How EA-Driven Dynamic Capabilities Enable Agility: The Mediating Role of Digital Project Benefits

How EA-driven dynamic capabilities enable agility: the mediating role of digital project benefits

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Abstract. As the modern business environment is highly volatile and demanding, orchestrating all business and IT components and capabilities are crucial. Firms use enterprise architecture (EA) for this purpose. However, it is currently by no means clear how EA-driven firm capabilities facilitate becoming agile. When firms are agile, they can recombine digital resources to change the business practice while also coping with uncertainty and recovering rapidly from disruption through innovative digital technologies. This study embraces the dynamic capability view (DCV), develops a model, and validates the associated hypotheses using cross-sectional data from 177 firms using a Partial Least Squares approach. The outcomes show that EA-driven dynamic capabilities are a crucial antecedent of digital project benefits. In turn, these benefits positively enhance agility. The findings shed light on becoming agile, and this study provides insights and guidance on achieving the EA-driven benefits.

Keywords: Dynamic capabilities, enterprise architecture, EA-driven dynamic capabilities, digital project benefits, agility, entrepreneurial agility, adaptive agility

1 Introduction

Modern firms in hyper turbulent markets are pressured to increase both the efficiency and effectiveness of business operations to realize the firm's strategic direction and unlock the true potential of new and disruptive digital business models [1]. Among the core directions and objectives, firms typically aim to provide digitally enhanced products and services to their customers that subsequently drive new revenue streams and increase profitability while minimizing operational and overhead costs. In recent years, firms have to respond to current challenges using new innovative digital technologies (e.g., big data analytics, Internet of Things, robotics process automation, distributed ledger technology, digital security, cloud, mobile, and social media platforms, platformization). These digital opportunities have excessively altered existing value chains and the need to become agile as a means to integrate and reconfigure digital assets and capabilities [2-5].

To orchestrate all business and information systems (IS) and information technology (IT) components and capabilities in digital and organizational transformation, firms increasingly adopt Enterprise Architecture (EA). EA helps firms document current and desirable future states of firms' digital infrastructure, processes, and capabilities [6, 7]. Therefore, EA can be considered 'a strategy' to achieve specific business

goals and objectives [6] and enable firms to become agile, aligned, customer-focused, and enable better decision-making across the firm [8, 9].

There is a wealth of scholarship on the concept of EA. However, limited scholarship exists on how firms can leverage EA to create digital business benefits and value, and therefore, substantial gaps remain in the literature [7, 10, 11]. To be more specific, there is currently no empirically work that assesses the relationship between EA-driven capabilities—that synchronize business and IT resources using EA while aligning goals, objectives with the particular use of IS/IT—, digital projects benefits, and their collective effect on agility [7, 12-15]. Digital project benefits can be considered the outcomes of discrete projects improved by EA-driven dynamic capabilities within the focal firm and consist of four components: digital distinctive competencies, digital strategic alignment, data diagnosticity, and decision-making effectiveness [1, 9, 16-18]. Digital and business-driven changes in firms typically contain these components' elements, depending on the change project's nature [7, 15, 19, 20].

Agility can be considered the firm's stance of exploring and creating new resources and their applications using new innovative digital technologies and the firm's capability to cope with uncertainty and recover rapidly from disruption through these innovative digital technologies [21-24]. In this regard, it is essential that firms consciously build and deploy the ability to proactively change while going forward as firm resources are typically scarce in the current hyper turbulent economic environment. The relationships between dynamic capabilities, digital project benefits, and agility have neither been empirically investigated nor statistically estimated. This study, therefore, aims to extend existing work on EA and benefit realization through the dynamic capabilities view (DCV) and tries to explain how EA-driven dynamic capabilities enhance agility through digital project benefits. To this end, this study's research question is as follows:

What is the effect of EA-driven dynamic capabilities on the firm's agility by realizing digital project benefits?

2 Background

Recently, studies have emphasized deploying EA resources—that focus on the development and deployment of EA artifacts—to be leveraged for business transformation and contribute to better EA-driven capabilities [7, 14]. EA-driven capabilities highlight EA's particular usage in the process of decision-making and the organizational routines that drive IT and business capabilities [7, 8]. These capabilities inform business strategies and the achievement of business objectives. They do so by evoking strategic and operational benefits and drive competitive firm performance. These particular studies build upon the DCV. Various studies argue that dynamic capabilities are the primary source of sustainable competitive advantage in industries where technology and the market change [25, 26]. Following [27, 28], this study defines dynamic capabilities as a specific subset of capabilities that allow firms to integrate, build, and reconfigure internal and external resources and competences to create new products and processes and respond to changing business environments. Teece [27] argues that strong dynamic capabilities are required for fostering the organizational

agility and associated requirements necessary for digital-driven innovation. This study claims that EAs can be leveraged within firms, but only when they are infused in the firms' dynamic capabilities that collectively use the EA to sense environmental threats and business opportunities implementing new strategic directions. Therefore, this study conceives 'EA-driven dynamic capabilities' as a dynamic capabilities that drives the firm's strategic direction and the deployment of new business and IT initiatives.

Based on the conceptualization of dynamic capabilities by [28] and recent EA-driven capabilities work [7, 29-31], three related but distinct capabilities can be synthesized, i.e., EA sensing capability, EA mobilizing, and an EA transformation capability. Firms can cultivate these capabilities and business value sources to support their strategy, business goals, and organizational benefits. We will elaborate on each of these three dynamic capabilities. A firm's EA sensing capability accentuates EA's crucial role in firm-wide procedures and routines to sense and identify new business ventures and undertakings and even possible threats. EA sensing capability also facilitates firms by proactively cultivating both a reactive and proactive capacity in the business domain [7, 32, 33].

Moreover, EA sensing capability involves evaluating the consequences of ongoing transformations on a firm's EAs [7, 33]. This capability also accentuates the deployment of EA resources to improve business processes and review EA services (e.g., providing content, EA standards, skills, and knowledge) and ensure that they are in line with what key (internal and external) stakeholders want [29]. The second capability, i.e., EA mobilizing capability refers to the firms' capability to use EA to evaluate, prioritize and select potential solutions and mobilize resources in line with a potential solution or potential threats [4, 7, 32, 34]. Once business opportunities are sensed (e.g., technological or market), firms should address them through the use of new products, processes, or services [27]. Thus, EA mobilizing capability focuses on seizing opportunities using EA and drawing up detailed plans to carry out a potential solution. The EA mobilizing capability construct also concerns EA's use to review and update firm-wide routines that are orchestrated with recognized good practices [34]. An essential requisite for EA mobilizing capability is to secure access to resources (e.g., human capital, financial resources, other capabilities) behind an informed conjecture [27]. An EA transforming capability concerns the firm's dexterity to apply EA to reconfigure working processes and the IS/IT landscape, engage in resource recombination, and adjust for unexpected changes [7]. This capability is crucial for firms that want to achieve sustained profitable growth as markets and technologies continuously change [26, 27]. Hence, an EA transforming capability accentuates the importance of using the EA in response to competitive strategic moves or market opportunities [7]. An EA transforming capability helps firms match better product-market areas and assets [33] while simultaneously using EA to create new or substantially changed ways of achieving our targets and objectives [35].

3 Model and hypotheses

Figure 1 summarizes the research model and the associated hypotheses. The model shows that four essential elements and concepts are involved, i.e., EA-driven dynamic capabilities, digital project benefits, and entrepreneurial and adaptive agility that collectively form this study's hypotheses.

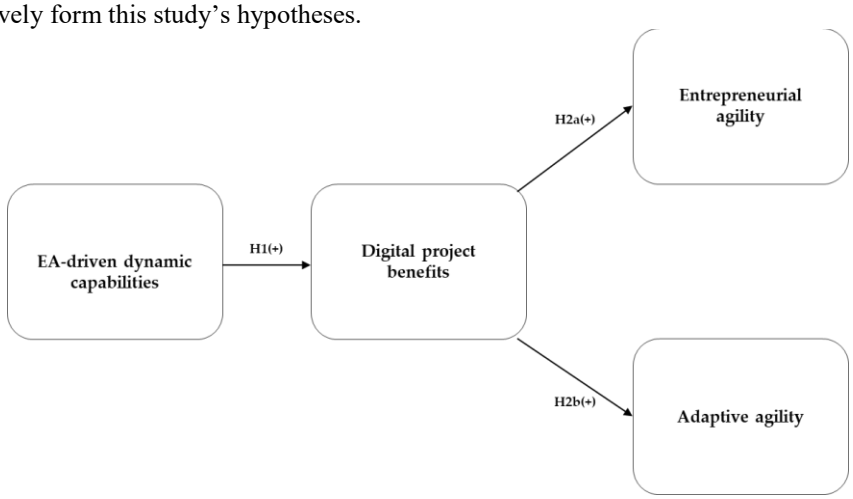

Fig. 1. Research model

EA-driven dynamic capabilities provide firms the ability to use EA in the process of enhancing data diagnosticity (i.e., retrieval of information from basic data) [16, 36], which leads to improved firm decision-making processes and support competencies to change the position of IS/IT and other firm resources geared toward the operational functioning of the firm [7, 37]. Firms can, therefore, use EA-driven dynamic capabilities to progress their digital distinctive competence—an organization's expertise in mobilizing various new innovative digital technologies through a series of routines and procedures—in key business processes and facilitate innovative work practices [12, 38, 39]. Dynamic capabilities leverage the firms' EA to bridge the communication gap between business and IT stakeholders, facilitate cross-organizational dialogue and input [40, 41], and improve digital strategic alignment [42]. Hence, it can be argued that EA-driven dynamic capabilities allow firms to continuously sense the ongoing firm-wide transformations and sufficiently react to these evolvements by recombining and redeploying business and IT assets and resources. These EA-driven capabilities provide a better understanding of business processes and IS/IT, their interdependencies, and possible synergies. They provide a foundation for identifying those critical stakeholders within the firm that might be consulted and engaged during the process and technology-driven changes [40]. Thus, EA-driven dynamic capabilities provide firms with the ability to reconfigure the business successfully and the IS/IT landscape, recombine resource, and adjust for and respond to unexpected changes is an essential driver for digital strategic alignment and thus that the firm's strategy is designed and subsequently implemented to leverage

innovative digital resources and achieve differential value [9, 43, 44]. Based on this thorough analysis, the following hypothesis is formulated:

Hypothesis 1: *EA-driven dynamic capabilities exhibit a positive effect on the firms' digital project benefits.*

This study follows previous agility scholarship [21, 24, 45] by claiming that to become agile, the firm's ability to pursue adaptive agility and entrepreneurial agility, specific digital investments, and projects is essential. Adaptive agility (i.e., exploitation mode) concerns the firm's ability to cope with uncertainty and recover rapidly from disruption by using these innovative digital technologies without fundamentally changing products or processes [21-23]. On the other hand, entrepreneurial agility (i.e., exploration mode) concerns a firm's stance on creating new resources, ideas, and applications beyond the firm's boundaries using new innovative digital technologies [21, 23, 24]. Digital project benefits facilitate various operational and strategic processes within a firm that customers ultimately value [2]. To enhance business success in the current turbulent market, firms should consider and activate the digital resources and capabilities and make digital project investments that focus on digital innovations, enhancing business operations, and synchronizing the firm's assets and resources [46]. This study argues that digital project benefits lead to agility in several ways.

First, digital distinctive competencies allow firms to utilize firm-wide technological advancements to effectively transform inputs (e.g., information, investments) into outputs, e.g., specific products or services [39]. These competencies are crucial for developing new digital innovations that reinforce the prevailing product/service and rapidly develop new digital business approaches or solutions. Improved data diagnosticity and thus the retrieval of information from basic data will enhance the firms' exploration and exploitation capabilities [16, 47] through, for instance, real-time snapshots of customer segments. These insights will enable the organization to continually look for new innovative ways to reinvent the organization using new innovative digital technologies to serve their clients better while also enabling firms to react to emerging opportunities in customer needs. Enhanced decision-making effectiveness helps firms render customers' business priorities, understand customers' needs, serve the market place better, and positively influence innovation success in turbulent markets and respond more quickly to change [17, 48, 49]. Digital strategic alignment allows firms to leverage digital resources to create differential value and improve their capacity to easily and quickly reshape their business processes in turbulent business environments through digital innovation [22]. Research on EA-driven capabilities has demonstrated that agility benefits can be achieved through EA [7, 14]. However, to achieve agility, firms need to develop particular data diagnosticity and decision-making skills and digital distinctive competences [2-4, 16, 17, 39]. Firms also need to execute their strategy by leveraging digital resources to create differential value [1, 9, 18]. Following the extant literature, it can be argued that EA-driven dynamic capabilities' effect on agility is intermediated by digital project benefits [19, 50, 51]. Firms can enhance their agility level when they direct the dynamic capabilities to develop complementary digital project benefits such as enhanced data-

driven decision-making benefits and digital resource leveraging benefits [9, 16, 17, 39, 43, 52]. Hence, the current study proposes that:

Hypothesis 2a: *Digital project benefits mediate the effect of EA-driven dynamic capabilities on the firms' entrepreneurial agility.*
Hypothesis 2b: *Digital project benefits mediate the effect of EA-driven dynamic capabilities on the firms' adaptive agility.*

4 Research method

4.1 Data collection

An online survey was developed to investigate the research hypotheses. This survey was pretested on multiple occasions by five Master students, four Ph.D. students, and five senior business professionals. The target respondents included senior IT and business managers and staff. Participating Master students of an advanced course on strategic EA management of a Dutch University were asked to fill in this survey. All the students (*N*=214) were asked to distribute the survey to two knowledgeable practitioners within their respective professional networks. The survey items were operationalized using a seven-point Likert scale ranging from strongly disagree (1) to strongly agree (7). Data were collected between the 7th of October 2019 and the 11th of November 2019. A total of 369 unique respondents from different organizations started the questionnaire. This study includes a total of 177 usable questionnaires for the analyses after carefully removing incomplete (*N*=25) or unreliable (*N*=21) cases. The majority of respondents operate either in the private sector (i.e., 52%) or the public sector (i.e., 39%). A small percentage (i.e., 9%) comes from other categories such as private-public partnerships and non-governmental organizations. The majority of responses come from senior managers (including Chief Information and Executive Officers, IT, business, and innovation managers (approximately 65%).

4.2 Measures and conceptualization

The selection of measurement scales was made following previous empirical and validated work. EA-driven dynamic capabilities are operationalized following Van de Wetering's conceptualization [29]. Hence, this construct is operationalized as a higher-order construct. Specifically, these dynamic capabilities were operationalized using a reflective-formative type II model [53]. The construct was measured using 12 equally distributed indicators across three first-order constructs, i.e., EA sensing capability (EAS), EA mobilizing capability (EAM), and EA transformation capability (EAT). Digital project benefits are the outcomes of discrete projects improved by EA-driven dynamic capabilities that are likewise operationalized and contain four first-order constructs that are often mentioned in the EA-literature, i.e., digital distinctive competencies (DC) [39], digital strategic alignment (DSA) [9, 43], data diagnosticity (DAT) [16], and decision-making effectiveness (DEC) [17]. Finally, agility is operationalized by two first-order reflective constructs entrepreneurial agility (EDA) and adaptive agility (ADA). Three items for entrepreneurial agility were included based on the

work of [21, 23, 24]. The three measurement items for adaptive agility were based on work from [21-23]. This study also included control variables: firm size (ranging from 1.: less than 100 employees to 5. over 3000 employees) and industry segment (i.e., private and public sector, private-public partnerships, non-governmental organization, non-profit organization). All measures are included in Appendix A.

4.3 Analyses using Partial Least Squares

This study applied SmartPLS version 3.2.7. [54]. SmartPLS is a Structural Equation Modeling (SEM) tool that uses Partial Least Squares (PLS). PLS is used to estimate the research model and run its associated parameter estimates. PLS maximizes the explained variance in the dependent construct and handles both reflective and formative measures [55, 56], as is the case in this research. The PLS algorithm, this study uses the path weighing scheme within SmartPLS.

Finally, a non-parametric bootstrapping procedure (using 5000 replications) was employed to obtain stable results and interpret their significance of the path coefficients between this study's key construct. This study uses a two-step approach to investigate PLS outcomes. First, using confirmatory factor analyses assesses the model's psychometric properties. Then, the hypotheses are tested using the outcomes of the structural model assessment.

5 Empirical findings

5.1 Measurement model analysis using PLS

The model's psychometric properties were assessed using the internal consistency reliability, convergent validity, and measurement validity of the first-order latent constructs [54]. All construct-to-item loadings exceeded a threshold of 0.70. Next, all Cronbach's alpha (CA) values are above the same threshold. The Appendix includes an overview of reliability and validity results. The average variance extracted (AVE), to evaluate convergent validity, is used to assess the degree of variance captured by the latent construct while relating it to the amount of variance due to measurement error [54]. The AVE-values exceeded the lowest recommended mark of 0.50 [57]. Finally, to assess discriminant validity, this study employed a heterotrait-monotrait ratio of correlations (HTMT) analysis. HTMT proved to be the most reliable method of assessing discriminant validity in variance-based models [58]. HTMT values are all well below the upper bound of 0.90, confirming discriminant validity.

5.2 Hypotheses testing

The outcomes of the model fit1 index analysis were strong. Hence, the obtained Standardized Root Mean Square Residual (SRMR) of 0.06 is well below the con-

[1] Please note that these particular PLS model fit indices are in an early stage of development.

servative proposed mark of 0.08 [59]. Hence, the structural model and the hypotheses test can now be examined. This study investigated each hypothesized path's significance and the coefficient of determination (R^2), measuring the model's predictive power [60] to test the hypotheses. Also, the model's predictive power is assessed [60].

The results show that dynamic capabilities positively influence (β =.55; t = 9.061; p < .0001) digital project benefits. Thus, hypothesis 1 is supported. Also, digital project benefits had a significant impact (β =.67; t =17.29; p < .0001) on entrepreneurial agility, thereby confirming hypothesis 2a. Digital project benefits also significantly impact adaptive agility (β =.71; t =18.05; p < .0001); confirming hypothesis 2b.

This study follows mediation guidelines by [60] to systematically investigate if digital project benefits fully or partially mediate the relationship between dynamic capabilities and adaptive and entrepreneurial agility. When digital project benefits were removed from the model, the direct effects of dynamic capabilities were significant. It can be concluded that digital project benefits fully mediate the effect of dynamic capabilities on the firms' adaptive and entrepreneurial agility. The included control variables 'size,' and 'industry' showed non-significant effects. Outcomes show that the assessed model explains 30% of the variance for digital project benefits (R^2 = .30), 51% of the variance for adaptive agility (R^2 = .51) and 45% of the variance for adaptive agility (R^2 = .45). These effect sizes are considered moderate to large [60]. A blindfolding procedure is used to assesses the model's predictive power [60]. Hence, the obtained Stone-Geisser values (Q^2) for the endogenous latent constructs should all be higher than 0 as an indication of predictive relevance. All Q^2 values exceed 0.30, indicating the research model's overall predictive relevance [60].

6 Discussion of the results and concluding remarks

This study tried to explain how EA-driven dynamic capabilities enhance firms' agility through digital project benefits. This paper shows that EA-driven dynamic capabilities positively affect the firms' digital project benefits and that these benefits positively influence the firms' capacity to pursue an entrepreneurial and adaptive stance on agility. Finally, the outcomes show that the effect of dynamic capabilities on agility is indirect, and thus digital project benefits fully mediate this particular effect. Hence, firms that do not have developed their EA-driven dynamic capabilities could be underutilizing their resources, thus prohibiting digital agility and the recombination and development of new products, services, and business models that enhance the value created for the customer.

This work adds to the theoretical knowledge base by making three contributions. The results shed light on the current lacunas in the extant literature concerning the mechanisms through which business benefits can be achieved using EA-driven capabilities. Second, this work extends existing work on EA-driven capabilities and the 'type' of benefits that can be achieved. Third, prior studies of dynamic capabilities have focused on how firms could address the turbulent business environment by facilitating managers to modify existing operational capabilities into new ones and thereby create a competitive edge over competitors [35]. This work complements previous

studies by focusing on the value of digital project benefits in achieving agility, an essential quality required to achieve digital transformation in the current turbulent market using innovative digital technologies like AI, big data analytics, and IoT [2, 3, 61].

The outcomes of this study provide managerial implications in two ways. First, the outcomes imply that decision-makers and senior business and IT practitioners need to have a comprehensive view of the state of practice of their respective dynamic enterprise architecture capabilities. EA-driven dynamic capabilities are crucial in leveraging the firms' business and IT resources and obtaining digital project benefits. Hence, dedication and shaping appropriate conditions for developing these capabilities are essential for a firm's ability to obtain digital project benefits. Second, as the EA-driven dynamic capability construct reveals, it comprises various underlying key capabilities and complementary managerial practices. Investing in each of these elements in isolation is unlikely to achieve the desired outcomes [62]. Consequently, the impact of a system of complementary EA-driven practices will be greater than the sum of its parts because of the synergistic effects of bundling practices together [62]. Therefore, decision-makers should actively look for ways to invest in these capabilities and routines to build and develop digital resources and project benefits.

Several study limitations should be mentioned. First, data were collected at a single point in time (cross-sectionally) and thus providing only a snapshot of the firm's well-being, limiting our comprehension of the relationships among the included constructs in this study. A longitudinal approach could provide a richer understanding of the dynamics among the critical constructs in this study. Second, this study used self-reported measures that could be subject to hindsight and possible biases. However, obtaining comparable archival and objective measures is a challenging endeavor, and self-reported data is justifiable, as these data types are typically strongly correlated to objective measures.

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Appendix A: Survey constructs and items

Construct	**Measurement item**
*To what extent do you agree with the following statements? (1. Strongly disagree–7. Strongly agree). * EAS EAM, EAT use the same Likert scale.*	
EAS*	We use our EA to identify new business opportunities or potential threats
	We review our EA services regularly to ensure that they are in line with key stakeholders wishes
	We adequately evaluate the effect of changes in the baseline and target EA on the organization
	We devote sufficient time to enhance our EA to improve business processes
EAM	We use our EA to draft 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
EAT	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 better match our product-market areas and our assets
	Our EA enables flexible adaptation of human resources, processes, or the technology landscape that leads to competitive advantage
Please choose the appropriate response for each item (1 – strongly disagree 7 – strongly agree)	
DSA	Our organization has a digital strategy to use novel digital technologies (e.g., big data analytics, IoT, robotics process automation, cloud) to enter new market segments.
	Our organization has a digital strategy to develop new innovative digital technologies for new kinds of products/services.
	Our digital strategy is one that in practice encompasses a fusion view, in which both the information technology and business strategy are equated.
Indicate the degree to which you agree or disagree with the following statements about whether the organization has (1 – strongly disagree 7 – strongly agree)	
DC	Competence to obtain information about the status and progress of science and relevant new innovative digital technologies like big data analytics, IoT, robotics process automation, digital security, cloud, mobile and social media platforms
	Competence to generate advanced processes driven by new innovative digital technologies
	Competence to assimilate new innovative digital technologies and useful innovations
	Competence to attract and retain qualified scientific-technical staff with adequate digital technologies skills
	Competence to dominate, generate or absorb basic and new innovative digital business technologies
We are more effective than our competitors at: (1 – strongly disagree 7 – strongly agree)	
DEC	Responding quickly to change
	Making real-time decisions
	Understanding customers
To what extent do you agree or disagree with the following statements? (1 – strongly disagree 7 – strongly agree). In my firm, the understandings/conclusions that we arrive while processing information are often	
DAT	Sophisticated
	Deep
	Creative
	Relevant
Please indicate your firm's capabilities relative to competition for each of the following. (1 – strongly disagree 7 – strongly agree).	
EDA	We constantly look for ways to reinvent/reengineer our organization using new innovative digital technologies to better serve our market place
	We are the first to market with new digital business approaches or solutions
	We develop digital innovations and solutions that fundamentally change our prevailing products/services
ADA	We rapidly react to emerging opportunities in customer needs using new innovative digital technologies
	We rapidly respond to competitive and operational threats (e.g., process and organizational disruptions) through the use new innovative digital technologies
	We develop new digital innovations that reinforce our prevailing product/service lines