Coordinated Continuous Digital Transformation

6

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Introduction

The overall focus of this book is on the transformation of enterprises towards *AI-Enabled Enterprises*, involving a strong role for both AI and digital twin technologies. At the same time, it is important to realize that for enterprises, the transformation towards AI-Enabled Enterprises is "just" a logical, albeit important, next phase in the continuous flow of digital transformations which enterprises are (and need to be) engaged in. In this chapter, we therefore specifically zoom in on both the challenges facing enterprises regarding digital transformations in general and the transition to AI-Enabled Enterprises in particular. In doing so, we will review, and integrate, both insights from practice and insights from research results.

Since digital transformations have (by definition) a profound impact on the structure of an enterprise, it is important to ensure that such (enterprise) transformations are well-coordinated [1, 2]. Enterprise (architecture) models are traditionally regarded as an effective way to enable such informed coordination and decision-making [1, 3]. In line with this, we take a model-enabled perspective on the needed coordination, in particular in the context of what we call *enterprise design dialogues* [4].

In the second section, we start by defining more precisely what we mean by digital transformation. The third section then reflects on the fact that digital transformations should be seen as a continuous process. This is then complemented in the fourth section with the

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101

observation that it is essential for these continuous digital transformations to happen in a coordinated way, involving coordination among many different actors. The fifth section reviews the concept of *enterprise design dialogues* that we see as being at the heart of the needed coordination of transformations. In the sixth section, we then attend to the crucial role of models (including the virtual model included in a Digital Twin(s)) to support enterprise design dialogues. Finally, before concluding, the seventh section reviews challenges and opportunities towards future research.

Digital Transformation

Our society has transitioned well and truly from the industrial age to the digital age. As a result, "digital" has become an integral part of our lives. Tasks in our common lives that used to be completely "analogue" are now increasingly "digital": ordering pizza, ordering a taxi, booking a vacation trip, dating, etc. Similarly, in business, we see an increased transition from "analogue" via "digitized" (i.e. replacing paper with PDF) to "digital" (redesign of value proposition and operating model) business models [5]. The *on-going* development and maturation of "digital technologies", such as mobile computing, pervasive computing, cloud computing, big data, AI, robotics, social media, low-code, Digital Twin(s), etc., drive enterprises to transform. Even more, non-IT infrastructures, such as electricity networks, water networks, transportation networks and even cities and buildings, increasingly become IT-intensive infrastructures. As a result, it is now humans and IT, who are jointly the driving agents in an enterprise, where IT is increasingly also fulfilling the role of the "operating system" of the enterprise. The increased use of different forms of AI in conjunction with digital twin technologies now ushers in a further transition for enterprises, from being "digital" to being *AI-enabled*.

When we speak about "digital transformation", we do so primarily in the context of "enterprises". An "enterprise" is a "unit of economic organization or activity" [6] such as a company, a government agency, a factory, etc. It is also, at a more fundamental level, a purposeful system (i.e. its enterprise) in the sense of conducting (possibly as part of a network of enterprises) a particular business in the sense of a "particular field of endeavour" [6]. In some areas, this is stated as systems having a *function* in their environment (e.g. [7]). With this in mind, we [8] define *digital transformation* as follows:

> The deliberate effort to transform the architecture of the enterprise, with a significant impact on its digital capabilities.

The phrase "digital capabilities" refers to those business capabilities [9] of an enterprise that are digitally driven or at least highly digitally reliant. In terms of [10, 11], digital transformations may not only change the *operational capability* (needed to execute the business and operating model) of enterprises but specifically also their *dynamic capability*

(needed to continuously improve and innovate the business and operating model in relation to new opportunities and challenges).

To expand on the above definition of digital transformation, it should be noted that the term *architecture* has different meanings. The way it is used in the above definition should be taken in line with the general definition of architecture as reported in our earlier work (e.g. [12]):

> Those properties of an artifact that are necessary and sufficient to meet its essential requirements; or in more colloquial terms it is about 'what (should) keep(s) stakeholders awake at night'.

In line with [13], the latter is usually operationalized for *system architectures* by the assertion that, for systems, architecture concerns (1) the fundamental properties of a system (in terms of components and their relations) and (2) the principles guiding design and evolution. In light of the definition provided by [12], this implies that digital transformation initiatives are aimed at changing the *essence* of the organization. The corollary is that (relatively) minor changes that leave the essence of the organization intact do not count as digital transformation initiatives.

A further observation with regard to the definition is digital transformation is the focus on *digital capabilities*. The implication is that transformation initiatives that do not have a significant impact on the digital capabilities of the organization do not count as digital transformation initiatives. As before, we are not claiming that these do not occur nor that they are not important. We simply do not consider these to be digital transformation initiatives.

Continuous Digital Transformation

The *on-going* development and maturation of "digital technologies" certainly drives enterprises to change. However, this is certainly not the only source for change in enterprises. Market dynamics, new regulations, opportunities offered by other (non-digital) new technologies, etc. force modern-day enterprises to change almost continuously. This is sometimes referred to as the "VUCA" world (volatile, uncertain, complex and ambiguous; see, e.g. [14, 15]).

At the same time, we argue that enterprises have always had a need to change. Before the Industrial Revolution, such changes might have (in general) occurred at a slow pace. Social and political developments (including wars and revolutions) may have caused a temporary increase in the pace of change. The technological advancements driving, and causing, the Industrial Revolution added more speed to change. Enterprises could innovate at a higher pace due to the technological developments, while society at large also became more demanding regarding products and services. During this period, companies with the

"best" innovations "won" in the market (first-mover advantage), often leading to extravagant market positions.

We are now experiencing the "Digital Revolution" [5, 16–18], which is increasing the speed of change even more. Our observation is that this is a *reinforcing loop*. Market developments drive the need to innovate, which is faster in a digital space. Demand creates supply: organizations innovate at a higher and higher pace. This in turn drives market developments, which sets in motion the next "cycle".

What also strengthens the reinforcing loop is the fact that, as mentioned above, digital transformations can not only be used to transform the operational capabilities of an enterprise but their dynamic capabilities as well. Initial examples of the digital transformation of dynamic capabilities include the use of workflow engines, business rule engines and low-code solutions. The introduction of AI to support different tasks in digital transformations (see, e.g. [19–21]) is a prelude towards things to come for the dynamic capabilities in AI-Enabled Enterprises.

As a result, we would argue that one needs to increasingly consider digital transformation to be a continuous process and certainly not as a "one-off" project.

Coordinated Continuous Digital Transformation

So far, we have discussed what digital transformation is and that it should be considered as a continuous process. We now shift perspective to emphasize the fact that digital transformation requires strong *coordination* to be successful.

We start with two related observations based on the previous discussion. As the definition of digital transformations stipulates, digital transformations have a significant impact on the digital capabilities of an enterprise. We can also observe how, over the past decades, the role of IT in enterprises has increased from the mere automation of information processing, via the automation of actual business processes, to now being a core element of their business models. As the role of IT in enterprises increased, so did the need to ensure a coherent design between IT and all other aspects of an enterprise [22], from the operational alignment between human and IT-based activities to the longer-term strategic alignment [3, 23]. A second pertinent observation is that experience shows that digital transformation requires a *deliberate effort* to achieve an outcome [24, 25].

Our position is that both of these observations, i.e. (1) the need for *coherent design* and (2) the fact that digital transformations require a *deliberate effort*, point towards the need for a *coordinated* [1] approach to digital transformation to ensure that the *profound impact* of these transformations pushes the enterprise in the right direction in a coherent and deliberate manner.

In the remainder of this section, we argue that there is another fundamental reason for requiring a coordinated approach: social and technical *complexity*. Different frameworks exist to classify, and reason about, *complexity* of problems in general. For our discussion below, we primarily rely on the Cynefin framework (see, e.g. [26–29]). In this *sense-*
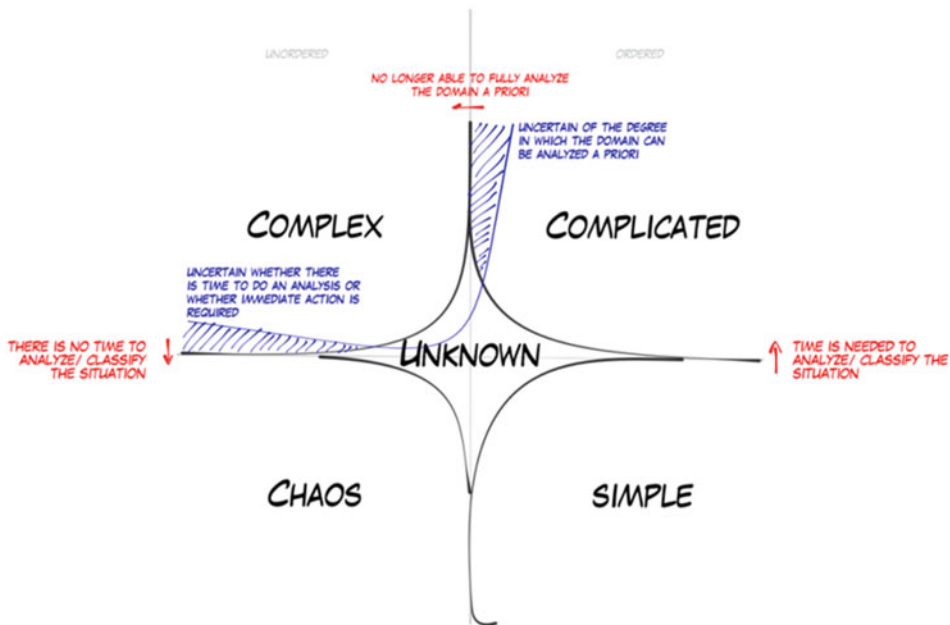
Fig. 6.1 The Cynefin framework [28], enhanced with our own interpretation

making framework, "problems" are classified into different *domains*. The framework, enriched with our interpretation, is visualized in Fig. 6.1. To understand why it is important to understand in which domain a problem at hand fits, we use a quote from the GUM:[1]

> Throughout the day, we are forced to deal with numerous new impressions and experiences. In order to get to grips with the chaos that characterises the world around us, we are constantly on the lookout for connections and patterns. Based on those, we are able to classify reality and create order. Scientists draw up similar classifications. However, these need to be underpinned by clearly defined criteria which will determine in a straightforward way whether or not something belongs to that classification, and, if so, where. Now, you might wonder: does that order truly exist? Alternatively, do scientists impose said order on reality?

The domain of *simple* problems is characterized by the fact that challenges are recognized as belonging to a certain class, so the solution to these challenges is immediately obvious, while there is none to moderate time pressures to realize the solution. A good example would be the update of the operating system as used on the desktop or the migration of e-mail services to a new e-mail platform.

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[1]Gents Universitair Museum https://www.gum.gent/en/collection-album/chaos-1; seen on 27-Dec-2022

In the domain of *chaos*, the complete opposite is true; whenever there is chaos and a (life-threatening) crisis emerges, an immediate response is usually lacking. In situations of this type, it is suggested [28] that decisive leadership is required in order to stabilize the situation. In practical terms, this would entail returning to one of the other three problem domains. This is why, e.g. officers in the military speak of *the terrible burden of command*: when the proverbial shit hits the fan, they still have an army to lead with potentially lethal consequences [30].

This leaves the *complicated* and *complex* domains. The former refers to situations for which an a priori, provably correct solution can be developed. This does not mean that these are simple, or trivial, problems. They are, however, *complicated* [30]. Usually, these situations involve challenging *engineering problems*, such as the design of bridges or other intricate water works. The generally used approach in these kinds of situations is to *analyse* the situation, *design* a solution and then *implement* it. Note that in these situations, a *reductionist* approach is common: the "essential" properties of the problem domain are analysed (whatever these may be), and the irrelevant aspects are (and are assumed safe to be) ignored.

In contrast, for problems in the domain of *complex* problems, no a priori correct solution can be found. The situation is characterized by the fact that the interplay between variables is so complex that cause and effect can only be analysed (fully) a posteriori. Problems in this domain are also called *wicked problems* [31]. This is the realm of emergent change, where a hypothesis of the situation is the input for deciding about potential action which has to be evaluated a posteriori to see if it delivered the expected results. In software engineering, this usually entails to the use of an *agile* approach. Note that the approach here does not favour reductionism; the whole point in this domain is that a full analysis is not possible. The emphasis is, indeed, on *probing* the organization and *evaluating* results – something that is often referred to as *situational awareness* [32, 33].

Note further that:

- There is a fifth "unknown" domain of problems in the centre of the framework. This is used to signal situations here we do not yet know in which of the four main domains we are.
- The left-right "split": both the simple and complicated domains are said to be *ordered*. This is intended to signify that a correct solution can be derived a priori. The complex and chaos domains are said to be *unordered* and do not have this property.
- Going from the simple domain to the complicated domain signifies a clear distinction between situations where a full understanding is immediately apparent (simple domain) versus situations where time for analysis is needed.
- Going from the complicated to the complex domain signifies a clear distinction where time is available for analysis (complex) versus situations where it is not (complicated).
- The "squiggle" at the bottom, between the chaos and simple domains, is intended to signify a rift/barrier: it is not possible to go from the chaotic domain to the simple domain; one will have to go "up" to the complicated or complex domain.

- The blue areas are "in-between" areas. These signify the areas of doubt and uncertainty where we are unsure in which of the two adjacent areas we are.

Our claim is that (continuous) digital transformations are primarily in the *complex space*. We motivate this claim by referring to the earlier observation that, in our view, the *profound* impact suggests that many parts of the enterprise will be impacted. These "parts" come in many shapes and forms that are intricately intertwined: people in their roles, processes (structured and creative), data, information systems, infrastructure, team meetings and perhaps even culture are all considered [34]. Furthermore, AI-based actors/components will add even more complexity to the mix, especially, when taking the complex interplay between multiple human and AI-based actors into account.

In [35], the complexity that originates from people and their different interests and backgrounds is referred to as *social complexity*. Inspired by this, in [34], the following pseudo-formula for *social complexity* is suggested:

social complexity = #stakeholder roles × diversity of stakes × diversity of cultures

This could be complemented further with *technical complexity* due to the interplay between the different components and relations involved in a digital transformation. As mentioned before, the increased use of AI and the potential interplay (and associated uncertainty regarding causes and effect).

The social complexity and technical complexity involved in digital transformation put more stress on the need for coordination. To further illustrate this, we introduce two new notions: (1) a single-effort digital transformation initiative refers to a situation where a single initiative attempts to achieve a digital transformation outcome, and (2) a multi-effort digital transformation refers to a situation where a group of *parallel* initiatives does the same. We deliberately use the "vague" term *initiative* to avoid a (waterfall) project versus agile discussion while also embracing the earlier observation that digital transformations (be it single-effort or multi-effort) should be thought of as continuous processes.

Let us now, briefly, examine each of these kinds of digital transformations in turn. In a single-effort digital transformation initiative, one attempts to change the core/architecture of the enterprise in a single initiative. Our earlier claim is that digital transformation initiatives are in the complex space, which suggests that a full a priori understanding of the domain is, by its very nature, not possible. We argue that multiple stakeholders are involved in such an initiative, also requiring the balancing of "local" interests (e.g. at business unit level) and "global" interests (e.g. at company-wide level) [1] (including, for instance, the need to comply to regulations). This emphasizes the need for coordination: both within the group of stakeholders that shape and execute the transformation initiative and with the stakeholders that are impacted by it. Indeed, in agile methods (e.g. SCRUM), there is much focus on communication and rituals (daily stand-up, retrospective, etc.) to arrange for this kind of coordination.

In a multi-effort digital transformation initiative, these coordination challenges become even more pressing. Here, we not only see the need for coordination (among stakeholders)

within a transformation initiative but also *across* different (parallel) initiatives. A more flexible approach seems to be called for, i.e. also less "Big Design Up Front" [36, 37]. At the same time, concerns, such as regulatory compliance, risk management, security, etc., do require an integrated view (and design) of all relevant aspects of an enterprise [3, 38]. In practice, we tend to see variations of *scaled agile* emerge.[2] Scaled agile methods are characterized by coordinating mechanisms "on top of" agile initiatives, ensuring that their goals and efforts align sufficiently.

To summarize our point, digital transformations are highly complex (and will be even more complex when AI is involved). They are also continuous and require strong coordination either within or across initiatives. In the next section, we will investigate the role of models in light of this point.

Enterprise Design Dialogues

We [4] take the view that, in general, the design of the structure (processes, hierarchies, (IT) infrastructures) of an enterprise is (re)shaped by a continuous flow of (top-down and bottom-up) *enterprise design dialogues* between the different involved human actors. (Coordinated and continuous) digital transformations are no exception to this.

This may sound abstract, but in practice, such design dialogues occur all across enterprises. Or in the words of [39]: "Design literally shapes organizational reality". Each time co-workers discuss "how to" divide work or conduct a (new) task, they essentially engage in an enterprise design dialogue. When process engineers discuss with senior business management how to shape a business process, they are having a design dialogue. When database engineers discuss with domain experts what information needs to be captured in the database, they are having a design dialogue. When the enterprise architects that are involved in a digital transformation coordinate with different stakeholders regarding the future direction of the enterprise, they are having a design dialogue. These examples show how design dialogues occur across an enterprise, meanwhile (re)shaping the design of the enterprise.

As a more concrete example of (1) what a design dialogue looks like and (2) what the value of such a dialogue can be, consider the situation at a utilities company that we[3] consulted to. This company had had a "best of breed" software strategy in the past. They ended up with a set of systems from different vendors that were only loosely connected. The situation served them well for years on end, but the need for a more integral approach to data access (both for operational and for business intelligence purposes) had arisen. It had been decided that "we need an integral platform" to make that happen, without having

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[2] Several frameworks to scale agile methods have emerged. A full listing would be beyond the scope of this chapter.

[3] One of the authors works as an enterprise architect for different clients.

a good discussion of what that really is/means. This task fell to the project team which "should be able to figure that out". After the project team had struggled with the issue for several months, it became apparent that this was not as easy as it seemed. A cursory root cause analysis showed that (1) there were too many disparate perspectives on the problem, (2) the language that stakeholders used to talk about the problem space varied greatly and (3) some politics were going on in the background as well. It was decided that a smaller group (three professionals) were to come up with a proposal for a definition of what an integral platform is, an ontological question, and a by-and-large overview of what it could look like for this organization – a practical question. Over a period of 3 weeks, we had three meetings (lasting 1.5–2 h each) where we carefully explored the problem area. Within this smaller group, we were able to strictly separate the two questions. The biggest hurdle was to standardize terminology, with questions such as "What is a process?", "What is a platform?" and "What does 'integral' mean?". With those questions answered, the onto-logical question was quickly resolved. We also managed to draft a rough outline of (the design of) what we think an integral platform should be and used that to align the views within the larger project team. The project is still on-going, but we can already conclude that a deliberate and brief design dialogue helped to align the views within our project team.

The notion of *enterprise design dialogue* also intends to reflect notions such as authoring "authoring of organizations" [40], as well as views from organizational design [41]. It also acknowledges the fact that an enterprise is certainly not a "machine" (in the sense of [42]) that can be "engineered" as such. In our view, a perspective on an enterprise as an "organism" or even a "learning system" (e.g. [43]) makes more sense, especially when dealing with continuous digital transformations. We do, however, assume that these dialogues result in some artefact that represents some abstraction of some aspect(s) of the design of the enterprise, i.e. an enterprise model in the broadest sense.

In dealing with the many levels and speeds of change that confront enterprises, it will become increasingly important for enterprises to be aware of all relevant activities and activities inside, and outside, the organizational boundaries. Even more, the different actors involved in/impacted by these changes need to (1) have an insight into the existing structures and operations of an enterprise; (2) be able to express, assess and evaluate different design options for their future; and (3) have instructions on how to make the necessary changes to these structures and operations and (4) how to operate in the future.

Mirroring the fact that digital transformation can occur in a top-down as well as a bottom-up fashion, *enterprise design dialogues* may occur bottom-up, but they may also take place as part of an orchestrated enterprise development/transformation process. In the latter case, one may explicitly develop a conversation strategy [44], spanning multiple design dialogues. As suggested in [44], the different steps (i.e. distinct design dialogues) involved in a conversation strategy can serve more specific goals with regard to "enterprise knowledge", such as *share* (or create) knowledge, *agree to* the shared knowledge and *commit* to the consequences actions resulting from the shared/created knowledge.

Figure 6.2 illustrates our way of thinking. First, note that stakeholders have transforma-tion goals (which may or may not conflict) with regard to a domain. In order to achieve
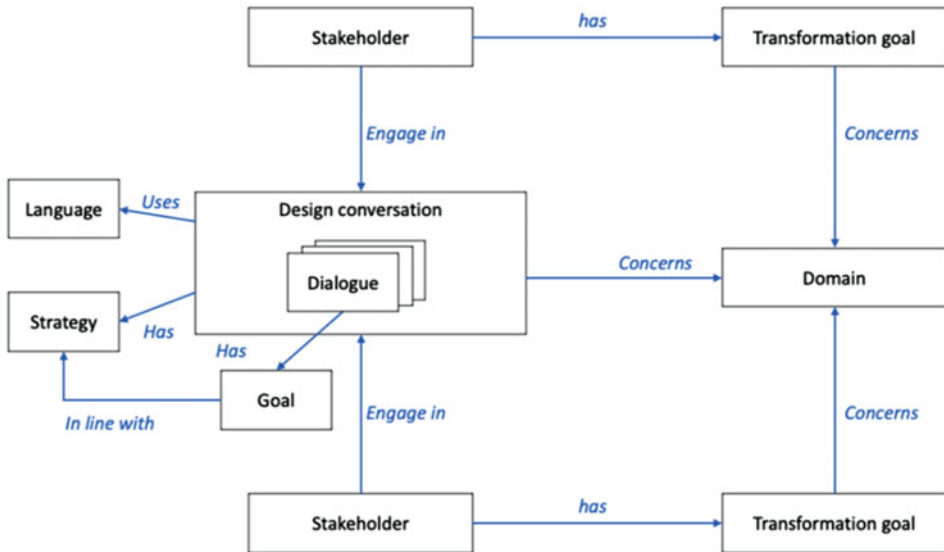
Fig. 6.2 Design conversation and dialogues

these goals, they engage in a design conversation. This conversation uses a (standardized) language and follows a strategy. As part of the conversation, they have different dialogues, each with a specific goal that is in line with the overall strategy. Based on our claim that digital transformation is a *deliberate* effort, we also claim that *design* is an activity that is part of digital transformation initiatives.

The Role of Models

Whenever we, as humans, have a need to (jointly) reason/reflect about some part of an existing/imagined domain, we essentially use models to express our understanding of this (part of the) domain [45], i.e. *domain models*. We take the view that such *domain models* have an important role to play in the design dialogues that shape an enterprise.

Based on the foundational work by, e.g. Apostel [46] and Stachowiak [47], more recent work on the same by different authors [48–51] as well as our own work [45, 52–57], we currently [58] understand a *domain model* to be:

> A social artifact that is acknowledged by a collective agent to represent an abstraction of some domain for a particular cognitive purpose.

With *domain*, we refer to "anything" that one can speak and/or reflect about, i.e. the domain of interest. As such, *domain* simply refers to "that what is being modelled". A model is seen as a *social artefact* in the sense that its role as a model should be recognizable by a

collective agent (e.g. people). The *collective agent* observes the domain by way of their senses and/or by way of (collective) self-reflection and, based on this, should acknowledge/accept the artefact as indeed being a model of the domain (for a given purpose). A model must always be created for some *cognitive purpose*, i.e. to express, specify, learn about or experience knowledge regarding the modelled domain. Finally, a model is the representation of an *abstraction*. This implies that, in line with the *cognitive purpose* of the model, some (if not most) "details" of the domain are consciously filtered out.

In the context of digital transformations, different aspects of an enterprise, including its structures, purpose, value proposition, business processes, stakeholder goals, information systems, etc., can be captured in terms of (interconnected) domain models. The latter also enables "cross-cutting" analysis [3, 59] across different aspects and perspectives.

Models pertaining to any aspect of an enterprise are, by definition, *enterprise models*. Enterprise models typically take the *form* of some "boxes-and-lines" diagram. As argued in, e.g. [60–62], enterprise models should also be understood from a broader perspective than mere "boxes-and-lines" diagrams. As such, domain models can, depending on the *purpose* at hand, take other forms as well, including text, mathematical specifications, games, animations, simulations and physical objects.

Enterprise models are traditionally regarded as an effective way to enable such informed coordination and decision-making. Just as senior management uses financial modelling to *enable* decision-making from a financial perspective, (enterprise) models covering the other aspects of an organization can be used to enable informed decision-making regarding the other aspects as well [36, 38, 63], as well as operational use in Digital Twin(s) and advanced rule-based systems (i.e. for tax law execution, [64, 65]). More generally, as suggested in [61, 66], high-level purposes for the creation of enterprise models include *understand* the current affairs on the enterprise, *assess* the current affairs, *diagnose* possible problems in the current affairs, (re-)*design* changes towards the future, *realize* such changes, provide guidance/direction for (human or digital) actors who *operate* in the enterprise and enable regulators to express regulations in order to *regulate* the activities of the enterprise.

More specifically, enterprise models potentially capture important enterprise knowledge [67]. This can, e.g. pertain to knowledge in relation to the well-known interrogatives (*why*, *who*, *whose*, *when*, *how*, *with*), be positioned in time (*as-was*, *as-is*, *as-planned*, *to-be*, etc.), be nuanced in terms of modalities (*must*, *ought*, *desired*, etc.), take a prescriptive or a descriptive perspective, etc. As a result, enterprise models can be used to support design dialogues and/or capture the results of design dialogues. Some concrete examples, across different objectives, would be:

- *Coherence of the enterprise*: Models can be used to capture different aspects of an enterprise, as well as their coherence. This was actually also one of the key drivers [68] in the development of the ArchiMate standard for enterprise (architecture) modelling.

- *Engagement of stakeholders*: Models can be used to capture requirements and/or regulations reflecting the needs from different stakeholders. They can also be used to express balanced compromises regarding the positive/negative impacts on the respective goals and concerns (security, regulatory compliance, environmental impact, flexibility, etc.) of stakeholders.
- *Evidence-enabled decision-making*: Models can be used to represent past and current design(s) of an enterprise, its desired future design as well as different options for its future design, all in relation to its (evolving) context. Such models enable among others (1) the analyses of the current, or future, affairs of the enterprise and its environment and (2) the evaluation of the potential impact of design decisions on (new) concerns or (3) assess the compliance of a design with regard to requirements or regulations.
- *General design knowledge*: Models can capture general design knowledge in terms of, e.g. construction theories, design patterns and reference designs (leading to reference models/architectures).

In line with the earlier discussed Cynefin framework, the potential role of models needs to be nuanced towards the specific domain in which the problem fits. For instance, if a problem can be classified as complicated, then the key properties of the problem (and its potential solution) can easily be caught in a model, which – in such a setting – has the interpretation of a simplified (yet relevant) version of reality. In the case of a problem that is classified as complex, models may still be used, but in a more humble role as hypothesis to decide about potential action. In the latter case, the emphasis is on *probing* the organization and *evaluating* results – something that is often referred to as *situational awareness* [32, 33].

Challenges and Opportunities

In this section, we will discuss the challenges and opportunities related to (the use of) design dialogues (as part of modelling initiatives) for digital transformation. We will first discuss the challenges – roughly following the line of reasoning in this chapter – and then the opportunities.

We started this chapter with our definition of digital transformation. This definition, loosely, boils down to changing the *core* of the enterprise with a significant impact on the digital capabilities of the enterprise. To see where the main challenge lies, from this perspective, one has to realize that the organization has been shaped – deliberately or not – the way it is for a reason. We can assume that the designer (i.e. management) of the organization made decisions in the past with the future of the enterprise in mind. The enterprise is the way it is because stakeholders have made their decisions with a bright future in mind, and now we are about to change that. Worse, we are about to embark on a digital transformation journey with uncertain outcome *with the doors open*: we still have to perform the main functions of the enterprise. The consequence is that there is a period of *fluid organization* – meaning parts of the enterprise conform to the old architecture and

parts conform to the new architecture. This is a sub-optimization and may hamper service levels towards customers.

We then argued that digital transformation efforts are *continuous* in nature, which appears to lead to many organizations adopting agile methods with shorter turn-around times to realize (initial version of) capabilities. The challenges related to this aspect are closely related to the previous point, for it entails that the enterprise is continually in flux. There is no such thing as moving from one stable situation to the next, as the transformation is a continuous, on-going process. The consequence is that, at any point in time, we do not have a full understanding of the enterprise. We only have a by-and-large understanding based on what we know of a past situation (which we can analyse because it is in the past) and our knowledge of the on-going transformation initiative(s). This means that, when we make a decision about transformation initiatives or their implications on the enterprise, we do so on an incomplete information position. We base our decisions on what we believe to be true, rather than on what we know to be true. In our view, this emphasizes once more that a thorough understanding of the architecture of the enterprise is crucial: the architecture will change/evolve slowly, whereas (implementation) details change more rapidly as a result of transformation initiatives. Models, of course, are a key enabler to mitigate the risks around this challenge, as they are intended to capture the shared understanding of what we believe to be true.

This brings us to the third point in this chapter: the need for coordination. As we have seen, the enterprise is in a constant state of flux, with uncertainty for all stakeholders involved. We believe that there is no such thing as "the" future of the enterprise that we are working towards: each of the stakeholders has their unique view of what the future should look like. From the perspective of attaining a bright future for the enterprise, the challenge is to align the views of stakeholders as much as possible which is the definition of coordination as used in this chapter. Based on our experience in the field (both authors are/have been active as consultants), we feel justified to conclude that this is rarely the case: in many organizations, stakeholders engage in politics to further their own agenda and maximize their own power/influence rather than achieving the best possible future as seen by the community at large within the enterprise. We should add that "decisive leadership" is sometimes useful or even necessary – but perhaps not at the level that we sometimes see.

As a small example, consider the tension that might occur between stakeholders with a more "risk-averse" mindset and with a more "innovation-driven" mindset. The former group of stakeholders may want to move cautiously from one semi-stable state to another, whereas the latter may desire a more bold approach, taking bigger steps to achieve success. When this tension is not (sufficiently) managed, then conflict/strive and sub-optimal results are bound to occur in the enterprise.

Solving this stakeholder puzzle is beyond the scope of this chapter. Yet, we do believe that models can aid in resolving these puzzles: they offer a focus to key discussion points as part of enterprise design dialogues.

The point of a dialogue is that stakeholders engage in thoughtful and purposeful conversation about the enterprise. This emphasizes the next challenge that is addressed

in this chapter: language. It is well-known that language – particularly getting a shared understanding of an utterance – is notoriously difficult (see, e.g. [69]). When shaping a digital transformation, seemingly small differences in the interpretation of important concepts may have large consequences. For example, take the notion of *causation* (*a* causes *b*). Someone with an engineering background is likely to have a more strict interpretation of what causation really means. When, in a design dialogue, it is claimed that *a* causes *b* and we know that *a* will be changed, then it may occur that one stakeholder logically infers that since *a* is no longer the case, it must be the case that *b* is also no longer the case, whereas the other stakeholder might have a more loose interpretation and conclude that *b* still could be (somewhat) the case. Worse, it may *appear* that these stakeholders are in agreement on some course of action, whereas in fact they are not (since the exact interpretation of their commitments is unclear). This is why we believe that design dialogues should be explicit and argue that the meaning of any key term must be clarified – and models are a good way to do so. We are aware that (a) this takes time and (b) this goes against what agile practitioners are accustomed to – yet we also argue that there is a potentially high "return on modelling effort" [58, 70].

Last but not least, there are challenges related to the notion of *models* and *modelling*. As noted, we see models as a social artefact; stakeholders should be able to examine it and assert whether the model (of a domain) can stand for that domain. We also observed that models are an *abstraction*: details that – according to the modeller(s) – are not relevant are left out. And here lies the challenge: how does one decide what is relevant and what is not? It may appear that this is a trivial choice made by the modeller(s). Yet, the work of Bjeković [71] shows that there is more to it than that: what is relevant is determined by the *goal* of the modeller. Going back to the previous points on design dialogues, we can see how the point on shared understanding of modelling objectives as well as key concepts "propagates": without the shared understanding, it is hard to decide *collectively* which details to include/ leave out.

This leaves the discussion of the opportunities that are to be reaped. In light of the overall theme of this book, we focus on AI-related opportunities and leave other opportunities for future research and exploration.

Recall that we spoke of digital transformation of an *enterprise*, which we defined as "unit of economic organization or activity". We also expressed that enterprises are *organized* in the sense that actors and other means of production (data, materials, etc.) are used to achieve specific outcomes. In AI-Enabled Enterprises, these actors come in the form of humanoids and AIs which interact to create value. We have noted that, in terms of the Cynefin framework, digital transformations tend to belong to the *complex domain* which implies that no a priori full understanding of that domain can be obtained. This is where an opportunity for AIs comes in: correctly trained AIs may be able to take over a large part of the modelling effort (particularly the "complicated part") so that human modellers can focus on the truly complex parts.

As an illustration, consider software bots that can "crawl" a network to discover application interfaces (see, e.g. [72]) or mine data to discover how processes work (see,

e.g. [73]). This type of bots exists for other domains as well. It seems safe to assume that in the foreseeable future, bots can be trained to not only discover/mine for processes but also to connect them to form a (detailed) model of the "things that exist" as well as "how they are related". Perhaps the ability to create "useful abstractions" is a bit far-fetched, but it seems only a matter of time before we are able to achieve such results. This would be of tremendous help for human actors attempting to build up an understanding of the existing enterprise as well as shape a future enterprise: it takes away the burden of having to do a lot of background research.

This brings us to the second opportunity. Recent advances in *chat bots* and related technologies (e.g. [74]) show that meaningful conversations with an AI are available in specific domains. Anyone who has tried to talk their way to an AI over a phone line attempting to resolve business issues is probably well aware that the technology is not yet perfect. Let us assume that the domain we are applying this type of technology to is the domain of digital transformation initiatives. In this case, the AI could be a meaningful and valuable partner that would assist us in creating models with likely future state scenarios and assess impact in terms of digital transformation initiatives [20]. Given the big computational power that an AI has, it should be able to run scenarios and apply heuristics to test which scenarios are most feasible. While useful, we do expect that human judgment remains imperative – even with a well-trained AI (e.g. to ensure that there are no issues around bias/ethics, something we do not expect an AI to resolve for itself).

Conclusion

This chapter started with the observation that the transformation of enterprises towards *AI-Enabled Enterprises* is a logical next phase in the continuous flow of digital transformations which enterprises are (and need to be) engaged in. In line with this, this chapter zoomed in on both the challenges facing enterprises regarding digital transformations in general and the transition to AI-Enabled Enterprises in particular.

In doing so, we argued that digital transformation should be seen as a continuous process while also needing coordination among many different involved stakeholders and activities, as such resulting in *coordinated continuous digital transformation*. We then positioned *enterprise design dialogues* as being at the heart of the needed coordination of transformations while then also positioning enterprise models as a key artefact in support of enterprise design dialogues. Finally, we reviewed some of the challenges and opportunities towards future research.

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