MASTER'S THESIS

The impact of dynamic enterprise architecture capabilities and digital capabilities on organizational performance

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Abstract

Technological progress seems to become an everyday thing. Technological developments proceed in an exponential fashion since the dawn of the information age by invention, innovation and improvement of technology. The rapid increase in calculation and processing power of computers created endless digitalization possibilities. Somewhere within this fast expansion of technology, structure is required to take advantage of these new technologies by aligning organizational resources with strategical objectives. Organizations that mastered the ability to adapt to these changes have exceeded and sometimes crushed their competition. This study aimed to support organizations in their search of this competitive advantage. The results show that dynamic enterprise architecture capabilities as an antecedent of digital capabilities can assist in steering organizations to make this alignment possible. This study finds that organizational performance is positively influenced by dynamic enterprise architecture capabilities. This effect was fully mediated by digital capabilities. Technological turbulence did not seem to have a moderating effect on the relationship between digital capabilities and organizational performance. This study advances our understanding on how organizations can utilize these capabilities to get a step closer or maintain greatness, outperforming the competition over a sustained period of time.

Key terms

Dynamic enterprise architecture capabilities, digital capabilities, technological turbulence, organizational performance, partial least squares structural equation modeling.

Summary

The main purpose of this study was to investigate the relationship between Dynamic Enterprise Architecture Capabilities, Digital Capabilities and their effects on Organizational Performance. This while considering the possible moderating effects of Technological Turbulence. Based on existing literature, three hypotheses were defined. To empirically test these hypotheses quantitative data was collected by means of surveys. After the data had been collected the data was analyzed and cleaned before testing the research model. The hypotheses as summed up below were tested using 119 surveys mainly fulfilled by CIO's, CDO,s, controllers and enterprise architects from Dutch companies. The survey contained 30 questions reflecting the indicators from the 4 constructs within the research model. Before testing the hypotheses, the measurement model and the structural model were assessed on internal consistency, validity, reliability and respectively on collinearity and model fit.

H1: Dynamic enterprise architecture capabilities has a positive effect on digital capabilities.
H2: Dynamic enterprise architecture capabilities mediated by digital capabilities has a positive effect on organizational performance.
H3: Technological turbulence has a moderating effect on the relationship between digital capabilities and organizational performance.

The research model was tested using the SmartPLS application. First, the constructs-to-item loadings were assessed and the Outer Loading Relevance Test was done. Some outer loadings were below the acceptable boundary of 0.70. However only the indicator Technological Turbulence 3 (TT3) was removed because this indicator negatively impacted the internal consistency and convergent validity. The internal consistency was assessed using the statistical measures Cronbach's Alpha (CA) and Composite Reliability (CR). The convergent validity was assessed with the Average Variance Extracted (AVE) score. Secondly, the discriminant validity was assessed by means of the Fornell-Lacker criterion and the heterotrait-monotrait ratio (HTMT). All values were satisfactory because they did not exceed their threshold therewith confirming validity and reliability of the measurement model. After the measurement model had been tested, the structural- or inner model was tested for collinearity. The Variance Inflation Factor (VIF) values did not indicate any critical level of collinearity within the structural model. The Standardized Root Mean Square Residual (SRMR) was considered to measure the model fit. Although this measure should be interpreted with caution, the value did indicate a satisfactory model fit.

The structural model and the hypothesized relationships were tested by analyzing the path coefficients (β) and R^2 values, the F^2 size, Stone-Geisser's (Q^2) values of the constructs and the relationships, indicating the predictive power and their significance. All relationships were positive however the T and P values indicated that not all relationships were significant. Hypothesis 3 (H3) was not supported by the data because the relationship was non-significant. Therefore, this construct was removed from the structural model. This was done because it disturbed the predictability of the other constructs. After the removal of this construct the structural model's predictiveness was assessed of the other constructs. Dynamic Capabilities (DC) is explained for 16.8% by Dynamic Enterprise Architecture Capabilities (DEAC) and Organizational Performance (OP) is explained for 17.3% by DC. The F^2 values showed a medium effect size of the relationship between DEAC and DC and a relatively small effect size of the relationship between DC and OP. The predictive power was further verified with the Q^2 measure. All Q^2 values were satisfactory which ensured the predictive relevance of the dependent variables. The findings show that the other Hypotheses H1 and H2 were indeed supported. The direct effect of DEAC on DC is both positive and significant (β=0.41, P=0) as well as the direct effect of DC on OP (β=0.292, P=0.005). The direct effect DEAC on OP is non-significant (β=0.163, P=0.118). This indicates that the relationship between DEAC and OP is fully mediated. Herewith hypothesis 1 and 2 were both supported and thus affirmed.

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1. Introduction

The introduction includes background information, the exploration of the topic, the problem statement, the research objectives and questions, and the main lines of approach of the research.

1.1. Background

In this ever faster-moving economic and technological environment, organizations strive to achieve and maintain their competitive advantage. To do so some firms utilize multiple strategical concepts and models like SAAS, the balanced scorecard, 5S, Deming's PDCA cycle, lean six sigma, enterprise architecture (EA) and dynamic capabilities (DC). With EA, organizations map the current and desirable future state of their organization on multiple business levels like organizational structure, business processes, data, applications and technology (Shanks, Gloet, Asadi Someh, Frampton, & Tamm, 2018). The desirable future state of these different business areas are achieved by designing and executing strategies and objectives. This way organizations try to align these business areas to create synergy advantages and therewith increase organizational performance. Another way to improve organizational performance is by utilizing DC which is to integrate, build and reconfigure internal and external competencies to address to the current rapidly changing environment (Teece, Pisano, & Shuen, 1997). Organization's that have developed the organizational routines and possess the managerial skills to do so are dynamically capable. Some companies utilize both of these methodologies, utilizing EA to map the desired state of specific business areas to share, recompose and renew the organizational resources to proactively address to the rapidly changing environment (van de Wetering, 2019a). Organizations that use their managerial skills in combination with EA to optimize their organizational processes and align their business units by utilizing their resources efficiently is called dynamic enterprise architecture capabilities (DEAC). It is of importance to sense, shape and seize opportunities and minimize threats when they occur to stay competitive (Teece, 2007). Nowadays, digital innovation causes a lot of these opportunities and threats. More advanced computers, IoT, cloud, big data, better ERP systems, AI, data analytics and automated processes for example all contribute to the competitiveness of organizations. In other cases these developments can be considered a threat in other organizations which become obsolete because they are not able to utilize these new technologies to their advantage (book, polaroid and video rental stores). In this sense organizations could benefit from their digital capabilities by using their digital technology to create market offerings, business processes, or models (Nambisan, Lyytinen, Majchrzak, & Song, 2017). Khin and Ho (2018) include the ability to respond to changing market circumstances in their definition of digital capabilities. The main objective of this research is to investigate the relationship between dynamic enterprise architecture capabilities and digital capabilities and its effect on organizational performance considering the moderating effect of technological turbulence. Technological turbulence being the degree of development, change, predictability and complexity of new technologies.

1.2. Exploration of the topic

A lot of definitions and terminology within this subject is used and to prevent any misconceptions about what is meant, the definitions have been outlined in this paragraph.

Dynamic enterprise architecture capabilities

EA facilitates an approach to govern the organizational structure, business processes, data, applications and technology and defines the current and desirable future states of these capabilities and provides a roadmap for achieving this target state (Shanks et al., 2018, p. 139). By sensing and shaping opportunities and threats and seizing opportunities, dynamic capabilities should be used to maintain competitiveness through enhancing, combining, protecting, and reconfiguring an enterprise's intangible and tangible assets (Teece, 2007, p. 1319). By combining these two concepts we get dynamic enterprise architecture capabilities. These are described as ''an organization's ability to leverage its EA for asset sharing and recomposing and renewal of organizational resources, together with guidance to proactively address the rapidly changing internal and external business environment and achieve the organization's desirable state" (van de Wetering, 2019a, p. 3). DEAC essentially provides a strategy for firms to build and enhance their dynamic capabilities. DEAC is often measured by means of three related extension points being EA sensing capability, EA mobilizing capability, and EA transforming capability. EA sensing capability refers to an organization's ability to proactively address opportunities and threats by evaluating changes between the baseline and target EA. EA mobilizing capability refers to an organizations ability to use EA to optimize it's use of assets for potential business solutions. EA transforming capability refers to the ability of an organization to utilize its resources to change its business processes and technological landscape during unexpected changes (van de Wetering, 2020).

Digital capabilities
Digitalization is becoming a more discussed and important topic for many firms. Emerging technological developments such as internet of things (IoT), big data analytics, and cloud computing create new opportunities for firms. To anticipate on these opportunities, firms have to be digitally capable. Khin and Ho (2018) describes digital capability as a part of dynamic capability that describes the ability to create new products and processes and respond to changing market circumstances using technology. Nambisan et al. (2017) had a similar description of digital capabilities, namely an organization's ability to use their digital technology to create market offerings, business processes, and or models.

Organizational performance
Organizational performance (OP) is used for strategy and objective formation within multiple business areas of firms and is measured by different key performance indicators (Singh, Darwish, & Potočnik, 2016). Organizational performance, involves analyzing a company's actual results in comparison to the intended results. According to Richard, Devinney, Yip, and Johnson (2009) organizational performance mainly consist of three main components being shareholder return, financial performance (also referred to as firm performance), and product market performance. Chen and Tsou (2012) also indicated that customer service and customer loyalty are important factors that influence organizational performance.

Environmental turbulence.
Environmental turbulence is a concept which includes multiple variables being market turbulence, technological turbulence and competitive intensity (Jaworski & Kohli, 1993). These variables where specified by Jaworski and Kohli (1993) to create a better understanding of the concept of environmental turbulence. Market turbulence was described as the degree of change within product preferences, price elasticity, amount of new customers, and customer loyalty. Technological turbulence was defined as the degree of technological change, technological related opportunities, predictability of new technologies, product development, and technological development. Competitive intensity was defined by the degree of competitiveness, the amount of promotion wars, and pricing. It is determined that the effects between certain relationships can be contingent of or influenced by these moderating variables (Wilden & Gudergan, 2015).

1.3. Problem statement
Only limited empirical research has been done on the relationship between digital capabilities and organizational performance and the relationship between DEAC and organizational performance. In these instances these effects were determined indirectly where these positive effects of digital and IT

capabilities on firm performance were mediated by digital innovation, digital transformation and respectively process innovation and business-IT alignment (Khin & Ho, 2018; Nwankpa & Roumani, 2016; van de Wetering, 2020). To get a better understanding of the possible effects between the relationships in questions, other related studies have been examined. Quite some research has been done on the relationship between DC and firm performance (Eisenhardt & Martin, 2000; Fainshmidt, Pezeshkan, Lance Frazier, Nair, & Markowski, 2016; Teece et al., 1997; Winter, 2003; Zahra, Sapienza, & Davidsson, 2006; Zott, 2003). However, the conclusions vary whether these capabilities have a positive, non-effect or rather a negative effect on firm performance. Some studies suggest that this relationship between dynamic and operational capabilities and organizational performance are contingent of environmental turbulence (Rai & Tang, 2010; Wilden & Gudergan, 2015; Wilden, Gudergan, Nielsen, & Lings, 2013). Because of these divergent results it is still inconclusive whether these capabilities can create any value at all or that they specifically can create value under certain circumstances.

This research aims to advance our current understanding of the relationship between DEAC and digital capabilities and its effects on organizational performance considering the moderating effect of technological turbulence. The effect of technological turbulence is considered moderating because it influences the strength and or direction of a relationship between two other constructs according to studies earlier mentioned. By studying these relationships and its effects on organizational performance, the value of DEAC and digital capabilities can be assessed.

Based on this knowledge, organizations can determine whether it is worthwhile to invest their resources into improving these capabilities or not. Also a better understanding will be obtained about the probable moderating effect of technological turbulence and the influence it can have on not only the capabilities mentioned in this study, but also other "similar" capabilities. It could cause the need for investigating the effect technological turbulence could have on other relationships. This would contribute to creating a more conclusive answer about these relationships and its effects on OP. This way this empirical study will contribute to the current body of knowledge by analyzing these specific relationships. Also because the direct relationship between DEAC and digital capabilities has never been studied.

1.4. Research objective and questions

The objective of this research is to investigate the proposed relationships amongst dynamic enterprise architecture capabilities, digital capabilities and organizational performance considering the moderating effect of technological turbulence, a main research question and a set of sub-questions have been set up. The main research question that followed from this objective is as follows: To which degree do the relationships between dynamic enterprise architecture capabilities, digital capabilities and organizational performance show significance considering the moderating effect of technological turbulence?

To answer the main research question the following sub-questions have been formulated: What is the effect of dynamic enterprise architecture capabilities on digital capabilities and therewith on organizational performance? What is the effect of dynamic enterprise architecture capabilities on organizational performance? Are there any differences in results concerning the relationship between digital capabilities and firm performance considering different technological conditions? By answering these questions a clear view will be created of the relationship between all these variables. Therefore giving insight of the effects of these models and strategies on firm performance and whether organizations should implement them to gain competitiveness.

1.5. Main lines of approach

This report will follow with the theoretical framework in chapter 2. Within the theoretical framework the definitions, research approach, hypothesis and follow up research will be discussed. In chapter 3 the methodology will be described. In this chapter the conceptual design, technical design, data analysis and reflection will be underlined. In chapter 4 the results are substantiated and in chapter 5 the discussion, conclusion and recommendations of this report are given.

2. Theoretical framework

This section provides the research approach and the development of the hypotheses. The hypotheses in relationship with the structural model are shown in Figure 1.

2.1. Research approach

Initially the existing literature was studied. Within the master of the BPMIT the concept EA was already introduced within the course Enterprise Architecture. Within this course a notion was created by reading approximately 15 EA, resource based theory and DC related articles. At the beginning of this research the baseline theory was studied which included another 21 articles. To gain an even better understanding of these concepts an additional 50 articles had been found. After reviewing the articles only 31 seemed relevant for this study and have therefore been used. Appendix A shows all the articles and books that were used for this study. The table also indicates the technique which was used to find them. The articles were searched with Google Scholar and the library of the Open University. To specify the searches the following selection criteria were used: publication date, peer-reviewed, business/management. To exclude any outdated and less relevant articles the selection criteria publication date was set on 2015. Articles were selected based on reading the abstract of the top prioritized, most relevant and most cited articles. A combination of research related definitions were entered to find related articles. The backward snowballing method was used to acquire relevant articles from related studies. Articles were searched based on interesting citations and references. If the abstract seemed relevant with regards to this study, the article was further analyzed and used.

2.2. Hypotheses development

In this section the research questions have been translated into hypotheses. These hypotheses are based on the current literature and will include the anticipated relationship between the different variables within the structural model. The hypotheses as described below and their relationship within the structural model are displayed in Figure 1.

In many cases structure and strategy are key to improve any process, practice or approach. DEAC provides this structure for organizations to align their resources to create business alignment and therewith create synergy advantages. In a study, van de Wetering (2020) reported that DEAC positively influence business-IT alignment which is described as the degree in which business and IT strategies, objectives and priorities are aligned. Another study reported that business-IT alignment has a positive impact on agility which is defined as the ability to detect and respond to opportunities and threats with ease, speed, and dexterity. Agility represents an organization's responsiveness to changes in demand, innovation, pricing, supplier networks, new products, market expansion, changes in product mix, and adoption of new production IT (Tallon & Pinsonneault, 2011). Looking at the variables that describe agility it shows a lot of similarities with digital capability. Khin and Ho (2018) describes digital capability as the ability to use technology to create new products and processes and respond to changing market circumstances. Other literature described digital capability as a firm's ability to give instantaneous answers either internally or externally, using digital channels to improve processes and customer relationships which contribute to generate value to the company (Jr, Maçada, Brinkhues, & Zimmermann, 2016). Both agility and digital capabilities focus on utilizing technology to respond to changing environmental circumstances by improving products, processes, innovation, and relationships. Because of these similarities it is expected that an investment in DEAC will ultimately lead to an improvement of an organization's digital capabilities because their business and IT strategies will be better aligned. Hence, firms will be better capable to digitally improve when identifying and reacting on opportunities like artificial intelligence, IoT, and big data.

H1: Dynamic enterprise architecture capabilities has a positive effect on digital capabilities.

Every organization strives to improve their organizational performance to stay competitive in this fast-paced economy. Therefore organizations try to find solutions to adapt to rapid changing environments. Improving organizational performance can be done in many ways. One way to achieve this is by improving dynamic capabilities to timely sense and seize opportunities with regards to digitalization for example. By integrating digital solutions with specific customer needs, processes can be optimized to improve processing time for example which therewith improves customer satisfaction. As a results, less complaints from customers and a decrease in processing time could mean a decrease in overhead costs because less staff is required to manage these business processes. Both the increase in customer satisfaction and a decrease in overhead costs would improve overall organizational performance. Fitzgerald, Kruschwitz, Bonnet, and Welch (2014) stated that transformation through digital technology is necessary to enable business improvements such as enhancing customer experience and engagement, streamlining operations and creating new business models. By enhancing these facets, organizations could improve their organizational performance. This has been empirically confirmed by Nwankpa and Roumani (2016) whom reported that digital transformation has a positive effect on firm performance. Another study from Khin and Ho (2018) reported similar results where digital capabilities mediated by digital innovation leads to an increase in financial performance. Based on former and the premise that DEAC will have a positive effect on digital capabilities, it is expected that DEAC mediated by digital capabilities will have a positive effect on organizational performance.

H2: Dynamic enterprise architecture capabilities mediated by digital capabilities has a positive effect on organizational performance.

Organizations face many challenges when it comes to environmental turbulence. Rapidly changing technological, market and competitive conditions could either form threats or form opportunities. Wilden and Gudergan (2015) for example showed that the level of competitor turbulence has a big impact on the relationship between marketing and technological capabilities and firm performance. They also identified and researched technological turbulence and market turbulence as moderating effects on firm performance. It is of importance to sense, shape and seize opportunities and minimize threats when they occur to stay competitive (Teece, 2007). Therefore, dynamic capabilities plays a critical role in adapting to these changes by integrating, building and reconfiguring internal and external competencies (Teece et al., 1997). Digital capability would provide the ability to identify opportunities and threats that occur with regards to digitalization. Digital breakthroughs like artificial intelligence, IoT, and big data could either form an opportunity or a threat. Whether it is an opportunity or a threat depends on an organization's ability to take action on such kinds of development. Digitally capable firms have the ability to quickly identify these developments as opportunities and manage their resources accordingly to integrate them and therewith increase organizational performance. In an highly technological turbulent environment these developments would occur more often. It is expected that organizations with a higher level of digital capability would perform better in high technological turbulence since they would be better capable to identify these opportunities and threats and act on them. This would give them an competitive advantages from those that cannot. Therefore, having a high level of digital capability would have a positive effect on organizational performance in a high technological environment.

H3: Technological turbulence has a moderating effect on the relationship between digital capabilities and organizational performance.

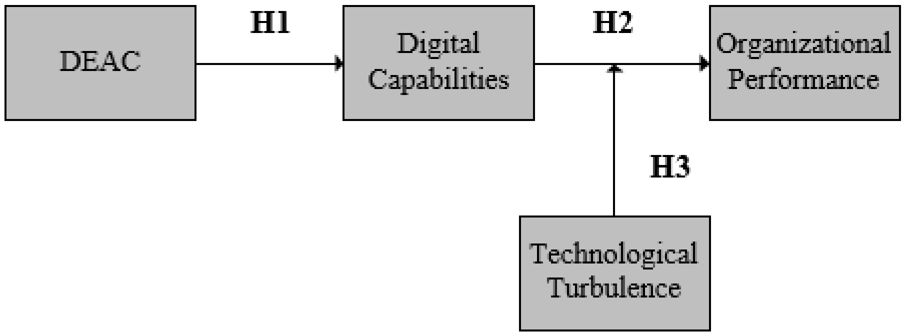

Figure 1 Structural model and hypotheses

3. Research method

In this section the research method is described including the research approach, data collection and analysis, an explanation of the structural model and its constructs and items, the methods of measurement and ends with ethical concerns.

3.1. Approach

The objective of this part of the research was to set up a plan for data collection, data analysis including measurement and ethical. Initially an exploratory literature review was conducted by reading the baseline literature, searching and reading more related articles until a proper understanding of the subject was obtained (Saunders, Lewis, & Thornhill, 2019). Based on the literature, research questions were set up and hypotheses were formed. These hypotheses are tested based on quantitative data. This study concerns a cross sectional study, the data was collected over a specific period of time. To test the designed hypotheses, enough data had to be collected to form a proper sample which represents the population. The substantiation of the sample size of this research will be elaborated in the next paragraph.

Methods which could have been used to collect data were surveys, archival and documentary research, case studies, ethnography, action research, grounded theory, narrative inquire (interviews) and experiments (Saunders et al., 2019). This study aimed to statistically test the hypotheses and therewith examine the relationship between the variables. Which means that it is considered a confirmatory research and therefore a quantitative research (Saunders et al., 2019). Qualitative data could also be used to test the hypotheses but it would be much more time consuming to collect enough data.

Since it concerns a quantitative study, a lot of data was required to have an appropriate dataset to ensure the reliability of the results. While experiments and case studies could provide answers to the research questions, they are known for their time intensity. Action research focusses on improving organizational processes by resolving organizational issues. Grounded theory, interviews/focus groups and ethnography are mainly used for qualitative studies so these would not fit this research. Because of the time limitation of this research, and because the research is not about an organizational issue and is not considered a qualitative study, these methods have not been chosen as the data collection methods of this research. Survey was the best options for this research because sufficient data could be collected within the limited time boundaries of this research. Therefore this data collection method had been chosen.

3.2. Data collection and analysis

First a questionnaire had been developed (Appendix A) that included 7 questions relating to back-ground information, 30 questions related to the items of the constructs and 1 additional question relating to adequacy of understanding of the respondent. The 30 questions representing the indicators within the measurement model are described in Appendix B. The questionnaire was pilot tested and refined where necessary. The testing was done by 4 students from the course BPMIT and 4 others whom were contact for the pretest. The final survey was set up and distributed using the program "Lime Survey". After the questionnaire had been pilot tested and set up in Lime Survey, the data was collected. The actual data collection started on the 17th of October 2020 and the survey was closed in the same year on the 6th of December. To minimize any risk of disclosure and ensure the confidentiality of the information the data collected was made unidentifiable by deleting all personal data after the data collection period had ended. Respondents were also asked to leave their email address in case they would like to receive the results of the research.

To collect the data the following roles were approached: CEO's, CIO's, Chief Data/Digital Officers (CDO), business manager, IT managers, business and enterprise architects, and data analysts. The data had been acquired mainly by means of the non-probability sampling methods being convenience sampling and respondent-driven sampling. The questionnaires were primarily distributed within our own network and on LinkedIn. The survey link was also posted on Reddit in the Enterprise Architecture thread and on the website of the Koninklijke Nederlandse Vereniging van Informatieprofessionals (KNVI). Respondents who completed the survey had also been asked to distribute the questionnaire within their own network (respondent driven sampling). To increase the response rate an incentive had been created were a donation was promised of € 1,50 to the WWF for each completed survey.

A sample size of less than 100 is considered a very small dataset (Hair Jr, Hult, Ringle, & Sarstedt, 2017). A larger sample size increases the generalizability of the results (Saunders et al., 2019). Therefore the aim of this research was to collect at least 150 datasets in total. Eventually 157 complete datasets had been collected. All incomplete datasets were removed since the missing data exceeded the boundary of 15% as described by (Hair Jr et al., 2017). If the respondent did not understand the subject the dataset was also removed. This was determined by the additional question in the survey asking the respondents to which degree they understood the subjects and concepts mentioned (N=4). Leiner (2013) suggested that a good way to clean data is to analyze the completion time of the surveys. Therefore datasets which were completed under a time span of 5 minutes were removed (N=13). It would seem unrealistic that the respondent completed the survey diligently, considering the size of the survey. The manual analysis indicated that these datasets indeed showed suspicious response patterns like straightlining. The analysis of the response patterns in SmartPLS also indicated absolute values of greater than 1 for skewness and kurtosis which indicates that the data is not normally distributed. This was done by transposing the responses in Excel from rows to columns so that every response could be analyzed individually. Upon further investigation of the SmartPLS results another (N=21) values were removed. These responses also indicated high levels of skewness and kurtosis and suspicious response patterns. Finally 119 datasets were used to test the hypotheses.

3.3. Structural model, constructs and items

In this paragraph the measurement model (external to the blue line), structural model (internal to the blue line) and its constructs and items are described.

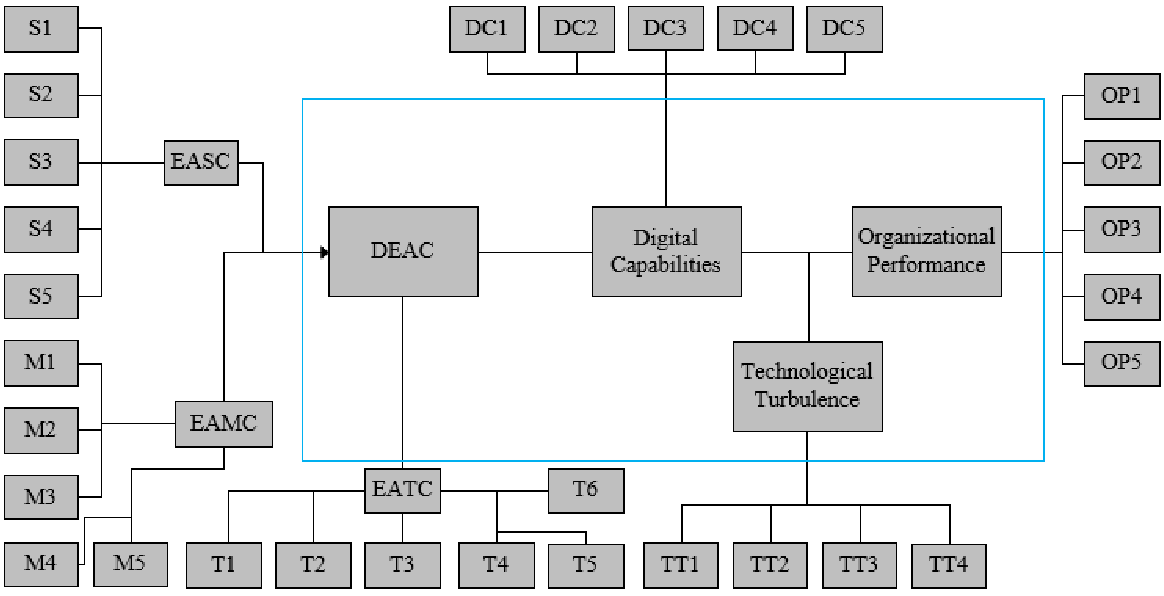

Figure 2 Measurement and structural model of all constructs and its indicators.

The constructs and items that describe DEAC have been adopted from previous work from (van de Wetering, 2019a, 2020). This second-order construct is modeled as a reflective-formative type II model (Becker, Klein, & Wetzels, 2012). This means that DEAC is formed by three constructs being EA-sensing capability, EA mobilizing capability and EA-transforming capability. These constructs and items have been tested by means of items-sorting analysis and expert reviews to enhance reliability and construct validity. Therefore they give a good representation of the construct being DEAC. The items used to measure the construct digital capabilities are based upon earlier validated work from (Khin & Ho, 2018). Organizational performance was measured by items which were designed by (Chen & Tsou, 2012). Lastly, technological turbulence was measured by items mentioned in earlier validated work by (Jaworski & Kohli, 1993). The latter constructs are all modeled as reflective first-order constructs. All the constructs have been adopted from previous work because they have already been rigorously tested and reviewed. This process of creating and testing items for constructs is very time consuming. Therefore considering the time limitations of this study the best option was to adopt the constructs from earlier validated work. All the constructs, items and their outer loadings are described in Appendix B.

3.4. Measurements

Because this research concerns a quantitative research, a statistical data analysis method was required. An in dept statistical multivariate analysis was conducted. Meaning that the multiple variables as mentioned before were simultaneously analyzed. The data was analyzed with partial least squares structural equation modeling (PLS-SEM) using SmartPLS 3.3.2. PLS-SEM had been chosen for this research because it is well suited for multivariate analysis (Hair Jr et al., 2017). The best way to do this analysis is by using an interval scale where the (latent) variables or constructs are redefined into numerical values. Therefore the items in the survey were measured by means of a 7 point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). This way the variables were statistically measured and the hypothesis could be empirically be tested. All constructs have been measured by means of multiple items which serve as proxy variables to define the construct. Proxy variables are used to measure and give meaning to constructs within the structural model. This ensures the quality of the measurement and ensures validity of the research (Barclay, Thompson, & Higgins, 1995).

The hypotheses defined within this research were tested by predictive power between the constructs of the structural model. Initially the outer loadings were estimated using the PLS path algorithm. Thereafter the predictive power (R^2) between the relationship of the constructs was estimated using the same method. The significance of the regression coefficients (R^2) was computed using the bootstrapping procedure running 5000 subsamples for stable results. Finally the blindfolding procedure was used to compute the Q^2 value. The final results will be discussed in the next chapter.

3.5. Ethics

From an ethical standpoint this research was conducted without pressuring anyone who participated in this research. Data was collected only upon consent of the participants. Anyone involved within this research has been treated with respect and had the right to withdraw at any given time. As described earlier in this report all data have been anonymized to ensure confidentiality. With regards to the General Data Protection Regulation (GDPR) no personal information was requested from the respondents. Meaning that no telephone number, address, social number or the alike was retrieved. Respondents did have the possibility to enter their name their email address to receive the results of this study. These details have never been published or distributed, they have also not been included in this paper.

4. Results

In this chapter the results will be explained with regards to estimating the measurement model and the structural model. First the measurement model was analyzed and secondly the structural model by using the two-step approach as suggested by (Anderson & Gerbing, 1988). The testing of the structural model will substantiate whether the hypotheses are supported or not. The discussion, conclusion, and future implications of this research will be discussed in the next chapter.

4.1. Measurement model

The measurement model or outer model was tested using the PLS path weighting algorithm which is the recommended approach for SmartPLS. Initially the constructs-to-item loadings were assessed and the Outer Loading Relevance Test was done. Some outer loadings were below the acceptable boundary of 0.70 (Hair Jr et al., 2017). This concerned the items M4 from the construct EA-mobilizing capability and TT3 and TT4 from the construct technological turbulence. However only the outer loading of TT3 negatively affected the internal consistency and the convergent validity of the research model. Therefore only this items has been removed to improve these measures. The other items did not decrease these measures below their threshold and were kept to minimize the impact on the content validity of this study.

The construct validity and reliability of the research model were tested by means of multiple statistical tests within SmartPLS. The internal consistency was assessed using the statistical measures Cronbach's Alpha (CA) and Composite Reliability (CR). These provide an estimate of the reliability based on the intercorrelations of the observed indicator variables. The CA values as indicated in Table 1 can be considered satisfactory because they all fall within the limit between 0.70 and 0.90 (Hair Jr et al., 2017). The CR values can also be regarded as satisfactory since they are all above the desired lower limit of 0.70. The convergent validity was assessed with the AVE score which averages the squared number of all outer loadings of each construct. Herewith measuring to what degree the latent variables explain the variance of each indicator. All outer loadings exceeded the minimum threshold of 0.70 which resulted in satisfactory AVE values above 0.50.

The second-order construct DEAC has been measured in SmartPLS using the repeated indicator model – mode A (Becker et al., 2012). The AVE score of DEAC was manually calculated based on the loadings of the items on their underlying constructs. This was necessary because the AVE score within SmartPLS was based on the repeated outer loadings from DEAC. However, since DEAC is explained by its underlying constructs, the loadings referring to these constructs are the ones that actually represent DEAC. Therefore these are the actual loading which have to be used to calculate the true AVE value. The actual AVE score was calculated by taking the square of all item loadings and dividing the total by the total number of items. The AVE score DEAC computed to 0.617 which also is above the generally accepted lower limit of 0.50.

Table 1 Construct reliability and convergent and discriminant validity of all first-order constructs

F-L C	DC	EAM	EAS	EAT	OP	TT
DC	**0.845**					
EAM	0.219	**0.792**				
EAS	0.380	0.585	**0.771**			
EAT	0.421	0.642	0.590	**0.778**		
OP	0.376	0.194	0.250	0.330	**0.811**	
TT	0.358	0.113	0.293	0.175	0.228	**0.822**

CA	0.900	0.850	0.829	0.869	0.871	0.751
CR	0.926	0.893	0.880	0.902	0.906	0.860
AVE	0.714	0.627	0.594	0.605	0.658	0.676

Discriminant validity was determined by analyzing the cross loadings, the Fornell-Lacker criterion and the heterotrait-monotrait ratio (HTMT). Herewith the correlations between the constructs themselves and the correlation between the indicators and the constructs were measured. The outer loadings of the indicators are the highest for each associated construct. This means that the cross loadings analysis as shown in Appendix D supports discriminant validity. The Fornell-Lacker criterion as shown in Table 1 also shows similar results where the AVE values are greater with their associated construct than with any other construct. The results from the HTMT ratio also support discriminant validity. All outcomes were way below the upper conservative threshold of 0.90 (Hair Jr et al., 2017). Based on these results it can be concluded that all first-order reflective constructs are valid and reliable. The next step is to test the hypotheses by estimating the structural- or inner model. This will be discussed in the next section.

4.2. Structural model and hypotheses.

After the reliability and the validity had been tested the collinearity of the structural model was assessed. Assessing the collinearity of the second-order construct DEAC and the structural model was done by analyzing the VIF values. All VIF values were below their upper limit of 3.5 which indicates that critical levels of collinearity are non-existing. This combined with the fact that DEAC's variance is fully explained by it underlying constructs (R2=1) and these relationships are significant (Kock & Lynn, 2012). This means that the predictor variables can independently predict the value of the dependent variables.

Standardized Root Mean Square Residual (SRMR) was considered to measure the model fit. A SRMR value of 0 is considered a perfect fit, a value less than 0.08 is considered a good fit for CB-SEM although it is argued that this value is somewhat low for PLS-SEM. The measure is relatively in early development for PLS-SEM therefore the results should be interpreted with caution. The SRMR value could not be measured with the normal path model because it was disturbed by the second-order construct. The indicators from DEAC were duplicated with the second-order constructs therefore the model fit could not be measured properly because the duplicates of DEAC's first- and second-order constructs interfered with each other. When threating DEAC as a first-order single item construct, the model fit showed good results with a score of 0.071 which is below the accepted boundary of 0.08 (Hair Jr et al., 2017).

To further test the structural model, the path coefficients (β) were analyzed to determine the significance hypothesized relationships. The structural model, path coefficient and R^2 values as indicated by SmartPLS are displayed in Figure 3. Values ranging from +1 to -1 indicate a strong positive and respectively a strong negative relationship between the variables. All relationships seem to be positive but not all relationships seem to be significant as further explained in the next paragraph.

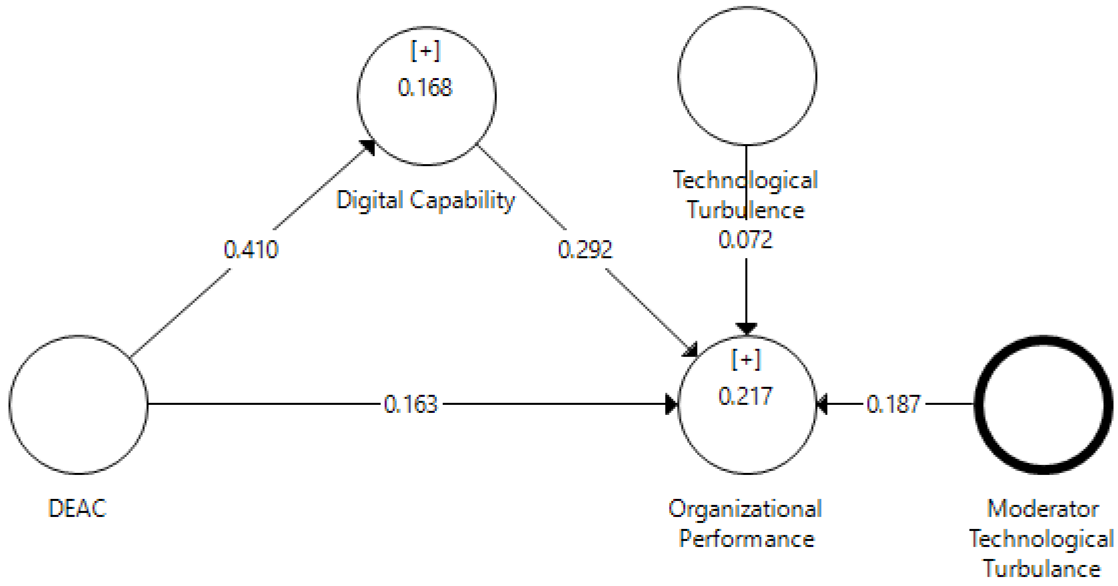

Figure 3 Structural model (SmartPLS)

By running a 5000 samples bootstrapping procedure the T and P values of the paths were estimated as shown in Table 2. The P value represents the probability of obtaining the T value and thus describes whether the effects are significant (Hair Jr et al., 2017). The next step within the study was to determine the predictive power of the model. This was done by analyzing the coefficient of determination (R^2 value) of the endogenous constructs. This value explains how much of the construct is explained by their exogenous constructs. DC is explained for 16.8% by DEAC and OP is explained for 21.7% by DC, TT, and MTT. When removing the non-significant constructs TT and MTT, the R^2 value of DC to OP drops to 17.3%. Table 2 also shows the F^2 size, which relationships are significant and which hypotheses are therefore supported. The effect size (F^2) between the direct significant relationships differ from medium to small. Namely, values of F^2 0.02, 0.15, 0.35 represent a small, medium, and large effect of the exogenous latent variable on the endogenous latent variable (Hair Jr et al., 2017). These values differ for moderating effects, however since the moderating effect is not significant, this analysis is unnecessary. The relationship DEAC, DC show a medium effects size of 0.202 and DC, OP show a relative small effect size of 0.082. Additionally, the Stone-Geisser's (Q^2) value was examined to assess the predictive power of the model. This was done running the blindfolding procedure. All Q^2 values were above the threshold of 0 which ensure the predictive relevance of the dependent variables. The values being 0.419 for DEAC, 0.153 for DC and 0.094 for OP.

Table 2 Evaluation of the structural model and hypotheses

Model Path	β	F^2 size	T Values	P Values	Significant	Hypothesis
DEAC -> DC **(H1)**	0.41	0.202	5.057	0	Yes	Supported
DEAC -> OP	0.163	0.028	1.563	0.118	No	
DC -> OP	0.292	0.082	2.786	0.005	Yes	
MTT -> OP **(H3)**	0.187	0.048	0.881	0.378	No	Not supported

TT -> OP	0.072	0.006	0.731	0.465	No	
Total Effect (Mediation)						
DEAC -> DC -> OP **(H2)**	0.283		3.144	0.002	Yes	Supported

Looking at the total effects of the bootstrapping analysis as displayed in Table 2, shows that the relationship between DEAC and OP mediated by DC is significant. The direct effect of DEAC on DC is both positive and significant (β=0.41, P=0) as well as the direct effect of DC on OP (β=0.292, P=0.005). Where the direct effect DEAC on OP is non-significant (β=0.163, P=0.118). This indicates that the relationship between DEAC and OP is fully mediated by DC (Hair Jr et al., 2017). Considering these results the relationships as suggested with H1 and H2 are being affirmed. DEAC has a positive influence on DC and the effects of DEAC on OP are fully mediated by DC as predicted. In contrary, H3 was not affirmed since the moderating effect of TT seems non-significant and thus irrelevant.

During this study the direct relationship between technological turbulence and digital capability was also analyzed. Remarkable was that this it showed a significant positive relationship (β=0.281, P=0.001) between the two variables. It also increased the variance explained of DC from 16.8% to 24.2% which is positive for the overall predictiveness of the structural model.

5. Discussion, conclusion and recommendations

This chapter contains a discussion, conclusion, managerial implications, limitations and recommendation for further research.

5.1. Discussion, conclusion

This study examined the relationships between dynamic enterprise architecture capabilities, digital capabilities and organizational performance and the moderating effects of technological turbulence. These relationships were tested with the results from 119 surveys mainly fulfilled by CIO's, CDO's, controllers and enterprise architects from the Netherlands. The main goal of this study was to provide empirical evidence to determine whether these capabilities influences organizational performance. It was confirmed that DEAC plays an important role in the relationship between business IT-alignment and process innovation which mediated the effects of DEAC on organizational benefits (van de Wetering, 2020; van de Wetering, Kurnia, & Kotusev, 2020). In another study van de Wetering (2019b) demonstrated that DEAC also has a positive influence on operational capabilities. One of the goals was to test whether the role of DEAC stretches beyond just these three drivers to see the possible added value it could bring companies with regards to other drivers or capabilities and therewith to organizational performance. In his study he also suggested that it would be beneficial to include the impact of environmental turbulence in further research. Tallon and Pinsonneault (2011) for example demonstrated that organizational agility, which is similar to digital capabilities, was influences by environmental volatility. As goes for Wilden and Gudergan (2015) whom reported that similar relationships are contingent of environmental turbulence. Khin and Ho (2018) reported that digital capabilities mediated by digital innovation had a positive effect on financial performance. However the direct effect of digital capability on organizational performance nor the effect of DEAC on DC have never been studied in this specific context. Especially considering the moderating effect of technological turbulence. In doing so, this study expands our understanding by building upon these earlier studies. The results show that there is indeed a direct positive relationship between DEAC and DC. This way DEAC seems to drive OP with DC as a mediator as earlier presumed. This builds our understanding of the role DEAC plays in the improvement of other capabilities and the indirect effect it therewith can bring to organizational performance. In contrary to what was presumed and the results that Wilden and Gudergan (2015) showed, technological turbulence did not have any effect on the relationship between DC and OP.

5.2. Managerial implications

Management usually tries to find ways to utilize their organizational resources to maximize performance. This study could support executives and managers in their search to do so. It reveals that DEAC is a driving force behind digital capabilities besides business-IT alignment, process innovation and operational capabilities (van de Wetering, 2019b, 2020). Confirming the view that organizations are better able to leverage its EA to create alignment between their strategical objectives and their organizational resources to proactively adapt to the changing business environment and achieve their desirable state. Therefore, executives and managers could consider building on this capability to enhance these drivers and therewith indirectly increase organizational performance. However, the concept of DEAC is quite young, thus it is unknown what other effects it might have. To determine and assess its value in a broader perspective it's suggested that more research should be done. Building on digital capability can aid organizations in identifying new digital opportunities, acquiring new digital technologies, creating new products and processes and respond to changing market circumstances. Making it a possible valuable asset for executives and managers that struggle to enhance organizational performance by utilizing these aspects. Hence, organizations could consider to adopt and invest in either DEAC or DC or in both to increase their organizational performance.

5.3. Limitations and recommendations for further research

The predictive power of the research model could be argued. The predictive values indicated earlier, did not show extraordinary high prediction rates. This might be the case because most variables mentioned could be reliant on other variables. Organizational performance for example can be influences by leadership, employees, process and product innovation, culture, strategic planning and external factors like political environment (boycott/regulations), trends (going green), interest rates, currencies, oil prices, competitive environment etc. (Bashaer, Singh, & Sherine, 2016; Collins, 2001; van de Wetering, 2020; Wilden & Gudergan, 2015; Zweig, 1997). In SmartPLS the predictive power is dependent on the number of exogenous variables pointing at an endogenous variable (Hair Jr et al., 2017). Which means that the predictability would increase with a larger structural model.

Only 8 participants pretested the questionnaire. Saunders et al. (2019) indicated that the internal validity and reliability of the data are dependent on the degree of pilot testing, question design and structure of the questionnaire. This could mean that the reliability and validity of the results could have been improved when more time had been invested in the pretesting phase. The survey was also quite big, this was the case because multiple studies were combined. In some instances this was mentioned by the respondents whom took part in the survey. Roughly 22.4 percent of all datasets had to be removed since they showed anomalies such as straightlining. Fortunately, enough datasets were collected whereof 119 datasets remained after data cleansing. Although this is considered sufficient for proper statistical analysis with PLS-SEM, it would have been preferable if more datasets were available for the study. Data was collected only by means of a survey which might be a concern with regards to the bias of the respondents and the objectivity of the outcomes. By triangulating the survey results with other data sources like archival data this concern could have been contained.

As formerly noted, it is recommended that DEAC is further researched to determine the effects it has in a broader sense. Meaning that the effects it has on other capabilities are investigated. Only then the true value of DEAC can be determined. While this paper was being written, other students were also investigating DEAC but within other contexts. All these results form a foundation within the literature with regards to the value of DEAC. However, this view ought to be extended and confirmed by other researchers to build upon this foundation. Besides that the data primarily represent Dutch firms. More research is therefore also recommended to increase generalizability of the results.

Technological turbulence did not seem to have any moderating effect on the relationship between digital capabilities and organizational performance. It was remarkable however to see that there was a direct positive significant relationship between technological turbulence and digital capabilities. This could indicate that organizations adapt their digital capabilities based on the degree of technological turbulence if necessary. Meaning that a technological turbulent environment might force companies to seek digital improvement. However, the actual reason for the correlation is unknown but it could be interesting to include in further research on digital capabilities. Besides that market and competitive turbulence were not included in this research. Therefore it remains unknown whether these factors influence the described relationships. Further research is necessary to determine the impact of these factors for these relationships.

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Appendices

Appendix A

Method	Queries	Source	Results	Article
Building Blocks	Digital capability and digital transformation and firm performance Since 2015	Google Scholar	17000	Nwankpa, J. K., & Roumani, Y. (2016). IT capability and digital transformation: a firm performance perspective
Building Blocks	Zimmerman Digital capabilities and organizational performance Since 2015	Google Scholar	16800	Jr, J., Maçada, A. C., Brinkhues, R., & Zimmermann, G. (2016). Digital Capabilities as Driver to Digital Business Performance
Building Blocks	dynamic capabilities organizational performance Since 2015	OU library	7731	Fainshmidt, S., Pezeshkan, A., Lance Frazier, M., Nair, A., & Markowski, E. (2016). Dynamic Capabilities and Organizational Performance: A Meta-Analytic Evaluation and Extension.
Building Blocks	dynamic capabilities organizational performance Since 2015	OU library	7731	Zhou, S. S., Zhou, A. J., Feng, J., & Jiang, S. (2019). Dynamic capabilities and organizational performance: The mediating role of innovation.
Building Blocks	Measuring Organizational Performance Since 2015	OU library	7343	Singh, S., Darwish, T. K., & Potočnik, K. (2016). Measuring Organizational Performance: A Case for Subjective Measures. British Journal of Management
Building Blocks	Dynamic capabilities and digital capabilities Since 2015	OU library	1678	Warner, K. S. R., & Wäger, M. (2019). Building dynamic capabilities for digital transformation: An ongoing process of strategic renewal.
Backwards Snowballing	None	(Singh et al., 2016)		Richard, P., Devinney, T., Yip, G., & Johnson, G. (2009). Measuring Organizational Performance: Towards Methodological Best Practice.
Backwards Snowballing	None	(Richard et al., 2009)		Dyer, L., & Reeves, T. (1995). Human resource strategies and firm performance: what do we know and where do we need to go?
Backwards Snowballing	None	(Richard et al., 2009)		Zahra, S. A., & Bogner, W. C. (2000). Technology strategy and software new ventures' performance: Exploring the moderating effect of the competitive environment.
Backwards Snowballing	None	(Khin & Ho, 2018)		Anderson, J. C., & Gerbing, D. W. (1988). Structural equation modeling in practice: A review and recommended two-step approach.
Backwards Snowballing	None	(van de Wetering, 2020)		Kock, N., & Lynn, G. (2012). Lateral Collinearity and Misleading Results in Variance-Based SEM: An Illustration and Recommendations.

Backwards Snowballing	None	(Wilden & Gudergan, 2015)		Wilden, R., Gudergan, S. P., Nielsen, B. B., & Lings, I. (2013). Dynamic Capabilities and Performance: Strategy, Structure and Environment.
Backwards Snowballing	None	(Nwankpa & Roumani, 2016)		Bharadwaj, A. S. (2000). A Resource-Based Perspective on Information Technology Capability and Firm Performance: An Empirical Investigation.
Backwards Snowballing	None	(Nwankpa & Roumani, 2016)		Dale Stoel, M., & Muhanna, W. A. (2009). IT capabilities and firm performance: A contingency analysis of the role of industry and IT capability type.
Backwards Snowballing	None	(Nwankpa & Roumani, 2016)		Ho-Chang, C., Chang, E. K., & Prybutok, V. R. (2014). INFORMATION TECHNOLOGY CAPABILITY AND FIRM PERFORMANCE: CONTRADICTORY FINDINGS AND THEIR POSSIBLE CAUSES.
Backwards Snowballing	None	(van de Wetering, 2020)		Becker, J.-M., Klein, K., & Wetzels, M. (2012). Hierarchical Latent Variable Models in PLS-SEM: Guidelines for Using Reflective-Formative Type Models.
Backwards Snowballing	None	(Warner & Wäger, 2019)		Rogers, D. L. (2016). The digital transformation playbook rethink your business for the digital age.
Backwards Snowballing	None	(Hair Jr et al., 2017)		Barclay, D., Thompson, R., & Higgins, C. (1995). The Partial Least Squares (PLS) Approach to Causal Modeling: Personal Computer Use as an Illustration.
Backwards Snowballing	None	(van de Wetering, 2020)		Chen, J.-S., & Tsou, H.-T. (2012). Performance effects of IT capability, service process innovation, and the mediating role of customer service.
Backwards Snowballing	None	(Wilden & Gudergan, 2015)		Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: what are they?
Backwards Snowballing	None	(Khin & Ho, 2018)		Fitzgerald, M., Kruschwitz, N., Bonnet, D., & Welch, M. (2014). Embracing digital technology: A new strategic imperative.
Backwards Snowballing	None	(Wilden & Gudergan, 2015)		Jaworski, B. J., & Kohli, A. K. (1993). Market orientation: Antecedents and consequences.
Backwards Snowballing	None	(Khin & Ho, 2018)		Nambisan, S., Lyytinen, K., Majchrzak, A., & Song, M. (2017). Digital Innovation Management: Reinventing Innovation Management Research in a Digital World.
Backwards Snowballing	None	(van de Wetering, 2019a)		Rai, A., & Tang, X. (2010). Leveraging IT Capabilities and Competitive Process Capabilities for the Management of Interorganizational Relationship Portfolios.
Backwards Snowballing	None	(van de Wetering, 2020)		Tallon, P. P., & Pinsonneault, A. (2011). Competing perspectives on the link between strategic information technology alignment and organizational agility: insights from a mediation model.
Backwards Snowballing	None	(Teece, 2007; Teece et al., 1997)		Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management.

Backwards Snowballing	None	(van de Wetering, 2020)		van de Wetering, R. (2019). Dynamic Enterprise Architecture Capabilities: conceptualization and validation.
Backwards Snowballing	None	(Wilden & Gudergan, 2015)		Winter, S. G. (2003). Understanding dynamic capabilities.
Backwards Snowballing	None	(Zhou, Zhou, Feng, & Jiang, 2019)		Zott, C. (2003). Dynamic Capabilities and the Emergence of Intraindustry Differential Firm Performance: Insights from a Simulation Study.
Baseline literature	None	Open University		Other articles.

Appendix B

Survey: Dynamic enterprise architecture capabilities and digital transformation

Introduction

Welcome to the survey on dynamic enterprise architecture capabilities and digital transformation. This research is part of ongoing research of The Open University of the Netherlands on how Enterprise Architecture (EA) and EA-based capabilities contribute to organizational benefits, business value, and firm's overall digital transformation.

At the end of this survey, you can fill in your contact details. Then, you will be the first to receive the findings of our research, with a list of managerial implications.

Confidentiality and anonymity

All obtained data will remain completely anonymous and confidential and will be used only for research purposes.We analyze the data at an aggregate level, and we will not make any references to an individual or company.At all times, the data will remain accessible to only the researchers of the study and will not be distributed to third-parties.At any given point, you can ask to revoke your participation in the study, and we will proceed to delete the provided information.

Key definitions

Enterprise Architecture:
We define an EA as the fundamental organization of an enterprise defining its current and desirable future state, along with the principles governing its design and development. Following this definition, an EA embodies all relevant components for describing an enterprise, including its operating model, organizational structure, business processes, data, applications, and technology. EA allows firms to add value across all business units, operations, human resources, and align strategic objectives with the particular use of digital technologies.

Dynamic enterprise architecture capabilities:
We define these capabilities as an organization's ability to leverage its EA for asset sharing and recomposing and renewal of organizational resources, together with guidance to proactively address the rapidly changing internal and external business environment and achieve the organization's desirable state. Dynamic enterprise architecture capabilities enable enterprise-wide digital transformations and provide an opportunity to build capabilities in parallel with implementing a new strategic direction.

Structure of the survey

The structure of the survey is as follows: After some background questions, we start with the survey items on EA capabilities and their use in practice. This section follows by questions on how firms use digital (platform) capabilities and networking capabilities. This survey continues with questions on operational digital capabilities and business model innovation. The final four parts of this survey concern questions about environmental aspects and organizational performance and business value. The questions are measured by means of a 7 point Likert scale where 1 equals strongly disagree and 7 equals strongly agree.

Researchers

This research is led by four graduating researchers: Mikolai Soldatenko, Bauke van der Woude, Max Külbs and Jordy Dijkman.
This research is supervised by dr. Rogier van de Wetering, Associate Professor in Information Systems and Business Processes (rogier.vandewetering@ou.nl).

Many thanks for your time in participating in this research.
As a token of appreciation and to take action for our world, we will donate **€1.50** to the WWF for each completed survey.
You can follow the progress of donations made concerning this research here.

Constructs	**Sources**
1. Please indicate the size-class of your company. (Number of employees)	Less than 100 employees 101–300 employees 301–1000 1001–3000 Over 3000 employees
2. Please select the category under which your organization falls under	Private Sector Public Sector Private-Public Partnerships (PPP) Non-Governmental Organization (NGO) Non-Profit Organization (NPO)
3. In which industry does your organization operate (considering only the core-business of your organization)?	Manufacturing Wholesale/retail Energy and utilities Telecommunications Finance and insurance Publishing/news Technology Consumer business/goods Basic Materials (Chemicals, paper, industrial metals & mining) Industrials (Construction & industrial goods) Oil & Gas Auto/car industry Pharmaceutical Legal Restaurants Transportation Agriculture Health Care Education Hotel industry National government Municipal governments

	Real estate Police Consulting Services Other:…
4. Please indicate the age of your company.	0–5 years 6–10 years 11–20 years 20–25 years Over 25 years
5. Please indicate the amount of your working experience	0–5 years 6–10 years 11–20 years 20–25 years Over 25 years
6. Please indicate what part of the total budget does the IT budget represent:	Less than 1% Between 1% and 3% Between 3.1% and 5% More than 5%
7. Please indicate your current function within the organization:	Chief executive officer (CEO) Chief information officer (CIO) Chief digital/data officer (CDO) Business manager IT manager Operations manager Innovation manager Business or enterprise architect IT architect Internal business / IT consultant External business / IT consultant Other:

Dynamic Enterprise Architecture Capabilities *To what extent do you agree with the following statements? (1 – strongly disagree 7 – strongly agree)*
(1) EA sensing capability
We use our EA to identify new business opportunities or potential threats
We review our EA services (e.g., providing content, EA standards, skills and knowledge) on a regular basis to ensure that they are in line with what our key (internal and external) stakeholders want
We adequately evaluate the effect of changes in the baseline and target EA on the organization
We devote sufficiently time enhancing our EA to improve business processes
We develop greater reactive and proactive strength in the business domain using our EA
(2) EA mobilizing capability
We use our EA to draft potential solutions when we sense business opportunities or potential threats
We use our EA to evaluate, prioritize and select potential solutions when we sense business opportunities or potential threats
We use our EA to mobilize resources in line with a potential solution when we sense business opportunities or potential threats
We use our EA to draw up a detailed plan to carry out a potential solution when we sense business opportunities or potential threats
We use our EA to review and update our practices in line with renowned business and IT best practices when we sense business opportunities or potential threats
(3) EA transforming capability
Our EA enables us to successfully reconfigure business processes and the technology landscape to come up with new or more productive assets
We successfully use our EA to adjust our business processes and the technology landscape in response to competitive strategic moves or market opportunities
We successfully use our EA to engage in resource recombination to match our product-market areas and our assets better
Our EA enables flexible adaptation of human resources, processes, or the technology landscape that leads to competitive advantage
We successfully use our EA to create new or substantially changed ways of achieving our targets and objectives
Our EA facilitates us to adjust for and respond to unexpected changes

EA improvisational capability EA improvisational capabilities denote the capability to repetitively engage in improvisational actions without formal planning by building new EA products and solutions that seek to enhance operational and competitive benefits. (**Pavlou**) *To what extent do you agree with the following statements? (1 – strongly disagree 7 – strongly agree)*
We apply combinations of EA resources at hand to pursue new strategic initiatives such as entering a new market
We apply combinations of EA resources at hand for new business operations
We apply combinations of EA resources at hand to plan for business expansion
We apply combinations of EA resources at hand to create new products or services
Digital capability Digital capability are a fundamental building block with which companies can transform customer experience, operational processes and business models. Think in terms of *digital technology* on emerging technologies such as Big Data, Internet of Things (IoT), Cloud Computing, augmented and virtual reality, artificial intelligence (AI), and cyber physical systems *Please indicate the level of your company's capabilities in following areas. (1 – strongly disagree 7 – strongly agree)*
Acquiring important digital technologies
Identifying new digital opportunities
Responding to digital transformation
Mastering the state-of-the-art digital technologies
Developing innovative products/service/process using digital technology
Digital platform capability Digital platform capabilities refer to the digital information technology that support information exhange activities with partners. This capability examines the firm's ability to achieve platform integration "through the timely and idiosyncratic exchange of information with its partners" and its ability to reconfigure platform resources "through modular designs and standardized interfaces in applications and processes" *To what extent do you agree with the following statements? (1 – strongly disagree 7 – strongly agree)*
Platform integration
Our platform easily accesses data from our partners' IT systems
Our platform provides seamless connection between our partners' IT systems and our IT systems (e.g., forecasting, production, manufacturing, shipment etc.)
Our platform has the capability to exchange real-time information with our partners
Our platform easily aggregates relevant information from our partners' databases (e.g., operating information, business customer performance, cost information etc.)
Platform reconfiguration
Our platform is easily adapted to include new partners
Our platform can be easily extended to accommodate new IT applications or functions
Our platform employs standards that are accepted by most current and potential partners
Our platform consists of modular software components, most of which can be reused in other business applications
Networking capability A networking capability is the firm's ability to develop and use a network of actual and potential inter-organizational relationships to gain access to resources held by other actors and the focal firm's ability to develop these capabilities by integrating parts of the organization. In terms of networking capability, to what extent do you agree with the following statements?

To what extent do you agree with the following statements? (1 – strongly disagree 7 – strongly agree)
We analyze what we would like to achieve with which collaborators
We rely on close individual relationships to secure personnel & financial resources
We judge in advance which possible partners to talk to about building up relationships
We appoint coordinators who are responsible for the relationships with our collaborators
We discuss with collaborators regularly on how to support each other to achieve success
We can deal flexibly with our collaborators
We almost always solve problems constructively with our collaborators
Operational digital ambidexterity Operational ambidexterity is the ability of a firm to continually innovate and improve its operational processes using digital technologies *Operational digital exploration capability:* An ability to fundamentally change or invent new business operations (e.g., product/service development and production, supply chain management, customer delivery, and employee management) to create new ways of performing daily tasks Using digital technology *Operational digital exploitation capability.* The ability to enhance operational productivity by improving the efficiency and cycle time of current operations and reducing their cost using digital technology *Relative to other firms in your industry, please indicate the ability of your firm to (1 – strongly disagree 7 – strongly agree):*
Operational digital exploration capability
Implement extensive innovative digital technologies (e.g., analytics, big data, cloud, social media, mobile) in business operations (e.g., product/service development and production, supply chain management, customer delivery, employee management)
Implement radical innovative digital technologies in business operations
Implement operational innovative digital technologies that are difficult to replicate by other firms
Operational digital exploitation capability
Reduce the cost of existing business operations using innovative digital technologies (e.g., analytics, big data, cloud, social media, mobile)
Improve the cycle time of existing business operations using innovative digital technologies
Improve the efficiency of existing business operations using innovative digital technologies
Data-driven decision making *Please indicate the extent to which you agree or disagree with each of the following statements by circling the appropriate number. The following scale applies to all items (1 – strongly disagree 7 – strongly agree):*
Our major operating and strategic decisions nearly always result from extensive data analytics efforts
Our major operating and strategic decisions are nearly always detailed in analytics reports.
We rely principally on experienced-based intuition (rather than data analytics analyses) when making major operating and strategic decisions. **(reversed scored)**
In general, our major operating and strategic decisions are much more affected by industry experience and lessons learned than by the results of formal research and systematic evaluation of alternatives **(reverse scored)**
Business value Business value results from intermediate-process level impact and reflects the internal perspective effect from the firm capabilities. *(1 – strongly disagree 7 – strongly agree)* Our firm: (. . .)
has very low total quality costs relative to the total output (Cost-based efficiency)
reveals outstanding delivery speed and reliability (Time-based efficiency)
Delivers high quality of products/services (differentiation)
Customizes products and services to suit individual customers
Technological turbulence

Please choose the appropriate response for each item *(1 – strongly disagree 7 – strongly agree)*
It is difficult to forecast technology developments in our industry
The technology environment is uncertain
Technological development is predictable **(reversed)**
The technology environment is complex
Market turbulence *Please choose the appropriate response for each item* *(1 – strongly disagree 7 – strongly agree)*
Customer needs and preferences change rapidly
Product demands and preferences are uncertain
It is easy to predict change in Customer needs and preferences **(reversed)**
Market competitive conditions are unpredictable
Organizational performance *During the last 2 or 3 years we relatively perform much better than our main competitors in the same industry (for non-competing governmental agencies, you could also read competitors as 'other ministries or departments') in:* *For the past few years, our company has been able to . . .* *(1 – strongly disagree 7 – strongly agree)*
Increase market share
Increase customer satisfaction
Increase profit
Enhance business brand and image.
Enhance customer loyalty.
Q: Were you able to fill in this survey with an adequate understanding of all the concepts and questions?

Appendix C

Construct	Dynamic enterprise architecture capabilities		Outer Loadings
EA sensing capability	S1	We use our EA to identify new business opportunities or potential threats	**0.734**
	S2	We review our EA services (e.g., providing content, EA standards, skills and knowledge) on a regular basis to ensure that they are in line with what our key (internal and external) stakeholders want	**0.781**
	S3	We adequately evaluate the effect of changes in the baseline and target EA on the organization	**0.729**
	S4	We devote sufficiently time enhancing our EA to improve business processes	**0.790**
	S5	We develop greater reactive and proactive strength in the business domain using our EA	**0.816**
EA mobilizing capability	M1	We use our EA to draft potential solutions when we sense business opportunities or potential threats	**0.812**
	M2	We use our EA to evaluate, prioritize and select potential solutions when we sense business opportunities or potential threats	**0.834**
	M3	We use our EA to mobilize resources in line with a potential solution when we sense business opportunities or potential threats	**0.796**
	M4	We use our EA to draw up a detailed plan to carry out a potential solution when we sense business opportunities or potential threats	**0.694**
	M5	We use our EA to review and update our practices in line with renowned business and IT best practices when we sense business opportunities or potential threats	**0.813**
EA transforming capability	T1	Our EA enables us to successfully reconfigure business processes and the technology landscape to come up with new or more productive assets	**0.800**
	T2	We successfully use our EA to adjust our business processes and the technology landscape in response to competitive strategic moves or market opportunities	**0.808**
	T3	We successfully use our EA to engage in resource recombination to match our product-market areas and our assets better	**0.751**
	T4	Our EA enables flexible adaptation of human resources, processes, or the technology landscape that leads to competitive advantage	**0.796**
	T5	We successfully use our EA to create new or substantially changed ways of achieving our targets and objectives	**0.797**
	T6	Our EA facilitates us to adjust for and respond to unexpected changes	**0.711**
Construct	**Digital capabilities**		
Digital capabilities	DC1	Acquiring important digital technologies	**0.773**
	DC2	Identifying new digital opportunities	**0.845**
	DC3	Responding to digital transformation	**0.864**
	DC4	Mastering the state-of-the-art digital technologies	**0.868**
	DC5	Developing innovative products/service/process using digital technology	**0.871**
Construct	**Organizational performance**		
Organizational performance	OP1	Increase in market share	**0.783**
	OP2	Increase in customer satisfaction	**0.871**
	OP3	Increase in profits	**0.800**
	OP4	Measure of business brand and image	**0.794**
	OP5	Measure of customer loyalty	**0.809**
Construct	**Technological turbulence**		
Technological turbulence	TT1	Difficulty forecasting technological developments	**0.870**
	TT2	The technological environment	**0.878**
	TT3	The technological development (Reversed)	**-0.034**
	TT4	The complexity of the technological environment	**0.685**

Appendix D

Cross Loadings	Digital Capability	EA Moderating capability	EA Sensing capability	EA Transforming capability	Organizational Performance	Technological Turbulence
DC1	**0.774**	0.175	0.218	0.240	0.248	0.275
DC2	**0.846**	0.174	0.226	0.319	0.315	0.225
DC3	**0.863**	0.152	0.300	0.367	0.342	0.363
DC4	**0.868**	0.196	0.432	0.371	0.301	0.372
DC5	**0.870**	0.226	0.387	0.448	0.368	0.264
M1	0.099	**0.812**	0.490	0.490	0.135	0.054
M2	0.166	**0.834**	0.469	0.484	0.117	0.073
M3	0.301	**0.796**	0.485	0.537	0.227	0.137
M4	0.110	**0.694**	0.324	0.388	0.090	0.121
M5	0.177	**0.813**	0.518	0.614	0.181	0.072
S1	0.325	0.537	**0.734**	0.479	0.233	0.199
S2	0.345	0.448	**0.781**	0.509	0.209	0.199
S3	0.220	0.392	**0.729**	0.437	0.242	0.155
S4	0.256	0.399	**0.790**	0.398	0.078	0.318
S5	0.306	0.465	**0.816**	0.440	0.196	0.261
T1	0.280	0.540	0.496	**0.800**	0.183	0.104
T2	0.192	0.544	0.395	**0.808**	0.224	0.066
T3	0.407	0.497	0.467	**0.751**	0.273	0.232
T4	0.425	0.520	0.492	**0.796**	0.360	0.124
T5	0.283	0.484	0.402	**0.798**	0.336	0.131
T6	0.381	0.401	0.500	**0.711**	0.158	0.164
OP1	0.274	0.086	0.142	0.141	**0.765**	0.187
OP2	0.337	0.195	0.291	0.321	**0.871**	0.232
OP3	0.219	0.084	0.132	0.228	**0.791**	0.233
OP4	0.363	0.186	0.206	0.285	**0.807**	0.144
OP5	0.303	0.195	0.204	0.321	**0.818**	0.142
TT1	0.327	0.050	0.275	0.164	0.195	**0.872**
TT2	0.298	0.110	0.249	0.154	0.185	**0.900**
TT3	0.253	0.126	0.191	0.108	0.183	**0.676**