment processes (table 4.1) on the work by Walraven et al. (2019) to ensure conceptual consistency. Furthermore, we define COISA here as: *Continuously exercised alignment processes, characterized by co-evolutionary interactions between different IS stakeholders, in pursuit of a common interpretation and implementation of what it means to apply IT in an appropriate and timely way, in harmony with business strategies, goals, and needs.* We thus respond to earlier criticisms on traditional alignment perspectives, by focusing on actors (IS stakeholders), and their networked, co-evolutionary interactions (Ciborra, 1997; Leonard, 2008).

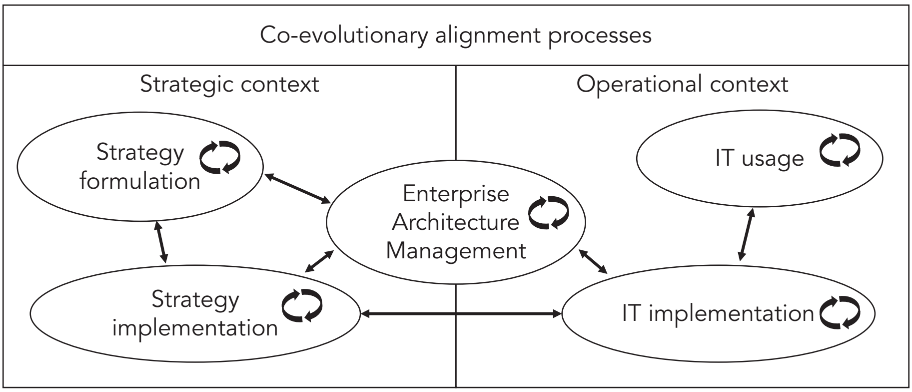

Figure 4.1. Conceptual model of co-evolutionary IS alignment

Table 4.1. Working definitions of COISA processes (adapted from Walraven et al. (2019))

Alignment process	Working definition
Strategy formulation	The process of defining strategic objectives underlying a particular IS
Strategy implementation	The process of setting up and maintaining structures to ensure that strategic objectives are realised in the operational context of the organisation
Enterprise Architecture Management	The process of managing an organisation's architecture
IT implementation	The process of embedding an IT solution within an organisation
IT usage	The process of employing a system to perform a task

4.2.2 Facilitators of efficacious COISA interactions

We used a structured search strategy to get a comprehensive overview of the literature that may inform our study in terms of facilitators of efficacious COISA. In doing so, we searched the Web of Science database, covering an extensive range of scientific fields. From our search results, we selected articles that highlight in their title or abstract that they focus on indicators, mechanisms or factors that lead to alignment, emergent order, emergent patterns, or self-organization among actors in organizations.

The findings of this extensive literature search show that several authors have done relevant research in this particular area. For example, Amarilli et al. (2017) identify factors influencing co-evolutionary alignment mechanisms, including (1) triggers, (2) dynamic actors, (3) controlling parameters, and (4) enablers. These come from traditional BITA studies, not necessarily taking a co-evolutionary alignment perspective or focussing on complex conditions. Nonetheless, they may provide valuable insights for our current study as these authors do apply the identified factors to co-evolutionary alignment mechanisms and may thus be relevant in unveiling efficacious co-evolutionary interactions toward alignment.

A second strand of research that may be of interest to the current study includes complexity theory and CAS-inspired alignment literature (Benbya & McKelvey, 2006b; Zhang, Chen, & Lyytinen, 2019; Zhang, Chen, Lyytinen, et al., 2019). Although mainly conceptual, the theoretical foundation of these works may be a promising direction to address the complexity in EMR alignment. These studies describe governance principles to enable efficacious co-evolutionary alignment, including deviation amplification, tension, rate of genetic variance, requisite complexity, near-decomposability, communication, resource allocation, and experimenting and learning (Benbya & McKelvey, 2006b; Zhang, Chen, & Lyytinen, 2019). Some of these principles are integral to our foundational COISA framework. Namely, the principle of requisite complexity is addressed by our view that the whole of IS stakeholder interactions resembles a CAS and thus should be able to address environmental complexity (Zhang, Chen, & Lyytinen, 2019). Furthermore, deviation amplification, indicating "*Two species mutually reinforcing the adaptive success of the other*" (Benbya & McKelvey, 2006b, p. 292), is inherent to the co-evolutionary nature of these interactions. The other principles may, however, be informative to identify the facilitators of efficacious COISA interactions.

A third research stream that has the potential to integrate and refine the abovementioned insights considers CAS- or complexity-inspired literature on efficacious decision-making in organizations facing complex conditions. (Campbell-Hunt, 2007; Eisenhardt & Sull, 2001; Grant, 2003, 2008; Mackey et al., 2006; McKelvey, 2001; Okhuysen & Eisenhardt, 2002; Rodon & Silva, 2015). These studies inherently focus on social and organizational aspects given complex conditions and use a theoretical foundation of complexity- and CAS studies. This notion resonates very well with the conceptualization of COISA as interactions between IS stakeholders in pursuit of alignment. Therefore,

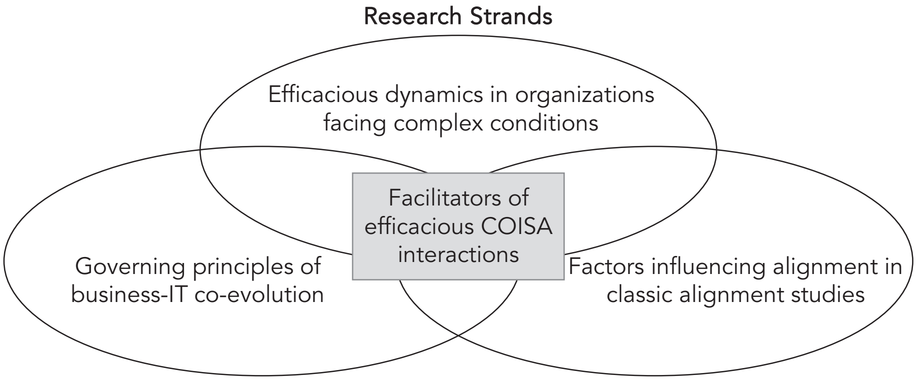

Figure 4.2. Strands of research taken into account in the theoretical framework

we use this stream of research to select and integrate the relevant findings of the first two strands of theory, as depicted in figure 4.2.

We followed a stage-based review approach in our study. In doing so, we used inductive coding techniques to identify the different facilitators mentioned across the literature (Saldaña, 2015) and thoroughly discussed the categorization of each specific facilitator among the research team. We finally identified two broad categories of facilitators in improving COISA efficacy. These categories are: (1) Facilitators that apply to IS stakeholders themselves and the co-evolutionary interactions between them, including adaptive tension, heterogeneity of actors and interconnections between actors; and (2) Facilitators considering the form or content of the types of intellectual alignment *decisions* emerging from these co-evolutionary interactions in specific alignment processes. These decisions, because of their form and content, may, in turn, benefit the efficacy of following COISA interactions. This category includes opting for a modular, flexible IT infrastructure (intellectual alignment decision in the EAM alignment process), defining strategy and architecture as simple rules (intellectual alignment decisions in the Strategy formulation & EAM processes) and balancing planned and emergent decision-making (intellectual alignment decisions in IT Implementation & Strategy Implementation processes). We will now elaborate on these categories and explain how they relate to existing work in each of the three described research strands.

Stakeholders & Interactions

Facilitators of efficacious interactions considering stakeholders and interactions tell us some-thing about the motivations (adaptive tension) and means (heterogeneous actors, interconnections between actors) to initiate and continuously maintain co-evolutionary alignment processes among IS stakeholders. We will now elaborate on the theoretical foundations of these facilitators.

The first facilitator that is found in the existing literature is adaptive tension, which we define as the motivating force that causes co-evolutionary interactions in alignment processes to initiate and continue, i.e., Alignment Motivation. Several articles focusing on dynamics in human or socio-technical systems in general touch upon this subject. For example, in their article discussing the future of management given modern complexity, Grant (2008) argues for adaptive tension to be an essential focus of managers. McKelvey (2001) applies complexity theory to organizations and looks into how to leverage distributed intelligence (DI). This study also mentions adaptive

The first facilitator entails infrastructure flexibility, as highlighted by Amarilli et al. (2017). Examples of flexible infrastructures include having a modular system and using updated technology. This particular facilitator is considered an intellectual alignment decision, because defining a modular IT landscape is an architectural decision. Taking this decision and acting upon it, therefore, is done as part of co-evolutionary alignment interactions in the EAM process, but it does not inherently characterize the stakeholder interactions themselves.

The second facilitator in this category is the use of simple rules, which is addressed by several authors. Campbell-Hunt (2007, p. 807) mention that these simple rules *"[…] are set free to adapt, add, and discontinue actions as a function of their effectiveness in social interaction."*. Eisenhardt and Sull (2001, p. 110) go one step further and argue for strategy as simple rules, *"[…] providing just enough structure to allow it to capture the best opportunities*." This viewpoint is underlined by Grant (2003), while Grant (2008) further refines the idea of simple rules by explicating their goal of creating boundary conditions for decision-making. Okhuysen and Eisenhardt (2002, p. 370) endorse this perspective in their study on group knowledge integration: *[…] simple formal interventions provide simple rules that act as a source of semi-structure […] that can help groups self-organize their improvement and pace their attention to both adapting and executing their task.*" Literature considering business-IT co-evolution does not explicitly speak of simple rules for efficacious co-evolutionary alignment interactions. However, they may be a practical manifestation of the controlling parameters and enablers as introduced by Amarilli et al. (2017). Controlling parameters reinforce or reduce dynamic actors' actions, while enablers motivate these dynamic actors to undertake transformative action in the different alignment processes.

The third facilitator in this category considers balancing planned and emergent decision-making. We define this facilitator as consciously balancing top-down decisions and bottom-up, emergent decisions. This facilitator is referred to in different ways in existing literature, e.g., as a combination of positive and negative feedback loops (Campbell-Hunt, 2007). Grant (2003) speaks of planned emergence, giving business units autonomy within constraints and guidelines as developed by corporate management. Mackey et al. (2006, p. 10) apply these ideas by thinking about modularization not of IT systems, but of the organization itself, based on the idea that "*[…] systems […] evolve toward fitness fastest when the cells (modules) are nearly, but not totally, disconnected from higher levels in biological or social system hierarchies*". Lastly, Rodon and Silva (2015) underline the importance of balance between planned and emergent decision-making in a healthcare information infrastructure setting. The topic of emergent decision-making is mentioned by Benbya and McKelvey (2006b) in the principle of near decomposability, i.e., to find the right balance in subunit autonomy and centralized steering in alignment management. Zhang et al. (2019) also mention bottom-up initiatives in their principle of experimenting and learning. Furthermore, these ideas tie in with the finding of Amarilli et al. (2017) that the absence of strict and rigid procedures is an alignment enabler.

4.3 RESEARCH METHOD

To answer our research question, we did a single case study of an EMR implementation in a top clinical hospital in the Netherlands, specifically focused on identifying the facilitators of efficacious alignment interactions across different stakeholders. This method enables us to investigate "*a contemporary phenomenon […] in depth and within its real-world context*" (Yin, 2018, p. 15). Subsequently, we conducted three focus groups, one in a second hospital, and two with industry experts. These focus groups were conducted to deepen our insights from the single case study.

4.3.1 Case study

The studied hospital implemented a new EMR (System A) in 2018 because their old system reached end-of-life. The new system would have a large impact on the hospital as a whole, since the old system was, in many ways, tailor-made to the separate specialisms in this hospital. The new EMR consists of a standardized, integrated solution that has recently been implemented across many hospitals in the Netherlands. This hospital is thus, at least in the Dutch context, considered a typical case study, in line with recommendations by Yin (2018) to improve external validity. Apart from inpatient and outpatient records, the EMR also includes functionalities for specialist work processes and administrative support across specialisms. Thus, specialisms who were used to working in silos and with autonomy now had to harmonize their ways of working. Furthermore, although the system is highly standardized, compared to the old EMR of this hospital, hospital-specific configurations still have to be made during the implementation phase. On these configurations and their impacts on work processes, the involved stakeholders had to decide to optimize the alignment of the EMR with stakeholders' strategies, goals, and needs. The EMR was finally implemented within-time, within-budget, and within-scope. Table 4.2 shows the interviewed roles, along with their involvement in the different alignment processes.

Interviewees were selected so that medical, administrative, technical and external perspectives were represented, in line with recommendations of stakeholder-focused alignment studies (Pouloudi et al., 2016). We also aimed to interview at least two respondents for each COISA process, so that our conclusions are demonstrably applicable to the COISA model as a whole. Interviews lasted, on average one hour, and questions were based on the approach taken by Walraven et al. (2019), however, with a focus more on facilitators of efficacious COISA interaction instead of on manifestation of co-evolution itself. Analyzed documentation included planning documents, the program structure, and a report on program objectives and corresponding operational elaborations.

4.3.2 Focus groups

To deepen and evaluate our insights from the single case study, we performed three focus groups. Focus groups are a valuable addition to the individual interviews done in our single case study because they can bring different perspectives together in a discussion Morgan (1996). One focus group was conducted in a second hospital that recently implemented a new EMR, to see if similar facilitators are found as those in the first hospital. This focus group consisted of six participants, representing medical staff (2), management (1), IT (1), and digital advisors (2), whose role explicitly considers the alignment of the EMR with hospital strategies, goals, and needs. A second focus group was done at a consulting firm specialized in healthcare IT, involving ten junior health IT consultants and one highly experienced health IT consultant, whose combined practical experience and recent education may provide interesting insights. The third focus group was conducted in yet another consulting firm specialized in EMR, involving four senior health IT consultants, whose insights are based on years of experience in the practice of EMR implementations. To prepare these focus groups, we set up a focus group protocol outlining the structure during the focus group. This structure was informed by the different alignment processes and the facilitator categories, as identified in our theoretical framework and our initial findings from the case study. We used theoretically informed guidelines to tailor the structure to the focus group set-up (Merton et al., 1990; Morgan, 1996; Stewart & Shamdasani, 2014). We asked three academics experienced in conducting focus groups to review our protocols and refined them accordingly.

4.3.3 Coding and analysis

All interviews and focus groups were recorded and transcribed. Additionally, pictures of paper input (notes written on post-its and flip overs) from the focus groups were added to the research data for further analysis. Coding was done by one of the researchers. To ensure the reliability of our analysis, we had regular meetings among the research team to talk about the coding process and analysis as the coder progressed, as recommended by Saldaña (2015), based on Burant et al. (2007) and Strauss (1987). We first coded the data inductively, identifying relevant facilitators of efficacious COISA interactions. For example, the following excerpt was coded with "Clear accountability": *"And appointing the problem owner. You are responsible, but also qualified to take decisions on this matter."* After this initial coding, we performed an additional analysis aiming to categorize all identified facilitators based on our theoretical framework. This analysis resulted in four

overarching categories, which are a slight refinement compared to our original categorization, as presented in section 2. The final categories include (1) Alignment motivation, (2) Stakeholder involvement, (3) Interconnections, and (4) Alignment decisions.

4.4 RESULTS

Table 4.3 shows our findings for each data collection method and category of facilitators. We will now elaborate on our findings.

4.4.1 Alignment motivation

The facilitator category Alignment motivation considers facilitators motivating IS stakeholders to engage in co-evolutionary interactions in a specific alignment process, answering the question: *"Why do we talk about this in the first place?"*. In this category, six facilitators were mentioned in all alignment processes and data collection methods. These facilitators include (1) Accountability & Mandate, (2) Planning & Monitoring, (3) Intrinsic motivation of actors, (4) Perceived EMR benefits, (5) (Prevention of) misalignments, and (6) Legal obligations. Accountability and mandate are particularly crucial in the EAM process, as responsibilities for processes crossing departmental boundaries are often not clearly assigned. Some facilitators were only mentioned in some alignment processes. These facilitators include (7) Support and leadership of Executive management, which was only mentioned for Strategy Formulation and EAM, (8) Compensate involved actors' time, mentioned for Strategy Implementation, EAM and IT usage and (9) End-user training, which was only mentioned for IT usage.

4.4.2 Stakeholder involvement

The category of stakeholder involvement involves facilitators related to the selection of actors to be involved in COISA processes, to ensure efficacious COISA interactions. In other words, the question to be answered here is: *"Who do we involve to ensure efficacy of alignment interactions?"*

Five facilitators in this category were mentioned in all alignment processes and different data collection methods. These facilitators include (1) Different perspectives represented (e.g., medical, IT, financial, quality management, etc.), (2) Internal & External actors, (3) Champions / motivators (4) 'Translators' and/or language unity, and (5) Knowledge of EMR (im)possibilities. Respondents from the various data collection methods unanimously agreed on the importance to include different perspectives to ensure all perspectives are taken into account in the final decision-making process. As an illustration, the CMIO in our case study hospital pointed out: *"The managerial staff of the hospital mostly thinks in terms of process optimization. And that is not necessarily the only thing that we* [doctors] *are looking for"*. The specific perspectives to include in the discussed alignment processes may vary for each hospital, depending on hospital type, hospital size and organizational culture, according to the respondents. Involving a mix of internal and external actors was also underlined, to balance knowledge of the organization and external expertise based on earlier experience.

Two facilitators were mentioned across all alignment processes except IT usage, namely (6) "Unofficial" leaders and (7) Openness to perspectives. Regarding the involvement of "unofficial" leaders, one focus group C participant clarified: *"Make sure you know who the unofficial leaders are. Often, you see, for example that the youngest medical specialist in the department is involved in the project group, and not the medical specialist who is unofficially in charge within their department."*

Three facilitators in this category were brought up relatively sparsely, both in terms of alignment processes and data collection methods. These facilitators include (8) leadership, (9) representatives of related projects, and (10) representatives of related systems. A consultant in focus group D illustrated the importance of connecting with related projects: *"I have worked for a hospital that did a PACS implementation simultaneously to the EMR implementation. Those projects did not interact at all, while I think there are many interdependencies, and they should, in fact, interact with each other".*

Table 4.2. Interviewees & their active involvement in alignment processes

Alignment process Interviewee	Strategy formulation	Strategy implementation	EAM	IT implementation	IT usage
Team leader patient portal				■	
Team member nursing records			■	■	■
Team leader nursing records	■	■	■	■	■
Team leader diagnostic specialisms				■	
Digital doctor			■	■	■
Project manager admin.		■		■	
Project manager outpatient records		■		■	
Chief Medical Information Officer	■	■	■		
Internal program manager	■	■			
External program manager	■	■			

4.4.3 Interconnections

Interconnections refer to the *means* that IS stakeholders have to engage in co-evolutionary alignment interactions, thus answering the question: *"By which means do we interact on making decisions on these topics among IS stakeholders to ensure the efficacy of alignment interactions?"*. Our findings reveal four facilitators of efficacious

COISA interactions that are mentioned across all alignment processes in this category. These facilitators include (1) Formal governance (2) Transparency, (3) Existing informal networks, and (4) Supporting tools. Firstly, formal interconnections were deemed important to *"know where which knowledge is,"* as explained by one of the participants of focus group B, but also to ensure that support can be easily arranged. Furthermore, supporting tools to enable interconnections, work towards language unity and transparency in needs and decisions were deemed highly important. One of the participants of focus group B elaborated: *"We have implemented Sharepoint and that keeps improving, I view it more and more as a means to create unity of language"*. Existing informal networks are also highly relevant, as explained by one of the participants in the hospital focus group: "*There is a part that does not take place in formal organizational structures, but over coffee, and that is what I am talking about. If you want to be effective, you need coffee.*".

Two facilitators in this category are mentioned only in a few alignment processes. These facilitators include (5) Physical project spaces and (6) Creating informal networks. They seem to be especially crucial for EAM, where cross-departmental or cross-functional decisions that need to be taken by actors that normally do not often collaborate and thus where there are no existing informal networks in place. An example of the creation of informal networks for these issues considered the organization of "speed-dates" among program participants in our case study hospital, as explained by one of the interviewees: *"We had speed-dates among team leaders in our restaurant, so we all knew who was involved in the program. Every two minutes you got to talk to another team leader. And that feels really different than just having a list of names on paper."* Furthermore, in this case study hospital, a specific part of the hospital building was dedicated to people involved in the EMR implementation. In this building, because everyone was quite literally in close proximity to each other, informal networks were easily formed, and many issues could be quickly and easily resolved.

4.4.4 Alignment decisions

Some of the facilitators consider specific decisions that are taken in the alignment processes themselves, and that may, in turn, benefit following COISA interactions in those same processes. In other words, the question to be answered here is: *"Which alignment-related decisions among IS stakeholders improve the efficacy of future alignment interactions?"* These facilitators include (1) Common guidelines, (2) Central coordination, (3) Allow emergent decision-making, and (4) Have technical infrastructure in place. We will now elaborate on these facilitators.

Table 4.3. Findings for Case study first hospital (A); Focus groups at second hospital (B); consultancy company 1 (C) and consultancy company 2 (D)

COISA process		Strategy Formulation				Strategy Implementation				EAM				IT Implementation				IT usage			
Data collection methods		A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
	Facilitators per category																				
Alignment motivation	Accountability & Mandate		X		X		X		X	X	X	X	X	X	X		X	X		X	
	Planning & Monitoring	X	X		X	X		X	X	X			X	X			X	X	X		
	Intrinsic motivation actors	X						X		X	X	X	X	X	X	X				X	X
	Perceived EMR benefits		X	X	X			X	X			X				X	X			X	X
	(Prevention of) misalignments	X	X					X	X			X	X				X			X	X
	Legal obligations			X	X			X	X			X	X			X	X			X	
	Support & leadership executive management.					X	X		X			X									
	Compensation of involved actors' time						X					X								X	
	End user training																	X	X	X	
Stakeholder involvement	Different perspectives represented	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Internal & External actors	X	X	X	X	X	X	X	X			X	X	X	X	X	X				X
	Champions / motivators	X	X		X	X	X	X	X			X		X	X		X		X		X
	'Translators' and/or language unity		X			X				X	X		X	X	X		X	X		X	X
	Knowledge of EMR (im) possibilities				X		X	X	X					X	X	X	X		X		X
	"Unofficial" leaders		X		X		X	X	X			X	X			X	X				
	Openness to other perspectives		X		X			X			X	X			X						
	Leadership						X				X				X				X		
	Representatives of related projects					X		X					X								
	Representatives of related systems			X								X				X					

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Table 4.3. (continued) Findings for Case study first hospital (A); Focus groups at second hospital (B); consultancy company 1 (C) and consultancy company 2 (D)

COISA process		Strategy Formulation				Strategy Implementation				EAM				IT Implementation				IT usage			
Data collection methods		A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
	Facilitators per category																				
Interconnections	Formal governance	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Transparency		X		X		X		X		X	X	X		X		X		X		X
	Existing informal networks				X		X	X		X		X	X			X	X	X			X
	Supporting tools		X				X		X		X		X		X	X			X	X	
	Physical project spaces		X							X		X		X		X					
	Creating informal networks									X			X								
Alignment decisions	Common guidelines	X	X	X	X		X		X	X	X	X			X	X	X		X		X
	Central coordination						X	X	X		X	X	X		X	X	X				
	Allow emergent decision-making									X	X			X	X						
	Have technical infrastructure in place											X			X					X	

Firstly, the facilitator of having common guidelines is important to ensure co-evolution between decisions in strategic and EAM alignment processes and interactions in operational alignment processes. As explained by one of the medical participants of focus group B: *"It has to be compact and readable, because it has to appeal to people, it has to stick, people have to identify with it. You cannot come up with something and say, this is it, you have to create support."* Our case study findings confirm this combination of simplicity and communication: One project leader explained that strategic principles played a major role in their decision-making, while others were more neutral, finding the principles too general to really guide decisions or so self-explanatory that they deemed it unnecessary to pay extra attention to them in the process. Some interviewees were only vaguely aware of their existence.

Central coordination of alignment-related decision-making was mentioned by several respondents as well: *"I think it is important to have a central group of stakeholder representatives with a clear vision, who are not afraid to put the interests of the organization over their own, individual interests."* On the other hand, in our case study, there were some examples of successful emergent decision-making. For example, the team member nursing records explained that cardiac nurses themselves came up with the idea to connect to first aid nurses because they share many work processes and patients. Therefore, it seemed logical to them to standardize some EMR configurations for both departments so that the new EMR would support the already existing inter-departmental collaboration. Further inquiry shows us a combination of central and decentral decision-making: Looking at the broader program structure in the case study hospital and in the focus group hospital, we noticed in both hospitals a specific choice for a modular program organization, where specialisms were authorized to make decisions for their own department locally, however, within centrally coordinated strategic and architectural boundaries.

The final facilitator that respondents identified in this category is having good supporting infrastructure in place. For example, a participant of focus group B explained: *"If you want to build on your software, you need sufficient testing environments, you need sufficient performance, et cetera."*

4.5 DISCUSSION & CONCLUSION

Our empirical findings resonate with earlier work, however some specific findings of our study are new, as is discussed below.

4.5.1 Alignment motivators other than misalignments or managers

Earlier studies perceive adaptive tension to come mainly from management (Benbya & McKelvey, 2006b; Grant, 2003, 2008) or from actors sensing misalignments (Amarilli et al., 2017), which both motivate actors to engage in alignment interactions. Our findings suggest that these motivations may also come from legal obligations and perceived EMR benefits. Perceived EMR benefits are addressed in earlier studies as the personification of the IT champion (Amarilli et al., 2017), who actively stands for these benefits. However, our study suggests that actors who perceive EMR benefits and are thus intrinsically motivated to engage in alignment interactions are not necessarily champions who take the lead in communicating these benefits to others.

4.5.2 Inclusion of heterogeneous, but also specific actors

Existing studies suggests that it is crucial to include heterogeneous actors (Benbya & McKelvey, 2006b; Campbell-Hunt, 2007; Mackey et al., 2006) and to have champions and 'dynamic actors,' bridging the gap between business and IT (Amarilli et al., 2017) Our study confirms these insights, but also adds to this perspective by underlining the importance of including specific actors. These include 'informal' leaders (addressing existing power relationships) (Cross et al., 2004) and actors that are not only able to represent their perspective but who are also open to under-standing different perspectives.

4.5.3 Supporting communication tools and process-specific needs

In terms of interconnections, existing studies remain quite general and underline the importance of communication (Zhang, Chen, & Lyytinen, 2019), balancing strong and "weak-tie" bridges (Burt, 2009) and of conscious efforts to create informal networks (Mackey et al., 2006). We confirm these insights, and add to them by the strong indication of the importance of communicating transparently and of having a clear formal governance structure with well-defined responsibilities. Furthermore, supporting tools such as Sharepoint are found to be important in our study, but are not explicitly mentioned in earlier works. Lastly, we found that organizing activities to create informal networks is specifically essential for EAM. This outcome may be explained by the fact that this is where cross-departmental, cross-system and cross-functional decisions are made among actors that normally do not collaborate often and where informal networks thus do not yet exist as they do within departments.

4.5.4 Supporting infrastructure, but not necessarily flexible?

The alignment decisions that were identified in our theoretical framework, combining bottom-up and top-down decision-making and having clear common guidelines (Campbell-Hunt, 2007; Eisenhardt & Sull, 2001; Grant, 2003; Rodon & Silva, 2015), are confirmed in our study. Furthermore, having a good supporting infrastructure in place was also recognized, however, not necessarily in terms of flexibility or modularity. This may still have played a role because the EMR systems that were implemented and discussed were in fact, modular. Therefore, respondents may not have recognized this as explicitly beneficial because they may not be familiar with non-modular systems as a comparison.

4.5.5 Implications, limitations and future work

Our study suggests specific facilitators for efficacious COISA interactions during hospital EMR implementations, based on a single case study and three focus groups. In doing so, we answer to the recent call for more empirical studies on business-IT co-evolution (Zhang, Chen, Lyytinen, et al., 2019). We selected and integrated existing theoretical insights on efficacious interactions in socio-technical systems with studies on business-IT alignment and COISA to form an integral theoretical framework and build upon existing COISA studies. In this effort, we explicitly respond to earlier criticisms on traditional alignment perspectives, by focusing on actors and their networked, co-evolutionary interactions (Ciborra, 1997; Leonard, 2008). Furthermore, we are the first to explicitly connect insights on efficacious alignment interactions to the COISA processes that have been empirically demonstrated to be relevant in EMR implementations (Walraven et al., 2019). Our findings are particularly valuable to practitioners in hospital EMR implementations. Namely, they can use our findings as guidelines to enhance alignment-related decision-making given internal and external complexity by evaluating their existing alignment mechanisms based on the suggestions in this research and improve them accordingly.

The study is not without limitations. First, we focus on a single system, i.e., EMR. Although these systems are large and comprehensive and thus may be seen as typical for systems facing complexity, further research is needed to determine whether our findings apply to other systems in complex conditions. Moreover, we focused on the implementation phase of the EMR. Although this is a critical phase, future studies could take a longitudinal approach, also taking into account EMR operations. Furthermore, we only did one round of focus groups, which were exploratory in nature. It would be interesting to do some additional confirmatory iterations (Stewart & Shamdasani, 2014) to refine and strengthen our findings. Lastly, this study chose not to concentrate on specific outcomes of COISA given complex conditions. Future studies could focus on the specific pathways to operational value by, e.g., looking at market agility, technological competences, dynamic capabilities, possibly also using configurational perspectives (van de Wetering, 2019b).

PART 2

MEASURING COISA AS AN ORGANIZATIONAL CAPABILITY AND SHAPING ITS EVOLUTION OVER TIME

5

CAPTURING CO-EVOLUTIONARY INFORMATION SYSTEMS ALIGNMENT: **CONCEPTUALIZATION AND SCALE DEVELOPMENT**

The results presented in this chapter have been published as a full research paper in the proceedings of the Hawaii International Conference on System Sciences 2021.

ABSTRACT

Co-evolutionary approaches to business-IT alignment, such as Co-evolutionary information systems alignment (COISA), have gained attention from scholars and practitioners over the last decade. COISA is an organizational capability defined as continuously exercised alignment competencies, characterized by co-evolutionary interactions between heterogeneous IS stakeholders, in pursuit of a common interpretation and implementation of what it means to apply IT in an appropriate and timely way. In spite of some conceptual and empirical work on COISA, a validated operationalization for empirical measurements for science and practice is not available in the extant literature. We developed a measurement scale through acknowledged procedures, entailing a multivariate structural model consisting of specific facilitators leading to effective alignment competencies. To the best of our knowledge, we are the first to propose such a scale.

Keywords: business-IT alignment; co-evolutionary information systems alignment; complexity; operationalization; scale development

5.1 INTRODUCTION

Business-IT alignment, or "applying IT in an appropriate and timely way, in line with business strategies, goals and needs" has been investigated for decades, using both qualitative and quantitative approaches (Chan & Reich, 2007b; Luftman & Kempaiah, 2007). Moreover, new digital technologies such as blockchain and artificial intelligence, and the growing attention for social and ethical aspects of technology have a major impact on organizations (Cearly et al., 2019). Furthermore, as organizations become more and more intertwined with their environment and with each other, more and more stakeholders are involved in IS initiatives, making the quest for alignment even more challenging, but nonetheless ever so crucial (Benbya et al., 2020; Benbya & McKelvey, 2006b; Walraven et al., 2019, 2020) even more challenging, but nonetheless ever so crucial (Benbya et al., 2020; Benbya & McKelvey(Chan & Reich, 2007b). The first one views alignment as a state that organizations should strive to obtain (e.g., typology-based alignment assessments such as the one by Sabherwal and Chan (2001)), while the second views alignment as a process that needs continuous efforts to be maintained (e.g., the Strategic Alignment Model by Henderson and Venkatraman (1993)). A common denominator of these approaches is the focus on the strategic level of alignment and, more implicitly, that the "business" is a homogeneous whole with which IT can be aligned (Chan & Reich, 2007b). However, the intertwinement of contemporary organizations and increasingly turbulent environments cause different or even contradictory views to emerge on what it means to apply IT appropriately (Walraven et al., 2019, 2020). Therefore, these approaches appear insufficient to effectively tackle the alignment problem.

To address these challenges, scholars have recently turned to co-evolutionary approaches to alignment (Benbya et al., 2020), such as the complex adaptive systems (CAS) theory-based concept of Co-evolutionary Information Systems Alignment (COISA) (Benbya & McKelvey, 2006b; Walraven et al., 2018). COISA applies CAS characteristics to the whole of interacting IS stakeholders, pursuing to reach and maintain a common interpretation and implementation of what it means to apply IT in an appropriate and timely way.

The CAS perspective fits the presumed diversity of mutually interdependent parts of organizational components and the multidirectional interactions among the many stakeholders across the organization (van de Wetering, 2016). Various scholars argue that this perspective is useful for organizations operating in turbulent environments

(Merali et al., 2012; Merali & McKelvey, 2006; van de Wetering, 2016). This particular argument stems from the principle of requisite complexity (Benbya & McKelvey, 2006b), entailing that CAS are on the edge of chaos, demonstrating just enough complexity to effectively respond to environmental turbulence without collapsing into chaos (Holland, 1995). Several scholars that study alignment from co-evolutionary perspectives have embraced this principle in conceptual papers (P. Allen & Varga, 2006; Benbya & McKelvey, 2006b)co-evolutionary perspectives have embraced this principle in conceptual papers (P. M. Allen(Amarilli et al., 2017; Yim et al., 2017). However, no large-scale quantitative empirical studies have been undertaken to further strengthen the claim that organizations whose alignment-related stakeholder interactions reflect CAS characteristics are better prepared for complex conditions. Nor, as an implication, have COISA-based instruments for practitioners been developed to steer applying IT in turbulent environments.

In this current paper, we contribute to closing this gap by executing an initial iteration in developing a validated operationalization for COISA. This instrument can be used for quantitative studies in pursuit of further evidence for CAS-based conceptualizations. Furthermore, practitioners facing turbulent environments with many stakeholders can use the instrument as a checklist to identify improvement areas in pursuit of a more effective alignment capability. Summarizing, our research question is as follows:

> **RQ:** How can Co-evolutionary Information Systems Alignment be operationalized for the purposes of quantitative studies and practical measurements?

5.2 THEORETICAL FOUNDATION

COISA takes a CAS perspective of organizations. Early works on this concept emphasize that alignment is an emergent phenomenon resulting from co-evolutionary interactions on multiple levels of the organization, i.e., strategic, operational, and individual (P. Allen & Varga, 2006; Benbya & McKelvey, 2006b). This strand of research defines the concept in terms of "[…] the series of coevolutionary moves that make IS aligned over time" (Benbya & McKelvey, 2006b, p. 288). More recently, scholars have built a more specific conceptualization upon this foundational work, approaching alignment from the perspective of continuously exercised IS stakeholder interactions within and between co-evolutionary alignment processes. These alignment processes entail the processes where co-evolutionary interactions between IS stakeholders take place, in pursuit of a common interpretation and implementation of what it means to apply IT in an appropriate and timely way, i.e., alignment (Walraven et al., 2019, 2020) and reflect the multi-level nature of COISA (Benbya et al., 2020; Benbya & McKelvey, 2006b). Alignment processes can be identified on both operational and strategic levels, as well as between operational and strategic levels and include among others Strategy formulation, Enterprise Architecture Management, and IT implementation (Benbya & McKelvey, 2006b; Walraven et al., 2018).

The manifestation of co-evolutionary interactions between IS stakeholders within the aforementioned alignment processes on its own is not sufficient for an organization's alignment processes to effectively maintain a certain level of alignment, as shown in several works on this topic (Amarilli et al., 2017; Benbya & McKelvey, 2006b; Walraven et al., 2020; Zhang, Chen, & Lyytinen, 2019). Specifically, certain facilitators are necessary to ensure stakeholders effectively interact in their pursuit of alignment, in other words, to ensure stakeholders indeed continuously maintain a common interpretation and implementation of what it means to apply IT in an appropriate and timely way. Existing insights on this topic stem from traditional alignment studies, from studies that take co-evolutionary viewpoints on alignment and from studies that focus on efficacious dynamics in complex organizations from a general perspective (Walraven et al., 2020). Based on these insights, four particular categories of these facilitators in practice can be distinguished (Walraven et al., 2020). These categories include (I) Stakeholder involvement (who to involve to interact toward alignment effectively?), (II) Interconnections (how to make these interactions toward alignment possible?), (III) Alignment motivation (why should stakeholders bother to contribute to these alignment interactions?) and (IV) Alignment decisions (which decisions within alignment processes help future alignment interactions to be more effective?).

All in all, COISA is an integrative framework consisting of several perspectives, making it challenging to capture its meaning in a single conceptual model. To take on this challenge, we base our next steps on the recommendations as outlined by MacKenzie et al. (2011). These authors recommend ten specific steps for the development of scales intended for quantitative studies. In this current paper, we do an initial iteration and address the first three steps of this approach, including Conceptualization, Development of Measures, and Model Specification. In the following section, we explain each of these steps in further detail.

5.3 CONCEPTUALIZATION

In this first step toward operationalization, we aim to extensively describe the conceptual model of COISA and provide clear definitions of its underlying dimensions (MacKenzie et al., 2011). As discussed in the theoretical framework, in earlier studies, COISA has been conceptualized in terms of continuously exercised alignment processes, characterized by co-evolutionary interactions between IS stakeholders within and between those alignment processes, enabled by certain facilitators. Some later empirical works on COISA clarify which facilitators are necessary to ensure efficacious co-evolutionary interactions between IS stakeholders in these processes, i.e., co-evolutionary interactions that move *toward* improved alignment among IS stakeholders and not away from it (Amarilli et al., 2017; Walraven et al., 2020; Zhang, Chen, & Lyytinen, 2019) alignment among IS stakeholders and not away from it (Amarilli et al., 2017; Walraven et al., 2020; Zhang, Chen, & Lyytinen, 2019).
We undertook two particular steps to deduce a conceptual model suitable for scale development, while staying as true to the original COISA works as possible. First, we defined three different alignment competencies based on the multi-levelled alignment processes we identified in the literature. These alignment competencies include the strategic alignment competency, the orchestrational alignment competency, and the operational alignment competency. These alignment competencies will be explained in more detail later in this section. Second, we synthesized among the facilitators of efficacious alignment interactions to ensure that the core facilitators are included in our final instrument. We finally included two facilitators, i.e. (I) Alignment Motivation and (II) Interconnections between Heterogeneous IS stakeholders.

The resulting conceptualization is compact enough to be suitable for operationalization in survey scales while still theoretically coherent with the original foundations of COISA. We will now further elaborate on this conceptualization process.

5.3.1 Alignment processes as the foundations of alignment competencies

We conceptualize the multi-level co-evolutionary alignment processes in terms of three different alignment competencies. In doing so, we underline that the key focus of COISA consists of the continuous execution of these processes, in line with the internal and external complexity faced by organizations. This insight implies that the alignment processes in themselves cover the intention of the framework only in part. Namely, they reflect *where* co-evolutionary alignment interactions take place, but not necessarily the continuous execution of the processes themselves and their evolution toward an improved level of alignment among IS (2004), who explain based on earlier literature: "*[…] competency refers to "a firms capacity to deploy resources, usually in combination, using organizational processes, to effect a desired end" […] and thus represent "..a bundle of skills and technologies rather than a single, discrete skill or technology*" (Peppard & Ward, 2004, p. 175). This definition underlines that organizational processes (such as alignment processes) play a vital role in organizational competencies. However, the main focus of organizational competencies is much more on putting organizational resources to use within these processes, as is the case with the intentions of the original COISA model. In other words, we argue that COISA consists of three alignment competencies, manifesting as continuously executed alignment processes, in line with internal and external complexity faced by organizations.

5.3.2 COISA as an organizational capability

Building on the above-described definition of organizational competencies, Peppard and Ward (2004) continue their argument toward the concept of organizational *capabilities*, which they define as "*[…] the strategic application of competencies […], i.e., their use and deployment to accomplish given organizational goals*" (Peppard & Ward, 2004, p. 175). In the same line of thought, we argue that COISA as a whole, i.e., the combination of all three alignment competencies, efficaciously executed thanks to the presence of needed facilitators that enable efficacious alignment interactions between IS stakeholders, can be seen as an organizational capability. Namely, current insights on COISA suggest that strategic value can only be maintained if *all* alignment competencies are executed in parallel, given the presence of certain facilitators to ensure efficacious stakeholder interactions toward alignment (Amarilli et al., 2017; Benbya & McKelvey, 2006b; Zhang, Chen, & Lyytinen, 2019).

In our synthesis of existing insights on facilitators of efficacious COISA interactions, we included facilitators that entail conceptual measures of the co-evolutionary alignment interactions between IS stakeholders themselves, including (I) Interconnections between heterogeneous IS stakeholders and (II) alignment motivation. Alignment competencies are expected to be stimulated by these facilitators, and the combination of alignment competencies and their facilitators cover the concept of COISA, as visualized in figure 5.1. The facilitator "interconnections between heterogeneous IS stakeholders" synthesizes the earlier mentioned categories of stakeholder involvement and interconnections, while the facilitator alignment motivation is directly based on earlier work (Walraven et al., 2020). We decided to leave out the earlier-mentioned facilitator category "alignment decisions" in our operationalization, because the specific decisions improving future alignment interactions are very much context-dependent and do not directly give insight in the alignment interactions themselves (Benbya & McKelvey, 2006b; Walraven et al., 2020), in line with the earlier-described criterion. Therefore, this specific category is not expected to be a reliable indicator to include in a generalizable operationalization of COISA.

The inclusion of the strategic, operational and orchestrational competencies specifically, are based on the results of an earlier structured literature review (SLR). This SLR focused on the specific areas where co-evolutionary interactions manifest in existing studies, leading to the earlier mentioned set of five alignment processes including strategy formulation, strategy implementation, enterprise architecture management, IT implementation and IT usage (Walraven et al., 2018).

We will now elaborate further on the specific operationalizations of each of the individual alignment competencies and the two facilitators that together comprise the COISA capability.

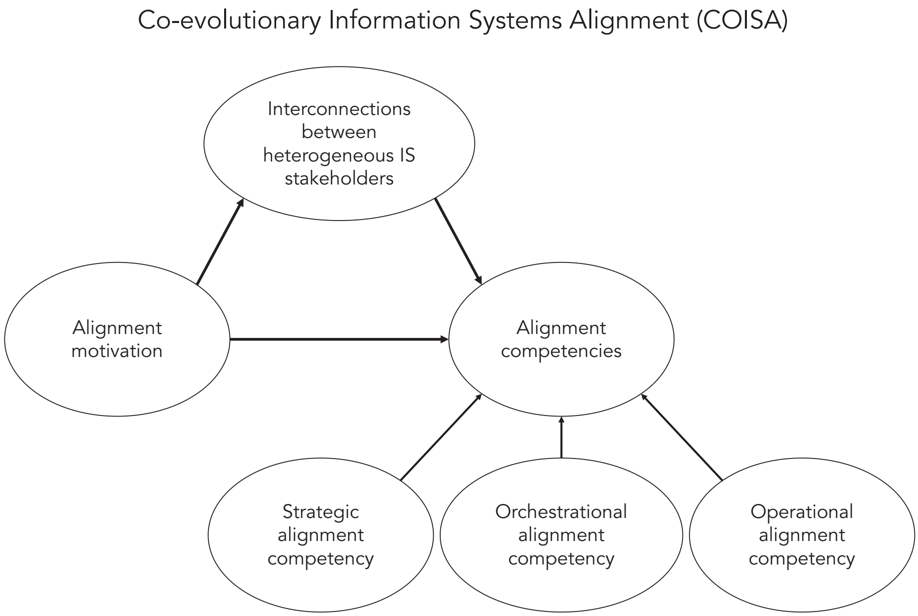


Figure 5.1. Conceptual model of COISA

Strategic alignment competency (STR)

The first alignment competency entails the strategic alignment competency (STR). This competency consists of the continuous execution of strategic alignment processes including strategy formulation and strategy implementation, where continuous is defined as the degree to which the execution of these processes is in line with the frequencies of internal and external changes faced by the organization at hand. Therefore, we define this competency as follows, coherent with the definitions of these specific alignment processes and continuous co-evolutionary interactions within and between those processes (Walraven et al., 2018, 2019, 2020):

An organization's ability to formulate strategic goals, and articulate strategic plans and structures to implement these goals in relation to IS, while monitoring relevance and topicality of these plans, goals, and structures, in line with frequencies of internal and external changes.

Orchestrational alignment competency (ORCH)

The orchestrational alignment competency (ORCH) considers co-evolutionary interactions between IS stakeholders in alignment processes bridging operational and strategic levels, essentially referring to the maintenance of a coherent Enterprise Architecture, i.e., coherence between goals, processes, information systems, data, infrastructure, roles, and functions (Schmidt & Buxmann, 2011). In doing so, it considers adequate coherence between decisions in strategic and operational alignment competencies, thus orchestrating the COISA capability as a whole (Walraven et al., 2018, 2019, 2020). We define the orchestrational alignment competency as follows:

An organization's ability to maintain the coherence of their architecture, through architectural practices such as the definition and application of architectural principles and standards, while monitoring relevance and topicality of these architectural practices, in line with frequencies of strategic and operational changes.

Operational alignment competency (OP)

The operational alignment competency (OP) finds its roots in the co-evolutionary interactions between IS stakeholders within and between operational alignment processes such as IT implementation and IT usage. We define this competency as follows (Walraven et al., 2018, 2019, 2020):

An organization's ability to collaboratively use IT solutions effectively in daily operations, and to implement and optimize IT solutions in operational settings in line with end-

users' needs, while monitoring and leveraging improvement possibilities during IT usage, implementations, and operations.

Interconnections between heterogeneous IS stakeholders (INT)

The facilitator of interconnections between heterogeneous IS stakeholders is based on earlier empirical work on facilitators of efficacious co-evolutionary alignment interactions (Amarilli et al., 2017; Zhang, Chen, & Lyytinen, 2019). This facilitator entails providing the means to make co-evolutionary alignment interactions possible between heterogeneous stakeholders. To do this, as pointed out by Walraven et al. (2020), IS stakeholders need to have both formal and informal interconnections, as well as supporting platforms to make involvement and co-evolutionary dialogue possible. Summarizing, we define the facilitator of interconnections between heterogeneous IS stakeholders as follows:

The degree to which heterogeneous IS stakeholders have means to engage in co-evolutionary alignment interactions within and between alignment processes through formal governance structures, informal networks, and supporting platforms.

Alignment motivation (MOT)

Alignment motivation ensures that IS stakeholders have a reason to engage in co-evolutionary alignment interactions. This motivation may be intrinsic, i.e., because IS stakeholders find alignment interactions intrinsically important to engage in. However, these motivations may also be extrinsic, e.g., triggered by legal obligations (Walraven et al., 2020), emerging misalignments (Amarilli et al., 2017), or executive management that actively advocates for the importance of leveraging IT (Amarilli et al., 2017). Furthermore, if alignment motivation is present, we expect interconnections among heterogeneous IS stakeholders to also improve because people have actual reasons to develop and maintain these interconnections, as visualized in figure 5.1. Based on the above, our definition of alignment motivation is as follows:

The degree to which IS stakeholders are motivated to actively engage in co-evolutionary (two-way) alignment interactions within and between alignment competencies (e.g., through intrinsic motivation, deadlines, legislations, support by Executive Management, being held responsible).

5.4 DEVELOPMENT OF MEASURES

The second phase of operationalization entails the development of measures. This phase consists of two steps, namely the generation of items to represent the construct and its dimensions, and assessing content validity of those items (MacKenzie et al., 2011). To execute this phase, we first looked into existing measures of related concepts that were used in high-quality, peer-reviewed journals in the field of IS. We did so by searching the AIS library using key words based on the steps taken as part of the conceptualization phase. To check for this quality criterion, we only evaluated scales in articles published in the basket of eight IS Journals, indicated by the Association for Information Systems (*Senior Scholars' Basket of Journals*, n.d.). Secondly, we created items ourselves based on key insights of qualitative results on COISA. Our initial item pool consisted of 24 items, as summarized in table 5.1.

To assess the content validity of this initial item pool and to improve the items accordingly, we undertook a three-step approach, as visualized in figure 5.2. The first step consisted of a card sort session among four graduate students in the field of Business Process Management and IT, writing their Master thesis on COISA. Card sort sessions are considered to be an established technique used in instrument development (Mikalef & Pateli, 2016; Moore & Benbasat, 1991). The second step involved an online survey among IS experts (BSc. degree or above in information science, information systems or a related field), based on Schriesheim, Cogliser, Scandura, Lankau and Powers (1999b) and the third and final iteration involved a second card sort session, with two Ph.D. candidates doing alignment-related research, i.e. in the field of Enterprise Architecture and Dynamic Capabilities, and two practitioners active in a large Dutch public organization and familiar with the challenges of alignment (i.e., one business analyst and one enterprise architect). We will now elaborate on each of these steps.

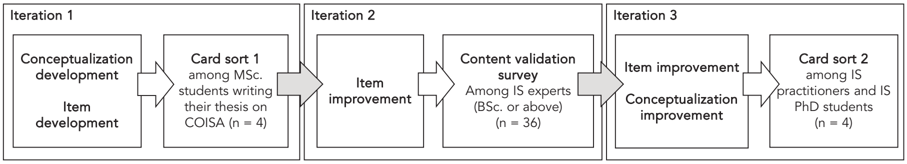


Figure 5.2. Iterations undertaken in the "Development of measurements" phase

Table 5.1. Initial items to measure COISA

Construct	# Items	Source
STR	4	Self-generated based on Walraven et al. (2019), adapted from Kim, Shin, Kim and Lee (2011)
ORCH	4	Adapted from Schmidt and Buxmann (2011) and Kim et al. (2011)
OP	4	Adapted from Kim et al. (2011), Wu et al. (2017) and Barki et al. (2007)
INT	6	Self-generated based on Walraven et al. (2019, 2020)
MOT	6	Self-generated based on Walraven et al. (2019); Walraven et al. (2020); McLean and Luftman (2004); Luftman, Papp and Brier (1999) and Pang, Lee and DeLone (2014), adapted from Kim et al. (2011)

5.4.1 Card sort session 1

The goal of the first card sort session was twofold: Firstly, we intended to check whether respondents placed the items in the hypothesized category, giving some first indications of content validity (i.e., do these items measure what they intend to measure?).

Secondly, we aimed to evaluate the formulation and completeness of the items by carrying out an in-depth discussion after the sorting was finished. The set-up of this first card sort session was as follows: The session started with a video recorded mini-instruction on the conceptual basis of COISA, after which the students were asked to individually categorize each of the 24 items under the COISA dimension they deemed the best fitting.

Following, we discussed their sortings and argumentations on why they chose specific categories in specific cases, and asked for additional feedback on the item formulation, comprehensibility, and underlying concepts. This discussion was recorded and transcribed to enable the processing of qualitative feedback on specific items. To analyze the results of this card sort session, we first assessed overall hit ratios, i.e., the number of times that participants placed an item in the intended categories. Furthermore, we assessed Fleiss' Kappa, which is deemed an appropriate instrument to assess inter-rater agreement among more than two raters (Fleiss, 1971). The results of this first card sort session are summarized in table 5.2 (Ohr=47,9, Avg kappa=0,12).

A high overall hit rate is necessary to ensure adequate content validity of an item set, as well as an average kappa of at least 0,65 (Moore & Benbasat, 1991). These criteria were insufficiently met in this first card sort session. However, the qualitative suggestions in the constructive discussion afterwards led to several changes, including changes in item formulation, and dropping particular items. With the improved set of items, we started the second iteration in our development of measures, i.e., the content validation survey.

5.4.2 Content validation survey

The second step we undertook to assess and improve content validity entailed an online survey among IS experts (i.e., students, academics and practitioners with a completed BSc. Degree or above in information systems, information science or a related field). The goal of this particular survey was to evaluate whether the improvements applied based on the first card sort session were effective enough to argue that the renewed

Table 5.2. Results of Card sort session 1

		Sorted categories				
		Strat	Orch	Op	Int	Mot
Theoretical Categories	Strat	**10**	2	2	0	2
	Orch	2	**8**	2	3	1
	Op	1	0	**10**	0	5
	Int	2	4	3	**14**	1
	Mot	5	5	7	0	**4**
Total item placement: 96 Hit: 46 O_{hr}: 47,9 Average kappa: 0,12						

item set has an adequate level of content validity. In this survey, participants were first asked to indicate their level and field of education to enable us to make the first selection in usable replies. Following, participants were asked to view the same video recorded mini-instruction as was used in the first card sorting session.

To assess whether respondents had a good understanding of the concept of COISA and were thus suited for this study, we asked respondents to indicate their understanding of the video on a scale from 1 (*"I have watched the mini instruction, but I did not understand the content at all")* to 5 ("*I have*

watched the mini instruction and the content is completely clear to me"). Respondents were then asked to assess the degree to which they found each item representative for each of the five COISA dimensions (strategic alignment competency, orchestrational alignment competency, operational alignment competency, interconnections between heterogeneous employees and alignment motivation). The content validity assessment by respondents was done using a 5-point Likert scale ranging from "not at all representative (1) to "very representative" (5).

This approach to content validity assessment is based on the recommendations as outlined by Schriesheim et al. (1999a). These authors utilized a comparable approach for instrument development, except we opted for an online set-up. To recruit participants, we applied a convenience sampling approach and asked our direct and indirect colleagues, and spread requests via Twitter and LinkedIn asking for academics with a background in information science, information systems, or a related field to contact us for this particular study.

Out of the 52 complete responses, we were able to take into account 36, which met all of our quality criteria, i.e., respondents had at least a completed BSc. degree in Information Systems, Information Science or a related field, and who indicated that they understood the mini-instruction well (score 4 on the 5-pt Likert scale) or that the content of the mini-instruction was completely clear to them (score 5).

Unfortunately, the number of respondents is too low to perform factor analyses, as was recommended for data analysis in the original work that formed the basis of this methodology (Schriesheim et al., 1999a). However, we still deemed the input of 36 IS experts highly valuable in our content validation improvement process and thus opted for a different analysis approach to leverage these inputs as much as possible.

Specifically, we started from the assumption that items that reflect their intended category well, i.e., items that have adequate content validity, should have high mean scores on their intended category. We thus calculated for each item the mean value for each category and looked at the standard deviation. We considered items that met the following criteria to be sufficiently content valid: (I) Mean value of the intended category is higher than 4.0; (II) Mean value on other categories do not exceed the mean value of the intended category; (III) Stdev is not higher than 1.0. As a result, three items remained for SAC, one for OPAC, two for ORAC, four for HIS and one for AM.

Based on these results, we took several steps in preparation for the third iteration of measurement development: We first critically reviewed the items with insufficient scores and compared them to qualitative feedback we received as a reply to this survey. Several items were reformulated or entirely dropped based on this analysis. Looking further into the data, we noticed that a frequently occurring problem was that some items had relatively high mean scores (>3) spread across different categories. We therefore concluded that our initial definitions of the COISA dimensions were insufficiently distinguishable from each other. We thus did another conceptualization iteration through extensive discussions among our team, which lead to the definitions found in this current paper. Lastly, we formulated several new items to ensure that each dimension has four representing items.

5.4.3 Card sort session 2

The final iteration of our content validity phase consisted of a second card sort session, this time with two Ph.D. candidates in the field of Information Systems and two practitioners, i.e., one enterprise architect and one business analyst. In this session, we did not make use of the video instruction anymore, as one of the measures we took based on the second iteration in this process entailed improvement in terms of conceptualizations and definitions, leaving the video instruction outdated. Instead, one of the researchers provided a mini-lecture at the beginning of the card sort session, along with a document where definitions of COISA and its sub dimensions could be found. The rest of the set-up of this card sort session was the same as our first card sort session: respondents were asked to individually categorize each of the 20 items under the category that they found the best fitting. Again, we performed analyses to retrieve the overall hit rate and calculated Fleiss' Kappa to assess inter-rater reliability (Fleiss, 1971).

The results of this second card sort session are summarized in table 5.3 (Ohr=93,8, Avg Kappa=0.84). This leads to a total of 20 content validated items, i.e., four items for each of the underlying dimensions of COISA. The final complete operationalization is included in the appendix of this article.

Table 5.3. Results of Card sort session 2

		Sorted categories				
		Strat	**Orch**	**Op**	**Int**	**Mot**
Theoretical Categories	Strat	**15**	1	0	0	0
	Orch	1	**15**	0	0	0
	Op	0	1	**15**	0	0
	Int	0	0	0	**15**	1
	Mot	0	1	0	0	**15**
Total item placement: 80 Hit: 75 O_{hr}: 93,8 Average kappa: 0,84						

5.5 MODEL SPECIFICATION

The phase of model specification considers the formal specification of the nature of the relationships between the established indicators and between the different sub-dimensions of COISA (MacKenzie et al., 2011). COISA consists of several different perspectives that form an integrative whole and thus cannot be captured in a single dimension or even a single concept. In fact, following our conceptualization, two crucial parts of a slightly different nature can be distinguished: firstly, the concept of alignment competencies. This first part is conceptualized as a multiplicative aggregate concept based on the parallel manifestation of the strategic alignment competency, the orchestrational alignment competency, and the operational alignment competency. This concept is modelled as a first-order reflective, second-order formative concept because the three different alignment competencies are not interchangeable, and the meaning of the concept is only adequately reflected when all three sub dimensions are present (G. Kim et al., 2010). Hence, this first part can be classified as a reflective-formative type II model (Becker et al., 2012; Jarvis et al., 2003), which has been applied to various related IS construct conceptualizations and validations (Mikalef & Pateli, 2016; Pavlou & El Sawy, 2006; van de Wetering, 2019a). Items representing a single alignment competency (e.g., Str1-Str4) are interchangeable and thus are reflectively related to the first-order alignment competencies.

The second part of the model consists of the two alignment facilitators, i.e., interconnections between heterogeneous IS stakeholders and alignment motivation. Since these facilitators can be seen as boundary conditions for the alignment competencies to reflect CAS characteristics, we argue that they should be included in multivariate structural models of future quantitative studies as independent variables positively influencing alignment competencies.

Summarizing, the conceptualization of COISA as a whole is in itself part of a multivariate structural model, as visualized in figure 5.3. This approach is in line with recommendations by Polites, Robert and Thatcher (2012), 39], who argue that this type of conceptualization is best suitable for measuring concepts where "*[…] a general idea exists behind the set of dimensions*" (Polites et al., 2012, p. 39) (in this case, the ideas behind complex adaptive systems and the related principle of requisite complexity) and where "*dimensions are distinct but don't represent a single theoretical concept*" (Polites et al., 2012, p. 39) (since the dimensions considering alignment competencies are clearly of a different nature than the dimensions considering the facilitators of efficacious alignment interactions).

Another essential element of model specification entails the formulation of scale labels. For the independent concepts, interconnections between heterogeneous IS stakeholders and alignment motivation, we opted for an often-applied 7-point Likert scale, ranging from "Strongly disagree" (1) to "Strongly agree" (7), as is visible in the appendix. In the case of the alignment competencies, we opted for a more context-aware labelling of scale, where scores are dependent on frequencies of change faced by the organization, bot externally and internally, and both on the operational and strategic level. These context-aware scales are more in line with our core definitions of alignment competencies, and are also better suited for complex organizations, that are characterized by context-dependent issues (Benbya & McKelvey, 2006b). The specific labeling of the scales for each alignment competency is shown in the appendix.

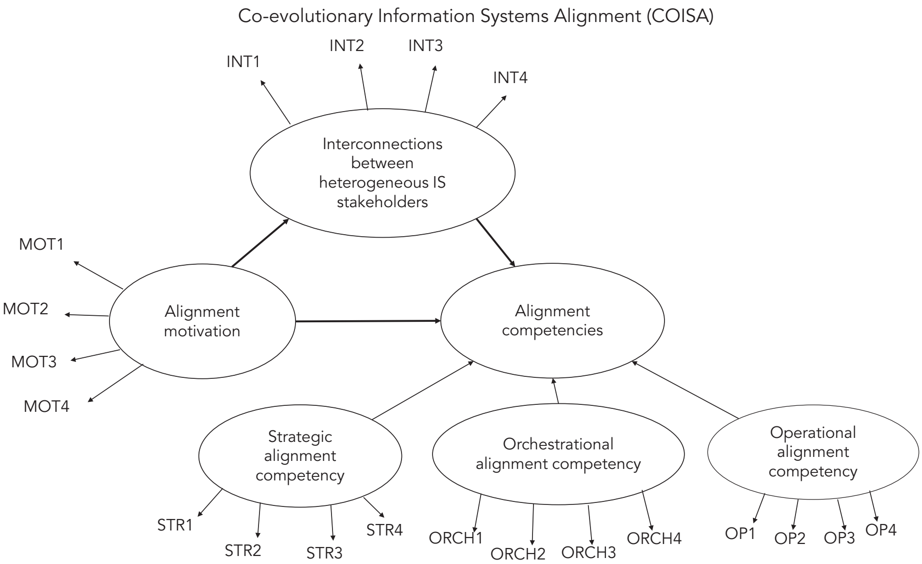


Figure 5.3. COISA measurement model

5.6 DISCUSSION, CONCLUSION, FUTURE RESEARCH

In this paper, we aimed to develop an operationalization of COISA for quantitative and practical measurements. In doing so, we presented a measurement instrument that is considered to have adequate content validity, based on the recommendations by MacKenzie et al. (2011). This instrument provides IS researchers with the opportunity to use quantitative approaches in studying COISA. Specifically, it provides the first step to larger-scale empirical studies looking into the premise that organizations facing complex conditions are better able to shape organizational capabilities when they leverage CAS principles. Moreover, practitioners can use the developed conceptualization and corresponding operationalization to measure their own COISA capability and identify specific improvement areas to further develop this capability.

Although the currently developed measurement instrument provides a valuable step towards more empirical research on COISA, our study is subject to several limitations. Firstly, the focus of this current paper and the steps we carried out were focused mainly on establishing content validity. As described, this considers the first three steps as prescribed by MacKenzie et al. (2011), including conceptualization, development of measures, and model specification. However, to further strengthen the validation of this measurement instrument, two extra steps are needed. First, data needs to be collected from an initial set of respondents to perform a pre-test to purify and refine the scale. Following, a second dataset should be collected to enable scale validity assessment and cross-validation (MacKenzie et al., 2011). Future studies should focus on these steps to address these particular endeavors.

Furthermore, we found that content validation surveys are challenging to be carried out online, since it is difficult to convey the survey's intention via written text only. We suggest future researchers that want to leverage the benefits of a quantitative approach here, to make sure that a clear explanation of the survey's intention is somehow included. This could be done during an in-person lecture, but it could for example also be facilitated by including an explanatory video at the beginning of the survey.

Lastly, it would be valuable to also assess the concept in relation to other, higher-order organizational capabilities, especially for organizations facing complex conditions. In doing so, another fruitful line of thought could involve the use of configurational approaches, to shed more light on the value of CAS-based conceptualizations of alignment in complex situations (Benbya et al., 2020).

CHAPTER 5

APPENDIX: FINAL OPERATIONALIZATION

Table 5.4. Final operationalization of COISA

Dimension	Items	Scale
Strategic alignment competency	**STR1.** Our organization periodically performs strategic IT planning processes (e.g., prioritizing IT projects)" *(Adapted from Kim et al.* (2011), *refined during development of measures (DOM) iteration)*	**1.** Never **2.** Way too infrequently given internal and external changes **3.** Too infrequently, given internal and external changes **4.** Somewhat in line with frequencies of internal and external changes **5.** Moderately in line with frequencies of internal and external changes **6.** Mostly in line with frequencies of internal and external changes **7.** Completely in line with frequencies of internal and external changes
	STR2. Our organization frequently adjusts strategic goals to better adapt to changing conditions *(Adapted from Kim et al.* (2011), *refined during DOM iteration)*	
	STR3. Our organization continuously works on creating the right conditions to enable implementation of strategic goals in relation to IT (e.g., setting up program structures and creating roadmaps) *(Based on Walraven et al.* (2019), *after DOM iteration)*	
	STR4. When making strategic IT investment decisions, our organization actively considers strategic goals from different departments, roles and perspectives *(Based on Walraven et al.* (2019), *after DOM iteration)*	
Orchestrational alignment competency	**ORCH1.** Our organization continuously works on maintaining architectural principles and standards to guide systems development and maintenance projects *(Adapted from Schmidt and Buxmann* (2011), *refined during DOM iteration)*	**1.** Never **2.** Way too infrequently, given strategic and operational changes **3.** Too infrequently, given strategic and operational changes **4.** Somewhat in line with frequencies of strategic and operational changes **5.** Moderately in line with frequencies of strategic and operational changes **6.** Mostly in line with frequencies of strategic and operational changes **7.** Completely in line with frequencies of strategic and operational changes
	ORCH2. Our organization continuously works on maintaining overall coherence between different processes, roles and IT components *(Based on Walraven et al.* (2019), *after DOM iteration)*	
	ORCH3. When making architectural decisions, our organization actively considers coherence with strategic principles and goals *(Based on Walraven et al.* (2019), *after DOM iteration)*	
	ORCH4. Our organization actively works on ensuring relevance and topicality of architectural practices, principles and standards and makes changes accordingly *(Based on Walraven et al.* (2019), *after DOM iteration)*	
Operational alignment competency	**OP1.** Overall, end users spend efforts in recommending changes to IT in use to better fit their works *(Adapted from Wu et al.* (2017); *Barki et al.* (2007))	**1.** Never **2.** Way too infrequently to leverage any opportunities for improvement

	OP2. Overall, end users spend efforts on changing their tasks so that these better fit the IT in use *(Adapted from Wu et al.* (2017)*; Barki et al.* (2007)*)*	**3.** Too infrequently to leverage many opportunities for improvement **4.** To the degree that we leverage some opportunities for improvement **5.** To the degree that we leverage a moderate amount of opportunities for improvement **6.** To the degree that we leverage a considerable amount of opportunities for improvement **7.** To the degree that we leverage (almost) all opportunities for improvement
	OP3. Our organization continuously works on implementing and improving IT systems in operational settings *(Adapted from Kim et al.* (2011)*, refined during DOM iteration)*	
	OP4. Our organization continuously evaluates implemented IT systems for alignment with business processes and working routines *(Based on Walraven et al.* (2019)*, after DOM iteration)*	
Interconnections between heterogeneous IS stakeholders	**INT1.** Our organization ensures adequate stakeholder participation in IT development and –improvement efforts *(Based on Walraven et al.* (2019)*, after DOM iteration)*	**1.** Strongly disagree **2.** Disagree **3.** Somewhat disagree **4.** Neither agree nor disagree **5.** Somewhat agree **6.** Agree **7.** Strongly agree
	INT2. In our organization, IS/IT people and line people from various departments periodically attend cross-functional meetings *(Adapted from Kim et al.* (2011)*)*	
	INT3. Our organization takes conscious action to improve informal connections across functions and departments *(Based on Walraven et al.* (2019)*)*	
	INT4. We have a dedicated platform where we share information across functions and departments, related to IT alignment efforts *(Based on Walraven et al.* (2019)*)*	
Alignment motivation	**MOT1.** Our employees are intrinsically motivated to continuously leverage and improve IT initiatives *(Based on Walraven et al.* (2019)*)*	**1.** Strongly disagree **2.** Disagree **3.** Somewhat disagree **4.** Neither agree nor disagree **5.** Somewhat agree **6.** Agree **7.** Strongly agree
	MOT2. Generally, our employees are enthusiastic to contribute to IT initiatives *(Based on Walraven et al.* (2019)*, after DOM iteration)*	
	MOT3. Our employees generally feel stimulated to engage in dialogues related to IT initiatives *(Based on Walraven et al.* (2019)*, after DOM iteration)*	
	MOT4. Our employees have clear reasons to actively collaborate with other stakeholders on leveraging and improving IT initiatives *(Based on Walraven et al.* (2019)*, after DOM iteration)*	

6

EVOLVING CAPABILITIES TO ALIGN ELECTRONIC MEDICAL RECORDS:

A DYNAMIC RESOURCE-BASED PERSPECTIVE ON CO-EVOLUTIONARY INFORMATION SYSTEMS ALIGNMENT CAPABILITIES IN HOSPITALS

The results presented in this chapter have been published in the Journal of Health Organization and Management.

ABSTRACT

This paper reports on a longitudinal multiple case study of three Western-European hospitals which each recently implemented an advanced Electronic Medical Records system (EMR). We conducted 35 in-depth interviews in 2 phases (before and after go-live of the EMR), and studied documentation related to the EMR implementations. Advanced EMR provide many potential benefits to hospitals. However, because of their broad scope, many stakeholders deal with the EMR, and a continuous effort has to be made to keep up with internal and external change. Therefore, hospitals need to deliberately shape their organizational competencies considering the pursuit of alignment, i.e., making sure that the EMR remains optimally aligned with strategies, goals and needs of the hospital and its stakeholders. This paper aims to investigate the evolutionary paths of these alignment competencies and their drivers, from a theoretical perspective of co-evolutionary information systems alignment (COISA). Our findings show that each hospital's COISA capability shows a different evolutionary path. However, two of our three case hospitals ended up coordinating part of their COISA capability to an ecosystem level, i.e., they incorporated other hospitals using the same EMR system to coordinate their alignment efforts, either from an operational perspective, or in terms of orchestration and strategy. The found evolutionary paths' key drivers include 'stakeholder initiative', 'accumulating experience', 'driving events', and 'emerging issues'. Our findings help healthcare practitioners to deliberately shape their organization's COISA capability in pursuit of EMR alignment. Furthermore, we add to the knowledge base on co-evolutionary approaches to alignment through our longitudinal approach.

Keywords: Electronic Medical Records; Co-evolutionary Information Systems Alignment; Capability evolution; Dynamic Resource-Based Perspective; Business-IT alignment

6.1 INTRODUCTION

Electronic Medical Records (EMR) have become an increasingly important resource for modern healthcare in Western countries, with many contemporary hospitals rapidly implementing advanced EMR. Traditionally, these EMR involve electronic repositories of patients' medical histories (Kohli & Tan, 2016). However, advanced EMR provide many additional functionalities and advantages such as hospital-wide integrated information, medical decision-support, and direct patient access via patient portals (Carvalho et al., 2019). As a consequence, EMR become interdependent with an increasing amount of processes. Through these developments, many stakeholders deal with EMR, all having their own views on how to apply the EMR appropriately (Davidson et al., 2018). Given these different and sometimes contradicting interests, it is challenging to develop and maintain the EMR such that it optimally aligns with strategies, goals and needs of the hospital and its stakeholders. Coping with this complexity requires hospitals to actively shape their capabilities to reach and maintain a certain degree of alignment of their EMR (Walraven et al., 2020). In doing so, potential benefits of the EMR such as cost savings, improved patient experience and better decision-making can be leveraged.

The specific conditions characterizing EMR in hospitals are exemplary of complex conditions where co-evolutionary approaches to alignment capabilities are argued to be useful (Amarilli et al., 2017; Benbya & McKelvey, 2006b). While some traditional approaches to alignment view the concept as an end-state (Chan & Reich, 2007b), this relatively new approach involves multi-level effects, multi-directional causalities, non-linearity and feedback loops, with a focus on the *"[…] series of co-evolutionary moves that makes IS aligned over time"* (Benbya & McKelvey, 2006b, p. 288). Furthermore, more recent conceptualizations of co-evolutionary information systems alignment (COISA) expand this dynamic approach to alignment by applying a stakeholder interaction perspective in pursuit of alignment (P. Allen & Varga, 2006). Thereby, these works explicitly address earlier criticisms on traditional alignment conceptualizations emerging as early as 1997 when Ciborra (1997, p. 79) underlined the blurring boundaries between business and IT and the importance to work towards "*An enlarged notion of alignment within a hybrid network of semi-autonomous actors*".

Given the complexity faced by contemporary hospitals in search of better EMR alignment, researchers have applied this co-evolutionary approach to alignment to EMR before (Walraven et al., 2020). This particular work illustrates that COISA could indeed be a fruitful way to understand the capabilities that hospitals need to effectively execute and maintain an inclusive, two-way dialogue in pursuit of better aligned EMR (Walraven et al., 2020). Thus far, these endeavors focus on the implementation phase of the EMR. However, given the many different stakeholders and the continuously changing external conditions, it is unlikely that the EMR is and will remain optimally aligned with the needs of the hospital and its stakeholders at the point of go-live. Therefore, hospitals will also need to develop and maintain their COISA capability after go-live to continuously align the EMR and optimally leverage potential benefits. Still, existing empirical works on EMR-related COISA capabilities focus on the EMR implementation phase only (Walraven et al., 2020). Therefore, it remains unclear what drives the evolutionary paths of the COISA capability, and thus hospitals have little guidance on how to best shape EMR alignment in the long run. We contribute to closing this knowledge gap by giving further insight into how the evolutionary path of the COISA capability develops before and after EMR go-live in different hospitals, and in the drivers behind these evolutionary paths. Hospitals may use these insights to better shape their COISA capability to maintain an adequate degree of alignment. Our research question is as follows:

RQ: How do EMR-related COISA capabilities evolve in hospitals, and what are key drivers for how these capabilities evolve?

To address this question, we did a longitudinal multiple case study, where we examined the EMR-related COISA capability in three different hospitals using in-depth retrospective interviews regarding two different phases, i.e., before EMR go-live and after EMR go-live. A longitudinal approach is appropriate because our goal is to look at the COISA capability's evolution over time, which fits with the logic to select a longitudinal approach (Yin, 2018).

6.2 THEORETICAL FRAMEWORK

This chapter outlines our research's theoretical foundation, as illustrated in figure 6.1. We will elaborate on each of the concepts of this model, including COISA as an organizational capability consisting of alignment competencies; describing capability evolution in terms of capability lifecycle stages following the dynamic resource-based perspective; and finally potential informative works on drivers of the COISA capability evolution in an EMR context. In this current study, we approach the COISA capability as alignment competencies in continuous pursuit of EMR alignment. Specifically, EMR alignment entails a common (i.e., held across EMR stakeholders) interpretation and implementation of what it means to apply the EMR in an appropriate and timely way, in harmony with strategies, goals and needs of the hospital and its stakeholders (Luftman & Brier, 1999; Luftman & Kempaiah, 2007; Walraven et al., 2020). This definition resonates with the concept of social alignment, i.e., *"[…] when groups share understanding and commitment towards an outcome, and the means of achieving that outcome"* (Gilchrist et al., 2018, p. 1), with the extension that EMR alignment not only incorporates the common interpretation across stakeholders, but also its practical implementation in terms of the configuration of the EMR and other hospital resources. Furthermore, because of the continuous change present in and around the hospital, EMR alignment is not an end-state, but a moving target, hence the need for long-term alignment capabilities to pursue it (Baker et al., 2011; Vessey & Ward, 2013).

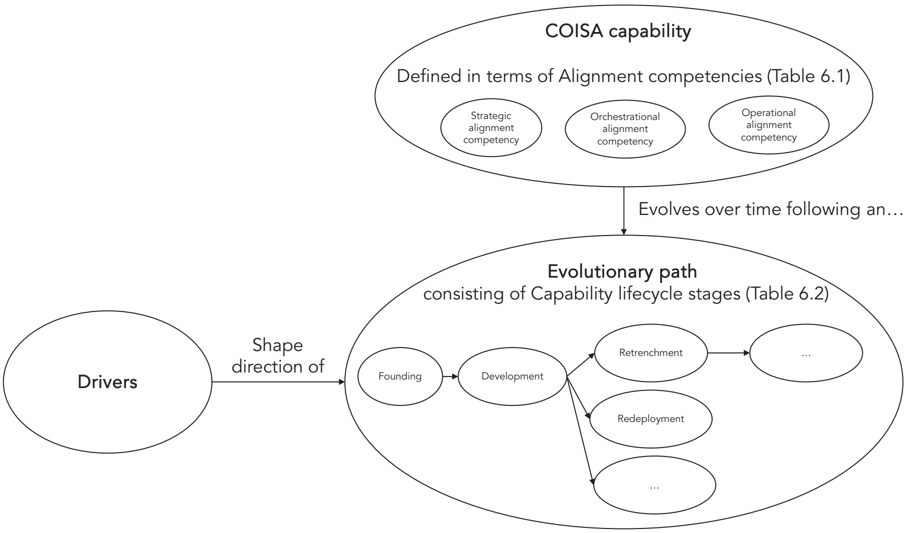


Figure 6.1. Conceptual model of our current study, researching evolutionary paths of COISA capabilities and their drivers

6

6.2.1 Co-evolutionary Information Systems alignment

COISA is a stream of alignment research suitable for complex conditions (P. Allen & Varga, 2006; Benbya & McKelvey, 2006b; Walraven et al., 2020). This school of thought focuses on the social actors comprising organizations and their co-evolutionary interactions in pursuit of alignment. These interactions prevail within and between individual, operational and strategic levels of the organization (Benbya & McKelvey, 2006b), which consists of several alignment processes (Kahre et al., 2017; H. Liang et al., 2017; Sabherwal & Chan, 2001)., 2017; Sabherwal & Chan, 2001), strategy implementation (Busquets, 2015; Grisot et al., 2014; H. Liang et al., 2017; Montealegre et al., 2014), enterprise architecture management (Schilling et al., 2017; Vessey & Ward, 2013; Weeger & Ulrich, 2016), IT implementation (Lyytinen & Newman, 2008; McLeod & Doolin, 2012; E. L. Wagner et al., 2010), and IT usage (D. K. Allen et al., 2013; Burton-Jones & Gallivan, 2007; Goh et al., 2011). The theoretical foundations of COISA are in line with a broader research area that positions alignment as a continuous process, emerging from networks of actors in the flow of organizational practice (Ciborra, 1997).

In this current study, we conceptualize COISA as an organizational capability, consisting of continuously exercised alignment competencies, characterized by co-evolutionary interactions between heterogeneous IS stakeholders, in pursuit of a common interpretation and implementation of what it means to apply IT in an appropriate and timely way (Walraven et al., 2021). In doing so, we distinguish three alignment competencies that are based directly on the abovementioned alignment processes as synthesized from the literature by Walraven et al. (2020) and the different levels of alignment as outlined by Benbya and McKelvey (2006b). These competencies include the strategic alignment competency, the orchestrational alignment competency, and the operational alignment competency. Table 6.I summarizes our definitions of each of these alignment competencies, as defined by Walraven et al. (2021) and based on leading articles using dynamic perspectives on alignment (e.g., Baker et al. (2011); Liang et al. (2017); Vessey & Ward (2013); Vidgen & Wang (2009); Weeger & Ulrich (2016)). This dynamic perspective particularly fits our research context of EMR as it is specifically hypothesized to be better able to deal with inte(Merali et al., 2012; Merali & McKelvey, 2006), 2012; Merali & McKelvey, 2006).

6.2.2 COISA as an organizational capability

In line with the conceptualization as explained by Walraven (2021), we view COISA as a whole as an organizational capability, with the three above-described alignment competencies as its foundation. This stance builds upon several existing works in the field of organizational capabilities, including Peppard and Ward (2004), who define organizational capabilities as *"[…] the strategic application of competencies […], i.e., their use and deployment to accomplish given organizational goals"*. In line with this definition, the COISA capability considers the use and deployment of the strategic, orchestrational and operational alignment competencies. Their combination, in particular, makes for a *strategic* application. Crick and Chew (2020, p. 12) argue that business processes are *"[…] the basis for an organization's capabilities and how they "earn their living"*. This also resonates with COISA: Namely, as shown in earlier works on COISA, alignment processes form the micro-foundations of the strategic, orchestrational and operational alignment competencies (Walraven et al., 2020, 2021), which in turn comprise the COISA capability.

Table 6.1. Definitions of co-evolutionary alignment competencies

Competency	Definition
Strategic Alignment Competency	An organizations' ability to formulate strategic goals, and articulate strategic plans and structures to implement these goals in relation to IS, while monitoring relevance and topicality of these plans, goals, and structures, in line with frequencies of internal and external changes. (Baker et al., 2011; H. Liang et al., 2017; Sabherwal & Chan, 2001; Tanriverdi et al., 2010; Walraven et al., 2021; Yeow et al., 2017)
Orchestrational alignment competency	An organization's ability to maintain the coherence between their information systems, goals, processes, data, infrastructure, roles and functions, through architectural practices such as the definition and application of architectural principles or standards, while monitoring relevance and topicality of these architectural practices, in line with frequencies of strategic and operational changes (Rolland et al., 2015; Schilling et al., 2017; Vessey & Ward, 2013; Walraven et al., 2021; Weeger & Ulrich, 2016)
Operational alignment competency	An organization's ability to collaboratively use IT solutions effectively in daily operations and implement and optimize IT solutions in operational settings in line with end-users' needs, while monitoring and leveraging improvement possibilities during IT usage, implementations, and operations. (D. K. Allen et al., 2013; Amarilli et al., 2017; Burton-Jones & Gallivan, 2007; Goh et al., 2011; Lyytinen & Newman, 2008; Vidgen & Wang, 2009; Walraven et al., 2021)

Helfat and Peteraf (2003, p. 999) define an organizational capability as *"[…] the ability of an organization to perform a coordinated set of tasks, utilizing organizational resources, for the purpose of achieving a particular end result"*. COISA fits well into this framework since a crucial part of COISA relies on coordinating tasks not only within but particularly between the different alignment competences. This coordination takes place *through* the social interactions between stakeholders (Walraven et al., 2020). Moreover, this perspective is resonant with the insight that the micro-foundations of capabilities consist of individuals interacting within and between organizational and managerial processes (Harris et al., 2013). Summarizing, COISA as an organizational capability considers the combination and successful application of the three different alignment competencies to continuously align IT.

Viewing alignment as a capability is not novel. For example, earlier research has suggested that strategic alignment may be conceptualized as a collection of complementary capabilities, including (1) Dynamic Capabilities, (2) IT flexibili(van de Wetering & Mikalef, 2017)van de Wetering & Mikalef, 2017). However, as this study also points out, this particular conceptualization remains quite general, and *"Future work could address how managers should deploy improvement projects done simultaneously and hence by an integrated alignment perspective"* (van de Wetering & Mikalef, 2017, p. 10). Other researchers that address the alignment challenge using a capability perspective include Baker et al. (2011). These authors conceptualize strategic alignment as *"an enduring competency that is a source of competitive advantage"*. However, in their study, they only focus on aligning IT strategy with business strategy, and thus do not consider individual and operational levels of alignment. The only study that takes an explicit co-evolutionary stance on the conceptualization of alignment as an organizational capability, is the one by Walraven et al. (2021), which is why we use that conceptualization as the theoretical foundation of the current study.

6.2.3 COISA as an evolving capability

Given our conceptualization of COISA as an organizational capability that needs continuous attention and effort, the question may be raised whether, how, and in what circumstances the COISA capability itself evolves over time in hospitals. Several researchers have looked into the theoretical foundations of the evolution of capabilities. Helfat and Peteraf (2003) argue that dynamic and organizational capabilities both can be described to have life cycles, consisting of three generic stages, i.e. (1) Founding stage, (2) Development stage and (3) the Maturity stage. A given capability can "branch" into different directions during the development stage or the maturity stage.

Table 6.2 summarizes the characteristics of each of these capability lifecycle stages. For this current study, we use the capability lifecycle stages by Helfat and Peteraf (2003) as a starting point.

6.2.4 Key drivers of COISA capability evolution in an EMR context

Several studies have written about drivers of evolutionary paths of organizational capabilities. Helfat and Peteraf (2003), whose capability lifecycle stages we use as a conceptual lens, argue that branching of a capability into another stage is triggered by selection events. These consist of threats to the capability or opportunities for the capability to grow. Furthermore, Zollo and Winter (2002) take a knowledge-based view and argue that the micro-foundations of the evolution of dynamic capabilities lie in learning mechanisms, including experience accumulation, knowledge articulation, and knowledge codification. Moreover, Resource Orchestration Theory suggests that managerial actions can be seen as potential drivers of capability evolution (Sirmon et al., 2011).

Table 6.2. Capability lifecycle stages, based on Helfat and Peteraf (2003)

Capability lifecycle stage	Characteristics
Founding	A group with leadership and with the ability to take collaborative action is formed, with a common goal to create a new capability within the organization
Development	The capability building group or team makes decisions on how to best shape the capability at hand, informed by accumulating experiences in doing so.
Maturity	The capability no longer changes, but is maintained by regular exercise by the organization
Retirement	The capability ceases to exist
Retrenchment	The usage of the capability declines over time
Redeployment	The capability is transferred to another product market
Renewal	The capability returns to the development stage after having left this stage at an earlier point in time
Replication	The capability is transferred to another geographic market (but applied to the same product or service)
Recombination	The capability is combined with other capabilities to serve a different but related market

This particular theory combines insights from resource management and asset orchestration to look deeper into the role of managers' actions in the effective structuring, bundling and leveraging of firm resources in pursuit of competitive advantage. In other words, from this perspective, the formation and evolution of organizational capabilities is explicitly seen as a managerial responsibility, and managers' actions are hypothesized to shape these orchestration efforts. This premise has been empirically demonstrated and holds for executive and operational and middle managers (Chadwick et al., 2015; Sirmon et al., 2011). Pelletier, Croteau, Raymond & Vieru (2021) looked into social IT alignment (SITA) through an asset orchestration lens and find that SITA is facilitated through the allocation, structuring and coordination of IT resources and that *"[…] proper management of the SITA process is founded on the exchange and sharing of IT competencies and knowledge"* (Pelletier et al., 2021, p. 3).

In terms of specifically EMR-related capability drivers, several works may give some insight into the potential drivers of related capability evolution. Sha, Cheng, Pan & Yeng Teoh (2011) find in their case study on the implementation success of healthcare information systems that normative pressure, top management support, domain knowledge sharing and having a culture of innovation drives the development of alignment capabilities. Palvia, Jacks & Brown (2015, p. 711) describe that the EMR vendor often has a large influence in the development of capabilities during EMR implementations: *"[…] the* [EMR] *vendor's active participation in the EHR implementation is necessary due to project management and change management expertise that the vendor possesses and that may be missing or insufficient in the healthcare organization"*. Additionally, Walraven et al. (2020) describe facilitators of efficacious co-evolutionary stakeholder interactions toward alignment during EMR implementations based on the literature on effective alignment (e.g., Amarilli et al. (2017); Zhang et al. (2019)) and efficacious dynamics in complex organizations (e.g., Burt (2009); Grant (2003); McKelvey (2001)) and applied in an empirical EMR setting.

These facilitators may be seen as drivers of capability founding and development since they contribute to the growth of the COISA capability. However, they do not explicitly give insights into the drivers of the other capability lifecycle stages, except that maybe the absence of one or more of these facilitators could lead to the capability's retrenchment or retirement. The facilitators described by Walraven et al. (2020) include alignment motivation, considering *"[…] facilitators motivating IS stakeholders to engage in co-evolutionary interactions in a specific alignment* *process"* (Walraven et al., 2020, p. 9); Stakeholder involvement, or *"[…] facilitators related to the selection of actors to be involved in COISA processes"* (Walraven et al., 2020, p. 9); Interconnections, or "*[…] the means that IS stakeholders have to engage in co-evolutionary alignment interactions*" (Walraven et al., 2020, p. 11) and finally alignment decisions, considering *"[…] specific decisions that are taken in the alignment processes themselves and that may, in turn, benefit following COISA interactions in those same processes"* (Walraven et al., 2020, p. 11). These alignment decisions include having common guidelines, putting in place central coordination of the COISA capability, allowing emergent decision-making, and having the adequate technical infrastructure in place.

6.3 METHODOLOGY

To answer our research question, we conducted a longitudinal multiple case study, carried out through retrospective interviews in two phases. Our multiple case approach improves generalizability since it enables us to compare the evolution of the COISA capability across different hospitals. We used a longitudinal approach because we are interested in the evolution of the COISA capability over time. The first interview phase focused on the EMR implementation and its preparation, and was carried out in the months right after the go-live of the EMR system in each hospital. Herein, we studied whether and how a COISA capability was founded to align the EMR prior to or during the implementation, and how the capability evolved in each of the studied hospitals during this period. The second interview phase was done during the six to twelve months after go-live of the EMR, to study and reflect on how the COISA capabilities further evolved after the initial go-live. The two-phased approach to longitudinal research is comparable to the longitudinal study method on stakeholder roles and perceptions in health information systems by Pouloudi, Currie & Whitley (2016). Furthermore, our approach is in line with the before-and-after logic for longitudinal research (Yin, 2018), where data collection is done in two phases, i.e., before and after a critical event. In our current study, this critical event entails the go-live of the EMR. We will now elaborate on each of the three case studies.

6.3.1 Case studies

We selected three Dutch hospitals based on two criteria: First, they all implemented a new, advanced EMR in the past few years, and second, that they are academic or top clinical hospitals. The latter criterion ensured the presence of complexity that the COISA capability is hypothesized to address. All hospitals implemented a vendor-built system: Hospital A and Hospital C opted for a vendor (Vendor 1). This Vendor originates from the United States and implemented their EMR solution in countries across the globe including the United Stated, Canada, England, and the Netherlands. They offer an EMR solution that is standardized to a certain degree, but still has many configuration possibilities for individual hospitals. Hospital B implemented a standardized EMR system from a different vendor (Vendor 2), which is also standardized and to some degree configurable. However, it is much less flexible than the system from Vendor 1. Vendor 2 is the Dutch market leader, having implemented their EMR system at 70% of all Dutch hospitals (van Eekeren et al., 2021). Hospital A and Hospital B both went through a merger simultaneous to the EMR implementation. These mergers were for both of these case hospitals, a main reason to implement a new EMR. Hospital C did not go through a merger, but its existing EMR was soon reaching its end-of-life.

Furthermore, the hospitals all carried out some preparations before the actual implementation program of the EMR, however, the scope and time spent on that pre-implementation phase differed for each case: Hospital A had the most extensive pre-implementation phase, considering an entire program focusing on process- and IT harmonization in preparation of the upcoming merger. Hospital B was also going through a merger and aimed to harmonize processes as much as possible before the EMR implementation. However, they did not set up a separate program to this end. Instead, they gave department heads the responsibility to pursue this before the implementation phase would start. Hospital C had a minimal pre-implementation phase, because of time limits and presumably because they did not face a simultaneous merger. The time limits were caused by a previously failed implementation of a different EMR, leaving the hospital very limited time before the end-of-life of their previous EMR.

Moreover, unlike Hospitals A and B, Hospital C opted for a two-staged implementation of the EMR of Vendor 1, to make sure that the most crucial EMR parts could go live in time. Specifically, in the first implementation stage, the hospital implemented the essential EMR modules to enable the different departments to administer and exchange patient information and support essential healthcare processes. In the second implementation stage, the hospital worked on optimizing these functionalities and added additional functionalities such as mobile apps for doctors and nurses, information exchange possibilities with general practitioners and integrations with medical devices. Table 6.3 summarizes relevant case information.

Table 6.3. Case hospital characteristics

	Hospital A	Hospital B	Hospital C
Size	750-1000 beds	500-750 beds	>1000 beds
EMR Vendor	Vendor 1	Vendor 2	Vendor 1
Simultaneous merger?	Yes	Yes	No
Scope EMR	Hospital-wide	Hospital-wide	Hospital-wide
Pre-implementation phase	Extensive (separate program)	Limited	Very limited
Implementation program approach	One go-live	One go-live	Two-stage approach
Hospital type	Top clinical	Top clinical	Academic

6.3.2 Data collection

We conducted in-depth interviews with key stakeholders in two phases. In doing so, we aimed for an optimal stakeholder representation (IT; external; management and medical), as recommended by Pouloudi, Currie and Whitley (2016). Furthermore, we selected respondents with a helicopter overview over the implementation program and the EMR, i.e., respondents who are strategically responsible for the EMR and its alignment and overview all relevant aspects. These stakeholders are most likely to have knowledge on the formation and evolution of formal governance structures in relation to EMR alignment. Moreover, we aimed to interview people whose primary role in relation to the EMR was to represent their constituencies during and after the implementation. For example, in hospital C, the digital doctors represented all doctors in the hospital in the decision-making around the EMR. The rationale behind this particular criterion is to optimize the stakeholder representation in our data and to get a better idea of informal influences on decisions related to EMR alignment on lower hierarchical levels. We could not cover the patient perspective, because we could not identify a representative of this group meeting this latter criterion. We could not include the vendor's perspective for hospitals A and C because this vendor was unwilling to participate in our study.

To identify suitable respondents for the second phase, we used the same selection criteria and first contacted our first-phase respondents. Then, depending on whether they were still actively involved with the EMR, we interviewed them a second time or asked them to refer us to suitable respondents. Our first data collection phase (phase I) took place between September 2018 and November 2018. Our second data collection phase (phase II) took place between March 2019 and June 2019. We finally interviewed at least five respondents per hospital per phase, amounting to 35 interviews in total, as summarized in Table 6.4.

Our questions focused on the respondent's experience with decision-making and stakeholder involvement on different levels during and after EMR implementation. We aimed to cover different levels by asking about the EMR implementation operationally, but also about the role of strategic and architectural practices (if present). Furthermore, we asked each respondent to elaborate on their role in relation to the EMR during implementation and/or after go-live. Specifically, we focused on how their role related to any official governance structures and how they played a role in any informal decision-making structures. We also asked about how these formal and informal decision-making structures and EMR alignment related decisions evolved during the implementation and after, and how the involvement and stance of the different stakeholder groups evolved over time and why. To enable triangulation, we also collected documentation related to the EMR, including project plans, strategic guidelines, and decision-making structures.

6.3.2 Data analysis

All interviews were recorded, transcribed, and coded. The coding process was informed by the recommendations by Saldaña (2015) and involved a three-step approach: First, passages that indicated a particular capability life cycle stage were coded using a deductive approach, based on the work by Helfat and Peteraf (2003). Then, each of the coded passages were labeled in a second round as either considering the operational, the orchestrational, or the strategic alignment competency. Lastly, we went through the entire dataset once more using a more inductive approach to identify and categorize the drivers of the COISA capability's evolutionary paths. To improve reliability, we pursued inter-coder agreement levels as follows: The resulting analysis and corresponding coding were independently reviewed by two other researchers, who coded the interview passages in terms of alignment competency and capability lifecycle stage. When disagreements arose, we had substantial discussions to come to a final analysis.

Table 6.4. Interviewees for each case hospital and phase

Hospital	A		B		C	
Phase Group	I	II	I	II	I	II
IT	ICT manager Project lead A	Head EMR ops Project lead A Project lead training	ICT architect	CIO ICT architect Head EMR ops	Project lead 1 Project lead 2	Program manager 2 Program manager 3
External	Project lead B	N/A	Program manager Vendor rep.	N/A	Program manager 1 Project lead 3 Project lead 4	N/A
Mgmt.	Project lead C	Manager healthcare	Project lead	Information manager	Project lead 5	Project lead 6
Medical	Project lead D	Project lead D Digital doctor Digital nurse	CNIO	CNIO	Digital doctor 1	CMIO Digital doctor I Digital doctor 2

6.4 RESULTS

Our results show that (parts of) the COISA capability of all three hospitals went through the founding-, development-, retrenchment-, and renewal stages. Furthermore, in Hospital B, parts of the COISA capability went into the redeployment stage. Finally, our results reveal a stage that was not included in the original model by Helfat and Peteraf (2003), which we named the "coordination" stage. We characterize this "coordination" stage as follows: a capability founded *within* organizational boundaries is brought to a higher *network- or ecosystem-level* by formally incorporating other organizations in the capability. In two of the three case study hospitals, part of the COISA capability evolved in this direction after go-live.

In the remainder of this chapter, we will elaborate on the evolutionary paths of the COISA capability and their drivers, highlighting similarities, differences, and possible explanations for our findings. In doing so, we will first go into the evolutionary paths of the COISA capability during the (pre)-implementation phase of the EMR, i.e., the results from our first data collection phase (see figure 6.2). Then, we will elaborate on our findings from our second data collection phase, considering the six to twelve months after go-live of the EMR in our three case hospitals (see figures 6.2-6.3). We will finally focus on the particular drivers of the COISA capability evolution, both during (pre-)implementation and after go-live.

6.4.1 Data collection phase I: Before go-live

Pre-implementation: founding of the COISA capability

At least a part of the COISA capability was founded in all three hospitals before the EMR implementation. As described in section 3.1, Hospital A had the most extensive pre-implementation phase. Namely, before the selection of the EMR had begun, this hospital set up a strategic committee consisting of executive and middle management, IT management, and medical staff, which in turn set up a preparatory project aiming to clarify and streamline existing processes of the merging hospitals (ICT manager; Project lead D, hospital A). During this project, the hospital initiated end-user groups for each specialism with adequate role representation (e.g., doctors, nurses, team leaders), forming a foundation for the operational alignment competency. (ICT manager; project lead D, hospital A). Moreover, this hospital set up hospital-wide end-user groups as a basis for their orchestrational alignment competency. These groups were responsible for streamlined processes that overarch several roles (e.g., doctors and nurses) or departments (e.g., the hospital pharmacy and several specialisms) such as medication and patient logistics, but also authorizations and medical technology integration (ICT manager; project lead A; project lead D, hospital A).

Hospitals B and C also founded part of their COISA capability during pre-implementations; however, these foundations' goal was mainly to select an EMR vendor and to a lesser degree to streamline and harmonize processes and thus these foundations were limited to the strategic alignment competency only (ICT architect, program manager, hospital A; project lead 1, hospital C).

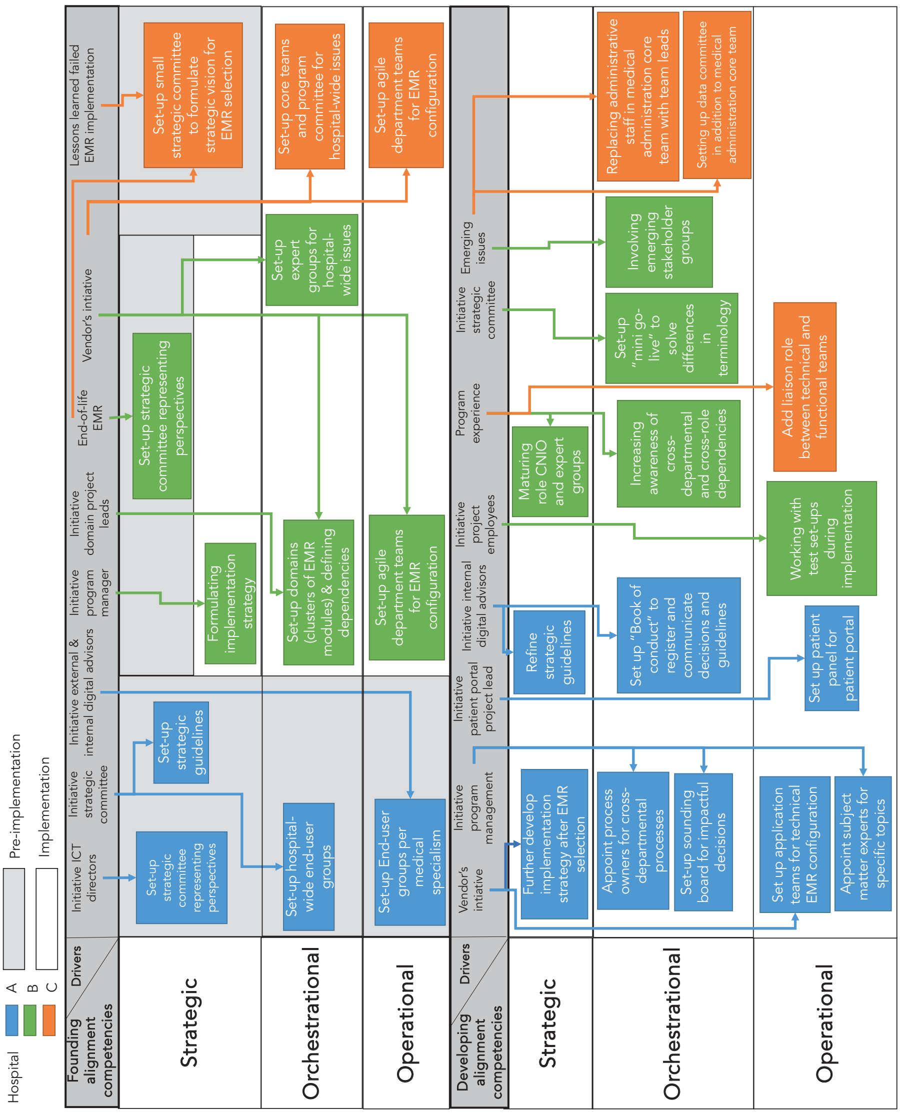


Figure 6.2. Results of data collection phase 1

Implementation: founding and development of the COISA capability

While Hospital A had already founded all alignment competencies during pre-implementation, Hospitals B and C founded their operational and orchestrational alignment competencies during the implementation, shaped by the EMR vendors' implementation strategy. Following, all three hospitals' COISA capabilities evolved into the development lifecycle stage during the EMR implementation.

In Hospital A, the initial implementation strategy set up during pre-implementation was incrementally updated based on input from the vendor, as pointed out by several interviewees (Project lead A, hospital A; Project lead D, hospital A). Based on these incremental updates, hospital A's strategic alignment competency developed into hybrid between the vendor's standardized implementation strategy and hospital A's own experience during the pre-implementation phase. For example, hospital A kept their process-focused hospital-wide and specialism-specific end-user groups, even though those were not usually part of the governance structure prescribed by the vendor: *"You have to be well-prepared because this vendor works mainly around applications, while we had deliberately set up our end-user teams around processes. In the beginning, this really was a struggle to keep it that way. But we believed in what we were doing: we felt like we knew why we did it that way. But we had to justify ourselves"* (Project lead D, hospital A). Furthermore, several internal actors in Hospital A initiated some additional developments of the COISA capability. For example, in terms of Hospital A's orchestrational alignment competency, process owners were appointed for cross-departmental processes such as outpatient clinic logistics (ICT manager, hospital A). Moreover, the "book of conduct" was set up as a development of the hospital's orchestrational alignment competency: *"In the book of conduct, all hospital-wide decisions were documented. So, for example, who is authorized to order medicine, and what kind of medicine?"* (Project lead B, hospital A).

In hospitals B and C, the COISA capability's development was influenced by their acquired experience during the implementation. For example, in hospital B, experience during the program caused the orchestrational alignment competency to evolve: *"While making configurational decisions while working together, people really saw through the entire process of a patient coming in at first aid, through the entire chain of departments including the operating room, and there really was some kind of realization. […] We really made some big steps there, also in terms of cross-departmental process harmonization."* (ICT architect, hospital B). A comparable mechanism emerged in hospital C: *"Most hospitals do not have much experience with* *these types of implementations. So in the beginning, the vendor is very much in the lead in the way operational decisions are being made. […] And as the implementation moves forward, you become more of a partner and the vendor gradually moves to the background and you start to shape things your own way."* (Program manager 1, hospital C).

6.4.2 Data collection phase II: After go-live

In our second data collection phase, we identified three lifecycle stages in all of our case hospitals (i.e., development, retrenchment and renewal) and two in only one or two of our case hospitals (i.e., redeployment, and a new lifecycle stage called "orchestration"). *Development, retrenchment and renewal of the COISA capability*

After go-live of the EMR, the COISA capability of all case hospitals showed evolutionary paths of development, retrenchment and renewal (see figure 6.3)
In Hospital A, the development of the capability consisted of two important types of actions. Firstly, these involve actions to address urgent issues emerging after go-live of the system. For example, in terms of its operational alignment competency, hospital A set up so-called task forces to solve these most urgent issues (project lead D; digital nurse; head EMR operations, hospital A). Secondly, these involve actions focused on improving existing structures to form a solid foundation for an effective COISA capability during EMR operations. For example, strategic guidelines were revised to further develop the strategic alignment competency, and agile optimization sprints including personal training based on "shadowing" were initiated as part of the operational alignment competency: *"All outpatient clinics get an agile sprint during three weeks, and then all doctors in those clinics are being "shadowed" […] to be able to analyze: how can this person make better use of the EMR? And during those same three weeks we look at, what are the department's wishes in terms of optimization and development of the EMR?"* (project lead training, hospital A).

At some point after go-live, Hospital A's COISA capability started to show signs of retrenchment, for example because there was less attention to end user training (digital doctor; project lead training, hospital A) and because there was confusion about how decision-making structures were supposed to work after the end of the implementation program (digital doctor, hospital A). The capability was then renewed in several ways, for example, using the momentum of a vendor-pushed EMR update to revive the key user role (digital nurse, hospital A).

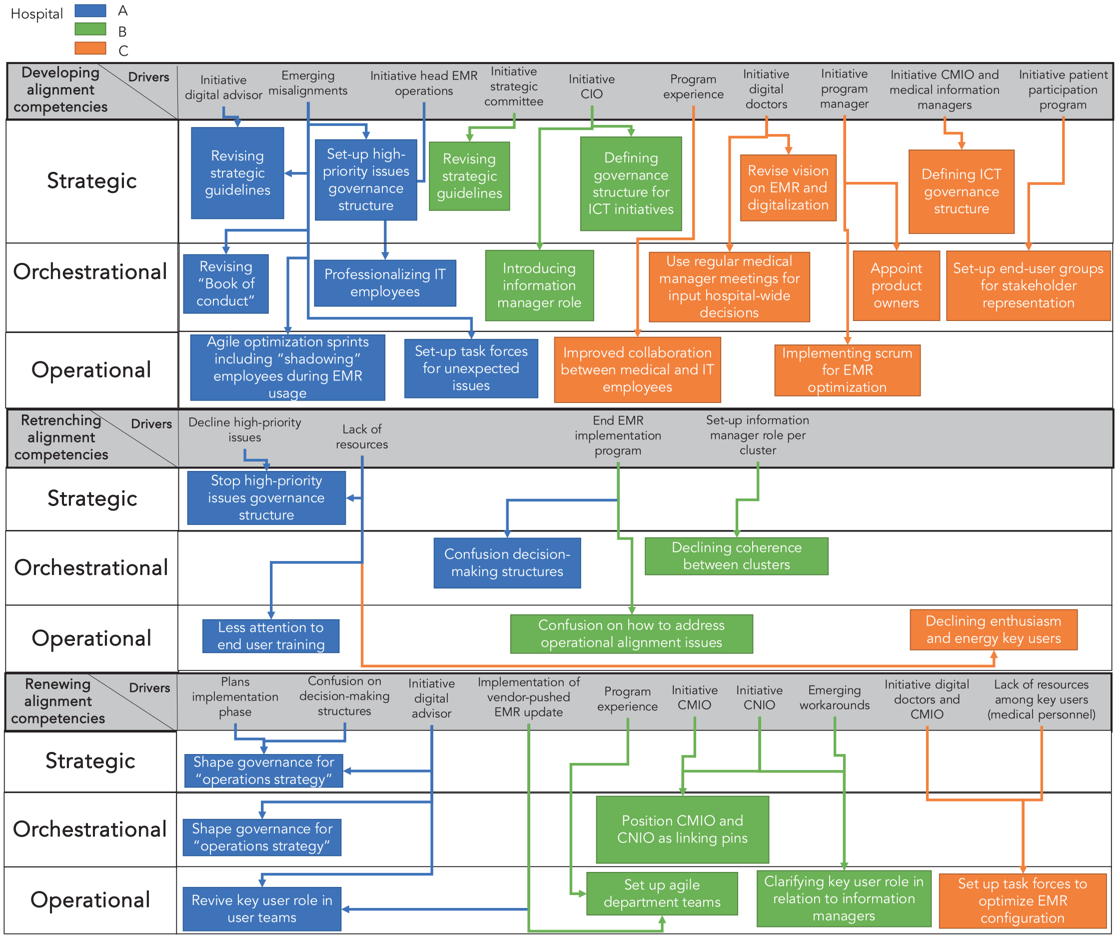


Figure 6.3. Results of data collection phase II (Results manifesting in all three cases)

In Hospital B, the development of the COISA capability, like in Hospital A, also involved solving urgent issues on the one hand and working towards a more mature COISA capability during EMR operations on the other hand. For example, this hospital also set up agile teams as part of their operational alignment competency, addressing both urgent issues and less urgent issues focused more on optimization (information manager; ICT architect; hospital B). Comparable to Hospital A, Hospital B's COISA capability also evolved towards retrenchment after go-live, for example because of the confusion that emerged after the end of the implementation program on how to address operational issues (ICT architect; CNIO, hospital B). The operational alignment competency was in turn renewed by setting up agile department teams to optimize EMR configurations (Head EMR operations, ICT architect, hospital B).

In Hospital C, the COISA capability's development was visible for example in the revision of the hospital's vision on the EMR (digital doctor 1; digital doctor 2; hospital C). Moreover, there was a parallel effort by the CMIO and several information managers to set up a governance structure for EMR alignment during operations: *"EMR operations are now situated in the implementation program and not in the regular organizational structure of the hospital. […] What we are working on right now is the transition from the program to the regular organizational structure, towards the department of information management. Together with those information managers, I will be responsible for all healthcare related information technology, including the EMR"* (CMIO, hospital C). Although not as clearly visible as in Hospitals A and B, Hospital C also showed some signs of COISA capability retrenchment because of the declining enthusiasm of key users: *"[…] enthusiasm is declining because many healthcare employees are back to their own work"* (digital doctor, hospital C). This particular hospital addressed this decline by renewing the operational alignment competency, i.e., by setting up task forces: "*the optimization teams visit all outpatient clinics in the hospitals to see what issues they face in the EMR, to be able to quickly fix emerging issues and optimize the EMR."* (digital doctor, hospital C).

Redeployment and coordination of the COISA capability
We identified the redeployment lifecycle stage in one of our case studies (Hospital B) and the new "coordination" stage in two of our case studies, Hospitals B and C (see figure 6.4).

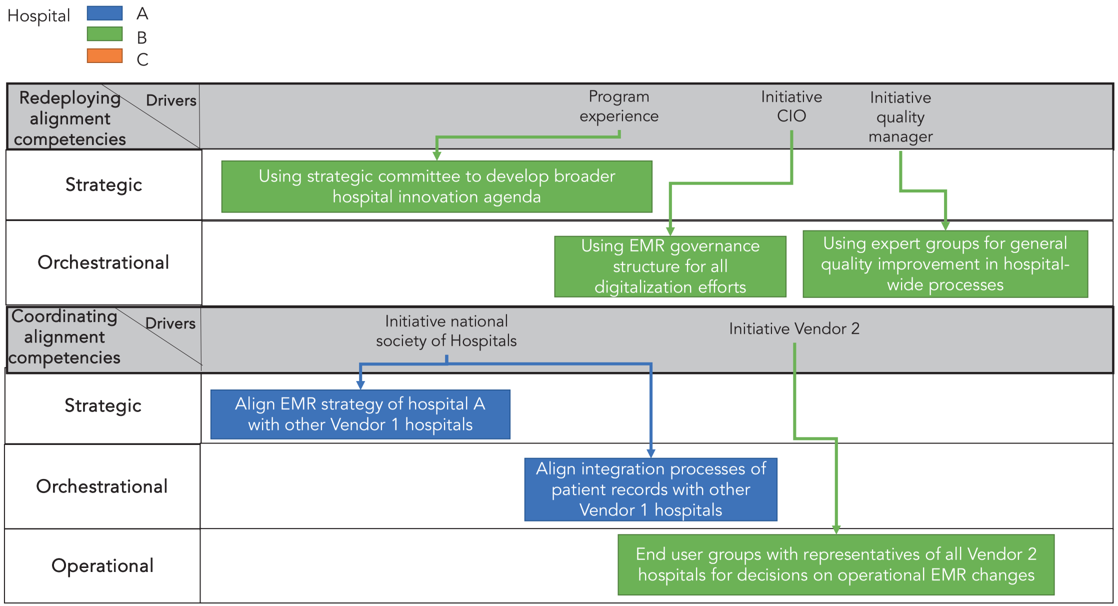


Figure 6.4. Results of data collection phase II (Results manifesting in one or two cases)

In hospital B, we found that after go-live, parts of the COISA capability were *redeployed* to IT-related innovations other than the EMR. For example, departments were encouraged to "pitch" innovative IT solutions (not necessarily within the EMR), supported by the newly founded role of information manager (present at each group). (ICT Architect; Information manager; CNIO, hospital B). The digital strategic committee that was initially founded as part of the EMR program was redeployed in this context because it reviewed and prioritized these pitches. Moreover, they developed a digital strategy broader than just the EMR after go-live (CNIO, CIO, Hospital B).

In Hospitals A and B, we identified a new lifecycle stage of the COISA capability relative to the predefined lifecycle stages based on Helfat and Peteraf (2003). We have named this particular stage the "coordination" stage. This capability lifecycle implies that a capability founded on an organizational level is extended to a broader ecosystem. This extension is done by formally incorporating other organizations in the capability to collaboratively coordinate alignment efforts, hence the name "coordination". In our empirical findings, these other organizations entailed other hospitals working with the same EMR. However, the particular focus of coordination differed depending on the vendor's strategy. The COISA capability of Hospital B, working with Vendor 2's highly standardized solution, evolved toward the coordination stage in the operational alignment competency. Namely, to ensure that the highly standardized solution fits the hospitals that have implemented this solution as much as possible, Vendor 2 has set up their end-user groups consisting of representatives of the different hospitals using Vendor 2's EMR (CNIO; Vendor representative, hospital B): "*For this standardized solution, we set up end-user groups. This is on the level of medical specialists, and they periodically meet. For example, we have an end-user group cardiology, consisting of cardiologists of all the hospitals working with our standardized solution. […] And the customers are in charge, so these groups' chairs are also representatives from one of the hospitals. We* [Vendor 2] *facilitate these meetings […] The benefit is that when consensus on a specific topic emerges among the different hospitals, we can adapt our standardized solution to their needs, and everyone is happy."* (Vendor representative, hospital B). In short, these end-user groups make decisions on specialism-specific issues that occur on an operational level, and can thus be considered to be a vendor-facilitated, cross-hospital execution of the operational alignment capability.

The COISA capability of Hospital A, working with Vendor 2 and its slightly less standardized solution, evolved toward the coordination stage in the orchestrational and strategic alignment competencies. The head of EMR operations elaborated: *"There is the directors' meeting among all hospitals working with the EMR solution of this vendor […] So you have all the national hospitals working with Vendor 1 there, and Vendor 1 is represented as well. The idea is to exchange knowledge, to set up contacts and to have a strong position in certain themes, priorities or developments in relation to Vendor 1."* (Manager healthcare, hospital A). Coordination of the orchestrational alignment competency was done across hospitals working with Vendor 1's EMR, for the theme of data integration (project lead A, hospital A)

6.4.3 Key drivers of the COISA capability evolution

Based on our literature review, we identified several potential drivers of capability evolution including (1) Selection events (Helfat and Peteraf, 2003); (2) Managers' motivation (Chadwick et al., 2015; Sha et al., 2011; Sirmon et al., 2011; Walraven et al., 2020); (3) Accumulating experience (Pelletier et al., 2021; Zollo & Winter, 2002); and (4) Vendor influence (Palvia et al., 2015) Using these categories as a starting point, through our hybrid deductive and inductive coding approach we finally identified four categories of capability evolution drivers in our case studies. These categories include (1) Stakeholder initiative; (2) Driving events; (3) Accumulating experience and (4) Emerging issues (see table 6.5).

Table 6.5 Definitions of key drivers of the COISA capability evolution

Driver	Definition
Stakeholder initiative	One or more stakeholder(s) (group(s)) take(s) initiative to drive capability evolution in a certain direction
Driving events	A specific event in time causes a capability to evolve in a certain direction
Accumulating experiences	Through accumulating experience with a capability and thanks to the resulting knowledge, the capability evolves in a certain direction
Emerging issues	Specific issues emerge during the execution and usage of the capability evolution that require immediate action, causing the capability to evolve in a certain direction.

The first category entails instances where specific stakeholders take the initiative to found or evolve the COISA capability because they feel motivated to do so. For example, this was the case in Hospital A, where digital advisors and an external consultant took the explicit initiative to set up end-user groups as a foundation of the operational and orchestrational alignment competencies (project lead B; project lead D, hospital A). The second category, i.e., driving events, considers specific events that form a concrete reason to set up, evolve, or retrench alignment competencies. A specific example includes a merger of two hospitals (visible in case hospitals A and B), causing strategy- and process harmonization to become an immediate issue (ICT manager, hospital A; CNIO, hospital B). In Hospital C, these driving events include an initially failed EMR implementation and the end-of-life of their old EMR (project lead 1, hospital C). The third category, i.e., Accumulating experience, considers evolutionary paths of the COISA capability caused by lessons learned through accumulated experience over time. For example, in hospital B, the orchestrational alignment competency developed through experience because people became more aware of the interdependencies between their departments (ICT architect, hospital B). The fourth category is emerging issues. This entails specific issues that emerge during the execution and usage of the capability requiring immediate action, then causing the capability to evolve in a certain direction. For example, in Hospital A, several high-priority issues emerged right after go-live, causing the hospital to set up a specific decision-making structure tailored for quick, high-priority decisions, thereby developing the strategic alignment competency (head EMR operations; digital doctor, hospital A).

A few things stand out in our results. First, we see that stakeholder initiative is a driver that is seen in all lifecycle stages considering a forward evolution of the capability. Only in the retrenchment stage, which entails a *decline* of the capability, there are no stakeholder initiative instances as a key driver. Second, out of the lifecycle stages where stakeholder initiative does seem to be a key driver, this seems most so the case for founding- and development stages. Furthermore, driving events seem to be a driver for lifecycle stages where the capability takes an entirely new direction, i.e., at its foundation, at its retrenchment, and when part of the capability is renewed. Lastly, the abovementioned findings seem to be valid for all three alignment competencies, and no clear differences or patterns seem to be present, looking at the alignment competencies individually.

6.5 DISCUSSION & CONCLUSION

Our study demonstrates that each of our case hospitals has a unique evolutionary path regarding its COISA capability in pursuit of EMR alignment. Previous work suggests that building such a COISA capability indeed promotes creating a common interpretation and implementation of what it means to apply EMR in an appropriate and timely way across stakeholders, i.e., EMR alignment (Keshavjee et al., 2006; Luftman, 2004; Luftman & Brier, 1999; Walraven et al., 2020). Even so, attention should still be paid to the fact that to effectively pursue this endeavor, continuous time and effort should be spent to maintain an adequate level of EMR alignment due to the complex and continuously changing environment that hospitals face (Keshavjee et al., 2006; Palvia et al., 2015; Walraven et al., 2019). Our theoretical contributions are threefold: First, we add to the existing works on EMR in hospital settings. We do so, by taking on the challenge of EMR alignment from a theoretical perspective that is new to this particular area of expertise. Combining insights into which capabilities are essential in EMR alignment and the key drivers of shaping and steering these capabilities provides health researchers with concrete concepts to do rigorous empirical research in health IT. Moreover, it provides a basis of scientific conversation to compare the value of the COISA capability for EMR specifically to its value in relation to other health and non-health IT solutions.
Secondly, we identified a new capability lifecycle stage in our current study, i.e., the coordination stage, meaning that a capability founded within organizational boundaries is brought to a higher network- or ecosystem-level, formally incorporating other organizations in the capability. With this particular addition, we expand on the theoretical developments in capability evolution, especially in terms of possible lifecycle stages that a capability may evolve towards (Helfat & Peteraf, 2003). Furthermore, this finding underlines the importance of the healthcare ecosystem and shows the importance of internal alignment capabilities to enable further upscaling of HIT innovations.

Third, we add a new perspective to viewing alignment as an organizational capability. Specifically, we unfold the different alignment competencies that comprise this particular capability. In addition, we incorporate not only strategic alignment challenges, like in earlier works (van de Wetering & Mikalef, 2017), but also operational and orchestrational competencies. We do so by providing a rich empirical, longitudinal perspective on how this particular viewpoint on alignment resonates with practical findings. A particularly interesting addition to the knowledge base considers our findings in terms of key drivers of alignment: A key finding in this current study is namely the importance of stakeholders as drivers of the COISA capability evolution, also in the long run. Namely, for all capability lifecycle stages except for the retrenchment stage, stakeholder initiative shows to be an essential driver of COISA capability evolution. This resonates with earlier findings on efficacious COISA in a healthcare setting, as described by Walraven et al. (2020). Furthermore, most (but not all) of the stakeholders that drove the forward evolution of the COISA capability in our case studies were middle managers and thus these findings confirm this particular aspect of resource orchestration theory, i.e., that managers can shape the successful orchestration of organizational capabilities (Chadwick et al., 2015; Sirmon et al., 2011).

Moreover, both driving events and emerging issues can be related to alignment motivation. Specifically, these should be seen as external factors that motivate stakeholders to engage in alignment competencies. Our findings also resonate with earlier work by Zollo and Winter (2002), who argued that the key drivers of capability evolution consist of threats and opportunities to the capability. Specifically, intrinsically or extrinsically motivated stakeholders show to provide opportunities for the COISA capability to evolve into different directions, while specific driving events and emerging issues can also form direct threats to the COISA capability, eventually leading to the capability's retrenchment.

6.5.1 Practical implications

Practitioners can use our findings to better build and shape their organization's capabilities to align EMR. A particularly interesting finding is the coordination of alignment competencies to an inter-organizational level. This coordination potentially enables healthcare managers to leverage the alignment competencies within organizational boundaries to work towards cross-organizational alignment on an ecosystem level. However, the specific alignment competencies that are coordinated to this ecosystem level all have their advantages and disadvantages: For example, an advantage of choosing to coordinate the operational alignment competency, as seen in case Hospital B, is that especially among healthcare employees, less resources are needed to maintain operational alignment. Since these resources are already scarce in primary healthcare processes, this clearly is an advantage. Furthermore, if coordination occurs at the operational level, orchestrational issues such as cross-organizational data integration become less challenging because they can be executed centrally through the decisions in the coordinated operational alignment competency. This is less so the case when just the orchestrational and strategic alignment competencies are coordinated and operational configurations are left to individual hospitals. However, choosing to coordinate the operational alignment competency also causes healthcare employees to feel less ownership of the EMR. Furthermore, fundamental changes to the EMR are generally difficult and slow to implement because all hospitals using the EMR have to agree to a specific change before it can actually be implemented.

For all of our case hospitals and in particular hospitals A and B, the EMR implementation provided a substantial opportunity to found and develop an internal COISA capability, which seems to be a sound basis to enable coordination and collaboration on an ecosystem level. Hospitals aiming to coordinate their alignment capabilities may consider to first found and develop such a capability in-house. Furthermore, hospitals could pay specific attention involving suitable stakeholders in building and evolving their COISA capability: Specifically, stakeholders' initiative shows to be an important driver of the evolution of the COISA capability. Furthermore, practitioners could be more conscious of potential external motivators for stakeholders to drive COISA capability evolution. Specifically, driving events and emerging issues could be leveraged to motivate stakeholders toward a co-evolutionary alignment dialogue, eventually leading to better aligned HIT solutions.

6.5.2 Limitations and conclusion

Although we view this particular study's added value for theory and practice to be substantial, our study is not without limitations. First, we only studied three hospitals, all situated in Western Europe. Especially given the seeming importance of stakeholders and thus human factors, it would be interesting to see whether our findings hold in different cultural contexts. Furthermore, our study was based mainly on retrospective interviews, which may have influenced our findings (Yin, 2018). Future research could apply ethnographic approaches and include observations as a research method to get an even deeper insight into how alignment capabilities evolve around EMR in a hospital context. Lastly, we did not get a comprehensive overview of all stakeholder perspectives in all hospitals. For example, in Hospital B, we mostly interviewed people in advisory or IT-roles and only a limited amount of healthcare employees, since these were relatively difficult to access in this particular hospital.

Concluding, our study reveals the different ways in which the EMR-related COISA capability evolved in three different hospitals. In doing so, we reveal a new lifecycle stage that shows how an internal COISA capability is scaled up to multiple organizations working with the same EMR vendor. This adds to multiple existing theoretical perspectives, including EMR alignment and capability evolution. Furthermore, we underline the importance of stakeholders in the COISA capability's evolution. Practitioners can use our findings to effectively improve their EMR alignment through effective COISA coordination and stakeholder involvement.

PART 3

THE VALUE OF THE COISA CAPABILITY IN HEALTHCARE AND THE PUBLIC SECTOR

7

LEVERAGING IS IN THE COMPLEXITY OF HEALTHCARE:

A COMBINED NCA- AND PLS-SEM ANALYSIS ON THE EFFECTS OF CO-EVOLUTIONARY IS-ALIGNMENT

The results presented in this chapter have been published as a full research paper in the proceedings of the European Conference on Information Systems 2022.

ABSTRACT

Several studies have advocated for the value of co-evolutionary approaches to business-IT alignment in healthcare settings, because they would be better suited to deal with complexity. However, empirical evidence supporting this premise is scarce and mainly based on qualitative works. We address this research gap by performing a survey among 85 Dutch healthcare organizations, looking into the effects of co-evolutionary information systems alignment (COISA) on organizational performance and the role of dynamic capabilities in this value path. We combine Necessary Condition Analysis and Partial Least Squares Modelling to see which aspects are indispensable and help further develop dynamic capabilities and performance. Our results confirm that COISA indeed positively influences healthcare organizations' organizational performance through dynamic capabilities. Furthermore, we demonstrate that alignment motivation and interconnections between heterogeneous IS stakeholders are indispensable, and show the seemingly higher importance of the operational and orchestrational alignment competencies and the sensing dimension of dynamic capabilities.

Keywords: Co-evolutionary Information Systems Alignment, Dynamic Capabilities, Organizational Performance, Healthcare, Necessary Condition Analysis, Partial Least Squares Structural Equation Modelling

7.1 INTRODUCTION

Healthcare is facing more complexity than ever before, because of the rising number of stakeholders through the shift to healthcare provision in ecosystems, and through societal developments including the COVID-19 pandemic and consistent healthcare personnel shortages (Korneta et al., 2021; Mohrman & Shani, 2014; Sutherland et al., 2020). Healthcare organizations do not only have to deal with these challenges, but they are expected to innovate and implement advanced information systems (IS) to improve their quality of care, cost efficiency and responsiveness amidst these complex developments further. These IS are expected to provide organizations with the ability to exchange information on an ecosystem level, to provide physicians and nurses with advanced decision support and to give patients more autonomy in their healthcare trajectories (Faber et al., 2017; Sneha & Straub, 2017).

To successfully leverage the potential benefits of these IS, healthcare organizations have to continuously bring and keep Information Technology (IT) in line with strategies, goals and needs of the healthcare organization and its stakeholders. In the extant literature, this effort is also referred to as business-IT alignment (BITA) (Luftman & Kempaiah, 2007). The importance of BITA in a turbulent environment has for example become clearly visible in the added value of applying telehealth during the COVID-19 pandemic (Monaghesh & Hajizadeh, 2020).

Recent qualitative studies carried out in the context of Electronic Medical Records implementations in hospitals have shown that a complex adaptive systems (CAS)-based, co-evolutionary approach to BITA could be helpful for hospitals to effectively deal with the abovementioned complexity in the pursuit of alignment of EMR (Walraven et al., 2019, 2020). The authors explain that this stance comes from the principle of requisite complexity, based on Ashby's law of requisite complexity (*"[…] only variety can destroy variety"*) (Ashby, 1956, p. 207). This principle states that *"[…] in order to remain viable, a system needs to generate the same degree of internal complexity as the external complexity it faces in its environment"* (Benbya & McKelvey, 2006b, p. 290). In other words, the authors of these studies imply that healthcare organizations should be better prepared to deal with their environment's complexity and perform better overall in these conditions, by applying CAS principles in their alignment capabilities.

However, research on this topic has been limited to conceptual and qualitative studies, and empirical work has not gone beyond EMR- or even hospital contexts. Therefore, there is a call for more empirical research to investigate the promise that CAS-based alignment capabilities actually help healthcare institutions on an organizational level to thrive in complex conditions (Zhang, Chen, & Lyytinen, 2019; Zhang, Chen, Lyytinen, et al., 2019).

This paper aims to address this issue by examining the effects of co-evolutionary information systems alignment (COISA) on organizational performance in healthcare settings. In this effort, we take a dynamic-capabilities perspective on organizational performance. Dynamic capabilities comprise a framework from strategic management literature (Helfat et al., 2009; Teece, 2007; Teece et al., 1997), addressing how organizational performance and competitive advantage can be improved. It is specifically suited for highly turbulent environments and looks into *"[…] the capacity of an organization to purposefully create, extend, or modify its resource base"* (Helfat et al., 2009) as a basis for organizational performance. This seems a fitting approach given its explicit focus on dealing with turbulence and complexity. Again, the added value of the rapid implementation of e-health solutions in the COVID-19 crisis is an excellent example of the importance of these capabilities to maintain quality of care (Monaghesh & Hajizadeh, 2020). Based on the above, our research questions are as follows:

> **RQ1:** To what extent does co-evolutionary IS alignment influence organizational performance in healthcare?
>
> **RQ2:** What is the particular role of Dynamic Capabilities in the value path?

In the remainder of this paper, we will first elaborate on the theoretical foundations of COISA and dynamic capabilities. Then we introduce our conceptual research model and hypotheses. Following, we explain the used methodology, which includes a quantitative dataset analyzed through Partial Least Squares Structural Equation Modeling (PLS-SEM) and Necessary Condition Analysis (NCA) (*"… a research approach and data analysis method that is based on the logic that factors can be necessary but not sufficient for an outcome to occur"* (Dul, 2019, p. 1)). Combining these analysis techniques is relatively new, but relevant, as Richter et al. (2020) argued. Finally, we elaborate on our results and their implications, followed by a discussion of our study's limitations and suggestions for future research.

7.2 THEORETICAL BACKGROUND

7.2.1 Co-evolutionary approaches to business-IT alignment

Co-evolutionary approaches to business-IT alignment view alignment as an emergent, continuously changing phenomenon arising from the co-evolutionary dynamics between business- and IS-components of organizations (Amarilli et al., 2016; Benbya & McKelvey, 2006b; Walraven et al., 2018). Early work on this topic underlines the viewpoint that alignment is a two-way street because the business does not only influence IT but also the other way around (Cecez-Kecmanovic & Kay, 2001). More recent work builds upon the notion of organizations as CAS, where alignment emerges from continuous socio-technical co-evolutionary interactions among actors and technologies in organizations (P. Allen & Varga, 2006; R. M. Kim & Kaplan, 2006; Walraven et al., 2018). This CAS perspective is argued to be specifically useful in complex conditions, because of the earlier mentioned principle of requisite complexity (Benbya & McKelvey, 2006b). Some of these studies applying CAS principles on alignment focus on describing alignment's microfoundations conceptually (P. Allen & Varga, 2006; Benbya & McKelvey, 2006b). Other works limit their application of CAS-principles to a specific level of alignment, e.g., strategic alignment (Baker et al., 2011; H. Liang et al., 2017; Tanriverdi et al., 2010; Yeow et al., 2017). However, as argued by Walraven et al. (2018, p. 5) in their structured literature review (SLR) of co-evolutionary alignment studies, based on the multi-level approach taken by Benbya & McKelvey (2006b): *"[…] to fully grasp COISA, taking a CAS perspective on organizations advocates a holistic perspective of alignment, while acknowledging its foundation of individual interactions"*.

In line with this viewpoint, these authors further developed the conceptualization of COISA in this particular SLR (Walraven et al., 2018) To do so, they identified the business processes where co-evolutionary alignment interactions take place in practice. These processes include 1) strategy formulation and 2) strategy implementation in the strategic alignment context; 3) IT usage and 4) IT implementation in the operational alignment context and 5) enterprise architecture management (EAM) bridging the two contexts (Walraven et al., 2018).

This perspective has been empirically tested and refined through its application to hospital EMR implementations using three case studies and several expert focus groups (Walraven et al., 2019, 2020). As a result, the alignment processes were empirically verified, and several factors were identified that promote *effective* co-evolutionary interactions in pursuit of alignment, including alignment motivation (*why do we do this in the first place?*), stakeholder involvement (*who should we involve to ensure efficacy of alignment interactions?*), interconnections (*By which means do we interact on making decisions on these topics among IS stakeholders to ensure the efficacy of alignment interactions?*) and alignment decisions (*Which alignment-related decisions among IS stakeholders improve the efficacy of future alignment interactions?*).

Based on these empirical studies, the same authors have developed a COISA scale suited for quantitative works according to well-known scale development standards where they conceptualize COISA as a whole as an organizational capability (Walraven et al., 2021). We choose to apply this particular conceptualization of COISA because of its theoretical foundations in CAS (Walraven et al., 2018), its earlier empirical application in healthcare settings (Walraven et al., 2019, 2020) and the fact that its operationalization for quantitative studies has been developed already through rigorous standards (Walraven et al., 2021). In the next paragraph, we will further elaborate on this particular conceptualization.

7.2.2 Co-evolutionary Information Systems Alignment

We conceptualize COISA based on the work by Walraven et al. (2021). These authors define COISA as follows: *"[…] an organizational capability defined as continuously exercised alignment competencies, characterized by co-evolutionary interactions between heterogeneous IS stakeholders, in pursuit of a common interpretation and implementation of what it means to apply IT in an appropriate and timely way"* (Walraven et al., 2021, p. 6017). Specifically, the conceptualization consists of three alignment competencies, enabled by two facilitators (figure 7.1).

The facilitators in this model are synthesized from the enabling factors (Walraven et al., 2020). Specifically, alignment motivation is taken directly from the findings of Walraven et al. (2020); interconnections between heterogeneous IS stakeholders is a construct that is synthesized from the enabling factors interconnections and stakeholder involvement; and the enabler alignment decisions has been deliberately left out of the measurement scale, as explained by Walraven et al. (2021, p. 6019): *"[…] the specific decisions improving future alignment interactions are very much context-dependent and do not directly give insight in the alignment interactions themselves"*. The definitions of the different concepts comprising the resulting model are summarized in table 7.1.

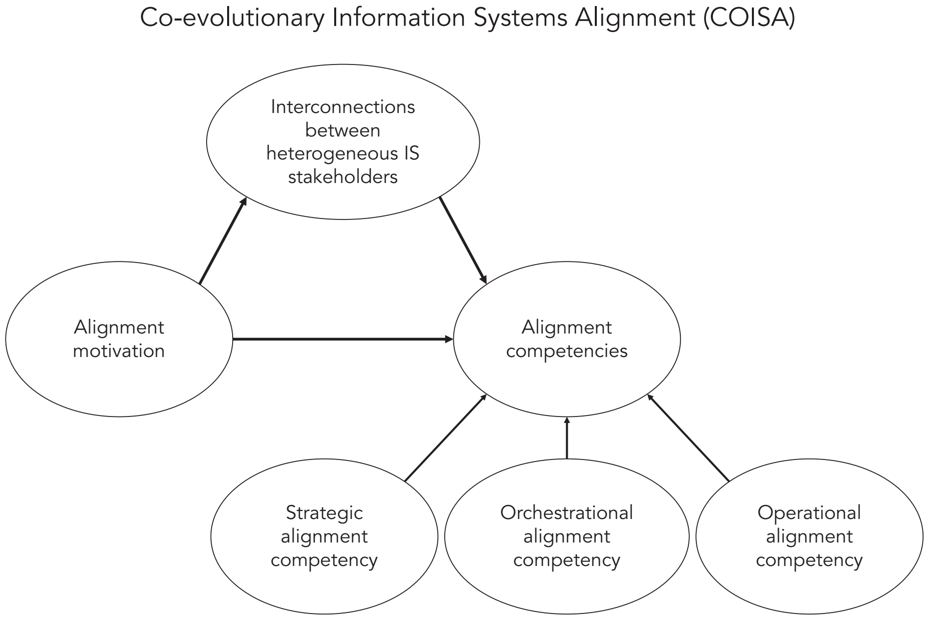


Figure 7.1. Conceptual model of COISA (Walraven et al., 2021)

7.2.3 Dynamic capabilities

The Dynamic Capabilities framework is a leading framework in the management literature that describes how firms can achieve and maintain a competitive advantage in turbulent and complex environments (Teece et al., 1997). The framework builds upon the resource-based view of the firm, which argues that a firm's competitive advantage emerges from its resources, competencies and capabilities, based on the idea that these internal assets are valuable, rare, inimitable and non-substitutable (Teece, 2007; Wade & Hulland, 2004; Wójcik, 2015). The dynamic capabilities framework adds to this perspective by focusing on a firm's capacity to extend, modify and reconfigure these internal assets in line with the complex environment of the organization at hand (Helfat et al., 2009; Pavlou & El Sawy, 2011). Generally, the microfoundations of dynamic capabilities are described in terms of three routines that organizations should have in place to be successful in complex conditions, i.e., (1) Sensing their environment, (2) Seizing opportunities, and (3) Reconfiguring assets (Teece, 2007). Dynamic capabilities are explicitly meant to enable organizations to perform better in complex circumstances. Their applicability to the public sector and thus healthcare has been demonstrated (Piening, 2013, p. 218): *"Like for-profit firms, PSOs* [Public Sector

Organizations] *function as a collection of resources and organizational routines aimed at fulfilling policy initiatives and providing services […] both types of organizations modify their operational routines in pursuit of improved effectiveness".* Therefore, we choose to adopt the dynamic capabilities framework to empirically investigate the premise that COISA as a CAS-based alignment capability enables organizations to perform better in complex circumstances.

Table 7.1. Definitions of concepts comprising COISA

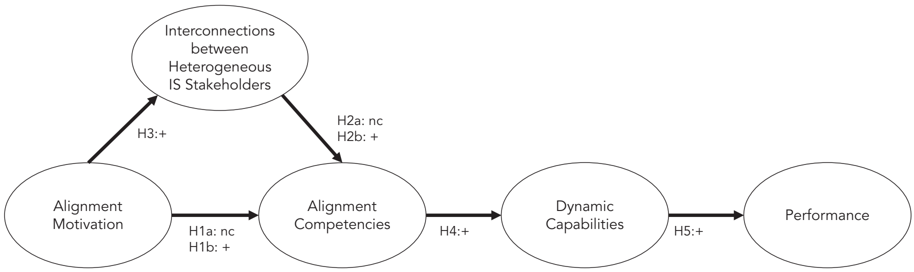
Concept	Definition
Alignment motivation	The degree to which IS stakeholders are motivated to actively engage in co-evolutionary (two-way) alignment interactions within and between alignment competencies (e.g., through intrinsic motivation, deadlines, legislations, support by Executive Management, being held responsible" (Walraven et al., 2021, p. 6021)
Interconnections between heterogeneous IS stakeholders	*"The degree to which heterogeneous IS stakeholders have means to engage in coevolutionary alignment interactions within and between alignment processes through formal governance structures, informal networks, and supporting platforms."* (Walraven et al., 2021, p. 6020)
Strategic alignment competency	*"An organization's ability to formulate strategic goals, and articulate strategic plans and structures to implement these goals in relation to IS, while monitoring relevance and topicality of these plans, goals, and structures, in line with frequencies of internal and external changes."* (Walraven et al., 2021, p. 6020)
Orchestrational alignment competency	*"An organization's ability to maintain the coherence of their architecture, through architectural practices such as the definition and application of architectural principles and standards, while monitoring relevance and topicality of these architectural practices, in line with frequencies of strategic and operational changes."* (Walraven et al., 2021, p. 6020)
Operational alignment competency	*"An organization's ability to collaboratively use IT solutions effectively in daily operations, and to implement and optimize IT solutions in operational settings in line with end-users' needs, while monitoring and leveraging improvement possibilities during IT usage, implementations, and operations."* (Walraven et al., 2021, p. 6020)

7.2.4. Hypotheses development

In line with our research question, we position the COISA capability as our independent variable and investigate its impact on organizational performance through the mediation of dynamic capabilities. The resulting conceptual model is pictured below in figure 7.2.

The first three hypotheses are an inherent part of our COISA conceptualization, i.e., the presumed *necessity* of alignment motivation and interconnections between heterogeneous IS stakeholders for the manifestation of alignment competencies (H1a and H2a), and the positive influence of these constructs on alignment competencies and of alignment motivation on interconnections between heterogeneous stakeholders (H1b, H2b and H3).

In their study on understanding IT business value, Cao et al. (2016, pp. 561–562) introduce the concept of systemic capabilities as *"[…] the emergent systems abilities generated at the systems level from the synergistic interrelations between IT and other systems elements within an organization*". This definition resonates with COISA in that these authors conceptualize organizations as systems. In doing so, they look at their capabilities (such as the COISA capability) as being shaped by the *synergistic* interrelations among its elements, such as IT components and employees. The elements comprising the systemic capability of COISA comprise for a large part human actors, as is clear from its description in section 5.2.2. Given this characteristic and the explicit goal of achieving and maintaining synergy, the human actors as part of the system must be motivated to engage in alignment competencies in a constructive manner actively.



Note: nc = "necessary condition"

Figure 7.2. Research model and hypotheses

This is demonstrated by the study by Walraven et al. (2020) in the context of Electronic Medical Records implementations, and supported by several strands of CAS-informed research on alignment and organizational decision-making (Kaminska-Labbé, Thomas, & McKelvey, 2008). In these research strands, this concept is often referred to as adaptive tension: *"[…] IS/Business coevolution is instigated by adaptive tension imposing on interactions among overlapping sets of individual and group perspectives.*

Furthermore, as the broader environment and the intersecting 'worlds' continue to change (slowly or rapidly), adaptive tension increases: changes that the system has to address if it is to remain effective become evident, as do tensions calling for aligning IS to changing organizational needs" (Benbya & McKelvey, 2006b, p. 290). Furthermore, of course, interrelations need to be there in the first place before they can be characterized as being synergistic. These insights bring us to our first and second hypotheses:

H1a: Alignment motivation is a necessary condition for alignment competencies

H1b: Alignment motivation has a positive impact on alignment competencies

H2a: Interconnections between heterogeneous IS stakeholders are a necessary condition for alignment competencies

H2b: Interconnections between heterogeneous IS stakeholders have a positive impact on alignment competencies

Furthermore, we argue that when alignment motivation is in place, chances are higher that interconnections between heterogeneous IS stakeholders are in place. Namely, when stakeholders are motivated to engage in co-evolutionary alignment interactions, they also have a motivation to set up formal communication structures to enable these dialogues, to use existing or set up new informal networks or to implement supporting platforms to do so (Walraven et al., 2021). Hence, we hypothesize:

H3: Alignment motivation has a positive impact on interconnections between heterogeneous IS stakeholders

Several strands of research may inform the hypothesized relationships between alignment competencies as part of the COISA capability, dynamic capabilities, and organizational performance. Firstly, several IS scholars have found that dynamic capabilities generally and in healthcare specifically can be IT-enabled (Mikalef et al., 2021; Pavlou, 2004; van de Wetering & Versendaal, 2021), in the sense that having specific IT assets in-house may enable an organization to better deal with complex and turbulent environments. In the same line of thought, we argue that having a COISA capability in place may also enable general dynamic capabilities, given the nature of the COISA capability. After all, COISA aims to have effective processes in place to continuously exercise alignment competencies, in pursuit of a common interpretation, but, more importantly, implementation of what it means to apply IT appropriately (Walraven et al., 2020). Thus, having an effective COISA capability suggests having aligned IT, which in turn can enable dynamic capabilities (Mikalef et al., 2021; Pavlou, 2004; Singh et al., 2011).

Furthermore, several studies suggest that dynamic capabilities are built upon other capabilities, as, for example, stated by Felin et al. (2012, p. 1355): *"The logic that dynamic capabilities operate on other capabilities indicates that capabilities evolve within a hierarchy."* We propose that this is also the case by looking at the relationship between the COISA capability and an organization's more general dynamic capabilities. Specifically, COISA can be conceptualized as a hybrid capability, i.e., a combination of an operational and a dynamic capability, as introduced by Helfat and Winter (2011). Namely, the alignment competencies are specifically measured in relation to the rate of change in operational, strategic, and external contexts and the rate of opportunities in operational settings, as Walraven et al. (2021) explained. Thus, the capability's focus is on adequate responses to change, comparable to general dynamic capabilities (Helfat et al., 2009). Therefore, the experience in building and developing a COISA capability may help in developing broader dynamic capabilities due to organizational learning (Zollo & Winter, 2002). Hence, we hypothesize:

H4: Alignment competencies have a positive impact on dynamic capabilities

The premise of dynamic capabilities is that they help organizations improve their performance in turbulent and complex conditions (Mikalef et al., 2021). Since the healthcare sector is characterized by a complex, turbulent environment, it is unsurprising that several studies have indeed found evidence for the proposition that dynamic capabilities help in promoting organizational performance in this particular sector (Singh et al., 2011). Hence, we propose:

H5: Dynamic capabilities have a positive impact on healthcare organization's performance

7.3 METHODOLOGY

We conducted a survey among 85 medium- to large healthcare organizations in the Netherlands to assess our hypotheses. Following, we performed a mixed analysis technique, using both PLS-SEM (Hair et al., 2019) and NCA (Dul, 2019). We use NCA, because of the nature of hypotheses 1a and 2a: in the conceptualization of COISA, both Alignment Motivation and Interconnections between Heterogeneous IS Stakeholders are viewed as necessary, but not sufficient conditions for effective alignment competencies. This is the reason that COISA is conceptualized as a structural model, to begin with: without these enabling facilitators in place, there cannot be effective alignment competencies and thus one cannot speak of an effective COISA capability in the organization (Walraven et al., 2021). The other hypotheses (H1b, H2b, H3, H4, and H5) are of a different, more commonly applied nature, i.e., they assume a certain correlation between concepts, but do not assume independent variables to be indispensable for the manifestation of the dependent variables. For these hypotheses, we use PLS-SEM (Hair et al., 2016, 2018).

7.3.1 Operationalization of constructs

In our operationalization of COISA, we adopted the scale as developed by Walraven et al. (2021). To further operationalize dynamic capabilities in our current study, we use an adapted version of the scale developed by Van de Wetering (van de Wetering, 2019b, 2019a; van de Wetering et al., 2021). We choose to use this operationalization because it reflects recent insights on dynamic capabilities and is developed using acknowledged procedures. This particular scale is developed in the context of Enterprise Architecture-related capabilities and captures three routines, including (1) Sensing of opportunities, (2) Mobilizing resources and (3) Transforming resources. These routines resonate with routines by Teece (2007). We adapted the scale by Van de Wetering (van de Wetering, 2019b, 2019a; van de Wetering et al., 2021) to fit our research goals by removing the specific focus on Enterprise Architecture from the items, leaving a more general operationalization of dynamic capabilities, which is still relevant and operationalized based on state-of-the-art literature on dynamic capabilities.

To conceptualize organizational performance, we sought a scale that is suitable in a healthcare context. Specifically, its focus should be broader than just financial aspects; it should also consider quality. Furthermore, the scale should not concentrate on comparing competitors, as competition is far less relevant in the public sector generally and healthcare specifically (Grosskopf & Valdmanis, 1987; Pee & Kankanhalli, 2009). Thus, we adopted the formative scale developed by Pee & Kankanhalli (2009), which is specifically suited for the public sector, consisting of items related to organizational responsiveness, quality of services, costs and incomes or budget allocated.

7.4 RESULTS

7.4.1 Sample description

Our final sample consists of 85 data points, consisting of different healthcare organizations, with sizes between 100-499 FTE and more than 5000 FTE (table 7.2). Our study targeted strategic IT-decision makers.

7.4.2 Assessment of model fit and reliability, convergent and discriminant validity of reflective constructs

First, we assessed goodness-of-fit of our model, using the SRMR index. The results of this analysis showed that the SRMR value (0.075) is below the recommended threshold of 0.08 (Hair et al., 2018). We thus deem the goodness of fit of our model as adequate. Next, we assessed reliability, convergent and discriminant validity of the reflective first-order constructs, including Alignment Motivation, Interconnections, and the Operational, Orchestrational and Strategic Alignment Competency. The results showed adequate reliability (Cronbach's alpha>0.7; Composite reliability>0.6 (Hair et al., 2016)) and convergent and discriminant validity (AVE>0.5; Outer loading > cross-loadings with other constructs (Hair et al., 2016)) (table 7.3).

7.4.3 Assessment of formative constructs

We assessed the formative constructs' reliability and validity, including the Organizational Performance construct, the higher-order construct Alignment competencies consisting of the dimensions Operational Alignment Competency, Orchestrational Alignment Competency and Strategic Alignment Competency and finally the higher-order construct Dynamic Capabilities, consisting of the Sensing, Mobilizing and Transforming dimensions (table 7.4). There were no collinearity issues, following the recommendations of Hair et al. (2016).

Table 7.2. Sample characteristics

Sample characteristics					
Industry	N	**Organization size**	N	**Respondent position**	N
Hospital	42	100-499 FTE	8	CIO	11
Mental Healthcare	14	500-999 FTE	5	CMIO	5
Healthcare (not specified)	13	1000-4999 FTE	50	CNIO	4
Elderly care	7	5000+ FTE	22	Enterprise Architect	3
Disabled care	6			Information Architect	11
Primary healthcare	1			Information Manager	6
Rehabilitation	1			IT director	4
Public Health	1			IT manager	16
				Other (e.g., CIO advisor, Business consultant, IT change manager, project leader)	25
Total	85	**Total**	85	**Total**	85

Table 7.3. Assessment of reliability, convergent and discriminant validity of reflective constructs. In bold on the diagonal are the outer-loadings, in comparison to cross-loadings.

	Construct	1	2	3	4	5
1	Alignment motivation	**0.882**				
2	Interconnections	0.405	**0.801**			
3	Operational alignment competency	0.553	0.642	**0.849**		
4	Orchestrational alignment competency	0.323	0.531	0.585	**0.898**	
5	Strategic alignment competency	0.367	0.525	0.683	0.737	**0.845**
	AVE	0.778	0.641	0.721	0.806	0.714
	Cronbach's alpha	0.905	0.814	0.871	0.919	0.865
	Composite reliability	0.933	0.877	0.912	0.943	0.909

Table 7.4. Formative construct validation

Construct	Measures	Weight	Sig.	Loading	VIF
Alignment competencies	OP	0.675	0.000	0.950	1.925
	ORCH	0.280	0.048	0.795	2.250
	STR	0.164	0.277	0.831	2.769
Dynamic capabilities	SENS	0.463	0.027	0.957	4.209
	MOB	0.310	0.125	0.924	3.814
	TRANS	0.309	0.075	0.875	2.370
Organizational performance	PERFPUB1 (cost)	0.271	0.152	0.519	1.139
	PERFPUB2 (income)	0.179	0.472	0.418	1.105
	PERFPUB3 (responsiveness)	0.003	0.991	0.672	1.997
	PERFPUB4 (quality of service)	0.834	0.001	0.938	2.023

Table 7.4 shows that the outer weights of the Strategic Alignment Competency dimension as part of the higher-order construct Alignment Competencies is nonsignificant. However, this dimension is important for the higher-order construct's validity. Moreover, the outer loading of the dimension is high (0.831). We chose to not delete this dimension from our analysis given these values, and following the recommendation by Hair et al. (Hair et al., 2016, p. 150): *"When an indicator's outer weight is nonsignificant but its outer loading is high (i.e., above 0.5), the indicator should be interpreted as absolutely important but not as relatively important"*. The same issue holds for the dimensions mobilizing and transforming as part of the higher-order Dynamic Capabilities construct. We decided to keep these particular dimensions in our analysis by the same logic. For the performance construct, the cost-, income- and responsiveness indicators had nonsignificant weights. We were able to keep the cost- and responsiveness indicators as they both had high loadings (0.519 and 0.672, respectively). However, this was not the case for the income indicator, which we therefore dropped. We then reran the analysis for the organizational performance construct, which left us with adequate results (table 7.5). These results show that only the quality construct has a significant weight, underlining its relative importance for the overall organizational performance in comparison to cost and responsiveness. However, cost and responsiveness are important as well, as they both have high loadings (0.517 and 0.694).

7.4.4 Hypothesis assessment

We first conducted the PLS-SEM analysis using SmartPLS v 3.3.3 (Ringle et al., 2015) to assess H3-H5 and H1b and H2b This approach is in line with the recommendations on combining NCA and PLS-SEM as outlined by Richter et al. (2020). The results of this PLS-SEM analysis provide support for all of these hypotheses, as summarized in Figure

Table 7.5. Second formative construct analysis of Organizational performance

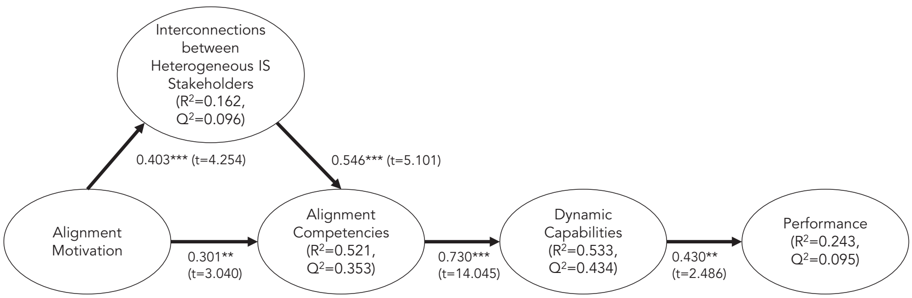
Construct	Measures	Weight	Sig.	Loading	VIF
Organizational performance	PERFPUB1 (cost)	0.304	0.107	0.517	1.081
	PERFPUB3 (responsiveness)	0.002	0.996	0.694	1.997
	PERFPUB4 (quality of service)	0.881	0.881	0.955	1.958

7.3. The complete model explains 24,3% of variance for organizational performance (R2=0.243).

Subsequently, we conducted a mediation analysis in SmartPLS (Ringle et al., 2015) looking into the direct effect of alignment competencies on organizational performance and its indirect effect through dynamic capabilities. We did this to assess RQ2, i.e., the specific role of Dynamic capabilities in the value path of alignment competencies in relation to performance. The results in table 7.6 shows that the effect of alignment competencies on organizational performance is fully mediated through dynamic capabilities. Namely, the direct effect is low and insignificant, while the indirect effect through dynamic capabilities is considerably higher and significant.

Table 7.6. Formative construct validation

Direct effect	97,5% confidence interval of the direct effect	t Value	Significance (p<0.05)?	Indirect effect through Dynamic Capabilities	97,5% confidence interval of the indirect effect	t Value
0.082	[-0.266, 0.436]	0.460	No	0.314	[0.056, 0.579]	2.409



Note: *** p<0.001, ** p<0.01

Figure 7.3. Results of structural model (PLS-SEM analysis)

Lastly, we conducted the NCA to assess H1a and H2a. In doing so, we used R in combination with the NCA software package (Dul, 2021), according to the standards as proposed by Dul (2019). For both Alignment Motivation and Interconnections between Heterogeneous IS Stakeholders, the NCA effect size (CR-FDH) in relation to Alignment Competencies was well above the proposed d=0.1 threshold. Specifically, the effect size of Alignment Motivation is medium and significant (d=0.225, p<0.001) and the effect size of Interconnections is large and significant (d=0.424, p<0.000). Thus, we find support for the hypotheses that both Alignment Motivation and Interconnections between Heterogeneous IS Stakeholders are necessary conditions for Alignment Competencies. This supports our earlier described conceptualization of COISA (alignment competencies, enabled by alignment motivation and interconnections between stakeholders). Table 7.7 summarizes the findings in relation to H1 and H2 according to the standards for combining PLS-SEM and NCA by Richter et al. (2020).

Table 7.7. Interpretations of the findings on H1 and H2

Construct	PLS-SEM	NCA	Conclusion
Alignment motivation	Significant determinant for Alignment competencies	Necessary condition for Alignment competencies	On average, an increase in Alignment motivation will increase Alignment Competencies. However, a certain level of Alignment Motivation is necessary for Alignment Competencies to manifest
Interconnections between heterogeneous IS stakeholders	Significant determinant for Alignment competencies	Necessary condition for Alignment competencies	On average, an increase in Interconnections between Heterogeneous IS Stakeholders will increase Alignment Competencies. However, a certain level of Interconnections between Heterogeneous IS Stakeholders is necessary for Alignment Competencies to manifest.

7.5 DISCUSSION AND CONCLUSION

Our study supports the premise that a CAS-inspired alignment capability enables healthcare organizations to better deal with external change. We do so, by demonstrating the significant positive impact of alignment competencies on dynamic capabilities and organizational performance using a dataset of 85 Dutch healthcare organizations. After all, adequately responding and quickly changing under complex conditions is the prime objective of dynamic capabilities (Teece, 2007; Teece et al., 1997). Several interesting nuances and specific outcomes arise from our data.

7.5.6 Theoretical contributions

Our study provides initial quantitative evidence for the value of co-evolutionary approaches to alignment in complex conditions, specifically for healthcare. In doing so, we apply scales that were developed through rigorous procedures and answer the recent call for more empirical studies on business-IT co-evolution (Zhang, Chen, Lyytinen, et al., 2019). Our results confirm the essence of the principle of requisite complexity, as introduced by Benbya & McKelvey (2006b), stating that *"[…] in order to remain viable, a system needs to generate the same degree of internal complexity as the external complexity it faces in its environment"* (Benbya & McKelvey, 2006b, p. 290). Namely, COISA, as a CAS-based operationalization of BITA, indeed seems to be helpful for healthcare organizations to adequately respond to complex conditions and perform better. Thus, our results advocate for a complex system (A COISA capability) to adequately respond to a complex environment (manifested as effective dynamic capabilities and resulting organizational performance).

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Furthermore, we add several nuances and specifics to the thus far quite general knowledge on COISA. Firstly, with our NCA-analysis, we demonstrate that in healthcare, the facilitating conditions of COISA are not only positively influencing healthcare organizations' alignment competencies, but that they are *indispensable* in the manifestation of these alignment competencies: Without interconnections between heterogeneous IS stakeholders and alignment motivation, there can be no alignment competencies. This confirms and further strengthens the findings of Walraven et al. (2020), who identified these facilitators in a qualitative study on effective EMR alignment. Moreover, we find several nuances in how alignment competencies and dynamic capabilities are important in the manifestation of overall organizational performance. Specifically, our results considering the formative construct analysis imply that the operational and orchestrational alignment competencies are relatively more important than the strategic alignment competency in a healthcare context. This finding specifies the framework's relevance further in comparison to earlier works on COISA in a healthcare setting (Walraven et al., 2019, 2020). It is difficult to assess what causes this finding from the data, but future research could look further into these outcomes to find possible explanations. Lastly, the same analysis implies that the sensing capability as part of dynamic capabilities seems to be relatively more important than mobilizing- and transforming capabilities. The most evident explanation for this finding would be that without knowing which opportunities exist (i.e., without *sensing* the environment for improvement opportunities), it is difficult to know which resources to mobilize and transform to respond to the opportunities at hand. Interestingly, this finding has not been reported in other contexts that looked into dynamic capabilities using a quantitative approach (van de Wetering et al., 2021), suggesting that this may be unique for the Dutch healthcare sector. This could also be an interesting avenue to be explored for future research.

7.5.7 Practical implications

Healthcare practitioners can use our results to help build their organization's alignment competencies and in doing so, help them perform better in complex conditions. Specifically, the dynamic capabilities enabled by alignment competencies demonstrate to positively influence organizational performance as a composite construct consisting of income, responsiveness and quality of service. It should be noted that in this composite, the quality of service is relatively the most important. Furthermore, our NCA results suggest that building interconnections between different IS stakeholders while simultaneously leveraging the motivation of these stakeholders to engage in alignment competencies are indispensable and should be prioritized. As described in earlier work, these interconnections manifest as (1) formal governance structures, (2) existing informal networks, (3) newly created informal networks and (4) supporting tooling (Walraven et al., 2020). Alignment motivation can be intrinsic to stakeholders, advocating for their involvement in the building of alignment competencies, but it can also be provided externally, for example by management explicitly prioritizing alignment efforts, by legislations, or by appointing specific personnel with alignment as their primary task (e.g., information managers) (Walraven et al., 2020). Furthermore, our results suggest that the operational alignment competency should especially get attention in building alignment competencies, given its relative importance compared to the orchestrational and strategic alignment competencies. Lastly, for the general dynamic capabilities that can be promoted through the development of alignment competencies, it seems that the sensing capability should get specific attention given its relative importance compared to the mobilizing- and transforming capabilities.

7.5.8 Limitations and research agenda

Although our study provides substantial contributions to theory on co-evolutionary alignment approaches and for healthcare practitioners to further shape their alignment competencies, it is not without limitations. Firstly, our dataset was limited to the Dutch healthcare sector, making it difficult to generalize its outcomes to different cultural or geographical contexts and industries. It would be interesting to see whether the findings hold in these different settings. Furthermore, as explained above, we found several specific nuances that we could not fully explain based on this quantitative dataset. Specifically, the explanations behind the seeming importance of the operational alignment competency and of the sensing capability remain vague and should be further examined. Qualitative approaches combining case studies, expert focus groups and observations could possibly help achieve this objective.

Furthermore, an important limitation of this current study is that one could question whether it is valid to measure organizational performance as a traditional, relatively static construct, in relation to the clearly more dynamic COISA- and dynamic capabilities constructs. This is especially relevant when considering organizational performance from a punctuated equilibrium perspective, which is not uncommon in works taking a CAS-perspective on organizations (Sabherwal, Hirschheim, & Goles, 2001). This premise implies that organizational performance always goes up and down and that sometimes a "dip" in organizational performance is necessary for the organization's performance in the long run. In other words, when you measure low organizational performance at a specific point in time, this does not necessarily mean that the organization performs low overall. Our work in part addresses this issue by including the dynamic capabilities construct in our survey, but it would be interesting to further address this idea in future studies. For example, a longitudinal approach looking into the effects of COISA in the long run, measuring the constructs at different points in time, may give some insights in the implications from this perspective.

8

DEALING WITH COMPLEXITY IN PUBLIC SECTOR DIGITALIZATION: DEMONSTRATING THE VALUE OF CO-EVOLUTIONARY INFORMATION SYSTEMS ALIGNMENT THROUGH A DYNAMIC CAPABILITIES LENS

The results presented in this chapter have been submitted to an academic journal as a full research paper.

ABSTRACT

Public sector digitalization faces many complexities, through a multitude of stakeholders and quickly changing conditions. The complex adaptive systems-based theory of co-evolutionary information systems alignment (COISA) addresses this issue. However, its value has only been demonstrated in healthcare. We investigate COISA's value for the broader public sector, using a quantitative study, a combination of complementary analysis techniques including Fuzzy set Qualitative Comparative Analysis, Necessary Condition Analysis and Partial Least Squares-Structural Equation Modeling and a theoretical lens of dynamic capabilities. The results confirm COISA's value in dealing with complexity and provide practitioners with specific configurations that are effective to this end.

Keywords: business-it alignment; co-evolutionary information systems alignment; dynamic capabilities; public sector performance; complexity

8.1 INTRODUCTION

Digitalization has been on the rise throughout society. Since digital possibilities become more and more a commodity, public sector organizations are expected to deliver the same level of digital services as their private sector counterparts (Koussouris et al., 2015; Nuhu et al., 2019; Wilson & Mergel, 2022). However, in the public sector, the challenge to apply IT appropriately is substantially more complex than in commercial companies. Namely, public sector organizations' goals are more ambiguous and sometimes conflicting (Piening, 2013). With complex, pluralistic organizations and corresponding goals, the quest for business-IT alignment (BITA), i.e., "*applying IT in an appropriate and timely way, in harmony with strategies, goals and needs of the organization*" (Luftman & Brier, 1999, p. 3), is evenly complex (Hafseld et al., 2021; Rusu & Jonathan, 2017; Winkler, 2013). Additionally, the involvement of different stakeholder types, including private sector parties, further increases the complexity of maintaining public values while leveraging the potential of digital opportunities (Fagnot et al., 2018).

The complexity of contemporary organizations in both public and private sectors has been a catalyst of criticism on the vast number of BITA publications (Merali et al., 2012; Merali & McKelvey, 2006). These scholars find the theories too rigid and not suited for complex conditions that contemporary organizations face (Jonathan et al., 2020). Namely, public sector organizations must be able to respond to the continuous change in their environment adequately. Additionally, many public sector organizations face internal complexity due to different stakeholders whom all have their interpretations of what it means to apply IT appropriately (Hafseld et al., 2021).

A new BITA approach emerged in the past two decades to address these challenges. This approach is the complex adaptive systems (CAS)-theory based concept of co-evolutionary information systems alignment (COISA) (Amarilli et al., 2017; Benbya & McKelvey, 2006b; Walraven et al., 2018; Zhang, Chen, Lyytinen, et al., 2019). All co-evolutionary approaches to BITA focus on bidirectional interactions between business and IT (Merali et al., 2012). Several works add the perspective of co-evolution between different levels of alignment, including individual, operational, and strategic alignment (e.g., Benbya & McKelvey (2006b), Amarilli et al. (2016)). Finally, many authors in this field argue that COISA's microfoundations consist of co-evolutionary interactions among actors situated across individual, operational, and strategic levels of alignment (e.g., Allen & Varga (2006), Benbya & McKelvey (2006b)).

Particularly, Walraven et al. (2021) emphasize considering stakeholders broader than the dichotomy of business and IT, resonant with the plethora of different stakeholders in public sector digitalization (Flak & Rose, 2005).

Organizations with a COISA capability aim to organize their alignment efforts following the underlying principles of CAS theory (Walraven et al., 2018). The premise of this approach is based on the principle of requisite complexity: To adequately respond to a complex environment, an organization should manifest at least the same level of internal complexity (Benbya & McKelvey, 2006b). Put differently, by applying CAS principles to an organization's alignment efforts, the organization is hypothesized to more adequately deal with complex conditions. Recent work has shown the value of this approach in healthcare through a variance-based quantitative study (Walraven, van de Wetering, Caniëls, et al., 2022).

While this study by Walraven et al. (2022) provides some initial evidence COISA's value, the insights are based on healthcare only and thus its applicability to the broader public sector remains unclear. However, healthcare organizations and other public sector organizations do share some important characteristics, including the importance of service to patients, or citizens, and the relatively subordinate role of financial performance compared to private sector organizations (Kattel & Mazzucato, 2018; Murphy et al., 2017). Hence, we aim to assess the potential added value of COISA for the public sector by expanding the research scope from healthcare to the broader public sector. In doing so, we address the call for more research on developing key aspects of strategic management in the public sector (Breen et al., 2020).
Moreover, given public sector complexity, it seems inadequate to limit analysis techniques to variance-based linear approaches as done by Walraven et al. (2022). Namely, several studies argue for equifinality in complex conditions, i.e., specific outcomes can be achieved in multiple ways (Fiss, 2007). Honouring this concept, we also include a configurational analysis approach to shed further light on the different configurations of COISA elements that could help public sector organizations deal with complexity.

Concluding, we aim to answer three research questions (RQs): (1) To what degree do existing propositions about the components of COISA apply in the broader public sector?; (2) Which unique configurations of COISA elements help public sector organizations to adequately deal with complexity? and (3) To what degree does a COISA approach to BITA help public sector organizations to perform in light of complexity?

To answer our RQs, we conducted a quantitative study among 210 Dutch public sector organizations and analysed our data using a combination of variance- and configuration-based analyses. We opt for a quantitative approach to investigate the value of COISA across different parts of the public sector, including government, public services, education, and healthcare. We operationalize the concept of adequately dealing with complexity through a dynamic capabilities lens. This is a well-established theoretical framework specifically aiming to enable organizations to perform in complex conditions (Teece, 2007). Furthermore, it has been demonstrated to be suitable for public sector organizations (Pablo et al., 2007; Piening, 2013) and it provides an umbrella perspective for other theoretical approaches to addressing public sector complexity including adaptive governance (Janssen, 2022; Janssen & van der Voort, 2016) and complexity leadership (Murphy et al., 2017).

8.2 THEORY DEVELOPMENT

8.2.1 Business-IT alignment in the public sector

BITA has been an important research subject for decades (Chan & Reich, 2007b; Sabherwal & Chan, 2001), especially in the public sector. However, the number of public sector studies on this topic is limited. This is remarkable, given some crucial differences in the alignment challenge between these sectors. Firstly, pursuing alignment in public sector contexts means dealing with the presence of multiple, equivalent, and sometimes conflicting goals. In addition, public sector organizations have a duty to address public values, legal and formal constraints, and sometimes political agendas in all their activities, including their digitalization- and alignment efforts (Pang et al., 2014; Sethibe et al., 2007). In comparison, in the private sector, even when conflicting goals exist, they can oftentimes be prioritized more straightforwardly, given the prioritized importance of shareholders and financial performance (Rusu & Jonathan, 2017; Sethibe et al., 2007). Furthermore, while private sector companies have a clear financial incentive for productivity, public sector organizations have these to a limited degree (Rusu & Jonathan, 2017; Sethibe et al., 2007).

Thus, public sector BITA is complex especially in comparison with the private sector. In line with this insight, Rusu and Jonathan (2017) how in their systematic literature that most public sector alignment studies focus on exploring and understanding BITA in this context (e.g., Fedorowicz et al., 2009; Pang et al., 2014). However, these studies do not explicitly address the abovementioned complexity and often use traditional theoretical lenses to BITA, such as the Strategic Alignment Model (SAM) by Henderson and Venkatraman (1993) (e.g., Sawyer et al. (2008)) and the strategic fit approach applied by Chan et al. (1997) (e.g., Meijer et al. (2010)).

Winkler (2013) was one of the first authors to explicitly include a stakeholder perspective into the public sector alignment literature. They aimed to conceptualize BITA for the public sector specifically (administration-IT alignment) and took the viewpoint of strategic alignment between IT goals and strategic goals of a public agency, and the degree to which stakeholders are committed to these goals. (Winkler, 2013). This basis of stakeholders and social interactions has also been pointed out as a promising avenue for further research into public sector BITA by Rusu and Jonathan (2017).

8.2.2 Co-evolutionary Information Systems Alignment

COISA is a relatively new approach to BITA, explicitly aiming to address complexity (Amarilli et al., 2017; Benbya & McKelvey, 2006b; Walraven et al., 2021; Zhang, Chen, & Lyytinen, 2019). Walraven et al. (2021, p. 6017) conceptualize COISA as an organizational capability, consisting of *"continuously exercised alignment competencies, characterized by co-evolutionary interactions between heterogeneous IS stakeholders, in pursuit of a common interpretation and implementation of what it means to apply IT in an appropriate and timely way"*. The COISA capability consists of two important aspects. The first aspect entails three alignment competencies, including the operational, orchestrational and strategic alignment competency (table 8.1) (Benbya & McKelvey, 2006b; Walraven et al., 2021). These alignment competencies are contingent on the alignment processes where co-evolutionary interactions take place, emerging from a systematic literature review on CAS-based alignment studies (Walraven et al., 2018).

Table 8.1. Alignment competencies as part of COISA

Alignment competency	Definition	Corresponding alignment processes
Strategic	An organization's ability to formulate strategic goals, and articulate strategic plans and structures to implement these goals in relation to IS, while monitoring relevance and topicality of these plans, in line with frequencies of internal and external changes	Strategy formulation Strategy implementation
Orchestrational	An organization's ability to maintain the coherence of their architecture, through architectural practices such as the definition and application of architectural principles and standards, while monitoring relevance and topicality of these architectural practices, in line with frequencies of strategic and operational changes	Enterprise Architecture Management
Operational	An organization's ability to collaboratively use IT solutions effectively in daily operations, and to implement and optimize IT solutions in operational settings in line with end-users' needs, while monitoring and leveraging improvement possibilities during IT usage, implementations, and operations	IT implementation IT usage

The second aspect of the COISA capability consists of two alignment facilitators that are necessary for the efficacious manifestation of alignment competencies in complex conditions. This efficacious manifestation translates to evolutionary fitness of the alignment competencies, i.e., how well they are in line with internal, external, operational, and strategic changes. The alignment facilitators include (1) alignment motivation, and (2) interconnections between heterogeneous IS stakeholders. Alignment motivation refers to the degree to which stakeholders are motivated to actively work towards a common interpretation and implementation of what it means to apply IT appropriately (Walraven et al., 2021). Interconnections between heterogeneous IS stakeholders refer to the means stakeholders have to engage in the interactions to work towards this goal, e.g., through formal and informal networks and supporting digital platforms. (Walraven et al., 2021). Importantly, a COISA *capability* is theorized to be present only when both aspects (i.e., alignment competencies and alignment facilitators) are present (Walraven et al., 2021).

The concept has so far mostly been applied in empirical healthcare settings, forming an excellent example of complex conditions as seen throughout the public sector (Bygstad & Bergquist, 2018; van de Wetering et al., 2022). In healthcare, results show that having a COISA capability contributes to organizations' dynamic capabilities, and finally their performance (Walraven, van de Wetering, Caniëls, et al., 2022).

8.2.3 Dealing with public sector complexity through dynamic capabilities

Several scholars have addressed how public sector organizations can perform in light of complexity. We use a dynamic capabilities lens to operationalize this challenge. The dynamic capabilities view is a strategic theoretical framework developed in management studies. Originally, it aims to describe how firms can obtain a sustainable competitive advantage in complex, dynamic markets (Teece, 2007; Teece et al., 1997). Its main premise is that to remain competitive, firms need to continuously keep their assets up-to-date, through organizational capabilities focused on the creation, extension, upgrades, protection, and renewal of these assets (Teece, 2007). These efforts can be divided into three principal components: sensing opportunities, mobilizing resources, and transforming organizational assets.

We choose to use this lens as our theoretical foundation because it has been demonstrated to be useful in a public sector context (Kattel & Mazzucato, 2018; Piening, 2013; van de Wetering & Versendaal, 2021) and because it provides an umbrella perspective for two other important approaches to dealing with complexity in the public sector, i.e., adaptive governance (Janssen, 2022; Janssen & van der Voort, 2016) and complexity leadership (Murphy et al., 2017).

Adaptive governance is an approach to public governance combining adaptability and stability through ambidextrous practices, with learning as a core value (Janssen & van der Voort, 2016). It is specifically meant for public governance institutes dealing with high uncertainty and high numbers of stakeholders (Janssen & van der Voort, 2016). Janssen (2022) refers to Ashby's law of requisite complexity and advises based on this premise that governments should have a sufficient variety of adaptive government instruments to deal with complexity (Janssen, 2022). Complexity leadership has comparable aims but focuses more on the specific role of management (Murphy et al., 2017). Both approaches explicate specific aspects how public sector organizations should adequately address complexity. These aspects, we argue, all relate to the overarching components of dynamic capabilities, i.e., sensing, mobilizing, and transforming. In the remainder of this section, we will further discuss the dynamic capabilities components and their relation to adaptive governance and complexity leadership.

Sensing

The sensing component of dynamic capabilities entails detecting and comprehending opportunities and threats in an organization's ecosystem. This ecosystem includes complementors, suppliers, regulatory institutions, legislative parties, educational and research institutions, and standard-setting organizations (Teece, 2007; van de Wetering, 2019a). The microfoundations comprising this component include organizational processes and cognitive and creative capacities of individuals. Examples include the investment in research and development activities, probing of the needs of target groups and technological developments, and understanding an organization's ecosystem and possible opportunities and threats arising from there (Teece, 2007).

The sensing component of dynamic capabilities is resonant with several aspects of both adaptive governance (Janssen, 2022; Janssen & van der Voort, 2016) and complexity leadership (Murphy et al., 2017). For example, Janssen and Van der Voort (2016) indicate that key aspects of adaptive governance include detecting early warning signals, enhancing local knowledge through scientific inquiry, and paying specific attention to diversity to enhance skills, expertise, and knowledge. These are all specific ways to enable or enhance an organization's capability to sense opportunities and threats, either by stimulating personal development of individuals or by improving business processes in service of sensing capabilities. Therefore, they directly relate to the dynamic capabilities framework. Complexity leadership also mentions diversity of skills and perspective as a key component to enable the sensing of opportunities and threats and adds to this with the inclusion of the ability to give meaning to events through sensemaking and sense giving (Murphy et al., 2017)

Mobilizing

Mobilizing is the second dynamic capabilities component, often also referred to as *seizing* (e.g., Teece, 2007). Mobilizing focuses on evaluating, prioritizing potential solutions to challenges faced by the organization, and mobilizing organizational resources to realize these solutions (Teece, 2007; van de Wetering, 2019a).

Several aspects of adaptive governance and complexity leadership can be connected to this component. Specifically, the adaptive governance framework mentions the importance of decentralized decision-making efforts, with a wide and diverse participation of stakeholders (Janssen, 2022; Janssen & van der Voort, 2016). This directly relates to the way that organizations evaluate and prioritize their potential solutions in response to sensed opportunities and threats, i.e., from different perspectives and organizational levels. Complexity leadership also suggests ways of coming to these solution evaluations and mobilized resources, such as stimulating innovative ideas, coordinating formal networks, and facilitating and enabling informal networks (Murphy et al., 2017).

Transforming

The last dynamic capabilities component is transforming, sometimes referred to as *reconfiguring* (Teece, 2007; van de Wetering, 2019a). Transforming entails the successful reconfiguration of business processes, recombination of organizational resources and assets and implementation of solutions in response to change.

Adaptive governance, again, gives specific examples of how organizations can implement this dynamic capabilities component, for example, by combining bottom-up and top-down approaches to decision-making, and by using experimentation (Janssen, 2022; Janssen & van der Voort, 2016). Complexity leadership mentions the changing of plans, procedures, and processes as essential in dealing with complexity, in line with the transforming component of dynamic capabilities. Furthermore, complexity leadership explicitly mentions the reconfiguration of human resources as a response to complexity (Murphy et al., 2017).

8.3 RESEARCH MODEL AND HYPOTHESES

COISA broadly consists of alignment facilitators and alignment competencies. Both have their own proposed correlations with public sector dynamic capabilities.

Interconnections between heterogeneous IS stakeholders is one of the alignment facilitators (Walraven et al., 2021). Earlier works have demonstrated its cruciality for efficacious alignment competencies in healthcare (Walraven et al., 2020; Walraven, van de Wetering, Caniëls, et al., 2022). Specifically, to align interpretations and implementations of what it means to apply IT appropriately, across divergent stakeholders, these stakeholders need to discuss these interpretations and collaborate to work towards their implementation. For those discussions and collaborations, interconnections through formal governance structures, informal networks and/or supporting platforms are indispensable. Winkler (2013) confirms this stance and argues that relational mechanisms are even more crucial in the public sector, given the generally lower IT competencies and skills compared to the private sector. Rusu and Jonathan (2017) u underline this finding, showing that communication generally has been identified as a key enabler of public sector alignment (Dulipovici & Robey, 2012; Sawyer et al., 2008). Hence, we propose:

> **H1a.** Interconnections between heterogeneous IS stakeholders are a necessary condition for alignment competencies in the public sector

> **H1b.** Interconnections between heterogeneous IS stakeholders have a positive impact on alignment competencies in the public sector

Apart from their importance for alignment competencies, we argue that interconnections between heterogeneous IS stakeholders positively correlate with public sector dynamic capabilities. Namely, the creation of formal and informal networks involving diverse stakeholders enables organizations to view challenges from different perspectives. This ability improves creative and innovative power, an important foundation of the sensing component of dynamic capabilities (Janssen, 2022; Janssen & van der Voort, 2016; Murphy et al., 2017; Teece, 2007). Apart from their importance for alignment competencies, we argue that interconnections between heterogeneous IS stakeholders positively correlate with public sector dynamic capabilities. Namely, the creation of formal and informal networks involving diverse stakeholders enables organizations to view challenges from different perspectives. This ability improves creative and innovative power, an important foundation of the sensing component of dynamic capabilities (Tawse & Tabesh, 2021). A multitude of studies confirm the importance of interpersonal relations, especially in diverse and cross-functional teams, for the creation of dynamic capabilities in the public sector (Guimarães et al., 2011; Pablo et al., 2007; Piening, 2011; Silva & Hirschheim, 2007).

Hence, we propose:

> **H2.** Interconnections between heterogeneous IS stakeholders have a positive impact on dynamic capabilities in the public sector

The second alignment facilitator is alignment motivation, referring to the willingness of stakeholders to work towards alignment (Walraven et al., 2020). This motivation can be intrinsic, or extrinsic, for example because managers advocate it (Walraven et al., 2020). When stakeholders are not motivated to work towards alignment, chances are that they will not contribute to this goal or even work against it by resisting changes that do not benefit their agendas. Hence, we argue that alignment motivation is not only positively correlated with alignment competencies, but it is in fact necessary for them to be efficacious. The importance of motivation in the successful implementation of strategic information systems has been demonstrated before (Silva & Hirschheim, 2007). Thus, we propose:

> **H3a.** Alignment motivation is a necessary condition for alignment competencies in the public sector

> **H3b.** Alignment motivation has a positive impact on alignment competencies in the public sector

The presence of alignment motivation across IS stakeholders may also have a positive impact on their interconnections. Namely, when stakeholders are motivated to work towards alignment, they are more likely to proactively form networks to this end. This insight has been confirmed by Walraven et al. (2022). In this work, these scholars show that stakeholder initiative is an important driver of the foundation and development of different types of interconnections as a foundation of alignment competencies. Hence, we hypothesize:

> **H4.** Alignment motivation has a positive impact on interconnections between heterogeneous IS stakeholders in the public sector

Furthermore, alignment motivation may also stimulate development of public sector dynamic capabilities. Especially for the mobilizing and transforming components, it seems crucial that stakeholders are willing to work towards shared interpretations on how to address organizational challenges. Specifically, the evaluation and prioritization of possible solutions as part of the mobilizing component of dynamic capabilities is much smoother when stakeholders are motivated to look beyond their own perspective (Teece, 2007; van de Wetering, 2019a). The same goes for implementing solutions as part of the transforming component of dynamic capabilities (Teece, 2007; Walraven et al., 2020). Walraven et al. (2020) described that alignment motivation can be both intrinsic and extrinsic. In the public sector literature, several works underline the importance of a specific type of extrinsic alignment motivation, i.e., performance evaluation or -management, as important drivers of public sector dynamic capabilities (Fernandez & Wise, 2010). Nuhu, Baird and Appuhami (2019) investigate the impact of management control systems (MCS) on organizational dynamic capabilities in public sector organizations and find that especially interactive approaches to MCS are effective to this end. This makes sense considering the multiple stakeholders and changing conditions the public sector faces. Hence, we propose:

H5. Alignment motivation has a positive impact on dynamic capabilities in the public sector.

Lastly, BITA, in terms of alignment competencies, is proposed to positively correlate with dynamic capabilities in the public sector. Earlier studies have demonstrated the positive relationship between IT governance principles and public sector dynamic capabilities (Luna-Reyes et al., 2020). Furthermore, Leonard & Seddon (2012) show in their literature review that when organizations execute their alignment activities in a co-evolutionary manner, and when they let strategy definition and IS resources emerge from those co-evolutionary activities (like in COISA's alignment competencies), the alignment activities are more likely to benefit the organization's dynamic capabilities. These dynamic capabilities are focused on improvisation, learning by trial and error and experimentation, in line with a complex, unpredictable environment. Lastly, several studies have shown that dynamic capabilities in themselves can be IT-enabled. Specifically, this refers to the opportunities created by technological assets to sense possibilities (e.g., through dashboards presenting relevant and aggregated management information), to mobilize resources (e.g., through the support of decision-making platforms to help evaluate and prioritize solutions) and to transform organizational resources (e.g., through visualizing necessary changes to make them easier to understand and implement) (Mikalef & Pateli, 2016; Singh et al., 2011). In the public sector this is particularly interesting given the complexity of the decision-making context (Pablo et al., 2007; Piening, 2013). Hence, we hypothesize:

H6. Alignment competencies have a positive impact on dynamic capabilities in the public sector

Our last hypothesis considers the correlation between public sector dynamic capabilities and organizational performance. In the private sector, organizational performance is often operationalized in terms of financial performance (e.g., Kim et al., 2011). In line with this view, dynamic capabilities have traditionally been conceptualized to enable competitive advantage for firms, through the creation and development of valuable, rare, inimitable, and non-substitutable resources and capabilities (Teece et al., 1997). However, in the public sector, organizational performance is more ambiguous, with parameters such as quality of service and responsiveness being equally important as financial measures (Nuhu et al., 2019; Pee & Kankanhalli, 2009). We argue that these latter parameters can also be enabled and developed through dynamic capabilities. Namely, through the sensing of opportunities and threats, the mobilizing of resources and the transformation of processes and assets, the quality of services as primary assets of public sector organizations can be improved (Teece, 2007; van de Wetering & Versendaal, 2021). Furthermore, we expect dynamic capabilities to also improve public sector organizations' responsiveness, since these capabilities explicitly aim to deal with fast-changing conditions and complexity. Summarizing, there is sufficient reason to believe that the benefits of dynamic capabilities go beyond financial performance measures and thus are also relevant for public sector performance. Hence, we propose:

H7. Dynamic capabilities have a positive impact on organizational performance in the public sector

Our final research model (figure 8.1) addresses all hypothesized relations.

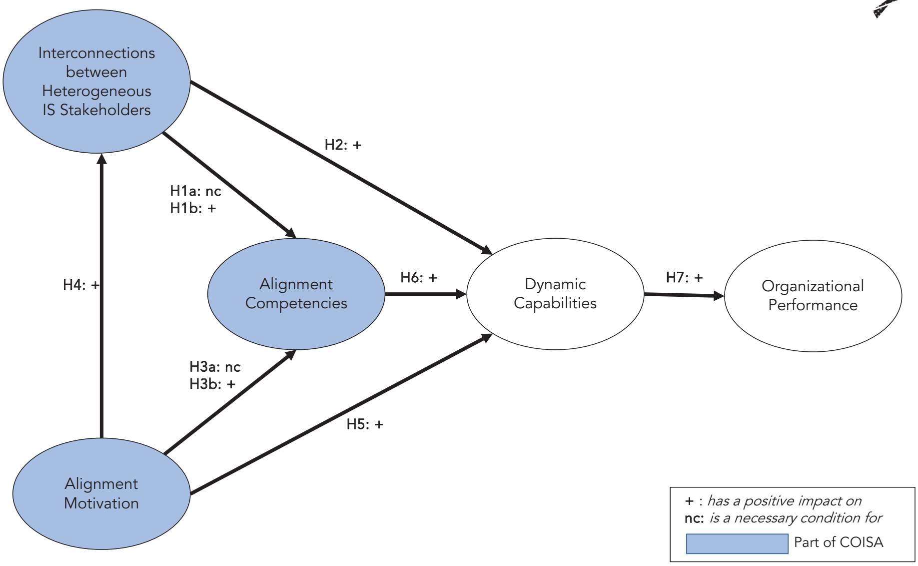

Figure 8.1. Research model of the study

8.4 METHODS

We conducted a quantitative study among 210 Dutch public sector organizations, assessing COISA's value across different public sector parts, including healthcare, education, government, and public services.

8.4.1 Variable definition and measurement

For all constructs comprising COISA, we used the rigorously developed and empirically validated scale by Walraven et al. (2021) (Appendix A). The Likert scales used to measure alignment competencies as part of COISA reflect evolutionary fitness because they explicitly assess the degree to which they are in line with internal, external, operational, and strategic changes.

We measured dynamic capabilities using an adapted scale based on by Van de Wetering (2019a) and later used by Walraven et al. (2022) in their study on the effects of COISA in healthcare. This scale is a second-order reflective-formative conceptualization consisting of three dimensions including sensing, transforming, and mobilizing of resources (Appendix B).

For organizational performance, we adopted the first-order formative scale especially developed for the public sector by Pee and Kankanhalli (2009), consisting of four items related to cost, income, responsiveness and quality of service (Appendix C).

8.4.2 Data collection

We used a targeted data collection strategy and approached people in an IT-related strategic decision-making role in public sector organizations via LinkedIn. Specifically, we used the platform's search option to look for suitable respondents and sent them personal messages, shortly explaining the aims of our study, and requesting them to fill out our questionnaire. We approached professionals several public sector segments including healthcare, to get a broad view. Data was collected anonymously, and respondents were free to drop out of the study at any moment. This led to a total of 210 full responses (table 8.2).

Table 8.2. Characteristics of our data set

Industry	N	Organization size	N	Respondent position	N
Healthcare	85	100-499 FTE	25	Chief Information Officer (CIO)/ Chief Medical Information Officer (CMIO)/ Chief Nursing Information Officer (CNIO)/ Chief Technology Officer (CTO)/ Chief Data Officer (CDO)	26
Education	22	500-999 FTE	30	IT manager / IT director	33
Government	54	1000-4999 FTE	99	Enterprise Architect	29
Public services	49	5000+ FTE	56	Information Architect	29
				Information Manager	42
				Program Manager	5
				Other (e.g., portfolio manager, information advisor, project manager)	44
Total	210	**Total**	210	**Total**	210

8.4.3 Model fit, Common method bias and measurement model

After collecting our data, we ensured their reliability and validity before conducting further analyses. We first assessed model fit and manifestation of common method bias (CMB). For model fit, we investigated the SRMR value and yielded an acceptable outcome (0.062) below the recommended threshold of 0.08 (Henseler et al., 2016) . Next, we assessed CMB, through a full collinearity test as recommended by Kock (2015). The outcomes show that our data set does not have CMB issues, with all inner VIF values considerably below the recommended threshold of 3.3.

Next, we assessed reliability and convergent and discriminant validity of our reflective constructs. The results (table 8.3) confirm their reliability (Cronbach's alpha >0.7; Composite reliability >0.6 (Hair et al., 2016)) and convergent and discriminant validity (AVE>0,5; Outer loading > cross loadings with other constructs (Hair et al., 2016)).

Finally, we assessed the reliability and validity of our formative constructs, including the second-order constructs of alignment competencies and dynamic capabilities, and the first-order construct organizational performance. The results show that there are no collinearity issues based on Hair et al. (2016) (all VIF values <5 (table 8.4)). Furthermore, all items have significant weights (Hair et al., 2016), except for the orchestrational alignment competency, and three of the organizational performance items.

Table 8.3. Assessment of reliability, convergent and discriminant validity of reflective constructs. In bold are the outer-loadings, in comparison to cross-loadings.

	Construct	1	2	3	4	5
1	Alignment motivation	**0.851**				
2	Interconnections	0.378	**0.788**			
3	Operational alignment competency	0.562	0.563	**0.804**		
4	Orchestrational alignment competency	0.405	0.468	0.610	**0.884**	
5	Strategic alignment competency	0.401	0.562	0.632	0.689	**0.851**
	AVE	0.724	0.621	0.646	0.781	0.724
	Cronbach's alpha	0.875	0.796	0.818	0.906	0.873

We decided to keep the orchestrational alignment competency, because of its conceptual importance, and because of its high loading, based on Hair et al. (2016, p. 150): *"When an indicator's outer weight is nonsignificant but its outer loading is high (i.e., above 0.5), the indicator should be interpreted as absolutely important but not as relatively important"*.

Based on the same logic, we kept the responsiveness-related performance item PERFPUB3 (loading > 0.5) and deleted the financially related items PERFPUB1 and PERFPUB2 (loading <0.5). After this deletion, we re-analysed the remaining two items, resulting in adequate values (table 8.5).

Table 8.4. Formative construct validation

Construct	Measures	Weight	Sig.	Loading	VIF
Alignment competencies *(second-order)*	OP	0.650	0.000	0.944	1.842
	ORCH	0.115	0.190	0.756	2.105
	STR	0.355	0.000	0.844	2.201
Dynamic capabilities *(second-order)*	SENS	0.420	0.000	0.923	2.814
	MOB	0.453	0.000	0.921	2.458
	TRANS	0.232	0.015	0.841	2.238
Organizational performance *(first-order)*	PERFPUB1 (cost)	0.086	0.585	0.366	1.138
	PERFPUB2 (income)	0.135	0.403	0.373	1.120
	PERFPUB3 (responsiveness)	0.369	0.121	0.850	1.872
	PERFPUB4 (quality of service)	0.641	0.003	0.944	1.922

Table 8.5. Second formative construct analysis of Organizational performance

Construct	Measures	Weight	Sig.	Loading	VIF
Organizational performance	PERFPUB3 (responsiveness)	0.413	0.061	0.870	1.862
	PERFPUB4 (quality of service)	0.672	0.001	0.953	1.862

8.4.4 Data analysis

Confirming the reliability and validity of our data, we applied suiting analysis techniques for each RQ. To answer our first RQ considering the necessary components of the COISA capability, we combined FsQCA (Mattke et al., 2021; Rihoux & Ragin, 2008) and NCA (Dul, 2019). FsQCA assesses sufficient configurations of variables for a specific outcome (Ragin, 2009). It supports the idea of equifinality, which is characteristic for CAS and thus fitting with the underlying philosophy of COISA (van de Wetering et al., 2022; Walraven et al., 2018). The FsQCA analysis in this case was done to test the premise of COISA that *only* the combination of *both* alignment facilitators is sufficient for efficacious alignment competencies (Walraven et al., 2021; Walraven, van de Wetering, Caniëls, et al., 2022). We complemented this analysis with NCA, enabling us to draw conclusions in terms of degree: *'a specific level of a condition is necessary or not for a specific level of the outcome'* (Vis & Dul, 2018, p. 872) in addition to FsQCA-enabled conclusions *in kind* (i.e., are the alignment facilitators necessary, yes or no?).

For our second RQ considering the sufficient configurations of COISA elements (alignment facilitators and alignment competencies) for public sector dynamic capabilities, we used FsQCA. The focus of this RQ on sufficient *configurations* fits well with the aims of FsQCA (Mattke et al., 2021; Rihoux & Ragin, 2008).

We finally conducted a PLS-SEM analysis on the correlations between the different COISA components, dynamic capabilities, and performance, answering our last RQ on the value of COISA for public sector performance in complex conditions (Hair et al., 2016, 2019).

8.5 EMPIRICAL RESULTS

8.5.1 Composing a public sector COISA capability

Our first analyses focused on the relationship between the alignment facilitators and the alignment competencies (RQ1).

FsQCA

The first step in FsQCA is calibrating the data (Rihoux & Ragin, 2008). Our data on the COISA dimensions and dynamic capabilities is collected using a 7-point Likert scale. Taking into account our data distribution and using a comparable approach as Van de Wetering et al. (2021), we calibrated our data by assigning values below 3 as non-membership (fuzzy score = 0.05), 4.5 as maximum ambiguity (fuzzy score = 0.5) and values of 6 or higher as full membership (fuzzy score = 0.95).

Next, we performed a truth table analysis using the FsQCA 3.0 software (Rihoux & Ragin, 2008) , where we assigned alignment competencies as our outcome, and interconnections between heterogeneous IS stakeholder and alignment motivation (i.e., the alignment facilitators) as our input variables. We applied a threshold for raw consistencies of 0.8, based on Mattke et al. (2021). Raw consistencies indicate the proportion of data points with a particular configuration that produces the intended outcome (Mattke et al., 2021). Furthermore, we applied a threshold of 0.5 for the PRI consistency, indicating *"[…] the degree to which a configuration is not simultaneously a sufficient configuration for the high and the low level of an outcome"* (Mattke et al., 2021, p. 568). Only one sufficient configuration of alignment facilitators emerged (table 8.6). In this configuration, both alignment facilitators are present, thus, only the *combination* of the two alignment facilitators is sufficient for efficacious alignment competencies.

Table 8.6. Configurations of alignment facilitators to achieve alignment competencies

	Alignment Competencies Solutions
Elements	i1
Alignment facilitators	
Alignment motivation	●
Interconnections between heterogeneous IS stakeholders	●
Raw coverage	0.656
Unique coverage	0.656
Raw consistency	0.857
Overall solution consistency	0.656
Overall solution coverage	0.857

NCA

Next, we conducted NCA, using the calibrated values of our variables, based on Vis & Dul (2018). We used R and the NCA package (Dul, 2021) to conduct this analysis, looking into the alignment facilitators as necessary factors, and alignment competencies as the outcome. The results show that the NCA effect size (CR-FDH) for both alignment facilitators is above the d=0.1 threshold as recommended by Dul (2019). Particularly, both the effect sizes of Alignment motivation ($d=0.118$, $p<0.001$) and of Interconnections between Heterogeneous IS stakeholders ($d=0.179$, $p<0.001$) are medium and significant.

These results confirm the FsQCA outcome that both alignment facilitators are necessary for efficacious alignment competencies. The next step in NCA is compiling a bottleneck table (table 8.7), indicating which level of conditions are necessary for which level of the outcome (Dul, 2019). The results suggest that a certain level of the alignment facilitators is necessary when the desired level of alignment competencies is above 50%. A 50% level of alignment competencies means that the mean value of all alignment competencies is 4.5 out of 7, based on our data calibration. This translates to strategic and orchestrational alignment competencies that are *somewhat* in line with internal, external, operational, and strategic changes, and an operational alignment competency that leverages *some* opportunities for improvement. Thus, for this basic level of alignment competencies, alignment facilitators are not crucial. However, for evolutionary fit alignment competencies, a specific level of both alignment facilitators is in fact necessary (table 8.7). For a 100% level of alignment competencies' evolutionary fitness, translating to strategic and orchestrational alignment competencies that are *completely* in line with internal, external, operational, and strategic changes and an operational alignment competency that leverages (almost) all opportunities for improvement, a 90.8% level of alignment motivation is necessary, and a 77.8% level of interconnections between heterogeneous IS stakeholders.

8.5.2 Configuring sufficient COISA elements for public sector dynamic capabilities

For RQ2, we conducted an FsQCA analysis, getting insight in the sufficient configurations of COISA elements for public sector dynamic capabilities. We followed the same guidelines as in our first FsQCA analysis and found three different sufficient configurations (table 8.8).

Table 8.7. Bottleneck table for the manifestation of efficacious alignment competencies (CR-FDH)

Alignment competencies	Alignment motivation	Interconnections between heterogeneous IS stakeholders
0% Non-existing alignment competencies	Not necessary (NN)	NN
10%	NN	NN
20%	NN	NN
30%	NN	NN
40%	NN	NN
50% Strategic and orchestrational alignment competencies ***somewhat*** in line with internal, external, operational and strategic changes Operational alignment competency leveraging ***some*** opportunities for improvement	NN	NN
60%	NN	10%
70%	NN	27%
80%	20.7%	43.9%
90%	55.8%	60.9%
100% Strategic and orchestrational alignment competencies ***completely*** in line with internal, external, operational and strategic changes Operational alignment competency leveraging **(almost) all** opportunities for improvement	90.8%	77.8%

Table 8.8. Different configurations to achieve high levels of dynamic capabilities

		Dynamic capabilities solutions		
Elements		i1	i2	i3
Alignment competencies				
Operational alignment competency			●	●
Orchestrational alignment competency		●	●	
Strategic alignment competency		●		●
Alignment facilitators				
Alignment motivation		●	●	●
Interconnections between heterogeneous IS stakeholders		●	●	●
Raw coverage		0.560	0.545	0.567
Unique coverage		0.047	0.032	0.054
Raw consistency		0.890	0.919	0.899
Overall solution consistency	0.872			
Overall solution coverage	0.646			

These results suggest that the alignment facilitators are not only necessary conditions for alignment competencies, but also for dynamic capabilities. Namely, there is no sufficient configuration where dynamic capabilities are created without both alignment facilitators. Furthermore, we see three possible configurations of alignment competencies are sufficient for public sector dynamic capabilities. These solutions resonate with three different approaches to the pursuit of BITA, i.e., (i1) a top-down approach, where alignment efforts are most prominent in the strategic alignment competency and translated to operational settings in the orchestrational alignment competency, (i2) a bottom-up approach, where alignment competencies are built in operational settings and translated to strategic levels through the orchestrational alignment competency and lastly (i3) a two-way approach, where both a strong operational and a strategic alignment competency are present, and an orchestrational alignment competency is not necessary.

8.5.3 Performing in complexity using COISA and dynamic capabilities

We finally conducted a PLS-SEM analysis to answer RQ3, assessing the hypothesized structural paths between the different COISA components, dynamic capabilities, and organizational performance. To do so, we used the SmartPLS 3.0 software (Ringle et al., 2015). The results in figure 8.2 confirm H1b, H2, H3b and H4-6.

We also conducted a mediation analysis investigating the degree to which dynamic capabilities play a role in the value path of COISA in relation to public sector organizational performance. The results (table 8.9) show that the effect of alignment competencies on performance in the public sector is fully mediated by dynamic capabilities.

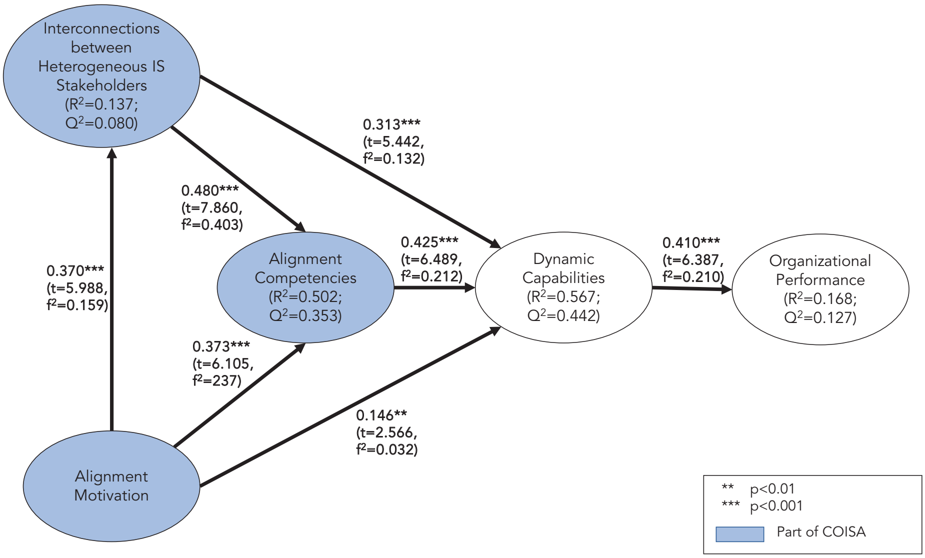

Figure 8.2. Empirical results structural model

Table 8.9. Direct and indirect effects of alignment competencies on organizational performance

Direct effect	97.5% confidence interval	t Value	p<0.05?	Indirect effect	97.5% confidence interval	t Value	p<0.05?
-0.040	[-0.214, 0.150]	0.447	No	0.314	[0.206, 0.445]	4.866	Yes

8.6 DISCUSSION AND CONCLUSION

This study aimed to shed light on the value of COISA in dealing with public sector complexity, using a quantitative approach and a dynamic capabilities lens. The results suggest that COISA contributes to the development of public sector dynamic capabilities and therefore, that it indeed has added value in adequately dealing with public sector complexity. Through the combination of FsQCA, NCA and PLS-SEM, we presented our results from multiple complementary perspectives (Richter et al., 2020; Vis & Dul, 2018). Specifically, we provide insights not only into the correlations between COISA; dynamic capabilities and organizational performance, but also into the specific configurations of COISA elements that help in developing dynamic capabilities, and from the perspective of necessity, both in kind (are alignment facilitators necessary, yes, or no?) and in degree (which levels of alignment facilitators are necessary for which levels of alignment competencies?).

8.6.1 Theoretical contributions

Our study contributes to theory in several ways: Firstly, we find further support for the value of CAS-based approaches to alignment such as COISA and thus, for the principle of requisite complexity (Benbya & McKelvey, 2006b). Namely, our results suggest that organizations that apply CAS-principles in their alignment efforts perform better in complex conditions. We also contribute to the external validity of the COISA framework by empirically demonstrating its value in settings broader than just healthcare, which has until now been the primary empirical context in which this framework has been developed and tested (Walraven et al., 2020; Walraven, van de Wetering, Caniëls, et al., 2022; Walraven, van de Wetering, Helms, et al., 2022).

Furthermore, we confirm that in public sector digitalization, there are multiple roads that lead to Rome: Namely, we find three different configurations of alignment competencies that can lead to the development of public sector dynamic capabilities. These configurations seem to be coherent with a bottom-up approach, a top-down approach and a combined top-down and bottom-up approach. All configurations have in common that their efficacy in dealing with complexity is contingent on the presence of alignment facilitators, including alignment motivation and interconnections between heterogeneous IS stakeholders. In other words, the alignment facilitators as part of

COISA are not only necessary conditions for efficacious alignment competencies per se, but also for the significant positive correlation between alignment competencies and public sector dynamic capabilities. This outcome further strengthens the value of COISA as a CAS-based approach to alignment.

Moreover, we add to the knowledge base on the public sector dynamic capabilities. Particularly, we confirm that the potential of dynamic capabilities goes beyond competitive advantage in terms of financial measures, which are the roots of this theoretical framework (Teece, 2007; Teece et al., 1997). Namely, we demonstrate the positive correlation between dynamic capabilities and performance, with our operationalization of performance focusing on quality of service and responsiveness (Pang et al., 2014; Pee & Kankanhalli, 2009). In doing so, we contribute to the call for more research on strategic public sector service improvement (Breen et al., 2020).

8.6.2 Practical implications

Public sector practitioners can use our results to indicate which COISA components need to be developed in their organization to stimulate better dynamic capabilities and performance.

Firstly, our results suggest that both alignment facilitators are necessary to ensure evolutionary fitness of the COISA capability. Thus, practitioners aiming to improve their organization's ability to adequately deal with complexity could invest in their stakeholders' motivation to interact and collaborate towards shared interpretations and implementations of what it means to apply IT appropriately. This can be done for example by enabling intrinsically motivated stakeholders, by having management actively advocate for this purpose (Walraven et al., 2020) or by appointing specific roles that have alignment as their primary responsibility (Walraven et al., 2020). Furthermore, ensuring that heterogeneous stakeholders have means to interact and collaborate is also necessary for the evolutionary fitness of the COISA capability. This can be achieved through clear governance structures, stimulating and leveraging existing and new informal networks and providing digital platforms to further enable collaboration across stakeholders (Walraven et al., 2020).

Apart from alignment facilitators, three different configurations of alignment competencies seem effective in creating dynamic capabilities: A combination of strategic- and orchestrational alignment competencies (resonant with a top-down approach); a combination of operational- and orchestrational alignment competencies (resonant with a bottom-up approach), or a combination of strategic and operational alignment competencies (where both top-down and bottom-up approaches are combined, making the need for orchestration less urgent). Practitioners could investigate which alignment competencies are already present to some degree in their organizations and based on their situation decide which COISA approach best suits their context and organizational culture.

8.6.3 Limitations and future research

Although we believe our study to have substantial value for both science and practice, it has several limitations. Firstly, we could not assess the effects of COISA and dynamic capabilities on financial performance indicators because these indicators were insufficiently reliable and valid in our data. Although financial measures may be less prominent in public sector organizations (Pee & Kankanhalli, 2009), they are not unimportant. Even more so, the rising costs of certain public sector parts (e.g., healthcare) are an important societal challenge to be solved (Mohrman & Shani, 2014), making it an important avenue of future studies. We recommend doing this research focused on specific subsections of the public sector, possibly using qualitative approaches, because of their very particular and different financial models.

Furthermore, our scope was limited to the Dutch public sector, which limits the results' generalizability to other cultural contexts. Moreover, each organization was represented by one respondent. Although we carefully selected respondents to optimize reliability, future research could further improve this by asking multiple stakeholder representatives per organization. Additionally, the cross-sectional character of the data does not allow inferences about causality. Future research may adopt longitudinal research designs to address this issue.

APPENDIX A: COISA OPERATIONALIZATION

Table 8.10. COISA operationalization

Dimension	Items	Scale
Strategic alignment competency	**STR1.** Our organization periodically performs strategic IT planning processes (e.g., prioritizing IT projects) **STR2.** Our organization frequently adjusts strategic goals to better adapt to changing conditions **STR3.** Our organization continuously works on creating the right conditions to enable implementation of strategic goals in relation to IT (e.g., setting up program structures and creating roadmaps) **STR4.** When making strategic IT investment decisions, our organization actively considers strategic goals from different departments, roles and perspectives	**1.** Never **2.** Way too infrequently given internal and external changes **3.** Too infrequently, given internal and external changes **4.** Somewhat in line with frequencies of internal and external changes **5.** Moderately in line with frequencies of internal and external changes **6.** Mostly in line with frequencies of internal and external changes **7.** Completely in line with frequencies of internal and external changes
Orchestrational alignment competency	**ORCH1.** Our organization continuously works on maintaining architectural principles and standards to guide systems development and maintenance projects **ORCH2.** Our organization continuously works on maintaining overall coherence between different processes, roles and IT components **ORCH3.** When making architectural decisions, our organization actively considers coherence with strategic principles and goals	**1.** Never **2.** Way too infrequently, given strategic and operational changes **3.** Too infrequently, given strategic and operational changes **4.** Somewhat in line with frequencies of strategic and operational changes

	ORCH4. Our organization actively works on ensuring relevance and topicality of architectural practices, principles and standards and makes changes accordingly	**5.** Moderately in line with frequencies of strategic and operational changes **6.** Mostly in line with frequencies of strategic and operational changes **7.** Completely in line with frequencies of strategic and operational changes
Operational alignment competency	**OP1.** Overall, end users spend efforts in recommending changes to IT in use to better fit their works **OP2.** Overall, end users spend efforts on changing their tasks so that these better fit the IT in use **OP3.** Our organization continuously works on implementing and improving IT systems in operational settings **OP4.** Our organization continuously evaluates implemented IT systems for alignment with business processes and working routines	**1.** Never **2.** Way too infrequently to leverage any opportunities for improvement **3.** Too infrequently to leverage many opportunities for improvement **4.** To the degree that we leverage some opportunities for improvement **5.** To the degree that we leverage a moderate amount of opportunities for improvement **6.** To the degree that we leverage a considerable amount of opportunities for improvement **7.** To the degree that we leverage (almost) all opportunities for improvement

8

APPENDIX B: DYNAMIC CAPABILITIES OPERATIONALIZATION

Table 8.11. Dynamic capabilities operationalization

Dimension	Items	Scale
Sensing	*Please indicate the degree to which your organization is competent in…*	**1.** Very ineffective **2.** Ineffective **3.** Somewhat ineffective **4.** Not effective, not ineffective **5.** Somewhat effective **6.** Effective **7.** Very effective
	SENS1. Identifying new business opportunities or potential business threats	
	SENS2. Reviewing organizational services and product development efforts regularly to ensure that they are in line with what our key (internal and external) stakeholders want	
	SENS3. Evaluating the effect of changes in existing and new products or services on the organization	
	SENS4. Devoting sufficient time to enhancing our current business processes	
Mobilizing	*Please indicate the degree to which your organization is competent in…*	**1.** Very ineffective **2.** Ineffective **3.** Somewhat ineffective **4.** Not effective, not ineffective **5.** Somewhat effective **6.** Effective **7.** Very effective
	MOB1. Evaluating, prioritizing and selecting potential solutions when we sense business opportunities or potential business threats	
	MOB2. Mobilizing business, and IT resources to draft a potential solution when we sense business opportunities or potential business threats	
	MOB3. Drawing up plans to carry out a potential solution when we sense business opportunities or potential threats	
	MOB4. Reviewing and updating our organizational practices in line with renowned business and IT best practices when we sense business opportunities or potential business threats	

APPENDIX C: ORGANIZATIONAL PERFORMANCE OPERATIONALIZATION

Table 8.12. Organizational performance operationalization

Items	Scale
Please indicate the degree to which the following statements apply to your organization:	**1.** Strongly disagree **2.** Disagree **3.** Somewhat disagree **4.** Neither agree nor disagree **5.** Somewhat agree **6.** Agree **7.** Strongly agree
PERFPUB1. Over the past two years, the cost of providing services by our organization has reduced significantly	
PERFPUB2. Over the past two years, our income and/or budget allocated to our organization has significantly increased	
PERFPUB3. Over the past two years, our organization's responsiveness to citizens' and businesses' requests has significantly improved	
PERFPUB4. Over the past two years, the quality of our services has significantly improved	

9

CONCLUSION AND OUTLOOK

9.1 RESEARCH QUESTIONS AND CONCLUSIONS

This dissertation presents the potential of a co-evolutionary approach to business-IT alignment for organizations facing complex environments. Specifically, the research presented gives more insight on what such an approach looks like, and how and to what degree such an approach can be helpful in adequately addressing complex environments. These complex environments manifest themselves through two main characteristics: Firstly, it can be seen in the pluralistic nature of contemporary organizations through the plethora of involved stakeholders. Secondly, complexity can be found in the quickly changing conditions, technologically, socially and legislatively. Literature has been pointing to the potential of complexity-based alignment approaches for these issues for a few decades now, however most works remained conceptual in nature or did not adequately address the challenges as seen in the public sector. This dissertation contributes to filling this research gap. In particular, the following overarching research question is answered:

What is the potential of a co-evolutionary approach to business-IT alignment for organizations to address complex environments?

In doing so, the following objectives were pursued, addressing the limitations of existing approaches as well as possible:

1. Conceptualize co-evolutionary alignment holistically in organizational settings, beyond top-down approaches, with individual interactions among diverse actors as its microfoundations.
2. Account for different, possibly conflicting stakeholder perspectives on alignment, broader than just the business-IT dichotomy
3. Provide an instrument to assess the new co-evolutionary alignment conceptualization in organizations

The breadth and depth of these objectives provides reason for the taken multi-MAP (methods, approaches, perspectives) approach (Levallet et al., 2020), combining multiple methodological and analytical approaches to research. This multi-MAP approach resonates with the three sub questions addressed:

1. What are the key components of COISA?
2. How can COISA be assessed cross-sectionally and shaped over time as an organizational capability?
3. How and to what degree does a COISA capability help organizations to address complex environments?

In the remainder of this chapter the key findings of the research as part of this dissertation will be presented through answering each of these research questions.

9.1.1 What are the key components of COISA?

The first research question is focused on identifying the key components of COISA, based on the foundation of complex adaptive systems theory.

In this effort, a structured literature review (SLR) was conducted on existing works using co-evolutionary approaches to alignment, as described in chapter 2. In this study, the alignment processes were identified in which co-evolutionary interactions working towards alignment manifest in practice. This resulted in a conceptual model of five interrelated co-evolutionary alignment processes in two organizational contexts (figure 9.1): Strategy formulation and strategy implementation, forming the co-evolutionary alignment processes in the strategic alignment context; IT implementation and IT usage, which are the co-evolutionary alignment processes in the operational alignment context; and enterprise architecture management, the co-evolutionary alignment process bridging the operational and strategic contexts.

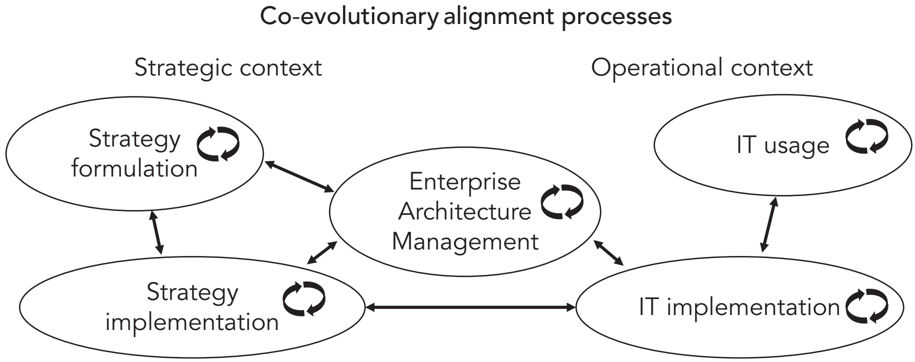

Figure 9.1. Co-evolutionary alignment processes

Next, a multiple case study was done on EMR implementations in three Dutch hospitals which all successfully implemented a new EMR, as described in chapter 3. In this effort, the conceptual model developed based on the SLR was validated and refined. The results of this study confirmed the manifestation of co-evolutionary interactions among IS stakeholders in all five alignment processes, in all three case hospitals. Furthermore, this study demonstrated that co-evolution also took place between different alignment processes. Moreover, no additional alignment processes were revealed. Lastly, this study showed that the degree of co-evolution and the focus of co-evolutionary interactions differed for each of the case hospitals. For example, in one case, co-evolutionary interactions prevailed mostly in the strategic context and to a lesser degree in the operational context. In another case, the focus of co-evolutionary interactions was much more visible in the operational context. This latter finding underlines the concept of equifinality in complex conditions, i.e., a successful EMR implementation can be reached via multiple different routes.

Table 9.1. Alignment facilitators for efficacious co-evolutionary alignment interactions

Alignment Facilitator	Definition	Answering…
Stakeholder involvement	The degree to which an adequate stakeholder representation is involved in interactions within and between alignment processes	Who?
Interconnections	The degree to which heterogeneous IS stakeholders have means to engage in co-evolutionary alignment interactions within and between alignment processes, through formal governance structures, informal networks and supporting platforms	How?
Alignment motivation	The degree to which heterogeneous IS stakeholder are motivated to actively engage in co-evolutionary alignment interactions within or between alignment processes	Why?
Alignment decisions	Specific alignment-related decisions that improve the efficacy of future alignment interactions	What?

An important limitation of this multiple case study was that the manifestation of co-evolutionary alignment interactions per se does not necessarily mean that these interactions are in fact efficacious in working towards alignment. Thus, our COISA conceptualization was still incomplete at this point. To address this limitation, another case study was conducted, complemented with several expert focus groups looking into the facilitators of efficacious alignment interactions in COISA. This study has been elaborated on in chapter 4. The theoretical foundation of this study was synthesized from three research strands, including (1) governing principles of business-IT co-evolution; (2) factors influencing alignment as identified in more traditional alignment studies and (3) works on efficacious dynamics in organizations facing complex conditions. This study finally resulted in four overarching categories of alignment facilitators, including alignment motivation; stakeholder involvement; interconnections and alignment decisions. (table 9.1)

Furthermore, several specific manifestations were revealed of these alignment facilitator categories in the context of EMR implementations which are discussed in chapter 4.

9.1.2 How can COISA be assessed cross-sectionally and shaped over time as an organizational capability?

To better enable COISA assessment, an operationalization was developed through further theoretical conceptualization and synthesis; complemented with card sort sessions and an expert survey. As described in chapter 5, these efforts resulted in a content-validated survey scale.

This operationalization moved beyond alignment processes and conceptualized COISA as a capability. This capability is underpinned by three types of alignment competencies constituting the continuous execution of alignment processes, characterized by co-evolutionary interactions between heterogeneous IS stakeholders (table 9.2). The first of these alignment competencies is the strategic alignment competency, comprising the continuous execution of the alignment processes strategy formulation and strategy implementation. The second alignment competency is the operational alignment competency comprising the continuous execution of the alignment processes IT implementation and IT usage. Lastly, the orchestrational alignment competency comprises the continuous execution of enterprise architecture management.

Table 9.2. Alignment competencies

Alignment competency	Definition
Strategic alignment competency	An organization's ability to formulate strategic goals, and articulate strategic plans and structures to implement these goals in relation to IS, while monitoring relevance and topicality of these plans, goals and structures, in line with frequencies of internal and external changes
Orchestrational alignment competency	An organization's ability to maintain the coherence of their architecture, through architectural practices such as the definition and application of architectural principles and standards, while monitoring relevance and topicality of these architectural practices, in line with frequencies of strategic and operational changes
Operational alignment competency	An organization's ability to collaboratively use IT solutions effectively in daily operations, and to implement and optimize IT solutions in operational settings in line with end-users' needs, while monitoring and leveraging improvement possibilities during IT usage, implementations and operations.

The efficacy of these alignment competencies is enabled by the presence of two alignment facilitators. These alignment facilitators are synthesized from the four earlier mentioned facilitator categories and focus on facilitators that relate directly to alignment interactions. These include firstly alignment motivation, referring to *the degree to which IS stakeholders are motivated to actively engage in co-evolutionary (two-way) interactions within and between alignment competencies*. Secondly, it includes interconnections between heterogeneous IS stakeholders, which is a synthesis of the stakeholder involvement facilitator and the interconnections facilitator. It refers to *the degree to which heterogeneous IS stakeholders have means to engage in co-evolutionary alignment interactions within and between alignment processes through formal governance structures, informal networks and supporting platforms.* We decided to leave out alignment decisions in our survey scale because they do not directly tell us something about the alignment interactions themselves and because they are context-dependent and thus difficult to put into a generalizable survey instrument.

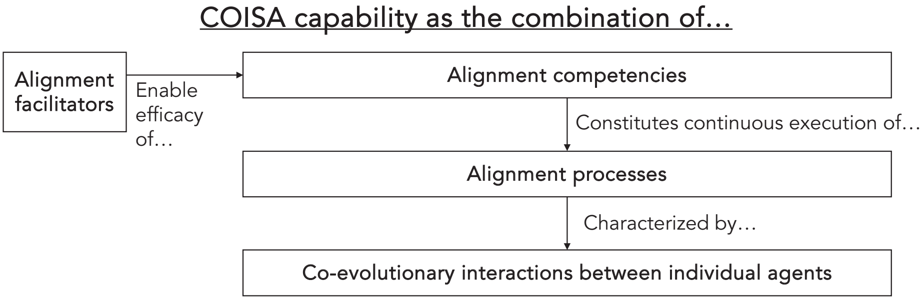

Figure 9.2. Visualization of how the different theoretical concepts as part of the COISA capability relate to each other

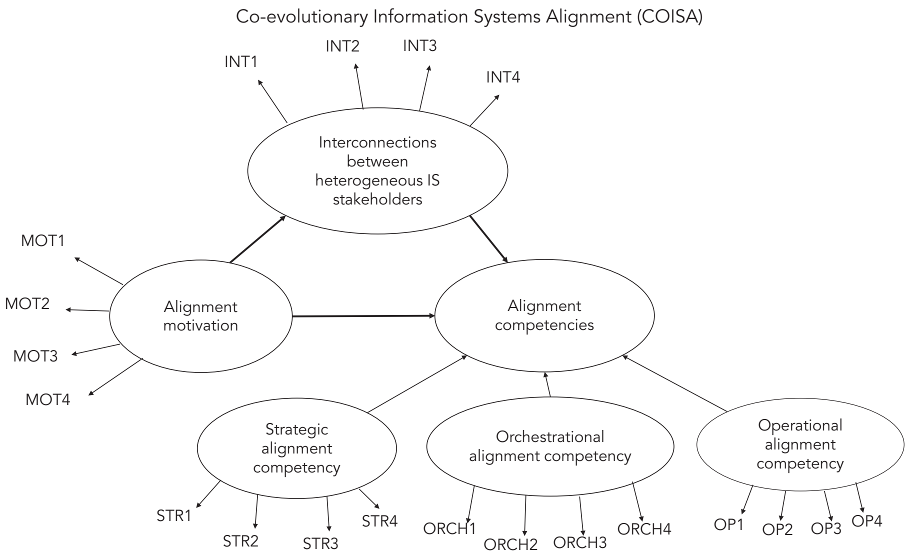

Figure 9.3. Measurement model of COISA

The final survey instrument is based on the above described conceptualization and constitutes a multivariate structural model (figure 9.3). This model comprises the two alignment facilitators as reflective constructs measured by four items each, and alignment competencies as a second order reflective-formative construct comprising the three alignment competencies which are each measured reflectively by four items each.

All items are measured using a 7-point Likert scale. For the alignment facilitators, these range from "Strongly disagree" (1) to "Strongly agree (7). The alignment competencies are measured in terms of evolutionary fitness. Specifically, this means that their scales are more context-aware because they are measured relative to the frequency of internal and external, and operational and strategic changes, depending on the alignment competency. For example, the strategic alignment competency is measured on a scale from "Never" (1) to "Completely in line with frequencies of internal and external changes" (7).

In conclusion, COISA is *an organizational capability defined as continuously exercised alignment competencies, characterized by co-evolutionary interactions between heterogeneous IS stakeholders, in pursuit of a common interpretation and implementation of what it means to apply IT in an appropriate and timely way".* In this definition, the pursuit of a common interpretation and implementation of what it means to apply IT in an appropriate and timely way is enabled through the alignment facilitators *alignment motivation* and *interconnections between heterogeneous IS stakeholders.* To enable cross-sectional assessment, we developed a content-validated survey scale.

Next, to enable shaping and assessing COISA over time, a study was done into the evolutionary paths of the COISA capability itself, and the drivers of these evolutionary paths. This research constituted a longitudinal multiple case study in three hospitals which all recently implemented an advanced EMR system, and it is described in detail in chapter 6. The longitudinal approach was based on the *critical event* logic as described by Yin (2018), recommending to do the longitudinal research in two phases, i.e., before and after a critical event. In this case, this critical event entailed the go-live of an advanced EMR system. To describe the evolution of the COISA capability in these hospitals, a theoretical foundation of the dynamic resource-based perspective was applied, which looks at capability evolution in terms of capability life cycle stages. The conceptual model of this study is visualized in figure 9.4.

The results of this study show that the COISA capability indeed evolves over time and remains relevant during the operations phase of EMR. Furthermore, we demonstrated that the specific evolutionary path of the COISA capability differs from hospital to hospital. A particularly interesting outcome is that some hospitals ended up *coordinating* part of their COISA capability to an ecosystem level. Specifically, this means that these hospitals incorporated other hospitals using the same EMR to coordinate their alignment efforts, either operationally, or in terms of orchestration or strategy. The key drivers of COISA's evolutionary path found in this study include (1) stakeholder initiative; (2) accumulating experience; (3) driving events and (4) emerging issues.

Stakeholder initiative showed to be particularly important for all capability lifecycle stages that entail a forward evolution of COISA (i.e., all lifecycles except for retrenchment, which indicates a decline of the capability). This finding can largely be related to the alignment facilitator alignment motivation. Namely, stakeholders' initiative to help the forward evolution of the COISA capability is often resonant with their motivation to work towards alignment. Moreover, accumulating experience relates to learning and may represent renewed insights that lead stakeholders to changing specific parts of the COISA capability. Lastly, driving events and emerging issues may well serve as external motivators to actively work towards alignment, resonant with some of the specific instances of alignment motivation as described in chapter 4.

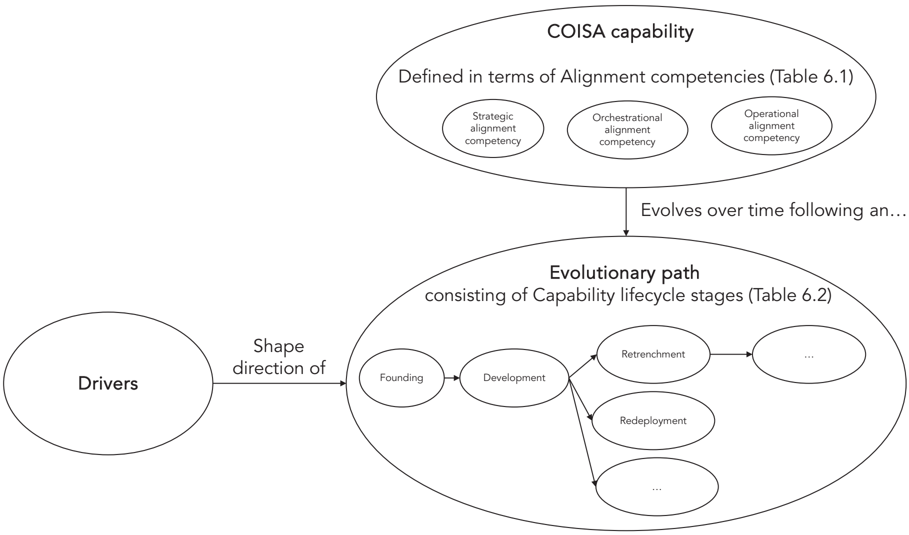

Figure 9.4. Conceptual model of our longitudinal study

In conclusion, these results provide scholars and practitioners with insight on the evolution over time of the COISA capability, and the drivers that may shape this evolution. The dynamic resource-based perspective provides a useful lens to understand the COISA capability's evolution, while the drivers can help steer this evolution in a particular direction.

9.1.3 How and to what degree does a COISA capability help organizations to address complex environments?

The third and last part of this dissertation focused on the value of COISA for organizations facing complex environments. In this effort, the survey scale as developed via the process described in chapter 5 was applied and the correlation between organizations' COISA capability, their dynamic capabilities and finally their performance was investigated. As described in chapter 5 and 6, the dynamic capabilities lens was applied to assess an organization's ability to perform in complex environments. Namely, this framework has been originally developed to address how firms can obtain and keep a competitive advantage in turbulent, complex markets. To measure organizational performance, we adopted a public sector scale looking into cost, income, responsiveness and quality of service.

In chapter 7, the value of COISA was first assessed in the Dutch healthcare sector through an online survey among 85 Dutch medium to large healthcare organizations, focusing on the hypotheses as visualized in figure 9.5. In addition to the evaluation of our regular hypotheses using Partial Least Squares Structural Equation Modelling (PLS-SEM), Necessary condition analysis (NCA) was applied to look into the role of

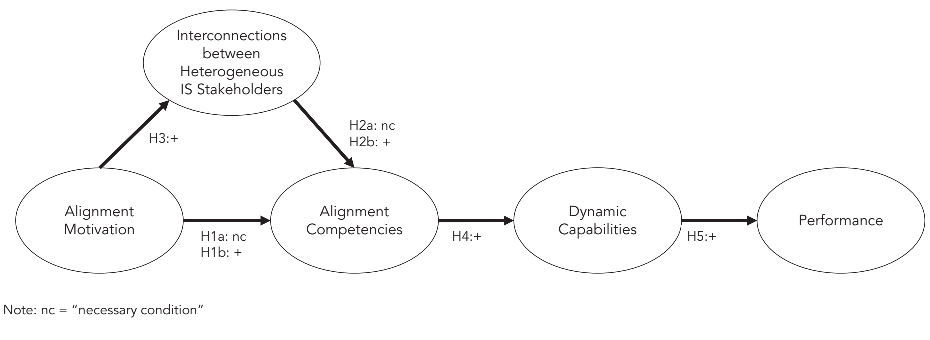

Figure 9.5. Hypotheses assessed in the Dutch healthcare sector

alignment facilitators for efficacious alignment competencies. Namely, based on the steps toward operationalizing COISA, it was expected that the alignment facilitators were not only *beneficial* to alignment competencies, but in fact a *necessary condition* for them to manifest efficaciously.

Several key findings of this study can be highlighted. Firstly, this study suggests that in healthcare, the operational alignment competency is relatively more important than the orchestrational and strategic alignment competencies. Furthermore, for organizational performance, the quality of service indicator seems to be relatively more important in comparison to cost, income, and responsiveness indicators.

All of the hypotheses, including those regarding necessity of alignment facilitators, were confirmed in this study. Thus, it can be concluded that without alignment facilitators, there can be no evolutionary fit alignment competencies. Furthermore, it was confirmed that COISA helps healthcare organizations to better deal with complexity, given its significant impact on dynamic capabilities, and indirectly, on organizational performance. Specifically, COISA explains 53.3% of variance for dynamic capabilities and 24.3% for organizational performance in this healthcare dataset.

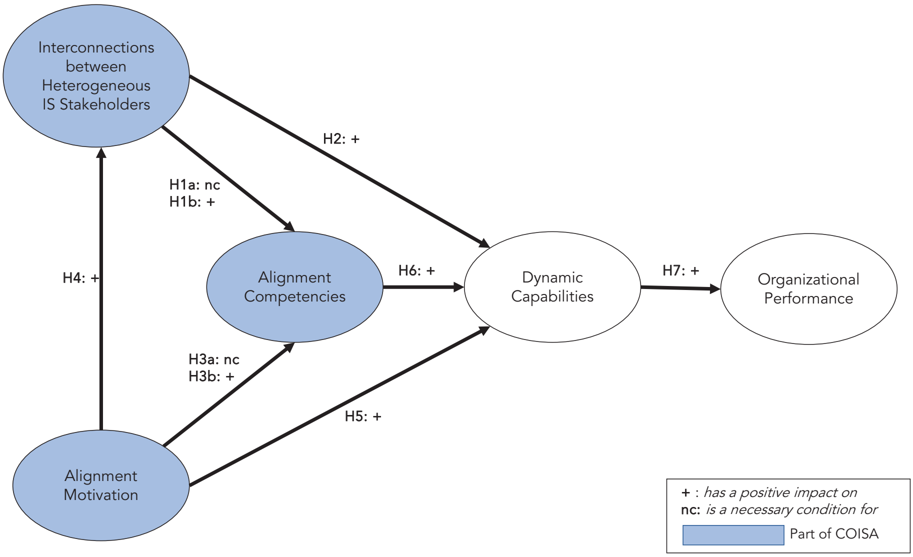

Figure 9.6. Hypotheses assessed in the broader public sector study using PLS-SEM and NCA

Next, the research scope and aims in assessing the value of COISA were broadened, as elaborated on in chapter 8. This was done in four different ways: Firstly, the research scope was broadened from the healthcare sector to the broader public sector, assessing a total of 210 public sector organizations. These organizations included institutes from healthcare, education, public services and government. Secondly, two additional hypotheses were added to assess whether there was a direct effect of alignment facilitators on dynamic capabilities, resulting in a total of 9 hypotheses (figure 9.6).

Thirdly, the NCA approach was expanded by adding an analysis on necessity of alignment facilitators *in degree*, in addition to an analysis *in kind*. This analysis *in degree* gives insight in the level of alignment facilitators that is necessary for a specific level of evolutionary fitness of alignment competencies. Lastly, a Fuzzy set Qualitative Comparative Analysis (FsQCA) was included to look into the different configurations of COISA elements that may contribute to the development of public sector dynamic capabilities and organizational performance. In healthcare, the operational alignment competency seemed the most important, but it was at this point unclear whether this holds for the entire public sector.

Several key findings of this study are relevant to highlight here. Firstly, this data set shows the orchestrational alignment competency to be relatively less important in comparison to the operational and strategic alignment competencies. Furthermore, the operationalization of organizational performance finally included only responsiveness and quality of service dimensions in this analysis, due to reliability issues of the cost related items. Furthermore, all of the hypotheses listed in figure 9.6 are confirmed. Hence, COISA enables dynamic capabilities, and indirectly, organizational performance, not only in healthcare, but in fact in the Dutch public sector as a whole. Furthermore, the alignment facilitators are also deemed necessary for alignment competencies to manifest based on this data set. Specifically, the results show that for a 100% level of alignment competencies (i.e., strategic and orchestrational alignment competencies that are *completely* in line with internal, external, operational and strategic changes and an operational alignment competency leveraging (almost) all opportunities for improvement), a 90.8% level of alignment motivation is necessary and a 77.8% level of interconnections between heterogeneous IS stakeholders. Only when the preferred level of alignment competencies is below 50% (i.e., strategic and orchestrational alignment competencies *somewhat* in line with changes and an operational alignment competency that leverages *some* opportunities for

Table 9.3. Configurations to achieve high levels of dynamic capabilities

		Dynamic capabilities solutions		
Elements		i1	i2	i3
Alignment competencies				
Operational alignment competency			●	●
Orchestrational alignment competency		●	●	
Strategic alignment competency		●		●
Alignment facilitators				
Alignment motivation		●	●	●
Interconnections between heterogeneous IS stakeholders		●	●	●
Raw coverage		0.560	0.545	0.567
Unique coverage		0.047	0.032	0.054
Raw consistency		0.890	0.919	0.899
Overall solution consistency	0.872			
Overall solution coverage	0.646			

improvement), alignment facilitators are not necessary. Hence it can be concluded that the facilitators are crucial in adequately addressing complex environments.

Lastly, three different configurations of COISA elements were identified that may be beneficial for public sector dynamic capabilities and -performance (table 9.3)

These configurations resonate with (1) a focus on operational alignment processes, orchestrated towards the strategic level through the orchestrational alignment competency; (2) a focus on strategic alignment processes, orchestrated towards the operational level through the orchestrational alignment competency; (3) or a combination of strong operational and strategic alignment processes, making the necessity of orchestration less urgent. This differing emphasis on different alignment processes is in line with our qualitative findings in EMR implementations as described in chapter 3 and confirms the concept of equifinality, i.e., that comparable outcomes can be achieved in different ways. Another outcome that deserves emphasis in these results is that both alignment facilitators are present in all three configurations. In other words, alignment facilitators are not only necessary for manifestation of alignment competencies themselves, but also for their beneficial impact on dynamic capabilities.

Summarizing, these results demonstrate that COISA indeed has value in the public sector through its positive impact on dynamic capabilities and, indirectly, on organizational performance. Furthermore, three different configurations of alignment competencies can be effective to this end. In the study done in the healthcare sector, the operational alignment competency seems relatively more important in comparison to the orchestrational and strategic alignment competencies, which fits our qualitative findings on co-evolutionary alignment interactions manifestation in chapter 3. In the study conducted in the Dutch public sector as a whole, the operational and strategic alignment competencies seem to be relatively more important than the orchestrational alignment competency. Lastly, alignment facilitators seem to be of particular importance in adequately addressing complexity: their presence is in fact necessary, for both the evolutionary fitness of alignment competencies and for their positive influence on dynamic capabilities.

9.2 IMPLICATIONS

9.2.1 Theoretical implications

This research contributes to the existing body of knowledge in several ways. A new framework for co-evolutionary information systems alignment was developed for organizations facing complex environments.

In this effort, two limitations of existing business-IT alignment approaches are addressed. Firstly, this new framework takes on a holistic view of alignment, moving beyond top-down approaches. It does so by incorporating interactions within and between both strategic and operational alignment processes, acknowledging that these interactions can go both ways (Walraven et al., 2018). Secondly, the framework recognizes that the micro foundations of co-evolutionary alignment consist of co-evolutionary interactions between individual IS stakeholders, broader than just the business and IT dichotomy. Even more so, the framework explicitly encourages practitioners to involve heterogeneous IS stakeholders in alignment processes at all levels. While several existing frameworks address one of these aspects, the combination of both is unique, as already explained in chapter 1.4 (see table 9.4):

Table 9.4 Characteristics of co-evolutionary approaches to alignment

Co-evolutionary approaches to alignment	Inclusive stakeholder approach, moving beyond Business-IT dichotomy	Holistic, multi-level approach to alignment, moving beyond top-down approaches
Amarilli et al. (2017)		■
Zhang et al. (2020)		■
Allen and Varga (2006)	■	
Benbya and McKelvey (2006b)		■
Vessey and Ward (2013)		■
COISA (this dissertation)	■	■

For example, the co-evolutionary alignment model by Benbya and McKelvey (2006b) uses a holistic, multi-level approach to alignment and in doing so goes beyond just top-down steering of alignment. However, this model does stick to the dichotomy of business and IT. Thus, it does not account for an inclusive stakeholder approach, ignoring the blurring boundaries between business- and IT actors (Ciborra, 1997). On the other hand, Allen and Varga (2006) focus very much on co-evolutionary interactions between individuals and do not necessarily stick to the business-IT dichotomy. However, these authors focus very much on an operational approach to alignment, not considering strategic, organizational goals. Thus, their approach is not holistic in that it does not consider multiple organizational levels. Vessey and Ward (2013) focus on the combination of different management approaches in enabling sustainable alignment and do so from a holistic, organizational perspective. However, they have no explicit attention for differing stakeholder views and how these management approaches can leverage the dynamics between these stakeholder groups.

Furthermore, extant research has been calling for more empirical research on business-IT coevolution, as most studies on this topic so far have been conceptual in nature (Zhang, Chen, Lyytinen, et al., 2019). This dissertation contributes to this aim by empirical validation and refinement of the COISA conceptualization, using a multi-MAP (methods, approaches, perspectives) approach (Levallet et al., 2020). In this effort, both qualitative and quantitative methods have been used to further develop the COISA conceptualization, from a cross-sectional and longitudinal perspective and using a combination of variance-based and configuration-based analysis approaches (Walraven et al., 2019, 2020; Walraven, van de Wetering, Caniëls, et al., 2022; Walraven, van de Wetering, Helms, et al., 2022). This combination of complementary methodologies and analysis approaches provides a more comprehensive understanding of the complex phenomenon of co-evolutionary alignment compared to other studies that have applied empirical methods to this area of research. Namely, to the best of our knowledge, all other existing conceptualizations of co-evolutionary alignment have been empirically validated and refined using only one empirical methodology and analysis approach (e.g., Amarilli et al. (2017) using a multiple case study, and Zhang et al. (2021) using agent-based modelling).

Moreover, through these empirical studies, several insights are presented into the ways in which COISA actually provides value in practice, a topic that so far has only been studied conceptually (Zhang, Chen, Lyytinen, et al., 2019): Firstly, initial empirical evidence was found for the value of COISA through demonstrating its significant positive impact on public sector dynamic capabilities and organizational performance. Furthermore, while alignment facilitators have been emphasized to be an important part of COISA in several earlier works (e.g., Amarilli et al. (2017); Benbya and McKelvey (2006b)), this dissertation adds to that line of research by providing evidence for their *necessity* for co-evolutionary alignment competencies and dynamic capabilities. This is done not only in kind (i.e., by showing that they are in fact necessary for the manifestation of alignment competencies), but also in degree (by giving insight into which degree of alignment facilitators is necessary for which degree of alignment competencies). Moreover, several configurations of alignment competencies are highlighted that may be effective in stimulating public sector dynamic capabilities and organizational performance, empirically confirming the concept of equifinality for co-evolutionary alignment (Fiss, 2007).

Lastly, we add to the knowledge base on alignment of EMR in hospital settings, with most empirical validation and refinement done in this context. Namely, we provide a new way of looking at the challenge to align these systems to the strategies, goals and needs of the hospital and its stakeholders by taking a theoretical perspective that has not been used before in EMR research (Kohli & Tan, 2016).

9.2.2 Practical Implications

This dissertation provides practitioners facing complex environments with specific tools and directions to shape efficacious co-evolutionary alignment in their own organization. In this section these directions are presented on two levels (see figure 9.7).

First, the generic concepts that are part of the final COISA conceptualization are presented. Furthermore, some insights will be given on how these may be applied in practice. Secondly, on a lower level, the specific questions are identified that practitioners can ask themselves to further and continuously shape these dimensions of their organization's COISA capability. The answers to these questions are context-dependent (as demonstrated in the empirical studies described in chapters 3 and 4) and dynamic in nature (as demonstrated in the longitudinal study in chapter 6). After all, this dissertation confirmed that alignment is a process that needs continuous attention and effort.

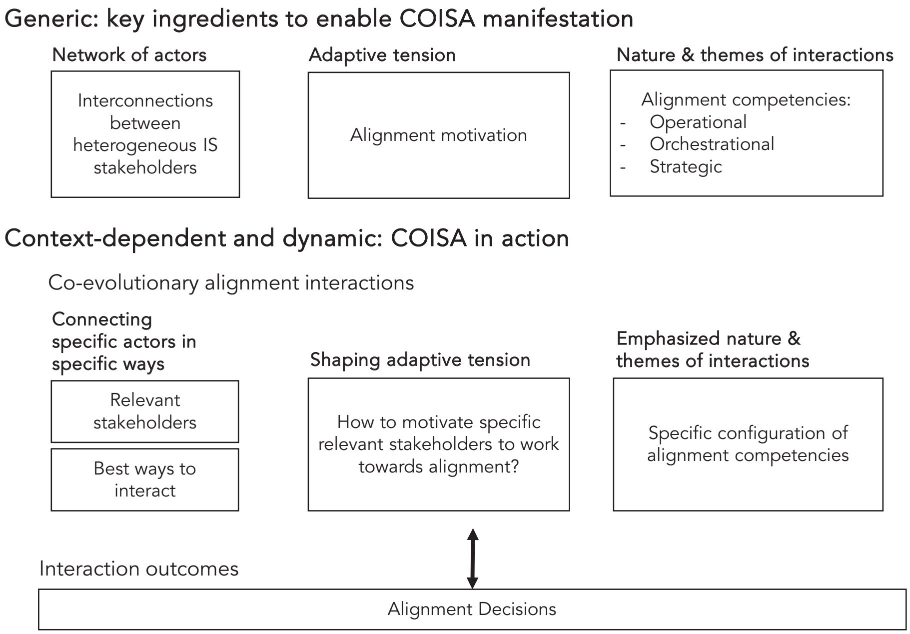

Figure 9.7. Practical directions based on the results of this dissertation

Looking at the final COISA operationalization, it can be concluded that practitioners need to consider two themes to efficaciously work towards alignment in their organization through enabling COISA manifestation: Firstly, they need a combination of alignment competencies (operational, orchestrational, and strategic), and secondly, they need alignment facilitators to make sure that these alignment competencies can adequately address the turbulence they are facing in terms of internal and external, and strategic and operational changes. These alignment facilitators can be translated to (1) a network of actors, i.e., heterogeneous IS stakeholders that have means to interact and (2) adaptive tension to make sure that the actors in the network in fact start and keep interacting to work towards alignment, i.e., alignment motivation.

Practitioners can use the measurement instrument developed in chapter 5 as a tool to assess their current situation and starting point for further development of their COISA capability. Getting organizational input through this instrument can give insight into the degree to which alignment competencies and -facilitators are in place within the organization. A possible interesting way to apply the instrument in practice is to have it filled in by multiple stakeholder perspectives, so that these can also be considered in the further development of the COISA capability. Items that score relatively low can provide pointers to possible avenues for improvement of the different COISA elements.

In addition, to further shape and continuously work on their organization's COISA capability, practitioners can ask themselves specific questions for each of these dimensions. Firstly, they should investigate the specific configuration of alignment competencies that would best suit their organization. As demonstrated in chapter 8, there are multiple roads that can lead to better dynamic capabilities and organizational performance. Specifically, at least two alignment competencies are necessary for the COISA capability to effectively stimulate dynamic capabilities and organizational performance. Hence, organizations can choose to put more focus on specific alignment competencies depending on their situation.

A pragmatic approach may be suitable here, to look into existing capabilities the organization already has in place to some degree (e.g., using the measurement instrument developed in chapter 5). For example, when an organization already has a strong operational alignment competency, practitioners may look into their resources to see which of the other two competencies (i.e., strategic or orchestrational) can be developed the most efficiently. However, for all alignment competencies goes, that they must be accompanied and characterized by the two main alignment facilitators. Namely, this ensures the CAS-based nature of these competencies and underlines the micro foundations of co-evolutionary interactions between individual IS stakeholders. In addition, the necessity of these alignment facilitators for the COISA capability's efficacy in dealing with complexity has been demonstrated in chapters 7 and 8.

To improve the alignment facilitator *interconnections between heterogeneous IS stakeholders*, practitioners should look to answer two questions:

1. Who are the relevant stakeholders in a specific alignment challenge (e.g., the implementation of an EMR system) and thus who should be involved in each of our alignment competencies?
2. How can we best enable these stakeholders to interact with each other (e.g., through formal governance structures, informal networks, supporting platforms or a combination), given our current situation?

Once the relevant stakeholders have been identified, practitioners can start looking into shaping alignment motivation of these stakeholders. In other words, they need to answer the question how to motivate relevant stakeholders to actively start working towards alignment. The answer to this question may differ for each stakeholder group or even for each individual, as demonstrated in the empirical study in chapter 4. For some actors, the motivation may be intrinsically present, while others may need external motivation.

Lastly, once the COISA capability is in place, the effects of the alignment decisions that are made as part of the COISA capability should be continuously evaluated to see whether these decisions contribute to the forward development of the COISA capability in context. Both are possible, as demonstrated in the empirical study in chapter 4 (highlighting specific alignment decisions that helped the efficacy of co-evolutionary alignment interactions themselves) and as demonstrated in the longitudinal study in chapter 6 (highlighting the effects of learning on the evolution of the COISA capability itself).

9.3 DISCUSSION AND FUTURE RESEARCH

This dissertation provides a new conceptualization for co-evolutionary information systems alignment, addressing several limitations of earlier conceptualizations. However, this research, too, has its limitations.

Firstly, quantitative evidence has been provided for a broad applicability of the alignment competencies and -facilitators as part of COISA (chapters 7 and 8). However, all qualitative empirical studies that give insight in *how* these competencies and facilitators manifest in practice have been conducted in the context of hospital EMR (chapters 3, 4 and 6). While this is an exemplary context in terms of the complex characteristics generally present in the public sector, it would be interesting to further investigate how COISA manifests in different contexts. Hence, practitioners in different contexts should critically reflect on what these facilitators would look like in their particular circumstances and researchers could zoom in on other systems or contexts to study the manifestation of alignment competencies and -facilitators there.

Another interesting research avenue could be to do more qualitative studies on how and why different configurations of alignment competencies manifest in practice. The quantitative studies as part of this dissertation (chapters 7 and 8) suggest that different configurations can lead to comparable results, and that sometimes, some alignment competencies are generally more important than others. For example, the findings presented in chapter 7 suggest that the operational and orchestrational alignment competencies are relatively more important in comparison to the strategic alignment competency in a healthcare context. These differences are confirmed in the qualitative study on co-evolutionary alignment interactions in EMR implementations (chapter 3), where all three cases of successful EMR implementation show at least a moderate degree of co-evolution in operational and orchestrational alignment competencies.

Furthermore, a comparable mechanism was found in terms of dynamic capabilities: In some cases, some dynamic capabilities seem to be more important than others. For example, the sensing capability came out as relatively more important in the study presented in chapter 7.

It would be interesting to look more in-depth into the question why this is the case and what this looks like for other contexts.

Interestingly, these insights in terms of configurations of effective capabilities seemingly contradict the findings by Van de Wetering, Mikalef, and Pateli (2017), who state that dynamic capabilities should in fact be balanced for an optimal organizational performance. This difference may be explained by the different research context (i.e., healthcare and public sector in this dissertation, and private sector firms in the work by Van de Wetering et al. (2017)). Namely, the amount of stakeholders and thus complexity is much larger in the public sector (Piening, 2013) and thus the right combination of alignment competencies and dynamic capabilities may well be context-dependent. The research presented in this dissertation already implies this context-dependency for the effective configurations of alignment competencies among themselves: they do not necessarily need to be balanced to be effective in stimulating dynamic capabilities. However, the studies in chapters 7 and 8 did not look into the combined configurations of alignment competencies and dynamic capabilities, leading to improved organizational performance, and thus no definitive conclusions can be drawn there based on the current work. Future studies could look more into the different configurations of alignment competencies and dynamic capabilities combined to see if a balance between those two would in fact stimulate organizational performance.

Another limitation lies in the nature of the used theoretical concepts. Namely, the implications of complexity for IS research as described by Benbya et al. (2020) and referred to in the introduction of this dissertation, have been considered as well as possible in developing and empirically validating the COISA conceptualization. However, the same cannot be said for the concepts of dynamic capabilities and organizational performance, used in assessing the value of COISA (chapters 7 and 8). While dynamic capabilities is a concept specifically meant to adequately deal with complexity, the operationalization used in chapters 7 and 8 is not specifically developed using a foundation of complex adaptive systems theory. Future research could work to conceptualize dynamic capabilities from the same theoretical standpoint to get a more theoretically coherent foundation and to further strengthen the assessment of COISA value in practice.

Furthermore, as also mentioned in chapter 7, while COISA and dynamic capabilities are both inherently dynamic in nature, the same cannot be said for the organizational performance construct. In particular, CAS-based studies have shown that organizational performance manifests through a punctuated equilibrium perspective (Sabherwal, Hirschheim, & Goles, 2001). This means that organizational performance always goes up and down and that a downward development of organizational performance is not always bad per se because it may be necessary for the organization's performance in the long run. Thus, a relatively low value on organizational performance at a certain point in time does not necessarily imply a low performance overall. Future research could adopt a more longitudinal approach, to see how COISA, dynamic capabilities and organizational performance develop in parallel over time.

Moreover, while the qualitative studies as part of this dissertation did try to include external viewpoints (e.g., that of consultants and EMR suppliers), the main focus of these studies was on the hospital itself. This implies to some degree that the boundaries of the business-IT alignment challenge stop at the boundaries of the hospital. However, with healthcare becoming more and more of a networked effort involving multiple organizations (see e.g., Pouloudi et al. (2016)), this assumption is questionable. Even more so, the longitudinal study on COISA capability evolution in a hospital EMR context (chapter 6) already shows that the alignment capability starts to cross hospital boundaries in a few cases after EMR go-live. This resonates with the fourth implication of complexity for IS researchers as described by Benbya et al. (2020): *'It is challenging to accurately circumscribe the boundaries of a complex sociotechnical system because complex systems are open systems"*. Future research could address this challenge more directly by even more explicitly moving beyond organizational boundaries.

Lastly, the methodological choices of the studies as part of this dissertation have some limitations. For example, all of the case studies (chapters 3 and 4) rely primarily on retrospective interviews, which may have influenced the reliability of the results to some degree. Namely, interviewees may not precisely recall all relevant events (Yin, 2018). Future research could adopt a more ethnographic approach and also include observations as part of the data collection process. Furthermore, in researching specific manifestations of alignment facilitators in an EMR context, only one round of (exploratory) focus groups has been conducted (chapter 4). It would be interesting to do another round of confirmatory focus groups to further consolidate and refine these findings. Lastly, the surveys conducted as part of the studies described in chapters

7 and 8 were both cross-sectional in nature. A longitudinal approach measuring the concepts on multiple points in time would help to further strengthen the conclusions on the value of COISA.

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SUMMARY

The promise of IT-based organizational innovation is a much-researched topic. However, organizations struggle to put in place adequate organizational complements to leverage IT in practice. This challenge has been often studied through the concept of Business-IT alignment (BITA), i.e., *"[…] applying IT in an appropriate and timely way and in harmony with business strategies, goals and needs"* (Luftman & Brier, 1999, p. 109). The pursuit of BITA is particularly challenging in complex environments. These environments are characterized by multiple concurrent, ambiguous and sometimes even contradicting goals within the organization. This translates to many different stakeholders all having their own views on what it means to apply IT appropriately. Furthermore, complex environments face quickly changing conditions, socially, legislatively and technically.
Traditional business-IT alignment approaches are inadequate in dealing with this complexity. Firstly, most models have a limited view towards the involved stakeholders, only distinguish the dichotomy of business and IT. Moreover, many traditional BITA approaches have a strong top-down focus, while in pluralistic, multi-stakeholder environments, this has been proven to not always be the most effective approach. Lastly, several models are relatively static in nature, and are therefore inadequate in addressing the dynamic environment in which digital opportunities have to be leveraged.

The complex adaptive systems theory-based concept of co-evolutionary information systems alignment (COISA) emerged in the literature as a potential approach to dealing with the above described complexity. This potential value is often explained through the principle of requisite variety: "*[…] in order to remain viable, a system needs to generate the same degree of internal complexity as the external complexity it faces in its environment*" (Benbya & McKelvey, 2006b, p. 290). Hence, existing literature proposes that when alignment efforts are organized according to underlying theoretical principles of complex adaptive systems theory, organizations should be better able to address external complexity.

While COISA seems a promising direction to adequately address complex environments in the pursuit of BITA, most works on this topic remain conceptual or do not fully address the above described limitations of existing BITA approaches. Furthermore, empirical evidence on its value is scarce. Hence, this dissertation addresses the following research question:

> What is the potential of a co-evolutionary approach to business-IT alignment for organizations to address complex environments?

In doing so, three sub questions are formulated and answered through a multi-MAP (methods, approaches, perspectives) approach, using a theoretical foundation of complex adaptive systems theory. These include (1) What are the key components of COISA?; (2) How can COISA be assessed cross-sectionally and shaped over time as an organizational capability? and (3) How and to what degree does a COISA capability help organizations to address complex environments?

The first part of this dissertation, i.e., Exploring the key components of COISA, addresses the first sub question: What are the key components of COISA? In chapter 2, five alignment processes are found in which co-evolutionary alignment interactions manifest in practice among heterogeneous information systems (IS) stakeholders. These alignment processes include 'strategy formulation' and 'strategy implementation' in the strategic context; 'IT implementation' and 'IT usage' in the operational context, and 'enterprise architecture management' bridging these two contexts. In chapter 3, these findings are empirically validated and refined through a multiple case study in the context of electronic medical records (EMR) implementations in hospitals, which are an exemplary case of a context where complexity is prominently present. The findings of this study confirm that co-evolutionary interactions take place within and between these alignment processes, however, in different degrees and with different foci of co-evolution (e.g., more in the strategic alignment processes in one hospital, and more in operational alignment processes in another hospital). In chapter 4, the facilitators are identified that are necessary to ensure that co-evolutionary alignment interactions move towards alignment and not away from it, also using the empirical context of hospital EMR. The identified facilitators include 'Alignment motivation', 'Interconnections', 'Stakeholder involvement', and 'Alignment decisions'. The combination of alignment processes and alignment facilitators form the key components of COISA.

The second part of this dissertation, i.e., Measuring and shaping COISA as an organizational capability addresses the second sub question: How can COISA be assessed cross-sectionally and shaped over time as an organizational capability? In chapter 5, the empirical results are synthesized with theoretical insights and COISA is conceptualized as an organizational capability. This chapter results in a survey instrument, enabling cross-sectional assessment of an organization's COISA capability. The final COISA conceptualization reflected in the survey instrument can be seen as an organizational capability, defined as *continuously exercised alignment competencies, characterized by co-evolutionary interactions between heterogeneous IS stakeholders, in pursuit of a common interpretation and implementation of what it means to apply IT in an appropriate and timely way*, and it consists of three alignment competencies (operational, orchestrational and strategic) and two necessary alignment facilitators (alignment motivation and interconnections between heterogeneous IS stakeholders).

To enable COISA assessment and -shaping over time, a longitudinal multiple case study on hospital EMR (chapter 6) was done, looking into the evolutionary paths of the hospitals' EMR-related COISA capability before and after go-live of the EMR system. A theoretical foundation of capability lifecycle stages was applied to describe COISA evolution over time. Furthermore, the study provides insights in the drivers behind the evolutionary paths of the COISA capability. The findings showed that each hospital's COISA capability had a different evolutionary path depending on contextual circumstances. Drivers of COISA evolution included 'stakeholder initiative', 'emergent issues', 'driving events' and 'accumulating experience', with stakeholder initiative being particularly important for the forward evolution of the COISA capability. Furthermore, the findings show that the COISA capability in two out of the three cases moved beyond hospital borders through the incorporation of other hospitals using the same EMR system in alignment competencies.

The third and last part of this dissertation addresses the value of COISA for organizations facing complex environments. This is done by assessing the correlation between an organization's COISA capability, and their dynamic capabilities and organizational performance. Dynamic capabilities give insight in an organization's ability to effectively sense opportunities and threats, to mobilize resources to address these, and to transform the organization accordingly. These capabilities are specifically designed to address complex and turbulent environments. In chapter 7, this relationship is assessed in the Dutch healthcare sector and the results show a significant positive correlation between COISA and dynamic capabilities, and through that value path, organizational performance (in terms of responsiveness, quality of service and costs). Herein, the operational alignment competency seemed relatively more important compared to the orchestrational and strategic alignment competencies. Moreover, these findings show that the alignment facilitators are not only contributing to the efficacy of alignment competencies, but that they are in fact *necessary* for their effective manifestation.

In chapter 8, the research scope is expanded from healthcare to the broader Dutch public sector and the results confirm again the significant positive correlation between COISA and dynamic capabilities, and through that value path, organizational performance (in terms of responsiveness and quality of service). This study also confirms the necessity of alignment facilitators for alignment competency manifestation and highlight the specific degrees of alignment facilitators that are necessary for a specific degree of alignment competencies. Moreover, three different configurations of alignment competencies are uncovered that are effective in stimulating public sector dynamic capabilities and performance. These configurations are resonant with (1) a top-down focus, with a strong strategic and orchestrational alignment competency; (2) a bottom-up focus, with a strong operational and orchestrational alignment competency and (3) a two-way approach, with both a strong operational and strategic alignment competency. These findings resonate with the results of the multiple case study as described in chapter 4, where the findings also suggest different foci of co-evolutionary interactions. Interestingly, in each of these three configurations, both alignment facilitators must be present, implying that these are not only necessary for the manifestation of alignment competencies, but also for their positive correlation with dynamic capabilities.

In conclusion, this dissertation provides renewed insight in the potential of COISA to address complex environments in the pursuit of business-IT alignment. It does so by (1) identifying the key elements of a co-evolutionary approach to business-IT alignment to adequately address complexity; (2) developing a survey instrument for cross-sectional COISA assessment and providing insights to describe and steer COISA's evolution over time; (3) evaluating and refining the identified COISA dimensions in the exemplary context of hospital EMR; (4) demonstrating the value of a COISA approach through its significant positive relation with public sector dynamic capabilities and organizational performance, both in healthcare and the broader public sector and (5) providing specific directions on how to implement a COISA capability in practice. The latter is done through demonstration of the necessity of alignment facilitators, and by providing several alignment competency configurations that drive the development of dynamic capabilities and with that, better performance in complex environments.

SAMENVATTING

De belofte van op IT gebaseerde organisatorische innovatie is een veel onderzocht onderwerp. Organisaties worstelen echter met het strategisch toepassen van IT en met het opzetten van de juiste organisatorische structuren om IT in de praktijk te benutten. Deze uitdaging is vaak bestudeerd aan de hand van het concept *Business-IT alignment* (BITA), d.w.z., "[...] het toepassen van IT op een gepaste en tijdige manier en in harmonie met de bedrijfsstrategieën, -doelstellingen en -behoeften" (Luftman & Brier, 1999, p. 109). Het nastreven van BITA is vooral een uitdaging in complexe omgevingen. Deze omgevingen hebben te maken met meerdere, ambigue en soms zelfs tegenstrijdige doelen binnen de organisatie. Dit vertaalt zich in veel verschillende stakeholders die allemaal hun eigen visie hebben op wat het betekent om IT op de juiste manier toe te passen. Bovendien worden complexe omgevingen gekenmerkt door snel veranderende omstandigheden, zowel op sociaal, wetgevend als technisch gebied.
Traditionele benaderingen voor BITA zijn ontoereikend om met deze complexiteit om te gaan. Ten eerste hebben de meeste modellen een beperkte kijk op de betrokken stakeholders, en onderscheiden zij meestal alleen de dichotomie van business en IT. Bovendien zijn veel traditionele BITA-benaderingen sterk top-down gericht, terwijl in pluralistische omgevingen met veel belanghebbenden is gebleken dat dit niet altijd de meest effectieve benadering is. Tenslotte zijn veel modellen betrekkelijk statisch van aard, en daarom niet geschikt om in te spelen op de dynamische omgeving waarin digitale kansen moeten worden benut.

Het op de complexe adaptieve systeemtheorie gebaseerde concept van *co-evolutionary information systems alignment* (COISA) is in de literatuur naar voren gekomen als een potentiële benadering om met de hierboven beschreven complexiteit om te gaan. Deze potentiële waarde wordt vaak uitgelegd aan de hand van het principe van de vereiste verscheidenheid: "[...] om levensvatbaar te blijven, moet een systeem dezelfde mate van interne complexiteit genereren als de externe complexiteit waarmee het in zijn omgeving wordt geconfronteerd" (Benbya & McKelvey, 2006b, p. 290). De bestaande literatuur stelt dan ook dat wanneer BITA-gerelateerde inspanningen georganiseerd worden volgens de onderliggende theoretische principes van de complexe adaptieve systeemtheorie, organisaties beter in staat zouden moeten zijn om externe complexiteit aan te pakken.

Hoewel COISA een veelbelovende richting lijkt om complexe omgevingen adequaat aan te pakken bij het nastreven van BITA, blijven de meeste onderzoeken over dit onderwerp conceptueel of gaan ze niet volledig in op de hierboven beschreven beperkingen van bestaande BITA benaderingen. Bovendien is empirisch bewijs over de waarde ervan schaars. Vandaar dat deze dissertatie zich richt op de volgende onderzoeksvraag:

> **Wat is het potentieel van een co-evolutionaire benadering voor business-IT alignment voor organisaties om complexe omgevingen aan te pakken?**

Daarbij worden drie deelvragen geformuleerd en beantwoord door middel van een multi-MAP (*methods, approaches, perspectives*) benadering, gebruikmakend van een theoretisch fundament van de complexe adaptieve systeemtheorie. Deze deelvragen zijn (1) Wat zijn de belangrijkste componenten van COISA?; (2) Hoe kan COISA cross-sectioneel worden gemeten en op de lange termijn worden gevormd als een organisatorische capaciteit? en (3) Hoe en in welke mate helpt een COISA-capaciteit organisaties om complexe omgevingen aan te pakken?

Het eerste deel van deze dissertatie, Verkennen van de belangrijkste componenten van COISA, behandelt de eerste deelvraag: Wat zijn de belangrijkste componenten van COISA? In hoofdstuk 2 worden vijf alignmentprocessen geïdentificeerd waarin co-evolutionaire alignmentinteracties zich in de praktijk manifesteren tussen heterogene stakeholders van informatiesystemen (IS). Deze alignmentprocessen omvatten ‘strategieformulering’ en ‘strategie-implementatie’ in de strategische context; ‘IT-implementatie’ en ‘IT-gebruik’ in de operationele context, en ‘enterprise architectuur management’, dat een brug slaat tussen deze twee contexten. In hoofdstuk 3 worden deze bevindingen empirisch gevalideerd en verfijnd aan de hand van een meervoudige casestudy in de context van implementaties van elektronische patiëntendossiers (EPD’s) in ziekenhuizen, die een goed voorbeeld vormen van een context waarin complexiteit prominent aanwezig is. De bevindingen van deze studie bevestigen dat co-evolutionaire interacties plaatsvinden binnen en tussen deze alignmentprocessen, echter in verschillende mate en met verschillende zwaartepunten van co-evolutie (bv. meer in de strategische alignmentprocessen in het ene ziekenhuis, en meer in de operationele alignmentprocessen in een ander ziekenhuis). In hoofdstuk 4 worden de facilitatoren geïdentificeerd die nodig zijn om ervoor te zorgen dat co-evolutionaire alignmentinteracties daadwerkelijk naar alignment toe werken, waarbij ook gebruik wordt gemaakt van de empirische context van EPD’s in ziekenhuizen.

De geïdentificeerde facilitatoren omvatten 'Alignment motivatie', 'Interconnecties', 'Betrokkenheid van de juiste stakeholders', en 'Alignmentbeslissingen'. De combinatie van alignmentsprocessen en alignmentfacilitatoren vormen de belangrijkste componenten van COISA.

Het tweede deel van deze dissertatie, namelijk het meten en sturen van COISA als een organisatorische capaciteit, behandelt de tweede deelvraag: Hoe kan COISA cross-sectioneel worden gemeten en op de lange termijn worden gevormd als een organisatorische capaciteit? In hoofdstuk 5 worden de empirische resultaten van hoofdstuk 3 en 4 samengevoegd met theoretische inzichten en wordt COISA geconceptualiseerd als een organisatorische capaciteit. Dit hoofdstuk resulteert in een enquête-instrument, dat een cross-sectionele meting van de COISA-capaciteit van een organisatie mogelijk maakt. De uiteindelijke COISA-conceptualisatie die in het enquête-instrument tot uiting komt, wordt gedefinieerd door continu uitgeoefende alignmentcompetenties, gekenmerkt door co-evolutionaire interacties tussen heterogene IS stakeholders, in navolging van een gemeenschappelijke interpretatie en implementatie van wat het betekent om IT op een passende en tijdige manier toe te passen. Deze capaciteit bestaat uit drie afstemmingscompetenties (operationeel, orchestrationeel en strategisch) en twee noodzakelijke alignmentfacilitatoren (alignment motivatie en interconnecties tussen heterogene IS stakeholders).

Om COISA op de lange termijn te kunnen beoordelen en vormgeven, is een longitudinale meervoudige case studie naar EPD implementaties en -beheer in ziekenhuizen (hoofdstuk 6) gedaan, waarbij de evolutionaire paden van de EPD-gerelateerde COISA capaciteit voor en na go-live van het EPD zijn onderzocht. Een theoretische basis van *lifecycle stages* van de capaciteit werd toegepast om de COISA evolutie in de tijd te beschrijven. Bovendien verschaft de studie inzicht in de drijvende krachten achter de evolutie van de COISA capaciteit. De bevindingen toonden aan dat de COISA capaciteit van elk ziekenhuis een verschillend evolutiepad kende, afhankelijk van contextuele omstandigheden. De drijvende krachten achter de evolutie van COISA waren onder meer 'initiatief van stakeholders', 'opkomende problemen', 'drijvende gebeurtenissen' en 'opgedane ervaring', waarbij initiatief van stakeholders in het bijzonder belangrijk was voor de voorwaartse evolutie van de COISA capaciteit. Bovendien tonen de bevindingen aan dat de COISA capaciteit in twee van de drie gevallen de ziekenhuisgrenzen overschreed door het betrekken van andere ziekenhuizen die hetzelfde EPD systeem gebruiken in de alignmentcompetenties.

Het derde en laatste deel van deze dissertatie behandelt de waarde van COISA voor organisaties die geconfronteerd worden met complexe omgevingen. Dit wordt gedaan door het bestuderen van de correlatie tussen de COISA capaciteit van een organisatie, en hun *dynamic capabilities* en organisatorische prestaties. *Dynamic capabilities* geven inzicht in het vermogen van een organisatie om kansen en bedreigingen effectief op te merken, middelen te mobiliseren om deze aan te pakken, en de organisatie daarop te transformeren. Deze *dynamic capabilities* zijn specifiek ontworpen om complexe en turbulente omgevingen het hoofd te bieden. In hoofdstuk 7 wordt de correlatie tussen de COISA capaciteit, *dynamic capabilities* en organisatorische prestaties beoordeeld in de Nederlandse gezondheidszorgsector. De resultaten laten een significante positieve correlatie zien tussen COISA en *dynamic capabilities*, en via dat pad, ook de organisatorische prestaties (in termen van reactievermogen, kwaliteit van de dienstverlening en kosten). Hierbij bleek de operationele alignment competentie relatief belangrijker in vergelijking met de orchestrationele en strategische alignmentcompetenties. Bovendien tonen deze bevindingen aan dat de alignment facilitatoren niet alleen bijdragen aan de effectiviteit van alignment competenties, maar dat ze in feite noodzakelijk zijn voor de effectieve uitvoering ervan.

In hoofdstuk 8 wordt de reikwijdte van het onderzoek uitgebreid van de gezondheidszorg naar de bredere Nederlandse publieke sector. De resultaten bevestigen opnieuw de significante positieve correlatie tussen COISA en *dynamic capabilities*, en via dat pad, de organisatieprestaties (in termen van responsiviteit en kwaliteit van dienstverlening). Deze studie bevestigt ook de noodzaak van alignment facilitatoren voor de effectieve uitvoering van alignment competenties en benadrukt de specifieke mate van alignment facilitatoren die nodig zijn voor een specifieke mate van alignment competenties. Bovendien worden drie verschillende configuraties van alignmentcompetenties blootgelegd die effectief zijn in het stimuleren van *dynamic capabilities* en organisatorische prestaties in de publieke sector. Deze configuraties komen overeen met (1) een top-down focus, met een sterke strategische en orchestrationele alignmentcompetentie; (2) een bottom-up focus, met een sterke operationele en orchestrationele alignmentcompetentie en (3) een tweerichtingsbenadering, met zowel een sterke operationele als strategische alignmentcompetentie. Deze bevindingen komen overeen met de resultaten van de meervoudige casestudy zoals beschreven in hoofdstuk 4, waar de bevindingen ook wijzen op verschillende zwaartepunten van co-evolutionaire interacties. Interessant is dat in elk van deze drie configuraties beide afstemmingsfacilitatoren aanwezig moeten zijn, wat impliceert dat deze niet alleen noodzakelijk zijn voor de manifestatie van alignmentcompetenties, maar ook voor hun positieve correlatie met *dynamic capabilities*.

Concluderend verschaft deze dissertatie hernieuwd inzicht in het potentieel van COISA om complexe omgevingen aan te pakken in het streven naar business-IT alignment. Dit wordt gedaan door (1) de belangrijkste elementen te identificeren van een co-evolutionaire benadering voor business-IT alignment om goed om te gaan met complexiteit; (2) een onderzoeksinstrument te ontwikkelen voor cross-sectionele COISA meting, en inzichten te verschaffen om de evolutie van COISA op de lange termijn te beschrijven en te sturen; (3) de geïdentificeerde COISA elementen te evalueren en te verfijnen in de context van EPD's in ziekenhuizen; (4) het aantonen van de waarde van een COISA-benadering door de significante positieve correlatie met *dynamic capabilities* en organisatorische prestaties in de publieke sector, en (5) het geven van specifieke aanwijzingen over hoe een COISA-capaciteit in de praktijk kan worden ontwikkeld. Dit laatste gebeurt door de noodzaak van alignmentfacilitatoren aan te tonen, en door verschillende configuraties van alignmentcompetenties aan te reiken die de ontwikkeling van *dynamic capabilities* en daarmee betere prestaties in complexe omgevingen stimuleren.

CURRICULUM VITAE

Pien Walraven was born on March 23rd, 1992, in Nijmegen, the Netherlands. From 2010 to 2014, she studied Communication- and Information studies (BA) and Information Science (BSc) at Radboud University. In 2015, she obtained her MSc. in Information Systems at Lund University. After working for the IT department of Wageningen University & Research as a business- and information analyst for two years, she started her PhD at Open University in 2017.

Starting in 2019, she officially transitioned to a part-time position as PhD student, and a part-time position as lecturer at Open University in the department of Information Science at the faculty of science. As a lecturer, she is involved in several courses as part of the bachelors' program in Information Science, the masters' program in Business Process Management and IT and the interdisciplinary masters' program in Health sciences.

Currently (starting from December 2022), Pien combines her teaching activities at Open University with a position as information manager education at Radboud University, where she aims to apply the knowledge of this dissertation in practice.