How to Measure the Speed of Enterprise IT? – An Enterprise Architecture-based Case Study in a Very Large Enterprise

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Abstract. In most enterprises, the speed at which information technology (IT) is delivered becomes increasingly important. Lately, many enterprises strive to increase the speed of IT delivery, e.g. through the establishment of a bimodal or fast IT. However, research and practice lack a grounded understanding of how this speed can be defined or measured. This paper advances the understanding of how to measure the speed of IT while also considering the interdependence with IT quality, resources, costs and business value of IT. We categorize the speed of enterprise IT according to the phases of plan, build and run. In our case study, we identified 10 activities to estimate and measure speed of enterprise IT in a very large enterprise based on expert interviews. We describe how the speed of enterprise can be measured in practice and identify factors that can speed up or slow down IT delivery. The findings identify options for increasing the speed through adapting the IT delivery in digital transformation (DT) projects as well though enterprise architecture management (EAM).

Keywords: Speed of Enterprise IT, Enterprise Architecture (EA), Digital Transformation, IT Delivery, Fast IT, Bimodal IT

1 Introduction

Technological and strategic decisions force organizations to change their value creation paths as part of their DT [1]. Changing these paths requires to acquire the needed expertise, to introduce new technological solutions and to improve business and IT processes with regard to the new or changed requirements and challenges. While DT encompasses significant changes in the technological domain, it also requires quickness and flexibility within the organization in order to recognize changes in requirements and to react to changes of customer and market demand in time. Organizations need to be agile in order to react to them promptly by further developing existing or innovating

new products and services [2]. Research confirms that enterprises that use DT to innovate business models and develop new IT products or services are destined to create new business units as fully agile structures [3].

For enabling this agility, the management of a company must redesign the IT organization in order to be able to implement changes quickly and flexibly while ensuring stability and effective provision of IT at the same time [2]. As a reaction to this challenge, many companies see the need of establishing a new "digital IT" (or "fast IT") unit or of shifting responsibility for IT systems to the business units to foster decentralized decision making. These changes should allow the business to be better informed, more flexible, and faster in adapting its IT as well as its IT-enabled services and products to market opportunities and customer needs [5]. Therefore, the introduction of agile practices and structures is required not only in IT, but also in the business units in order to increase the flexibility and speed of the entire organization [3].

Customer value becomes the focus of strategic and operational planning and development, both of business and IT [2]. As a result, strategies and plans are increasingly aligned with customer value [2]. In addition, more and more organizations are aligning their corporate structures along the value streams of their customers by adapting internal services, processes, and the underlying IT landscape. [2]. As digital products and services are inextricably linked to the underlying IT infrastructure, organizational agility depends on the agility of IT and the IT function [2]. However, IT departments are often neither structurally nor procedurally prepared to fulfill this new role [4].

To accelerate business and IT within the enterprise, the operational level is empowered to increasingly make (semi-) autonomous decisions, both business- and technology-related [2]. If companies establish a fast or bimodal IT as a part of their DT, they need to align this new IT with the existing IT and with the business. [5]. If they fail to react faster than their competitors, they risk losing their competitive advantage [5]. As technology change accelerates and new digital solutions emerge, many companies feel the pressure to perform a DT and to increase the speed of IT delivery [5].

A high degree of diversity in the goals and requirements of DT in projects and in the design of IT architectures and services influences business architecture and business IT alignment in multiple ways [6]. As EAM promises to support the alignment between IT and the business, it is required to purposefully accompany DT projects [7]. Additionally, EA aims to provide organizations with various benefits like improving organizational agility [8]. An increased organizational agility is an essential capability for organizations and a necessity to be able to respond and adapt to the rapidly changing environment [8]. Therefore, many organizations seek to leverage their EAM function to increase agility [9]. Previous studies [8], [9] based on the dynamic capabilities view explain how EAM investments lead to increased agility and how agility is promoted by strategic alignment. In this context, the EAM function holds a central role for supporting digital transformation in cross-functional issues for delivery teams and services [6].

Hence, our study addresses the following research question: *How do large enterprises measure the speed of enterprise IT by considering an EA perspective?*

This article is structured as follows. The following section summarizes the related research. The third section explains the research approach including the data gathering

and data analysis. The fourth section presents the results of our study. The final sections of this article comprise a discussion and a conclusion.

2 Related Research

The following sections describe the theoretical foundations of DT and enterprise IT, the role of fast IT and EA in supporting DT projects, and existing approaches for measuring the speed of enterprise IT.

2.1 Theoretical Foundations of DT and Enterprise IT

The understanding of DT in this study in grounded on Wessel et. al.'s study [10], which distinguishes between digital and IT-driven transformation. DT leverages digital technologies to (re)define an organization's value proposition, while IT-driven organizational transformation (ITOT) adopts digital technologies to support the value proposition [10]. DT is about creating a new organizational identity, while IT-driven organizational transformation is about improving an existing organizational identity [10].

In a conceptual sense, DT and ITOT can be divided into two types: First, into transformation activities for DT, where digital technology (re)defines the value proposition, and for ITOT, where digital technology supports the existing value proposition [10]. The result of DT is the emergence of a new organizational identity, while the result of ITOT is the emergence of a strengthened organizational identity [10].

Most of the digital technologies are not inherently revolutionary, but rather develop their innovative power through greater efficiency, significantly improved connectivity, and widespread adoption and use [4]. Legner et al. [11] describe the change in digitization in waves: The first the wave of technologies aims at the automation of work processes, the second wave focuses on the Internet as a global communication infrastructure, and finally the third wave is created by converging technologies with increasing computing power, storage capacity, and communication bandwidth.

The trend towards digitalization has increased the importance of IT due to its inherent focus on technology and increased the expectations towards IT functions in companies, making business activities not only more efficient but also inconceivable without IT [12]. Flexible and rapid adaptation of information systems is therefore of great importance in the digital age [12]. Based on experience with the development of corporate IT, it is not surprising that IT departments are often not optimally prepared for the challenges of DT [12].

To face the challenges of digitalization, the IT function needs to continuously transform and reorganize itself and adopt new forms of collaboration and integration with the business [12]. In this context, concepts such as cross-functional digital teams, IT innovation management and bimodal EAM can be seen as precursors of the 'new IT function', which is transforming IT from a service provider to a consultant, enabler and innovator [12]. The increasing importance of the IT function in DT raises questions about its effectiveness but also about how its speed can be measured.

2.2 Fast IT and EA as Support for DT Projects

Due to the fact that IT plays an important role in enabling the perceptiveness and responsiveness of organizations, IT is a key agility-enabling (or restricting) factor [15].

IT functions predominantly still follow the business by having the main task of providing IT services at high levels of stability, efficiency, and compliance as well as handling increasingly complex IT infrastructures in an effective way [2]. In many organizations, the IT function is still focused on efficiency and the provision of reliable, scalable and secure IT services [13]. Therefore, a new balance is needed between providing and maintaining (new) digital services [4], optimizing existing IT-enabled products, services and business models for customer needs, and securing the underlying IT architecture for optimal service delivery by the IT function [2].

This means that organizations must (1) decide on a desired form of the IT function and its integration into the overall organizational design, and (2) continuously assess the status quo and desired goal [2]. As a result, many companies have started to scale agile values and methods in their software and product development [2]. However, as the transformational journey towards agility affects the corporate way of how to do business at its core, agility involves (re)evaluating the organization as a whole – business and IT strategies, business models as well as organizational and IT structures, IT architectures, and methods [2]. Therefore, it is important to find ways to deal with change, speed and flexibility with their strategies and business models, organizational structures and business processes as well as IT infrastructure and IT architecture [2]. With bimodal IT functions, existing processes that encompass traditional and agile IT must also be reconsidered and changed, as otherwise there is a risk that traditional and agile IT will hinder each other [14].

Both IT and EA are seen as important factors in supporting DT projects regarding cost and technology decisions. For this reason, it makes sense to examine the role of IT not only in terms of cost savings, but also as an enabler of speed in supporting DT projects.

2.3 Measuring the Speed of Enterprise IT

To understand how enterprise IT speed is defined and how it can be measured, we conducted a systematic literature review (SLR) [16]. The review revealed, among other things, that there is no common understanding of speed of enterprise IT and of how it can be measured. The literature mentions several heterogeneous influences on the speed of enterprise IT, but its conceptualization is still weak [16]. However, from a practical point of view, measuring the speed of IT delivery in DT projects can bring several benefits in managing the various activities and measures [16]. We also identified the potential direct or indirect impact of these activities on enterprise IT and its speed. The results of the SLR showed that this research topic is largely unexplored and that a better understanding could support the collaboration and expectation management between the IT and business functions [16].

3 Research Approach

The following sections describe the research method, the data gathering process and the data analysis.

3.1 Research Method

To answer the research question, we conducted an explanatory, interpretive case study in a very large enterprise [17]. In the case study, we empirically investigated the phenomenon of "speed of enterprise IT" by exploring the details of this concept in practice. The selected very large enterprise is a prime candidate for such a study as it runs many DT projects and initiatives and also has a decade-long established EAM function. The enterprise has a high number of employees (more than 300.000), is technology-driven, has well-established IT processes and makes extensive use of standardized EA frameworks and agile methods in DT projects. The focus of the study is to understand the definition of the speed of enterprise IT and to investigate the measurement of the speed of enterprise's IT to support IT delivery.

3.2 Data Gathering: Qualitative Expert Interviews

We conducted 10 expert interviews with staff in different positions and working areas to develop a better understanding of the meaning of "speed of enterprise IT" and the challenges of measuring speed of enterprise IT. The qualitative expert interviews were developed, planned and conducted based on Kaiser's [19] data collection method. The interview guidelines were developed for experts in the fields of EA, DT projects as well as strategy. The interview guidelines were written as scripts for semi-structured interviews [18].

We created the interview guidelines for the experts in the work areas of EA, DT projects and strategy and adapted the questions according to the roles. The guidelines for people working in the areas of EA, DT projects and strategy contained qualitative questions on the speed of EA review of DT projects, on the reaction to EA changes, on the correct or incorrect IT delivery of DT projects, on the development of IT speed, on the role of IT complexity for IT speed, on the speed of IT architecture in relation to IT platforms, on ways to increase or decrease IT speed, on interactions between IT speed and IT architecture, on resources and their influence on IT speed in the company, on practical ways to measure IT speed in the company objectively or subjectively, and on the estimation of IT speed by the business units. We have supplemented the guidelines for DT projects and strategy with questions on the degree of automation of project management and the strategic relevance of speed in the implementation of DT projects. As planned, the interviews lasted an average of 60 minutes, some of them ten or fifteen minutes longer than planned, with 12 questions for the EA business unit experts and 14 questions for the project level experts and the EAM experts.

Experts were selected for voluntary interviews on the basis of their position, status, knowledge and experience. Other criteria for selecting experts were knowledge of relevant functions, ability to provide accurate information and availability for interview

[19]. The expert interviews were conducted in accordance with the principles of protection of personal data, informed consent, anonymity, integrity and objectivity. The interviews were conducted continuously during the fourth quarter of 2023. The interviews were fully transcribed and analyzed with the help of MaxQDA. For further analysis, directly identifying features such as interviewee names were replaced with function and position descriptions. For pseudonymization, respondents were assigned consecutive alphanumerical codes.

We selected the candidates for the interviews on the basis of working areas such as EA, DT project or strategy. To obtain relevant information and gain access to the functional knowledge of the experts, we also selected candidates with experience in one of the three areas of work DT projects, EA and strategy. Around 50 percent of the respondents deal with EA in their respective DT projects and business areas, a further 40 percent of the business experts work in the area of DT projects, and the remaining 10 percent of respondents are EAM managers. The interviewed experts have different positions and functions with regard to DT projects and EA. The experience of the interviewed experts related to project management and EA equates to several years of professional activity in their enterprise. Table 1 lists the experts' positions by alphanumeric code.

Table 1. Positions of the experts in the enterprise.

Expert	Position	Working area
E1	Enterprise and technical architect	EA
E2	Enterprise and technical architect	EA
E3	EA consultant	EA
E4	Enterprise and technical architect	EA
E5	Enterprise and technical architect	EA
E6	Project manager	DT project
E7	Project manager	DT project
E8	Product owner	DT project
E9	Product owner	DT project
E10	Enterprise architect	EAM

The experts working in the areas of project-related functional architecture, project management and EAM have shown particular interest in the findings of this case study, which relates to defining and measuring of speed in enterprises IT in order to measure their performance, improve the quality and timeliness of IT delivery and avoid time loss.

3.3 Data Analysis: Qualitative Content Analysis of the Expert Interviews

The general and basic information on IT processes in EA, IT delivery in DT projects and the company's EAM strategy, as well as the central EA tool, were taken from expert

interviews. Relevant information was derived from the expert interviews according to qualitative content analysis to Mayring [20]. From this amount of relevant information, findings and results were developed in the form of core statements and classified according to their significance for the importance of IT in the company. The core statements were compiled and categorized according to the areas of DT projects, EA, business and IT processes, degree of IT automation and strategy, as well as according to the measurement activities. The further subdivision of the core statements was based on the model of an IT organization in a company. In the core statements, we observed various activities in the conception and organization of IT. The observed activities were classified deductively as plan, build and run.

In a systematic process, we analyzed the key statements according to the information from the interviews in terms of source, area, description, reason, possible solution and evaluation. We further analyzed this information to measure the speed of enterprise IT. We categorized the information into activities, areas, factors that slow down or speed up IT, what to measure and how to measure, for measurement within the enterprise. In addition, the selected key statements were discussed with and verified by the EAM expert.

The identified key messages present new challenges or new questions that are relevant for measuring of speed in enterprise IT and IT delivery in the enterprise, and which activities can influence the speed of enterprise IT. The findings also show that the speed of enterprise IT is related to the context of quality, resources and cost, as well as to the business value of IT.

4 Results

We present the key findings from our case study in the form of a concept of the speed of enterprise IT, which will enable DT projects, IT department and the EAM function to work with a joint understanding for measuring the speed of enterprise and improving IT delivery.

Definition: Based on the findings of our study we propose that measuring the speed of enterprise IT cannot be done objectively but only subjectively. The speed can only be measured subjectively for two reasons: Firstly, different people may arrive at different measurements based on their experiences and expectations, and secondly, the measurement is subjective because subjectively defined plan values are used as a benchmark for evaluating the IT as ‘fast’ or ‘slow’. In certain contexts, the speed of enterprise IT can also be determined in relation to external reference values (benchmarks). If the realization of compliance requirements is not achieved by a certain deadline, it can be concluded that the IT was ‘too slow’ compared to this reference value. Where appropriate, the business strategy can also quantify certain targets as benchmarks in terms of lost business value, which can also have an impact on future IT value.

The measurement of the speed of enterprise IT is based on the subjective estimation by various stakeholders by judging on the difference between the expected delivery time in relation to reference values such as planned, target, expected and actual delivery time. This measurement can be grounded on one or more interactions with the IT

deliveries in plan, build and run. We consider the speed of enterprise IT in the context of factors such as the quality of IT, resource utilization, the cost of IT delivery and the potential benefits of enterprise IT. Speed must therefore be measured in relation to the available resources (high speed might require additional resources), the quality (high speed might lead to low quality) and the business value of IT (high speed might be required to realize business value).

The experts suggested measuring speed based on various data and information that can stem from different IT tools or other enterprise IT sources. In particular, data and values from IT or EA tools, process indicators, data-driven project documentation, customer reviews and survey tools are used as a source for objectively measuring the speed of enterprise IT. But the objective measurement of the speed of enterprise IT from these potential objective metrics is limited because the potential measures of experts are based on subjective benchmarks and subjective plan values. While one could measure that a project meets the expected delivery time of one year and is being perceived as "fast enough" by one person, another person could have the expectation that this project could be done within six months resulting in an evaluation as being "too slow". Another reason for the limited objectivity is that there is no uniform definition of the speed of enterprise IT (neither in the literature nor in the investigated company). Therefore, the subjective interpretation of the measurements is more important to people than the objective measurements.

For this reason, we divide the measurement of the speed of enterprise IT into two parts. One part is the subjective measurement of the speed of IT, and the second part consists of the sources of objective measures related to the speed of enterprise IT. Figure 1 shows a visual representation of the definition.

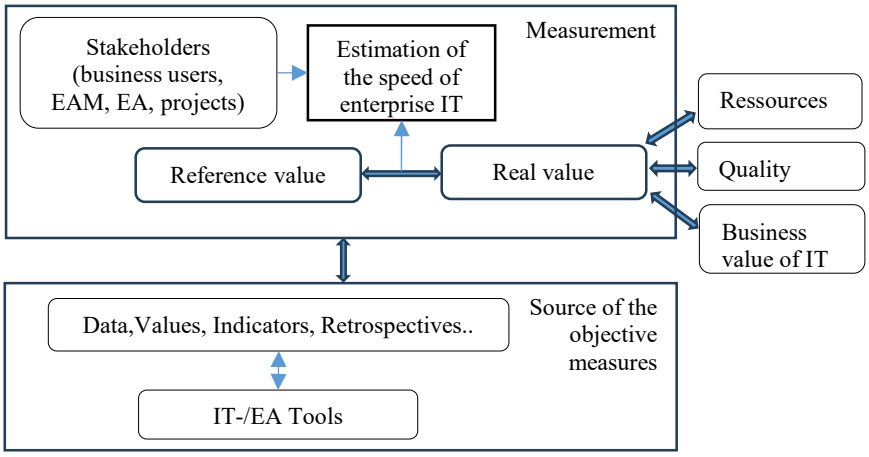

Fig. 1. The visual definition of the approach to measuring speed of enterprise IT.

Based on interviews with experts, we have developed a **definition for the speed of enterprise IT** focusing on the project perspective: We generally understand the speed

of enterprise IT to be the workload of a project divided by time. By the specific project-related speed of enterprise IT, we mean the correct deployment and delivery of IT according to defined time schedules based on planned resources while adhering to the target EA and otherwise constant conditions.

Regardless of the distinction between traditional and agile projects, all DT projects go through the following three modes: they are planned, they built solutions and they run systems and services. We refer to these modes as plan, build and run [21]. For plan, build and run, the speed of enterprise IT means something different. In general, speed of enterprise IT in plan mode is measured by the time it takes to plan a project or an IT product. In build mode, speed of enterprise IT is measured by the time it takes to develop, implement or improve IT. In run mode, speed of enterprise IT is measured by how fast the IT service processes (e.g. incident management, time-to-recovery, etc.) work. In a product-oriented organization, development and IT operations (DevOps) teams are formed to perform these tasks. Since all tasks in DevOps teams, especially in build and run mode, are performed by one team, the separation between plan, build and run IT should be understood as functional and not organizational.

Although it is not possible to measure speed of enterprise IT objectively, it is possible to measure the speed of enterprise IT subjectively in a regulatory and indicative way. For this approach, we were able to use the key findings to identify the potential activities that directly or indirectly affect the speed of enterprise IT. We extracted the measurement objects from the results as well as the reference and real values as indicators with corresponding sources to measure or estimate the speed of enterprise IT. In addition, we identified delay factors or speed-up factors for speed of enterprise IT. Figure 2 provides an overview of the approach to measure the speed of enterprise IT related to of the activities used to measure enterprise IT speed and in terms of the delay and speed-up factors.

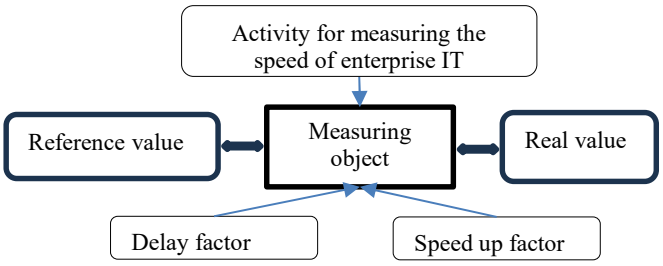

Fig. 2. Overview of the approach to measure the speed of enterprise IT.

We have identified the following 10 key activities for measuring the speed of enterprise IT (see Table 2). The activities are categorized according to the respective modes and working areas.

Table 2. Measuring activities by working area and mode.

No.	Working area	Activity	Mode
1	EA	Measure speed of enterprise IT through measuring IT complexity	Run
2	EA	Measure speed of enterprise IT through processing of the EA review	Plan
3	EA	Measure speed of enterprise IT through the specification and quality of requirements	Plan
4	EA	Measure time required to implement an IT requirement	Build
5	DT project	Measure speed of enterprise IT as a function of waiting times	Plan
6	DT project	Measure speed of enterprise IT based on the realization of IT delivery in projects	Build
7	DT project	Measure speed of enterprise IT based on speed on databases and technical resource consumption	Build
8	DT project	Measure speed of enterprise IT based on the quality of IT delivery	Build
9	Strategy	Measure speed of enterprise IT based on the complexity of strategy implementation of IT guidelines and architecture principles	Plan
10	Strategy	Measure delayed IT deliveries	Build

The activity **(1) measure speed of enterprise IT through measuring IT complexity** in run mode can be used to evaluate synchronous or asynchronous communication as a measure of coupling between systems and/or applications. The experts mentioned that the coupling of synchronous or asynchronous communication is an important reference value that is often seen as a response to functional requirements that lead to more or less coupling. The experts also explained that the speed of enterprise IT is negatively impaired by a highly complex application landscape.

Coupling refers to the degree of interdependence between software modules [22]. Coupling is used to measure the degree of interdependence between software modules [22]. High coupling indicates tightly coupled modules that affect each other as a result of changes [22]. Low coupling indicates independent modules, where changes in one module have little effect on other modules [22]. High coupling indicates higher complexity, says the expert. Due to the thousands of applications in large enterprises, a low degree of coupling enables faster changes of the related systems as fewer other systems are affected by the change.

Experts say that the focus of IT has traditionally been on applications. Applications support specific business functions. The applications are usually ordered by a department or are created indirectly and are usually delivered as departmental monoliths to support the department's employees in many roles. To support multiple business processes, multiple applications from different departments need to be integrated. The employees involved in the business process operate certain of the applications involved on a role-specific basis via the user interfaces of these applications.

When the IT support for a business process is changed, at least one application in such an IT landscape must be changed. In the case of the departmental monolith, this

means that a function or part of the user interface must be changed, but the technical dependencies of many other parts of the application must also be taken into account. This makes the change more difficult than if the application only contained parts that belong to the context of the change. Due to the size of the monolith and the dependencies, several teams usually must work closely together. This requires additional communication and coordination across team boundaries.

As reference values, the experts mentioned the number of interfaces between systems or applications, e.g. master data, personnel planning, bookings, complaints. These interfaces can be read out as real values both visually in system context diagrams in MS Visio, Enterprise Architect, draw.io tools and in text form in asset management tools. Other reference values are IT infrastructures that are to be designed as IT commodities and modular IT as a measure of elastic and faster IT with few redundancies. Factors such as rigid and non-modular IT, limited coupling and slow response to new business requirements delay IT responsiveness and contribute to IT complexity. Better control of IT complexity can be achieved through speed up factors, such as improving communication coupling, creating flexible IT in the sense of modularizing IT, providing the technical basis of the EA architecture as a scalable capability, developing small-scale IT infrastructures into IT commodities through EAM, using of automated IT, production-oriented IT, flexible EA as well as creating smaller IT.

To **(2) measure the speed of enterprise IT through processing of the EA review** in plan mode, the measurement objects such as the duration of the EA review in days, the quality assurance of the projects reviewed by EA, the duration of the inventory, the duration of the creation of the target EA and the gap analyses can be applied. The following reference values are used for assessing the speed: date of project receipt until the date of project approval, difference number of EA reviewed projects and rejected project proposal, date of contract approval to date of contract conclusion. The real values for this can be obtained from MS Project or the central EA tool. Factors such as the lack of automatic information capture for EA reviews, significantly increased IT security requirements, increasing demand for more EA support for analysis, manual data input and output in the central EA tool, no automatic review of EA principles and guard rails in EA reviews in projects delay the processing and speed of EA reviews. To improve the speed of the EA review, the experts mentioned speed up potential such as prioritizing the review of only critical requirements of the DT project to quickly deliver the first review results from the review, automatic creation of EA documentation using EA tools as well as the use of automatic EA templates for EA reviews in projects.

(3) Measuring the speed of enterprise IT through the specification and quality of requirements in plan mode is based on the understanding of IT requirements by developers, business engineers, EA architects and business experts. The error rate for incorrect requirements, the number of unclear requirements, the avoidance of time lost due to clarifications, the reduction in the number of changes such as change or new requests, the avoidance of IT false developments and additional costs were mentioned from experts as reference values. Corresponding real values from tools such as MS Project, JIRA and Enterprise Architect are used for comparison. The creation of specifications by customers as non-IT specialists rather than IT developers and the lack of functional requirements engineering from the outset, delay the creation of requirements

and degrade their quality, as implementation project specialists often do not understand the customer's requirements properly. A lack of standardization of requirement documentation also leads to case-by-case reviews and delays in project work. In order to improve the specification and quality of requirements, and to avoid additional time needed for clarification, the experts mentioned speed up factors such as creating requirements specifications with the help of the project's IT specialists, performing early specification of requirements, using standard solutions, specifying requirements using checklists, creating a back-end system to manage interactions between all partners in order to respond quickly to new requirements.

How long does it take until the requirement is in production? How much testing is required? Is test automation (TA) available as a basic requirement? These questions can be answered by **(4) measuring the time required to implement the IT requirement** in build mode. The experts suggested to take the following values as reference values in build mode: time of response to new requirements, means date of receipt of requirement until start of implementation, time span between date of processing and date of actual solution, scope and type of testing, frequency of delivery cycle, time to market. According to the interviews there are numerous real values in tools like MS Project, JIRA and ALM Explorer. Lack of test automation (TA), rigid delivery cycles, low delivery frequency, lack of transparency in the implementation of architecture and IT security requirements at department and IT service level, unclear requirements even in agile projects at the beginning of the project and a lack of standard solutions for requirements significantly delay the implementation of IT requirements. Experts call for more responsibility to be given to project managers or product owners to optimize release management. In addition, they recommend a flexible delivery cycle with a net release time of 2 weeks compared to a gross release time of 4 weeks. Two IT deliveries per day is a benchmark for flexible delivery. TA must be included in all deliveries and the TA should always be extensible.

Activity **(5) measure speed of enterprise IT as a function of waiting times** in plan mode is designed to answer questions such as: How long do approvals for personnel, funding and IT take? How long does it take for the introduction of new technologies to be approved? Waiting times and additional costs were named by experts as key reference values that need to be measured and reduced. Experts claim that the time in days for approval by the works council committee and the estimate of costs and lost benefits for the customer in MS Project can be used as real values for these reference values. Additionally, the experts cited long approval procedures for the introduction of new IT in the project as a delaying factor. By shifting approval decisions to DT projects and shortening long procedures, approvals for the introduction of new technologies, for personnel deployment and for financial decisions need to be accelerated, according to the experts.

Enterprises can **(6) measure speed of enterprise IT based on the realization of IT delivery in projects.** The realization rate of requirements and the delivered stories in agile IT projects compared to project costs, resources and quality can be measured in build mode. The experts suggest using the period from project start to project end, the resource consumption such as personnel costs in days and the costs per month or the number of completed stories per sprint as reference values. The experts can access

collecting the real values for this from JIRA, MS Project and retrospectives with customers. The main delay factors for delayed IT development mentioned by the experts are a lack of customer retrospectives and target/actual comparisons, long planning and review processes, too few resources, especially IT staff, lack of skills/competences, too much manual work in reviewing extensive approval bases and security requirements and no possibility of automatic review, lack of EA review of projects and delays in clarification. In addition, the highly complex management structure delays decisions and project meetings can be too complex. At the end of the project, top management can cause unexpected changes in IT delivery. The factors recommended by experts to speed up IT delivery are to conduct weekly or monthly retrospectives with the customer during IT delivery and at the end of the project. It is important to implement shorter cycles, work closely with the customer, create a minimum viable product, use an agile mindset for product testing with customers and bring the DevOps team into the tasks earlier. The interviewees recommend to transfer decision rights to the side with more knowledge and increase the power of the project manager and the DevOps team.

The activity **(7) measuring the speed of enterprise IT based on speed of databases and technical resource consumption** in build mode can compare resources in terms of costs and quantities between providers (hyperscalers like AWS, Azure, IBM Cloud) as measurement objects, according to the expert. As reference values, the experts suggest analyzing the information in the AWS and Azure accounts (quantity, licenses, etc.) and checking the invoices for product consumption on a monthly basis. To compare reference values with real values, invoices should be evaluated as real values for the product in order to check consumption and comparison and find favorable providers. Inefficient use of service resources and unused licenses and costs hinder and delay the use of technical resources in projects. Experts suggested increasing the transparency of the use and efficiency of hyperscalers databases, accelerating IT services, predicting the costs of software development and enabling the use of faster databases. The expert explained that technical resource consumption is of great importance when measuring the speed of enterprise IT, as the use of faster databases means that required data or relevant information can be searched for and found more easily and quickly, or customers' IT requirements can be met more quickly thanks to faster IT services.

Using the activity **(8) measure speed of enterprise IT based on the quality of IT delivery** in build mode, objects such as software components, modularization, time consumption, costs, functionality can be measured. Experts suggest to consider the extent of modularization of software components, time spent on software development, costs and functionality as reference values. As real comparative values for this, delivered software should be recorded and time and money contracts with the business units should be checked. As the main causes of delayed IT deliveries, the experts cite software monoliths, long and extensive projects, too few EA reviews of DT projects and customers' rough ideas and specifications regarding requirements. The experts suggest that the delivery of high quality IT can be improved by making software solutions more modular, by not delivering software monoliths and by organizing projects in smaller and shorter time frames. A balance should also be struck between time and quality.

The activity **(9) measure speed of enterprise IT based on the complexity of strategy implementation of IT guidelines and architecture principles** in plan mode can

be used to answer the following questions. How complex is the strategy? How long will it take to implement the strategy? How self-interested is the mindset of the business units? The number of planned activities, the implementation period and the mindset of the business units should be used as reference values. The real values for this can be collected with the central EA tool and the use of survey tools. The experts named the following as the main delaying factors: uncertain process for the functioning of the architectural principles, reworking of the EAM strategy, long agreement on the implementation of the strategy due to business units interests. In addition, local ways of thinking about the use of resources, budgets and personnel make strategy implementation more difficult. According to the experts, speed up factors such as executing the strategy more effectively, analyzing whether the strategy is being implemented too slowly or the activities are inappropriate, deriving the connection between activities and target achievement, aligning the strategy for IT technologically with the future and defining a strategic EA target for the next few years help to master the complexity of strategy implementation.

The activity **(10) measure delayed IT deliveries** in build mode is used to measure the loss of benefit due to a delayed IT delivery. Business value is selected as the measure object. The impact on the operational benefit of business units due to delayed IT deliveries can be applied as a reference value. Real values from the central EA tool, MS Project, retrospective with customers can be taken to compare the impact on the operational benefit. The delay factors are a lack of contract transparency and lost benefits due to delayed IT deliveries. By creating more transparency in contracts, delayed IT deliveries can be reduced, according to the experts.

5 Discussion

The presented results of our case study focus on developing a concept for measuring the speed of enterprise IT. An improved understanding can help to increase the speed while reducing time to market and to strategically leverage the effectiveness of IT in the enterprise.

In this case study, we have identified and described 10 specific activities which are employed in the case company for measuring and evaluating the speed of enterprise IT. The experts' responses summarized in this article describe in detail the measurement objects, the reference or real values, and the delay and speed up factors per activity. We also highlighted the role of different IT and EA tools for supporting these activities. These tools are specific to the 10 described activities and contain matching data, values or information, which are considered in the activities. With these 10 specific activities we advance research on measuring the speed of enterprise IT by providing a set of empirically grounded activities.

For example, if a change shortens the average time for an architecture review for DT projects while maintaining quality or deliberately accepting minor compromises in quality this change can increase the speed of IT in the plan mode. An increase in the speed of IT could also be achieved through additional staff or fewer review tasks. In the case of fewer review tasks, the quality of the EA review might be reduced. If a

project is delayed because the IT infrastructure takes a long time to deploy, this causes a negative impact on the speed of IT and IT delivery is slowed down. If measures are taken to eliminate the causes, projects can be accelerated.

The main goal of this case study was to determine how the speed of enterprise IT is being measured in practice. With regard to this question, our study provides five major insights: (1) The speed of enterprise IT cannot be measured objectively, but only subjectively. (2) In certain contexts, the speed of enterprise IT can be determined in relation (relatively) to external benchmarks (like meeting a deadline for fulfilling a legal requirement). (3) The speed of enterprise IT must always be considered in the context of resource consumption, cost, quality and the future business value of IT. (4) In general, high speed is considered desirable and worthwhile as long as it is not achieved at the expense of quality or excessive resource consumption. (5) Achieving a high speed of the enterprise IT is not an end in itself. It helps to maintain and improve the enterprise's competitive position, to differentiate itself from the competition, to meet internal and external customer expectations early, and to meet regulatory requirements on time.

EAM plays a significant role in enterprises for connecting IT with the business and for achieving the best possible implementation of the business strategy. This has been evident in many organizations for several years [23]. By virtue of its role, EAM is obliged to support DT projects in these tasks. Regarding EA/EAM, our study provides the following results: (1) The detailed planning and monitoring of projects by EAM costs time and slows down DT projects. (2) Careful and forward-looking architecture planning can help to ensure that projects can be implemented more quickly in the future, as the necessary measures are identified and implemented in the architecture. (3) Architectural approaches such as microservices can help to increase the speed of IT, as (sub)components can be (further) developed, tested and deployed as independently as possible. (4) The high cost and duration of EA reviews of project proposals can be reduced by prioritizing the review of only the critical requirements of the DT project to quickly deliver the initial review results and using automatic EA templates. With new EA approaches, the speed of IT can be increased through opportunities to develop (sub-)components or small IT deliveries of SW.

For DT, the implications of our study are fourfold: (1) In DT projects, a great deal of emphasis is often placed on speed in the conception and prototyping phase, which is at the expense of architectural conformity, stability, security, etc. (2) Delays occur when these are to be integrated into the regular IT infrastructure and scaled. (3) DT projects often have to be subject to fewer restrictions in the conception and prototyping phase which helps to be fast. (4) Continuous monitoring of DT projects by the EAM fosters a convergence between the activities in the project and the architecture requirements.

For strategy, we see two major implications: (1) The successful implementation of a strategy requires that the organization's IT department is able to deliver IT products and services quickly, in high quality and with low resource input. (2) Major changes to the IT architecture or the IT department may be required, so these changes must be included in the strategy to ensure that they are given sufficient weight and supported by the required resources.

6 Conclusion

This study contributes to research by improving the understanding of the estimation and measurement of speed in the enterprise IT and IT delivery in IT projects.

The findings were empirically investigated and based on a single case study in a large enterprise, using data from qualitative expert interviews. This paper provides results in the form of a structured approach to activities for measuring the speed of enterprise IT, identifies factors that increase or decrease the speed of enterprise IT, and outlines strategies for advancing IT in terms of quality, resources and costs, business value of IT and management of IT complexity. In this study, we found that the speed of IT can be made measurable. However and as mentioned above, we found that the subjective evaluation is more important while this evaluation is often based on objective measures.

Our findings highlight the relevance of a subjective understanding of the speed of enterprise IT. While it is possible to objectively measure time and resources used for a project as well as if the intended scope and features are delivered, the results can still be interpreted as "(too) slow", "as expected" or "fast" based on subjective plans or benchmark values. In our data, we could see a heterogeneous understanding of the speed of enterprise IT. Different people are involved in different activities and evaluate the speed of enterprise IT based on these activities. While our findings are based on a single case study, we assume that similar measures of the speed of enterprise IT can be found in other large enterprises. However, due to its methodological limitations, our study does not claim to be applicable to all large companies. Subsequent case studies may show that other organizations can identify similar or different activities for measuring speed of IT in enterprises. In the future, further case studies on this research question could be conducted in other large enterprises as well as in small in medium-sized companies.

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