Digital Twins of an Organization for Enterprise Modeling*

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Abstract. Today's dynamic business environment requires enterprises to be agile in order to remain competitive. Competition also impacts enterprise modeling (EM) aiming at the systematic development of the enterprise's business processes, organizational structures, and information systems. Although EM is a mature discipline, organizations still do not exploit the full potential of EM. We suggest, the concept of a Digital Twin of an Organization (DTO) provides a means of digitalization to introduce more agility. A DTO draws upon graph-based, machine readable knowledge representation of enterprise models. In order to run through various scenarios in real time, the DTO approach makes use of Context Spaces that provide the required information semantically structured, which improves the comprehensibility and applicability of the used models. The DTO combines EM with operational reality and, thus, increases the agility of the enterprise.

Keywords: Digital Twin of an Organization · Enterprise Modeling · Process Context · Context Spaces.

1 Introduction

To survive in the long term in a globalized and digital economy, it is essential for organizations to continuously adapt to their environment. A prerequisite for successful transformation is organizational agility. Being agile means to react proactively and flexibly to new demands. Agile organizations have structures that enable them to adapt to changing market conditions within a short period of time. This can be achieved by redesigning organizational structures and processes, for example, to adapt the core competencies or to strengthen customer

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and supplier relationships. Changes within the company that are not under control result in a multitude of heterogeneous, incompatible, and costly impacts on business processes, organizational structures, and business information systems.

A prerequisite for transformation is a common understanding of the elements of an organization and how they relate to each other. Enterprise modeling (EM) as a discipline provides the concepts to comprehensively describe the elements and relations of an organization, such as processes, applications, and structures. Enterprise models are used to understand and analyze an organization with the goal to improve its performance by representing the current and target architecture. This target architecture guides and assists the organization to process change. Over the past decades various modeling approaches have developed. This can be seen in the huge body of knowledge that addresses various aspects differing in goals, scope, and granularity.

Overall, EM can be regarded as a mature discipline that provides the necessary concepts to represent an organization. However, there is a gap between the approaches provided by the EM community and how models are used in organizations. The large-scale adoption of the modeling approach still fails in practice and many organizations do not exploit the potential of models. Organizational actors are often not willing to create and maintain enterprise models and do not fully utilize the models. EM is considered as a discipline that is mainly valued by enterprise architects and IT people. Since organizations do not regard it as mission critical, EM has not yet reached its maximum potential [37].

In today's dynamic business world, there is a need for real-time information that provides organizations with direct added value. It is important for organizations to grasp their current situation and to react accordingly, for example, making the right decisions at the right time. However, such an ability enables organizations to adapt quickly and take advantage of existing business opportunities [35]. Organizations need means that go beyond the established paradigms and exploit the full potential of enterprise modeling. They need more dynamic representations of organizational elements, which reflect changes in the organization immediately.

We think, Gartner's proposal of the concept of Digital Twin of an Organization (DTO) addresses the above-mentioned challenges. The DTO concept enhances that of the established "digital twin", which is mainly used in the context of the Internet of Things (IoT) [24,7]. The concept is now so successful that Gartner has claimed that digital twins will enter mainstream use and "over two-thirds of companies that have implemented IoT will have deployed at least one digital twin in production" [3]. In any case, the concept of the DTO opens up new opportunities of digitalization to enterprise architecture.

In this paper, we will investigate the reasons for this optimism and what makes the DTO concept so promising. We will give an impression of what a DTO could look like and how it could work. The paper is organized as follows: Section two introduces the digital twin approach. Section three conceptualizes the idea of the Digital Twin of an Organization using Context Spaces. Section four introduces a construction process use case to show how a DTO can support an organization in practice. Section five discusses the role of and interplay with enterprise models that helps us to draw some conclusions with respect to the implementation of the DTO. In Section six we summarize the findings and point to future research.

2 The Digital Twin Approach

In 2002, Michael Grieves introduced the digital twin in manufacturing as a virtual representation or dynamic model of a physical system [15]. One of its first and most prominent fields of employment was the application to satellites; digital twins were used to control satellites once they were launched into space and no longer physically accessible [39]. Among other uses, applications of digital twins include the design of new products, simulations that give early warnings of malfunctions, or the provision of further service offerings.

The architecture of digital twins has undergone a significant evolution. Today, we can assume a 5-layer architecture of digital twins starting from the physical objects. They comprise (1) a *Data Layer* collecting the data available from these objects, (2) a *Data Processing Layer* for sensemaking of the data, which is based on (3) the *Models & Algorithms Layer*, (4) an *Analytic Layer* for further analysis of data and (5) a *User Interface Layer*, which finally provides a comprehensive user interface to the digital twin [5]. These layers are innervated by a bidirectional data flow between the physical object, which produces observation data in real time, and its representation used to send control data in the opposite direction. Digital twins are not only real-time representations but also enrich objects with additional information based on instant analysis. This holistic, comprehensible, up-to-date, and enriched view of the physical object makes the digital twin so unique [31] and in use autonomous and flexible [36].

Based on the success of digital twins in manufacturing, Gartner [24,7] has extended the idea to processes and entire organizations, launching the concept of DTO. Following the model of the digital twin from manufacturing, the DTO serves as unique point of data reference for each process, providing a comprehensive real-time picture and basis for process simulation [28]. Regarding the DTO's architecture we can refer to their siblings from manufacturing and employ the same 5-layer architecture. Herein, human (and system) activities organized in processes replace the dynamics of physical objects. In the same way as sensors of physical objects produce data streams, these activities leave traces of data in information systems (IS) that fuel the DTO. Process mining is playing a prominent role in animating DTOs [24]. Based on the resulting extended understanding of processes, several possible applications of DTOs have been presented: Kerremans suggested the use of DTOs for linking strategy to operations or focusing on business change and digital transformation [24] while others see DTOs as a new tool for knowledge management [23] to mention but a few.

3 Conceptualizing the Digital Twin of an Organization

Digital twins in manufacturing (DTMs) resemble DTOs in many ways. For example, we can directly transfer the 5-layer-architecture of the DTM to the DTO. However, there are also differences. While a DTM is fed by sensor data of the physical object, which has a clear boundary, processes are more diffuse so that it is less obvious which data have to be included. The most obvious solution is the use of data from corporate IS with process mining as an appropriate means of restoring process information [24]. However, there are some problems with this approach. First, the often complex contextual information of human activities is largely lost in IS, since it only serves the specific purpose of the respective application (e.g., financial accounting) that does not require most of the work context. Here it is important that the work context is often responsible for deviations from the planned procedure. Therefore, putting the isolated pieces from IS back together, is one of the essential challenges for process mining. Second, the DTO is not only a recipient of data but conceptualized as an active operational tool that makes it possible to build, use and save work contexts (and the often heterogeneous data generated in it). Third, while the spacial proximity of parts provides a suitable guideline how to navigate through a DTM, the question of proximity and relation in a DTO is more complex. For example, there is a proximity in time difference of use but also a proximity in reference. All these aspects give the User Interface Layer of the DTO a prominent role.

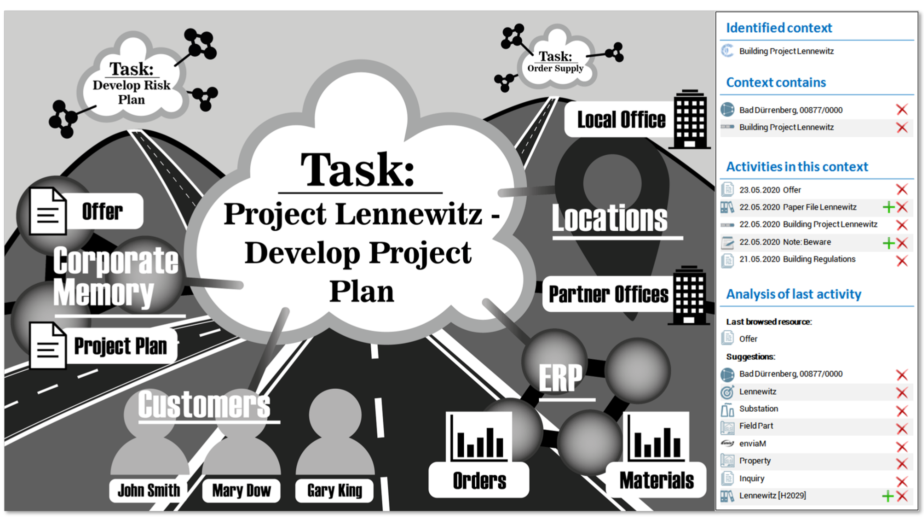

Fig. 1. Vision of a holistic view on a DTO with the cSpaces sidebar providing contextual information from the corporate memory as well as assistance for the resources of a DTO.

A central question is which design approach is most suitable for the DTO's User Interface Layer. Usual visualizations of processes resemble road maps that lead from one task to another. Therefore, it seems obvious to use a geographic visualization schema [11] as a starting point to create an intuitive image of the process. Fig. 1 depicts our vision of an adequate visualization of a DTO; it shows a corresponding design study. The graphic design indicates how tasks are related in the process model and displays the most significant work items related to them.

On the right-hand side, a context sidebar supplements the graphic illustration of the process and shows the work items from the graphic plus additional objects in an ordinary list view. The user interface provides a zoom-in navigation, which leads from the depicted process overview to a representation that shows more semantic relations between work items. Table 1 describes this transition in the DTO visualization.

Table 1. Overview of the levels of visualization in DTOs.

Level of Visualization	**Displayed Entities**	**Displayed Relations**
1st level	Focus on process tasks and most relevant objects attached	Relations between process tasks with attached objects
2nd level	Focus on one process task only, related objects come to the fore	Semantic relations between objects only
3rd level	Focus on related object groups with tasks attached	Semantic relationships between objects plus respective tasks

On the 1st level, users get an overview of the process they are working on. Focusing on one task and zooming in, work items of the focus task—these include persons and other objects—become visible while the non-focal tasks vanish in the background. Further zooming in makes the non-focal tasks disappear completely and brings more in-depth context information to the fore. Here we focus completely on the semantic relations between work items (2nd level). Finally, even the focal task disappears and only the work items and their relations remain visible; the name of the focal task may be shown in the headline. At this point tasks reappear, however, this time attached to the work items (3rd level). Which objects appear may depend on the strength of their relations or the recency of their use. The representation may also be used for navigation through the process in time, showing which work items were used in which order.

To establish relations between the different work items used in the task we suggest the use of Context Spaces (cSpaces) [21]. They allow identifying, deriving and explicating contextual information from users' daily work and keep exactly the contextual information that otherwise would get lost as well as provide context-specific assistance. We apply a twofold approach (see also Fig. 2): first, a corporate memory [1] infrastructure introduces a *Knowledge Description Layer* with ontologies—covering personal and organizational work items

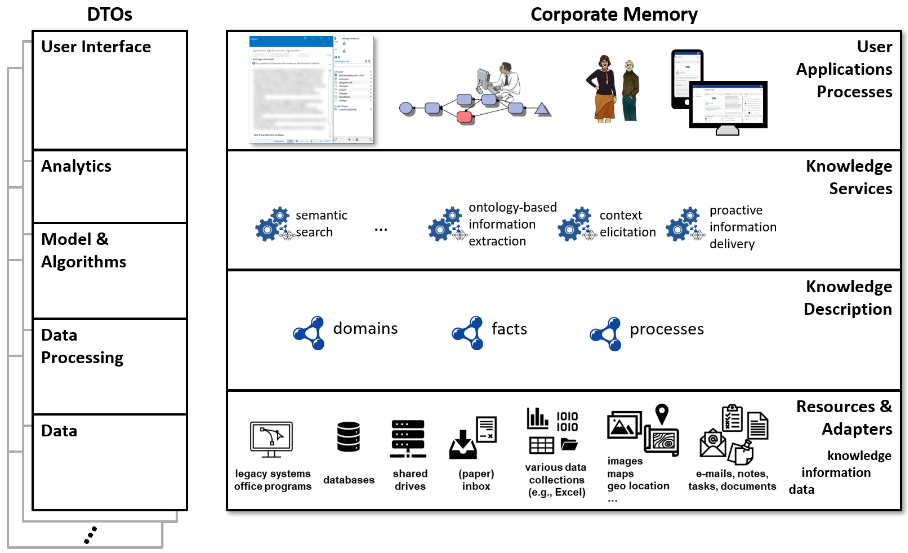

Fig. 2. Comparing DTO & Corporate Memory architectures. The layers of DTO and Corporate Memory are largely corresponding.

[33]—and knowledge graphs representing data, information and knowledge leveraged from the *Resource Layer*. This is realized by *Adapters* that semantify and represent resources to be machine understandable (e.g., [38]) and make them available to knowledge services in the *Knowledge Services Layer*. These services can be used in the *User Interface Layer* (e.g., to analyze an incoming e-mail) and derive entities from the knowledge graphs [22], proactively providing context information to users [2,25]. This approach is based on the corporate memory infrastructure CoMem[5] which started as a research prototype [29] but is now matured in several projects and used as a pilot at a German energy provider[6]

Second, to be embedded in the user's working environment and daily work, we use a Semantic Desktop that provides a system of plug-ins extending office programs (such as e-mail and chat tools or web browsers) as well as the file system. Personal knowledge graphs represent the user's mental model and interlink with the knowledge graphs from the organization [29]. To support the user, cSpaces provides an assistant sidebar (as depicted in Fig. 1 on the right-hand side), which shows relevant information retrieved from repositories or belonging to the current context (e.g., a selected e-mail in an office program) [20]. This integration allows cSpaces to derive, build and formalize contexts that the DTO can use for authentic representation of process tasks supporting users' daily work.

[5] `https://comem.ai`

[6] `https://www.plattform-lernende-systeme.de/map-on-ai-map.html` search for company 'envia' [10]

Information used during task execution is crucial for process sensemaking; it appears in cSpaces but is usually inaccessible for business information systems. Thus, cSpaces provides detailed insight of execution and information use, necessary for realistic process models in EM. Likewise, the approach improves the effectiveness of Business Process Management [34]. This is crucial since we expect that the importance of precisely these unstructured processes will increase in the future due to advancing digitalization.

The demands for flexibility to solve knowledge-intensive tasks or malicious problems [8] as well as the consideration of the working context are also part of the requirements for case management. Here, personalization, context and intelligent assistance for knowledge work are likewise seen as a research challenge [30]. In earlier work we proposed weakly-structured workflows [12] as a means to combine knowledge work, workflows within corporate memories to derive task know-how on the Semantic Desktop for process know-how re-use [19], as well as the use of data mining and clustering for identifying hidden process patterns as means of process-related knowledge maturing [6].

Another question is how the representation in the DTO can give users a holistic view of the process. The DTO must show users the business process dynamics without overwhelming them with an excess of information. An obstacle in this respect is the opaqueness of the business process concept [27,43]. Following Davenport [9], a "process is thus a specific ordering of work activities across time and place, with a beginning, an end, and clearly identified inputs and outputs: a structure for action." Here, key elements of a process, which a DTO should incorporate, are: *(work) activities* performed by *actors*, *inputs*, *outputs*, *times and places*. These features are grouped in *individual instances* started by a *trigger* and oriented toward certain *customers* as beneficiaries. The key feature that distinguishes the DTO from a business process model is the evolution of the respective entities in time and space. Once triggered, a business process instance is characterized by a *state* that consists of *employees* engaged in one or more *activities* associated with running processes. During execution, processes consume or produce *resources*, which can be *material objects* such as tools or *information items* such as data in IS or other repositories. Information items are semantically related to each other and only temporarily present to the users. This presence is to be reflected in the DTO and it must be clear which person used which resource and information at which time.

To make sense of this multitude of data, the DTO may use various kinds of enterprise models. The idea of a digital twin suggests keeping the model space as open as possible since it can change which models are actually required. Thus, EM assumes a new role in making sense of data. Due to the variability of process executions, we expect that a small but significant amount of data does not fit to the models. Here, the additional open semantic knowledge space of cSpaces is required.

Last but not least it should be mentioned that a DTO is not a replacement for traditional business information systems. These IS serve the purpose of supporting standardized sequences of work steps as efficiently as possible. To this end, they often implicitly fix the business process to a considerable degree. This works well as long as the incorporated process models mainly reflect the way processes are executed. This is the case in most process instances. In a smaller number of cases (or certain situations), it may be necessary to deviate from the standard process model. This means that the process leaves the zone of efficiency. Deviations are usually bought at the price of a significant delay and additional costs. We can refer here to an inverted Pareto principle saying that the 20% of deviations in process execution—the non-mainstream part—are likely to cause 80% of the costs. Nevertheless, the standard approach works well as long as we can limit the deviations to a small part of the process.

4 Use Case: Construction Process

In the following, we consider the example of a small to medium-sized construction project including third parties, such as craftspeople who serve as subcontractors. These projects are long-term processes with mainly consistent phases such as inception, design and construction, where notably the latter is split into various stages. Despite the clearly structured main process, construction projects are always unique in their composition; there are various exceptional situations during implementation that must be solved on the site and are often time-critical.

The process phases are characterized by a variety of services, each of which generates data of the most different forms. These include, for example, data about clients and partners as well as project data from calculations, planning, purchases, equipment, materials, and the actual execution. These data (including documents) are stored in various function-related information systems, for example, financial data and invoices in ERP systems, customer information in CRM systems and building specifications in CAD systems. However, various process participants also organize their daily work with additional resources which are not always covered by the existing IS such as documents, notes, webpages, or e-mails. It is therefore difficult to get a uniform impression of the whole construction process. It is the goal of the DTO to collect these different sources of information in one information object and to make them accessible to the people involved in the construction process at any time. This does not only refer to the employees of the construction company but also to the other parties with suitably configured views.

In order to fulfill this task, a DTO should support the work of the people in the project with components such as corporate memory, knowledge graphs (individual, organizational, procedural) and knowledge-based services, or work environment-integrated sensor technology & assistance (such as the Semantic Desktop and cSpaces). Hence, the corporate memory infrastructure taps into the legacy systems and represents the data with knowledge graphs allowing for a comprehensive view for the DTO. Due to its open *Data Layer* the DTO can take up more information than all individual information systems that only assume data related to their functions. Therefore, the DTO “knows” more about the construction process than all corporate systems together.

During construction, the process participants must deal with a lot of continuously changing data from different sources including those of partners. This includes documents such as delivery notes up to status messages received by phone or provided in unusual formats. cSpaces is an assistant to people which incorporates their information objects while working on their tasks. In their most basic form, cSpaces are collections that simply represent related information elements. They may evolve from a nucleus, e.g. a task, an event, a document a person has been working on, or more domain-specific items such as a support ticket arriving at the workspace of a clerk. When problems arise, external sources also provide valuable information for construction projects, such as addresses of local companies for unexpectedly arising orders such as repairs. The data can be available both electronically and in paper form. Smartphone apps may be used to take pictures of damage discovered by accident and forward them to other parties involved. Service providers may work in different inventory systems than the construction company or even use propriety software that cannot be easily processed. Although each individual problem can usually be tackled, it can ultimately lead to a situation where involved people, particularly on the construction site, lose the overview. The individual contributions captured in cSpaces increases the DTO's information density that is now able to provide an in-depth view involving the work done and used information objects from the "outside" information space, which are not covered by internal business IS.

We recognize the characteristics of weakly structured processes (see e.g., [19,34]) here. While the basic phases are mainly clear, the individual execution of every phase in each construction project can vary considerably. The occurrence of errors or planning inconsistencies usually leads to significant delays and increasing costs. To eliminate the errors, it is often necessary to significantly deviate from the predetermined process plan. Errors require additional activities, the involvement of new partners or even the involvement of the customers. In the DTO, these additional measures are recorded and their consequences for the overall process can be reviewed, for example, the impact on the schedule. The simulation property of the DTO is decisive when it comes to the prediction of consequences. Despite all deviation, the general objective will always be to return to the mainstream process and to continue other parallel activities as undisturbed as possible. In some cases, incidents can open new opportunities, for example, when a delayed timetable creates time margins elsewhere, or if customers accept deviations from the plan and take advantage of them.

From a company's strategic perspective, it is important that the management always has an up-to-date overview of all ongoing construction processes via the DTO. It is important for the accurate description of processes that process data are not extracted from information systems and reassembled to reconstruct the process execution, but that it is derived from real-time data via the DTO (see the example in Fig. 1). The awareness of deviations increases the quality of the process description and allows an efficient monitoring of all running construction processes as well as a timely control of each individual case. Analysis of deviations is important to the enterprise, for example: At which points do deviations occur most frequently? How well is the company prepared for this? What are the costs involved? How did the customers react to this? To check the quality of a process and the information systems supporting it, it is necessary to understand why deviations occurred and how they were handled. From the perspective of EM, individual circumstances are less relevant than systemic causes of deviation, for example misunderstandings due to the poor performance of information systems in communicating with partners or customers.

5 Digital Twins of the Organization and Enterprise Modeling

Enterprise models provide a multifaceted view of the organizational landscape forming the basis for the corporate memory infrastructure. There is a broad spectrum of semantics that support enterprise modeling. It ranges from modeling languages to formalized ontologies [41]. Exploiting the potential of a DTO requires a explicit specification of a conceptualization of the domain (ontologies; [17]) expressed in machine understandable models. Ontologies provide a formal language to represent the structure of a domain and allow combining data from different sources. Several approaches were suggested to describe enterprise ontologies, for example, TOVE (Toronto Virtual Enterprise) [14], the Enterprise Ontology [42] or the Context-Based Enterprise Ontology [26]. Besides enterprise ontologies, there are modeling languages that focus rather on the modeling aspect of the enterprise. Common modeling languages for describing organizational contexts are the enterprise architecture modeling language Archimate or the Business Process Model and Notation. Archimate provides a holistic view on the enterprise and allows modeling all layers from the strategy to the physical layer, BPMN focuses on the details of business process. These languages are based on practical experience and have proven to be effective.

However, Archimate and BPMN do not provide formalized ontologies, but a graphical notation including the conceptual description of the elements and its relationships. Therefore, a graph-based representation of the concepts and relations of these languages is required. Here existing ontologies could be reused, such as Archimeo, which is a standardized enterprise ontology which includes the Archimate and BPMN conceptual model [18].

In general, we expect the following benefits from DTOs for EM:

1. Due to a continuous flow of data, the DTO shows the *real-time performance* of its actual counterpart.
2. Due to incorporating an EM, the DTO becomes itself a *dynamic model*.
3. Combining the previous two points, the DTO should serve as a *conceptual and operational link* between EM and the actual process, that is, it shows how the entities described in the models behave in reality.
4. Collecting data of past behavior, the DTO enables *simulations and predictions* of future process behavior under changed conditions.

5. Last but not least, connecting to users' actual work, the DTO can provide a *comprehensive view and sensemaking* on all involved information sources, legacy systems and actually used information objects.

With a growing number of DTO-enabled processes, we expect the representation of the enterprise to become more and more complete to finally provide the same holistic view that now we get from EM. A DTO could not only show consequences of process deviations but also the resilience of the process against disturbances. Hereby, it may help us to learn how to improve processes and show which information from which IS is required to achieve such improvement. This is not restricted to internal information but can include an increasing degree of information from customers, partners and public sources. In contrast to an IS, a DTO digests new information sources more suitably—a precondition for increasing process effectiveness—and does not primarily focus on process efficiency. The latter requires well-tuned interfaces provided by IS. The DTO is expected to provide information to enterprise architects, who plan the development of the IT landscape in the enterprise. This would allow them to identify those process aspects that significantly decrease the efficiency and to think about alternatives how IS may better support the processes. Thus, information from the DTO helps to judge whether and where IS require adaptation.

With the rich context (such as semantically represented information objects, user interactions, concepts from knowledge graphs, their interrelations and relevancy) provided by cSpaces, the DTO can provide novel measures and services. The identification of similarities between contexts or anomalies within contexts will give a deeper insight into the process and its instances, instantaneously at any time. It can also give a more precise base for prediction and simulation. It is also worth noting that cSpaces are well-suited to adjust model granularity: (1) they are typically used as a hierarchy like a tree or a direct acyclic graph allowing for abstraction or gathering additional details when needed and (2) their information feed of observed user activities may be increased or reduced (by adding or removing sensors) according to given requirements.

A DTO may not only show how efficient the existing enterprise architecture is but also how resilient to internal or external disturbance: How well can the IS landscape deal with such disturbance? A DTO simulating certain scenarios gives an answer. However, process mining does not help us to immediately reconfigure process instances. This requires an environment that is both process-aware and open to change. Moreover, this presence of a process instance allows us to introduce reconfiguration in individual process instances, based on the idea of value chain reconfiguration [32]. With a DTO we would have a reconfiguration already on the level of individual process instances. To explain this, imagine the case of the construction process. It is not unusual that mistakes occur which enforce the construction team to rethink their entire process. Of course, it would be possible to simply undo the mistake but usually this is too expensive and would often disturb the timing of the whole process. What makes the situation different from changes in project management is that the case cannot be handled individually. The situation requires a temporary process reconfiguration with the aim of reintegration into the standard process. Thus, any reconfiguration must be considered against the background of the process as a whole. Reconfiguration can mean that new parties must be involved and possible solutions to fix mistakes must be checked in terms of their consequences for the process. We can do this on the basis of a process representation allowing for simulation and prediction. A DTO is exactly that.

To be agile, an organization must quickly perceive changes in its environment. A DTO is expected to do this because relevant changes will become apparent in the interaction with customers and partners during process execution, that is in cSpaces, even if they are not reflected in the rather inflexible business information systems. In this way, changes also become appreciable to the DTO and can be analyzed by managers and enterprise architects. Agility as successful adaptation is more likely if changes are tested before implementation. Due to the growing speed of change these tests must be performed rapidly and at low costs, in order to try as many scenarios as possible. This should be done by means of DTO. Thus, the DTO becomes a proper instrument for increasing an enterprise's agility.

6 Conclusions

Closing the gap between Enterprise Models and real-time business process execution is still a challenge [13]. Data and process mining may appear as a way to close the gap. They provide information about past work activities that have become manifest in event logs of business information and other systems. This information can be used to enhance enterprise models. However, the time that passes between execution and model adaptation is long and a considerable amount of context information gets lost. If we assume an accelerated demand for adaptation, as we observe it in the digital economy, such procedure may appear difficult even though process mining is already moving towards real-time processing [4].

A second drawback is a certain lack of a comprehensive picture of business processes as they actually take place. We may derive process deviations from event logs but often it is less obvious what caused them. Data is widely spread over various systems and may not yield a consistent picture. By the combination of abstract enterprise models and work context data from cSpaces we expect a continuous mutual update and a significant positive impact on both sides.

The trend leading from digital twins as object representations toward more process-oriented representations has become apparent due to the focus on including more dynamics [40]. By design, digital twins aim at closing the gap between static model descriptions and operational dynamics. As Grieves and Vickers described it, they show the differences between actual and imagined behavior indicating *undesirable behavior* or *inadequate models* [16]. Regarding the latter case, Fayoumi already referred to the role of future adaptive enterprise modeling platforms [13]. Moreover, we have to keep in mind that deviations often have a plausible cause: models do not meet the demands of the situation that people face in their work.

The DTO forms an intermediate between enterprise models and actual process execution. While EM represents the actual backbone of the organization, the DTO connects this backbone with the flow of activities, information and other resources in real-time. Thus, the DTO serves (at least) two purposes. On the one hand, it can inform an adaptive enterprise modeling platform about relevant mismatches between models and actual process execution and trigger model updates, on the other hand, it can streamline processes, making it easier for process executors to return to standard process paths after detours. This kind of interactiveness differentiates DTO from process mining.

Moreover, we expect that the use of data from external sources (e.g., customers' mobile apps) will more strongly influence process execution in the future. The data-providing applications may vary significantly and change frequently. DTOs may provide a suitable way to test the influence of including such data streams on a process before it is actually implemented.

While we have already gained significant experience with the architecture of digital twins from their applications in manufacturing, it is still an open question what an effective workable image of a process looks like. Process modeling methodologies give us a first insight but they lack all the details that belong to EM and real work contexts. The particular strength of the DTO consists in its holistic and comprehensible process representation that replaces the provision of various tables, graphs and dashboards. In this way it can prevent us from not seeing the forest for the trees. In this area, we see a priority for future research in developing suitable DTO representations that help process executors in their daily work and provide a basis for adaptive EM.

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