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How Does Enterprise Architecture Add Value to Organisations?

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Abstract:

Enterprise architecture (EA) is the definition and representation of a high-level view of an enterprise's business processes and IT systems, their interrelationships, and the extent to which these processes and systems are shared by different parts of the enterprise. EA aims to define a suitable operating platform to support an organisation's future goals and the roadmap for moving towards this vision. Despite significant practitioner interest in the domain, understanding the value of EA remains a challenge. Although many studies make EA benefit claims, the explanations of why and how EA leads to these benefits are fragmented, incomplete, and not grounded in theory. This article aims to address this knowledge gap by focusing on the question: How does EA lead to organisational benefits? Through a careful review of EA literature, the paper consolidates the fragmented knowledge on EA benefits and presents the EA Benefits Model (EABM). The EABM proposes that EA leads to organisational benefits through its impact on four benefit enablers: Organisational Alignment, Information Availability, Resource Portfolio Optimisation, and Resource Complementarity. The article concludes with a discussion of a number of potential avenues for future research, which could build on the findings of this study.

Keywords: enterprise architecture, IT architecture, IT planning, strategic planning, IT infrastructure, performance

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I. INTRODUCTION

Enterprise architecture (EA) is the definition and representation of a high-level view of an enterprise's business processes and IT systems, their interrelationships, and the extent to which these processes and systems are shared by different parts of the enterprise. The primary goal of EA is to define the desirable future state of the organisation's business processes and IT systems (often referred to as the "to-be" or target architecture) and to provide a roadmap for achieving this target from the current state ("as-is" or baseline architecture) [Zachman, n.d.]. Two key components of EA are the planning process ("definition"), and the direct and tangible outputs of that planning process ("representation"), i.e., EA documentation (e.g., architecture diagrams, roadmaps, and other artefacts).

As an organisational role, EA is positioned between IT and business strategy formulation on the one hand, and project-focused solution architecting (sometimes called system architecting) on the other. The task of EA is to translate the broader principles, capabilities, and goals defined in the strategies into systems and processes that enable the enterprise to realise these goals. In this regard, EA is a step towards enacting strategy. In turn, EA guides solution architectures that are defined prior to specific development or implementation projects and which provide the finer specifications necessary for operationalising those systems. The aim of EA is to guide the building of the organisation's operating platform, i.e., the IT systems and digitised business processes that support or automate an organisation's core capabilities [Ross et al., 2006]. This mediating role means that EA is similar to strategy, in that it aims to provide a long-term and organisation-wide vision of business processes and IT systems, but it describes this vision in significantly greater detail.

Since the concept of EA first appeared in academic literature around the early 1990s [Zachman, 1987; Richardson et al., 1990],[1] it has generated substantial practitioner interest. A recent survey by Infosys claims that around 90 percent of the respondent organisations have an EA function [Obitz and Babu K, 2009], various professional organisations (e.g. CAEAP, GEAO, IFEAD, The Open Group, ZIFA, etc.) and government EA initiatives (e.g., FEAF, DoDAF, GEA, MoDAF, etc.) have been established, and most large global management consulting firms offer EA-related services.[2] All of this suggests that organisations around the world spend a considerable amount of time and effort on EA.

At the same time, however, academic activity in the domain has remained comparatively modest. Much of the research and highest-cited works in the field come from the practitioner community, not academe. In fact, only three articles on EA have been published in the Senior Scholars' six top IS journals[3]—one in the *European Journal of Information Systems* [Peristeras and Tarabanis, 2000], one in the *Journal of Management Information Systems* [Boh and Yellin, 2006], and one in *MIS Quarterly* [Richardson et al., 1990]. Additionally, only two of the top ten highest-cited works on EA[4] have been published in academic journals or conferences. Existing studies tend to focus on the applied aspects of EA, in particular how to plan and represent it. At the same time, more fundamental questions—Why is EA useful? How do organisations benefit from EA?—have been somewhat overlooked. Although there are numerous benefit claims in the literature, these are often not explained nor supported by empirical evidence. Organisations also struggle to justify their EA investments [Aziz and Obitz, 2007; Obitz and Babu K, 2009], which again points to a lack of a clear understanding of EA benefits.

The significant practitioner and organisational interest in EA on the one hand, and the struggle to demonstrate value on the other, raise interesting questions about the value proposition of EA. What are the potential benefits of EA? What are the mechanisms through which EA leads to these benefits? What are the theoretical underpinnings, and empirical evidence, that support these expectations? It is these and similar questions that provided the motivation for this study. The question the study seeks to answer is: How does EA lead to organisational benefits?

[1] Zachman's [1987] article on "information systems architecture" is often regarded as the seminal work on EA. However, the term "enterprise architecture" (introduced to emphasise the necessity for a more business-oriented planning approach) appears to have been used in the academic literature for the first time by Richardson et al. [1990].
[2] Examples include Accenture, BCG, Capgemini, Deloitte, Ernst & Young, Fujitsu, Gartner, IBM, and KPMG.
[3] The statement by the AIS Senior Scholars Forum suggests that the top IS journals are *European Journal of Information Systems, Information Systems Journal, Information Systems Research, Journal of Association for Information Systems, Journal of MIS,* and *MIS Quarterly* [AIS, n.d.].
[4] Based on Google Scholar citation count as of September 17, 2008.

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To address this question, the study synthesises the existing EA literature and draws on broader IS and management theories to propose a synthesis of the EA benefit claims and an improved theoretical explanation of the underlying mechanisms. The paper begins with a description of the research method, followed by a discussion of the current state of knowledge on EA benefits. Drawing on the findings of the literature review, the paper proposes the Enterprise Architecture Benefits Model (EABM). It is hypothesised in the EABM that EA leads to organisational benefits through its impact on four key benefit enablers: Organisational Alignment, Information Availability, Resource Portfolio Optimisation, and Resource Complementarity. The paper concludes with recommendations for further research that could build on the EABM and other findings of this study.

II. RESEARCH APPROACH

To develop an overview of the existing literature on EA and its benefits, two search approaches were employed. First, a systematic review approach was used to look for publications on EA benefits, as well as EA in general. Average citation count per year was used as a proxy measure to identify highly cited and, therefore, probable core publications. However, filtering based on citation count alone might have excluded some useful and highly relevant works. Therefore, an exploratory approach was used in parallel to the systematic review to find additional insightful publications on the questions of interest. This proved useful, as it led to the identification of some studies that would otherwise have been overlooked (e.g., some very recent academic studies [Kettinger et al., 2010; Salmans and Kappelman, 2010], insightful practice-oriented EA surveys [Aziz and Obitz, 2007; Obitz and Babu K, 2009], etc.). The two review approaches, as well as the synthesis process followed to derive the EABM, are described below.

Systematic Review

The purpose of the systematic review was to ensure comprehensive coverage of the highly influential works in the EA space, based on a relatively objective selection method to reduce potential biases, e.g., the authors' familiarity with a subset of literature or personal preferences. This selection method also enabled some conclusions on the primary research interests in the field to be made.

To identify the relevant literature, two online databases were used to search for the term "enterprise architecture"—Scopus for its good coverage of academic journals, and Google Scholar for its extensive coverage of both journals and books. The search yielded a total of 5,079 results (4,639 from Google Scholar and 440 from Scopus). After merging and removing of duplicates, the sample (4,392) remained too extensive for an in-depth analysis. It was also found to contain a large number of entries with low (or no) relevance. Therefore, only the more influential works with EA as a key focus (in the case of books, the key focus in at least one chapter) were chosen for further analysis.

In order to determine the final set of publications for analysis, Google Scholar's citation count was used as a proxy measure of relative importance of the works. The threshold for inclusion in the review was set to a minimum of twenty-five citations in total, or an average of five citations per year. This limited the sample to 282 articles. Although representing about 6.4 percent of the total number of articles, the total citation count for the selected articles forms 72 percent of that of the entire result pool.

The 282 publications were then filtered for relevance by analysing the abstracts and skimming the content, resulting in fifty-three relevant (i.e., EA-focused) publications. The full texts of fifty of these could be obtained, and they form the basis for the systematic review. The first author then carefully examined all the fifty publications, searching for discussion of EA benefits. As part of the analysis, the key themes of each publication were also identified to develop a better understanding of the primary areas of interest in EA research, and to determine how many existing publications have had a significant focus on EA benefits. These fifty studies are listed in Appendix 1, along with a high-level analysis of the key topics discussed in each article.

For each publication, all EA benefit claims were summarised in a spreadsheet. The strength of evidence for each benefit claim was also recorded as belonging to one of three categories: empirical evidence, references to prior studies, or no evidence provided. In all, this resulted in 213 recorded benefit claims, many of which were identical or very close in meaning. After three cycles of comparing the different claims to identify similarities, overlaps, and groupings, a total of twelve unique EA benefits were identified. (These twelve EA benefits are listed shortly in the first row of Table 2.)

Following the analysis of individual benefit claims, the focus turned to the primary question of interest in the study: *How* does EA lead to these benefits? Despite the numerous benefit claims (forty one of the fifty studies mentioned at least some EA benefits), the explanations were in most cases missing. Among the fifty studies reviewed, only five

[Bernard, 2005; Richardson et al., 1990; Ross et al., 2006; Ross and Westerman, 2004; Spewak and Hill, 1992] provided more than a passing discussion of these details.[5]

A challenge that we faced in conducting this literature review was that it was difficult to get a concise overview of the explanations, as they were not always presented as a coherent whole in the publications. Instead, the supporting explanations often emerged piecemeal throughout the publication. In an attempt to assist with understanding and comparison, diagrams of the claims made in each of the five studies above were prepared. These diagrams are included in Appendix 2 in the hope that they may provide useful summaries and reference for future studies.

Exploratory Review

The sole use of the systematic approach described above has two potential weaknesses. First, it can lead to the exclusion of some highly relevant publications with modest citation counts. Second, some works on what is defined here as enterprise architecture refer to it with a different name. Therefore, an exploratory approach was used in parallel to identify highly relevant publications that would otherwise have been missed.

The primary criterion for including additional publications as part of the exploratory review was that they needed to contribute insights or empirical evidence beyond that of publications identified through the systematic review. As the name suggests, the exploratory review did not follow a strictly systematic approach. The search approach primarily involved trying various keywords using online search tools such as Google and following up references cited by the publications identified during the systematic review. The following terms were considered potentially relevant and were treated as candidates for inclusion: IS/IT architecture, enterprise service-oriented architecture (enterprise SOA), IS/IT platform, business architecture, strategic architecture, strategic capabilities architecture, business platform, architecture framework, and enterprise integration architecture. Also, publications using the term "enterprise architecture" which did not conform to the minimum citation count threshold for the systematic review, but which were found to be highly relevant to the EA benefits question, were included as part of the exploratory approach. In all, the exploratory review added seventeen further publications to the literature pool that informed this study, bringing the total number of reviewed publications to sixty-seven.

Synthesis and Theory Development

Although the existing explanations about how EA leads to organisational benefits, when provided, appeared logical and plausible, a general lack of empirical evidence and theoretical justification was of concern. Also, as can be seen in the diagrams in Appendix 2, it was evident that the proposed benefits were often interrelated or overlapping. Finally, some studies appeared to focus on the benefits derived directly from EA planning [e.g., Bernard 2005], whereas others focused on the benefits from the enactment of the plans [e.g., Ross et al., 2006].

The focus of the analysis therefore turned to integrating these findings. We revisited both (1) the list of EA benefit claims and (2) the studies that proposed explanations about the relationships between the different factors (primarily those presented in Appendix 2). The claimed resultant organisational benefits (e.g., cost reduction, strategic agility, operational excellence) were too distant from EA to clearly explain *how* these benefits can be achieved. Therefore, we focused on identifying the underlying benefit enablers—factors which could be clearly seen as EA outcomes, and that in turn are known to have the potential to deliver organisational benefits.

In order to identify these benefit enablers, the first author took the list of benefit claims and themes identified earlier as part of the systematic and exploratory literature review and examined and regrouped the factors until a classification was reached where all the major EA benefit claims could be explained by one, or a combination, of the identified benefit enablers. Also, the proposed EA outcomes and mechanisms through which they lead to organisational benefits were required to map back to the identified benefit enablers.

The identification of the factors passed through four major iterations and numerous smaller refinements. Diagrams and tables were used in the course of the analysis to assist with the factor groupings and mappings. An example of a table compiled to assist with the analysis is presented below (Table 1). The first column shows the benefit enablers. The initial set of benefit enablers was derived based on a preliminary analysis of the benefit claims and explanations, and then refined in subsequent iterations. The next step was to determine whether the other related concepts (second column) as well as the outcomes and benefits (third column) could be mapped to the identified benefit enablers. During the initial iterations, it was often found that gaps existed, which in turn led to revisions of the list of benefit enablers (e.g., a factor from the second column became a candidate benefit enabler).

[5] As shown in Appendix 1, nine studies had EA benefits among the primary themes. However, two of these studies only focused on a particular aspect of EA—Perks and Beveridge [2003] discuss technical architecture and Kosanke et al. [1999] concentrate on integration and modelling. Another two studies listed benefits, but did not describe the "how" and "why."

Once a more stable classification was reached, two other co-authors discussed and challenged the benefit enablers in order to identify potential gaps or overlaps. The aim was to ensure that the identified factors were both collectively exhaustive and mutually exclusive, i.e., that they collectively explained all the major benefit claims and that there were no significant overlaps between the benefit enablers. A degree of overlap between underlying drivers or outcomes was considered to be acceptable if the related explanation of *how* a particular organisational benefit may emerge was substantially different. For example, increased customer intimacy [Ross et al., 2006] can be explained by (1) knowing the customer better due to the increase in information availability, and (2) by sharing a common culture and approach of interacting with the customers achieved through increased organisational alignment. Although the high-level outcome may appear similar, the pathways and their specific influence is different.

Table 1: Benefit Claim Mappings

Benefit Enabler	Related Concepts	Related Outcomes and Benefits
Organisational Alignment	Integrated view of the enterprise; common understanding; improved communication [Bernard, 2005] Bridge between the business and technical domains; common goals and performance measures [Pereira and Sousa, 2004] Business-IT alignment [Ross et al., 2006] The link between organizational and IS strategies is made stronger [Segars and Grover, 1996]	Reduced rework [Bernard, 2005] Identify and resolve conflicts; consensus [Richardson et al., 1990] Encourage cooperation rather than conflict [Pereira and Sousa, 2004] More customer intimacy [Ross et al., 2006]
Information Availability	Standardised and shared reference information; better access to information; improved understanding of resources/processes [Bernard, 2005] Better access to customer data; shared data; more manageable IT environment, improved risk management; higher system reliability [Ross et al., 2006] Common data; more accurate, accessible and timely data [Spewak and Hill, 1992] Single sources of data; improve information quality [Venkatesh et al., 2007]	Better and faster decisions [Bernard, 2005] Improved information flow [Richardson et al., 1990] More customer intimacy [Ross et al., 2006] Prioritization of systems; business reengineering [Segars and Grover, 1996] Improved decision-making [Spewak and Hill, 1992]
Resource Portfolio Optimisation	Discovery and elimination of redundancy [Pereira and Sousa, 2004] Homogeneous architecture [Richardson et al., 1990] Standardisation; reduction of technologies [Ross et al., 2006] Fewer costly and complex interfaces; common code [Spewak and Hill, 1992] Standardizing IT applications and business processes [Venkatesh et al., 2007]	Reduced resource duplication, fewer people in a process; reduced costs [Bernard, 2005] Reduced support costs, software portability [Richardson et al., 1990] Reduced skill variation; simplified troubleshooting; lower IT costs; focus on core competencies through selective outsourcing [Ross and Westerman, 2004] Higher ROI from IT; better operational excellence [Ross et al., 2006] Economies of scale [Venkatesh et al., 2007]
Resource Complementarity	Improved resource integration [Bernard, 2005] Componentisation; enhanced interoperability [Ross et al., 2006] Integrated systems [Segars and Grover, 1996]	Improved performance [Bernard, 2005] Re-use of technology and expertise [Ross and Westerman, 2004] Increased IT responsiveness; strategic agility [Ross et al., 2006]

The study also sought to provide a theoretical explanation for the identified concepts and relationships. Therefore, an additional literature search was performed to identify key publications in IS and management theory that related to the emerging benefit enablers. This led to further refinement of the concepts, and aided in the interpretation of some benefit claims that had not been fully explained in EA literature. The result of this process is the Enterprise Architecture Benefits Model (EABM), described in-depth in Section IV below.

III. LITERATURE REVIEW

As noted above, the extant literature on EA benefits is generally characterised by numerous benefit claims with little supportive explanation and evidence. Table 2 shows a selection of these benefit claims from the literature review, and compares it with a few influential practitioner-oriented sources. Of the fifty studies analysed as part of the systematic literature review, forty-one mentioned at least some EA benefits. It should be noted, however, that only six of these studies provided empirical evidence (often limited) to support the benefit claims. Some of the most commonly cited benefits (listed in the first row of Table 2) were: (1) increased responsiveness and guidance to change, (2) improved decision-making, (3) improved communication and collaboration, (4) reduced costs, and (5) business-IT alignment.

Table 2: Organisational Benefits from EA Reported in Literature

Academic Studies	
Systematic Literature Review (50 studies)	(1) increased responsiveness and guidance to change; (2) improved decision-making; (3) improved communication & collaboration; (4) reduced (IT) costs; (5) business-IT alignment; (6) improved business processes; (7) improved IT systems; (8) re-use of resources; (9) improve integration; (10) reduce risk; (11) regulatory compliance; (12) provides stability
SIM EA Survey, 2007 [Salmans and Kappelman, 2010]	(1) improves interoperability between information systems; (2) improves utilisation of IT; (3) aligns business objectives with IT investments; (4) more effective use of IT resources; (5) better situational awareness; (6) more responsive to change; (7) improves organisational communications and information sharing; (8) assists with organisational governance; (9) improves ROI from IT spending; (10) less wasted time/money on projects which do not support business goals/objective; (11) more effective at meeting business goals; (12) improves IS security across the business; (13) better collaboration within organisation; (14) improves communications between the organisation and IT department; (15) reduces IT complexity; (16) reduces organisational stovepipes; (17) faster development and implementation of new IS; (18) standardises organisational performance measures; (19) improves communications within organisation
Professional Studies	
Infosys EA Survey, 2007 [Aziz and Obitz, 2007]	(1) reduced IT cost; (2) higher business and process flexibility; (3) improved customer satisfaction; (4) enabling of business and process change; (5) better business-IT alignment
Infosys EA Survey, 2009 [Obitz and Babu K, 2009]	(1) improved customer satisfaction; (2) reduced IT cost; (3) business process improvement/ standardisation; (4) better business-IT alignment; (5) higher business and process flexibility
TOGAF 9 [The Open Group, 2009]	more efficient IT operations; lower IT costs; maximum ROI from existing IT; reduced risk for future IT investments; reduced IT complexity; faster, simpler, and cheaper procurement
Zachman International [Zachman, 2001]	(1) alignment enabler; (2) integration enabler; (3) change enabler; (4) reduced time-to-market
The benefits from the literature review, Infosys, and SIM surveys are ranked based on how often they were mentioned by authors/respondents. The benefits from Zachman [2001] are listed in the order presented by the author, though it is not clear whether any ranking was implied.	

The most recent academic study with a significant EA benefits component [Salmans and Kappelman, 2010] was based on a survey of 377 practitioners. It presented respondents with a list of twenty potential EA benefits and asked to rate them on a 5-point Likert scale. For nineteen out of the twenty benefits, at least 60 percent of the respondents agreed or strongly agreed. These nineteen EA benefits are listed in the second row of Table 2. As acknowledged by the authors of the survey, this very high agreement rate may at least in part be attributed to the fact that the respondents were asked to comment on *potential* benefits of EA (rather than benefits they have actually observed) and that they were presented with a precompiled list of proposed benefits. The findings of the survey may, therefore, need to be treated with care.

In addition, Table 2 summarises the benefit claims from three influential practitioner sources: Infosys, The Open Group, and Zachman International. The annual Infosys EA survey [Aziz and Obitz, 2007; Obitz and Babu K, 2009],

is likely the largest regularly conducted survey focused on EA trends with publicly accessible reports.[6] The Open Group is among the largest professional EA communities and the author of possibly the widest-adopted EA standard—The Open Group Architecture Framework (TOGAF).[7] Zachman International is an organisation founded by John A. Zachman, who is often regarded as the founding author of EA and has written some of the most influential articles in the EA field.[8]

Comparison of the different claims reveals a high agreement between authors about the reduction of costs, particularly of IT costs, as a tangible EA benefit. Increased capability to change, improved alignment between business and IT, and business process improvements are also mentioned repeatedly by academic as well as practitioner sources.

How Does EA Lead to Organisational Benefits?

Despite the numerous benefit claims, very few studies provide explanations about how EA leads to benefits. Empirical evidence to back the explanations is even more scarce. As noted earlier, only five studies were identified that devoted considerable attention to explaining EA's role in achieving organisational benefits [Bernard, 2005; Richardson et al., 1990; Ross et al., 2006; Ross and Westerman, 2004; Spewak and Hill, 1992]. Their arguments are summarised in the diagrams presented in Appendix 2.

The analysis of the explanations about how EA leads to organisational benefits confirmed the need to distinguish clearly between benefits flowing directly from EA, and the subsequent impact of EA on the real-world state of the organisation [Zachman, 2010]. This distinction is often overlooked in existing research, but it leads to two distinct pathways from EA to organisational benefits.

Benefits from EA

In this study, EA is defined as the definition and representation of a high-level view of an enterprise's business processes and IT systems, their interrelationships, and the extent to which these processes and systems are shared by different parts of the enterprise. Here, "definition" refers to the *process* of EA planning, and "representation" to the direct and tangible *outputs* of that planning process (i.e., the EA artefacts, including architecture drawings, roadmaps, and other documentation). It is necessary to consider both when discussing EA benefits, as not all outcomes and benefits of the planning process may be reflected in the documentation. Additionally, it may not always be possible or meaningful to distinguish between outcomes from the process and from the documentation—e.g., should the better understanding of business processes be attributed to the planning (during which the knowledge was generated), or to the plans (in which the knowledge is stored)? Therefore, it is useful to view *both* the planning process and its outputs as an integral part of EA.

Some benefits may flow directly from EA. These benefits relate to the increased knowledge about the organisation and its goals (e.g., a better understanding of the business processes or the organisation's current IT systems as a result of the EA analysis) and may help decision-makers make better-informed decisions. This pathway has received very little attention in existing research, possibly because of lower visibility and difficulties in measuring the benefits from planning, as they tend to be less tangible.

Only one study that discussed benefits from EA planning was found [Bernard, 2005, see Figure A2.1]. Bernard suggests that a standardised planning approach (i.e., a common analysis and documentation methodology) applied across business unit and departmental boundaries leads to integrated and improved information about the organisation's resources. This, in turn, enables better communication and common understanding between different stakeholders and helps to reduce re-work and duplicated efforts. Ultimately, Bernard [2005] claims, this leads to better and faster decisions, reduced cycle times, improved (IT) performance, and lower costs.

The underlying benefit driver here is a better understanding and increased access to information about the organisation itself, emanating from the planning process and stored in the EA artefacts. Although at first glance the reasoning may appear similar to other studies discussed below, the explanations behind the source and the nature of the benefits presented by Bernard [2005] are in fact very different. This can be illustrated by comparing the seemingly similar factors of "better access to information" [Bernard, 2005] and "better access to customer data" [Ross et al., 2006]. Whereas Ross et al. [2006, p. 2] focus on the shared access to customer data—implying that an improved operating platform has been previously implemented—Bernard [2005, p. 69] refers to information about

[6] The survey had 315 responses in 2007 and 207 in 2008 (effective sample size 262 and 173 correspondingly).
[7] TOGAF had the highest adoption rate among Infosys EA survey respondents (32 percent) [Obitz and Babu K, 2009].
[8] Zachman's three highest-cited works on EA have a total citation count of 1,879 (based on Google Scholar as of August 12, 2009). This is higher than the combined citation count of the top twenty highest-cited works on "enterprise architecture."

the organisation itself, that is stored in the EA artefacts. The nature of the stored information in these two examples (about customers in Ross et al. and the organisation itself in Bernard)—and even how and where it is stored—is very different.

Although Bernard's [2005] study proposes a clear link between EA and benefits, its weakness lies in the lack of evidence to support those claims. Neither the research method nor the research sample are discussed. Nor are any illustrative real-world examples presented to validate the claims.

Benefits from an EA-Guided Operating Platform

Most of the EA benefits discussed in the literature depend on the enactment of the EA plans. This is not surprising since the key purpose of EA is to guide the building of an improved operating platform, i.e., the IT systems and digitised business processes that support or automate an organisation's core capabilities [Ross et al., 2006, p. 4].[9]

It is important to note that the operating platform can exist and evolve regardless of EA. Every organisation has processes and systems, but not all organisations engage in EA planning. Therefore, to demonstrate the value of EA in relation to the benefits that are contingent on the implementation, it needs to be shown that EA either enables the organisation (a) to build an operating platform that would otherwise not have been possible, or (b) to improve the delivery of the platform in some way (e.g., faster, cheaper, or with increased likelihood of success).

A number of studies discuss benefits from an EA-guided operating platform. A prevalent claim is that an EA-guided operating platform is likely to have a higher level of standardisation and integration [e.g., Bernard, 2005; Boh and Yellin, 2006; Ross and Westerman, 2004; Spewak and Hill, 1992]. However, apart from the themes of standardisation and integration (which are not organisational benefits *per se*), the various studies tend to diverge in the ultimate benefit claims and the discussion of related underlying mechanisms.

For example, in one of the earliest studies on EA, Richardson et al. [1990] (Figure A2.2) argue that it is through building consensus and a homogenous (standardised) architecture that EA enables an enterprise to achieve improved information flows and reduced IT costs. In a book published two years later, Spewak and Hill [1992] (Figure A2.5) claim that EA enables a firm to achieve well-planned and tightly integrated systems, leading to more reliable systems and data and to increased reuse, which ultimately results in higher responsiveness, better decisions, service improvements, reduced costs, and higher employee morale. More recently, Ross and Westerman [2004] (Figure A2.3) claim that through standardisation, EA enables componentisation and increases the possibilities for reuse and reduced duplication of technologies. According to the study, standardisation and componentisation improve a company's chances of succeeding with outsourcing and lead to a number of other improvements, which ultimately translate into lower IT costs, reduced time-to-market, and enable the organisation to focus on their core activities. These ideas are developed further by Ross et al. [2006] (Figure A2.4)—again, standardisation, integration, and componentisation appear to be the primary benefit drivers according to the study, but ultimately, Ross et al. claim, EA enables an organisation to improve operational excellence, customer intimacy, product leadership, and strategic agility. Note that the ultimate benefit claims in these studies are different.

Further, although most of these studies attribute improvements in the operating platform to EA, the role that EA plays in leading to these improvements is often not thoroughly discussed. For example, Ross et al.'s [2006] discussion of benefits is focused on the operating platform and the role of EA in building that platform receives only limited attention. Although the authors state that EA is of key importance by allowing the organisation to map out "important processes, data, and technology enabling desired levels of integration and standardisation" [Ross et al., 2006, p. 92], why this is the case and how this happens is left largely unexplained.

There are two key questions that need to be addressed to understand better the impact of EA on the operating platform and resultant benefits. First: *How does EA help improve the operating platform and could these improvements be achieved without the use of EA?* As will be shown in Section IV below, it appears that EA may really have the potential to contribute to improvements of the operating platform that may otherwise not be possible or very difficult to achieve. This is primarily due to looking across the various internal boundaries of the organisation, and the close consideration of both business and technology.

Second: *If EA does have a unique role in enabling improvements to the operating platform, are there any factors that affect moving from the plans to execution?* It is hardly surprising that having an EA plan is far from a guarantee of implementation success [Boh and Yellin, 2006], which is dependent on a number of additional factors. As the operating platform improvements proposed in the EA plans are implemented through a series of IT projects and

[9] The definition of "operating platform" has been adapted from Ross et al.'s [2006] "foundation for execution."

business improvement projects, all the usual project success factors apply [e.g., Finney and Corbett, 2007; Parr et al., 1999]. Such factors include top management support, change management, and project management, among many others. In addition to individual project successes, proper IT governance is of central importance to ensure that the various projects follow the EA guidelines [Boh and Yellin, 2006; Ross et al., 2006; Weill and Ross, 2004]. Also, due to the duration and cost, EA implementations are more likely to be subject to unexpected changes in business priorities, emerging financial constraints, or loss of interest [Armour et al., 1999; Richardson et al., 1990; Segars and Grover, 1996; Spewak and Hill, 1992]. Finally, due to its aim of enterprise-wide optimisation, which may mean trade-offs in local optimisation and autonomy, EA implementations are also very likely to be hampered by organisational politics [Janssen and Hjort-Madsen, 2007; Kettinger et al., 2010; Segars and Grover, 1996].

Towards an Enhanced Explanation of EA Benefits

Three key conclusions can be drawn from the findings of the literature review presented above. First, it is important to distinguish between benefits that can flow from EA directly and benefits that can be achieved only through the implementation of the EA plans, i.e., from an EA-guided operating platform. This distinction is important for two reasons. First, it helps to better understand the extant literature by differentiating between seemingly similar, but actually different sources of EA benefits (e.g., Bernard's [2005] "better access to information" and Ross et al.'s [2006] "better access to customer data" discussed in the "Benefits from EA" section above). Second, due to the high uncertainty in progressing from plans to implementation (see the previous paragraph) it seems likely that EA's impact on benefits that are contingent on implementation is somewhat weaker than on benefits that can be derived from the EA plans directly.

Second, a considerable amount of collective knowledge on the benefits of EA exists. It is evident from the discussion above and from the diagrams presented in Appendix 2 that there are many common themes in the explanations of how EA leads to benefits and what these benefits ultimately are. These include standardisation and integration, cost reduction, business-IT alignment, process improvement, etc. However, these benefit claims and related explanations are fragmented. No single study presents a concise overview of this existing knowledge. Integrating this existing knowledge can therefore provide a valuable step towards enhancing the understanding of how EA leads to organisational benefits.

Third, in addition to conceptual work needed to integrate the existing knowledge on EA benefits, further empirical enquiry is essential. Not only do the existing claims need further empirical validation, but due to the lack of studies focusing on a careful explanation of EA benefits, it seems likely that some benefits or explanations may have been overlooked.

The following section takes a step towards enhancing knowledge on how EA leads to organisational benefits by proposing the EA Benefits Model (EABM). The EABM integrates the existing explanations in the EA literature and draws on relevant IS and management theory to enhance these explanations. It suggests that it is through its impact on four key benefit enablers that EA delivers organisational benefits. While it does not address the third theme discussed above, i.e., the current study does not have an empirical component, the proposed model provides a useful starting platform for future empirical studies of EA benefits.[10]

IV. THE EA BENEFITS MODEL (EABM)

The EA Benefits Model (EABM) presented in Figure 1 synthesises the findings from the literature review. The model suggests that it is through the impact of EA on four key benefit enablers—Organisational Alignment, Information Availability, Resource Portfolio Optimisation, and Resource Complementarity (P1a–P4a)—that EA leads to organisational benefits (P1b–P4b). The term "benefit enablers" emphasises that these outcomes from EA are not benefits *per se*, but are factors which have been demonstrated in earlier research to have a high potential for enabling organisational benefits.

Definitions of the EABM constructs are summarised in Table 3 and discussed in detail in the following sections. The thickness of the arrows in P1a–P4a denotes the hypothesised strength of the relationship, based on how reliant a given benefit enabler is on the enactment of the EA plans. This acknowledges the high uncertainties involved in progressing from EA to implementation discussed in section III above. The least strong (dotted) lines indicate that Resource Portfolio Optimisation (P3a) and Resource Complementarity (P4a) are entirely dependent on at least partial enactment of EA plans. Information Availability (P2a) is partly contingent on enactment, and is presented as a thin line. Finally, Organisational Alignment (P1a) may to a large extent be achieved through the EA planning activities and resultant documentation *per se*, and is therefore represented as a thick line.

[10] Some potential avenues for empirical work are described in further detail in Section V.

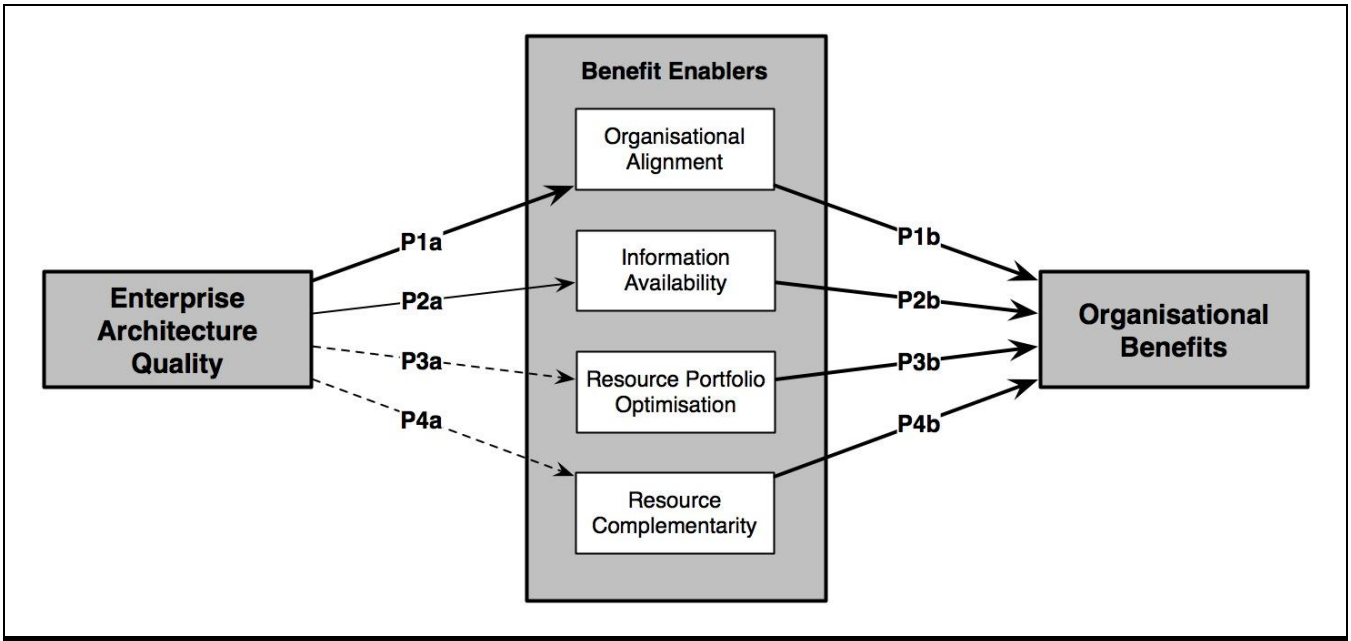

Figure 1. EA Benefits Model (EABM)

Table 3: Definitions of the EABM Constructs[11]	
Enterprise Architecture Quality	EA is the definition and representation of a high-level view of an enterprise's business processes and IT systems, their interrelationships, and the extent to which these processes and systems are shared by different parts of the enterprise. A high-quality EA is one that provides a vision for the future operating platform that is well-aligned with the organisation's strategic goals, complemented by an optimal roadmap for moving towards that vision, based on an accurate understanding of the current operating platform.
Organisational Benefits	Outcomes that contribute directly to organisational performance, including lower costs, increased revenue, competitive differentiation, more accurate decisions, strategic agility, etc.
Benefit Enablers	
Organisational Alignment	The extent to which an organisation's subunits share a common understanding of its strategic goals, and contribute towards achieving these goals
Information Availability	The extent of useful, high-quality information accessible to organisational decision makers
Resource Portfolio Optimisation	The extent to which an organisation leverages its existing resources, invests in resources that target performance gaps, and minimises unnecessary investments in duplicated resources
Resource Complementarity	The extent to which the organisation's resources synergistically support the pursuit of its strategic goals

The following discussion of the EABM begins with an explanation of the independent variable, Enterprise Architecture Quality. The four sections that follow draw on both the review of EA literature as well as broader IS and management theory to define the four benefit enablers, and explain how these relate to organisational benefits from EA. For this explanation to be complete, it is necessary to consider for each benefit enabler (1) the connection between EA and the benefit enabler (P1a–P4a) and (2) the connection between the benefit enabler and organisational benefits (P1b–P4b). As the benefit enablers draw on existing IS and management research, the latter relationships have usually been extensively explored in earlier studies. The primary contribution of this study lies in the synthesis of EA literature to explain the proposed relationships between EA and the four benefit enablers (i.e., P1a–P4a), as well as in the identification of these four enablers.

[11] These definitions are ours, though they have been adapted from the existing literature on the related concepts.

Enterprise Architecture Quality

A high-quality EA is one that provides a vision for the future operating platform that is well-aligned with the organisation's strategic goals, complemented by an optimal roadmap for moving towards that vision, based on an accurate understanding of the current operating platform. EA quality depends on the quality of the planning process and is embedded in the resultant documentation. Therefore, there are two ways of assessing EA quality. First, it is possible to directly evaluate the quality of the outputs, i.e., EA documentation. Second, it is possible to use EA planning process quality as a proxy measure of output quality.

Assessing the quality of EA documentation is likely to provide a more accurate and objective measure of EA quality. For example, the accuracy of EA in documenting the existing operating platform can be objectively assessed through audits and system analysis. Although assessing the EA roadmap can be more difficult due to the potential existence of equivalent alternatives, objective evaluation measures still exist, e.g., the costs and business impact involved in changing the processes and systems in a given sequence. However, the quality of the EA vision is very difficult to measure objectively, as it depends on guesses about future strategic directions, which may easily change. The best quality measure regarding the vision may, therefore, be a scenario analysis to test how easily the proposed EA can accommodate plausible shifts in business strategy.

Table 4: Proxy Measures for Evaluating EA Quality

Appropriate scope-detail-cost balance [Spewak and Hill, 1992, pp. 33, 34]	Skilled architecture team [Bernard, 2005; Spewak and Hill, 1992, p. 34]
Appropriate CIO skills [Ross et al., 2006, pp. 113–115]	Sufficient (on-going) funding [Bernard, 2005; Spewak and Hill, 1992, p. 21, 26]
Compatible org. culture [Spewak and Hill, 1992, p. 34]	Suitable management practices [Ross et al., 2006]
Clear and agreed-upon architecture principles [Richardson et al., 1990, p. 399]	Stakeholder acceptance & involvement [Bernard, 2005; Spewak and Hill, 1992, p. 33]
Documentation tools [Bernard, 2005; Spewak and Hill, 1992, p. 34]	Top management support and involvement [Ross et al., 2006, p. 111; Spewak and Hill, 1992, p. 33]
Effective presentations [Spewak and Hill, 1992, p. 34]	Use of consultants [Spewak and Hill, 1992]
Effective project management [Spewak and Hill, 1992, p. 33]	
Intermediate deliverables [Spewak and Hill, 1992, p. 34]	

Possibly the greatest weakness of evaluating EA quality through a direct assessment of EA documentation relates to practical considerations. Although the approaches discussed above provide potential avenues for directly measuring EA quality, such assessments require a substantial effort and time. For organisations, these quality measures may not be practicable due to the costs involved; for academic studies, both time, extent of required research access, and expertise are likely to be prohibitive.

A more cost-efficient, though less accurate, approach to evaluating EA quality may be to assess the quality of the EA planning process. This approximate evaluation can rely on assessing the extent to which a particular EA planning effort addressed key factors that have been found to be highly correlated with high-quality results. A number of indicators of EA planning quality, which can in turn act as proxy quality measures of the resultant plans, can be derived from EA literature. These are presented in Table 4. Reflecting on these measures leads to the following three conclusions about how the quality of EA planning process can be evaluated.

First, it appears that the most important determinant of EA planning quality is the availability of sufficient high-quality resources during EA planning. The higher the quality of the available resources, the higher the likely quality of the EA planning process and the resultant outputs. These resources include not only skilful and experienced enterprise architects [Bernard, 2005; Spewak and Hill, 1992], but also the involvement of top management [Ross et al., 2006; Spewak and Hill, 1992] and other key stakeholders [Bernard, 2005; Spewak and Hill, 1992], access to external expertise when necessary [Spewak and Hill, 1992], and sufficient ongoing funding to guarantee the availability of these resources for the duration of EA planning [Bernard, 2005; Spewak and Hill, 1992]. Whether or not the necessary resources were available for EA planning can be relatively easily assessed by interviewing the planning team members and reviewing attendee lists of key planning meetings.

Second, EA planning quality may also be measured by the quality of the methodologies and approaches used. For example, effective project management [Spewak and Hill, 1992], effective presentations [Spewak and Hill, 1992], and use of proper documentation tools [Bernard, 2005; Spewak and Hill, 1992] have been suggested to be related to EA planning success. However, it could be argued that these are largely contingent on the quality of resources. A

skilled EA team that has access to sufficient on-going funding appears likely to make use of the best methodologies and tools available.

Finally, it is important to note that a high-quality EA has to strike an appropriate balance among scope, detail, and cost [Spewak and Hill, 1992]. After the scope and depth of planning reaches a certain threshold, investing more resources and effort in the planning is likely to lead to diminishing returns. Eventually, the marginal improvements in the accuracy and amount of information captured in the plans will no longer be able to offset the required investments.

Organisational Alignment

Organisational Alignment is the extent to which an organisation's subunits share a common understanding of its strategic goals and contribute towards achieving these goals. The alignment between business and IT, an aspect of Organisational Alignment, has received extensive attention in IS literature [Chan and Reich, 2007a,b]. The underlying claim of the business-IT alignment literature is that IT strategies and the resultant deliverables should be closely informed by, and aligned with, business strategies and processes [Henderson and Venkatraman, 1993]. This is to ensure that the IT systems in which an organisation invests provide the best possible support for the strategic needs of the business.

However, it is not only alignment between business and IT that is a challenge in large, complex organisations. The relationship between alignment and organisational performance is also an important topic of interest in the broader management literature [e.g., Miller, 1986; Porter, 1996]. Alignment is not only a challenge across all functional areas (e.g., between Sales and Marketing), sometimes referred to as horizontal alignment, but also between the corporate level and various strategic business units (SBUs) [Reynolds et al., 2010].

How Does EA Improve Organisational Alignment?

Both EA planning as well as related improvements in the operating platform have the potential to improve Organisational Alignment. The EA planning activity itself requires cross-organisational dialogue and input. As EA is not only concerned with IT systems, but begins with an understanding of the business processes that these systems need to support, it has the potential to bring IT in closer alignment with the business goals [Gregor et al., 2007; Ross, 2003]. The objective of greater business-IT alignment is also among the top reasons why organisations invest in EA [Aziz and Obitz, 2007; Obitz and Babu K, 2009].

However, because the business analysis that is undertaken during EA planning spans different departments and/or business units, there is potential for EA to have a positive impact not only on business and IT alignment, but also on other dimensions of Organisational Alignment. The basis for this broader impact is the facilitation of dialogue and identification of interdependencies between the various parts of the enterprise [Segars and Grover, 1996]. The increased understanding of the process interdependencies and potential synergies provides a better basis for identifying the stakeholders that may be affected by, and should be consulted about, a given process or technology change [Bernard, 2005]. The relevant people can be involved early in the decision-making process, allowing for potential conflicts to be identified and resolved early, which may have a positive impact on collaboration and collective decision-making [Richardson et al., 1990]. The awareness that EA creates about the dependencies may also be used to ensure the alignment between performance measures of employees, which can further contribute to collaboration [Pereira and Sousa, 2004]. The set of agreed-upon EA principles also provides objective decision-making criteria, which in turn can help to avoid costly, prolonged, or repeated arguments.

Therefore, EA reduces the subjectivity of the decision-making process [Johnson et al., 2007; Spewak and Hill, 1992] and brings the business and IT investment decisions in closer alignment to the organisational goals, as opposed to the personal agendas of individual key stakeholders:

> P1a: A high-quality EA is likely to improve Organisational Alignment.

Organisational Benefits from Organisational Alignment

Extant research suggests that Organisational Alignment in general, as well as its sub-dimension of business-IT alignment, are related to improved organisational performance [Chan et al., 2006; Kearns and Lederer, 2003; Miller, 1986; Porter, 1996; Sabherwal and Chan, 2001]. Firms with high Organisational Alignment may achieve a better total return on investments through the reduction of incoherent or duplicated efforts, and achieve their strategic goals with minimal overhead. Based on this literature, it is posited in EABM that firms with higher Organisational Alignment are likely to achieve greater organisational benefits (P1b).

Information Availability

Information Availability is defined as the extent of useful, high-quality information accessible to organisational decision makers. Information quality does not only encompass accuracy, but also aspects such as relevance, completeness, timeliness, interpretability, and accessibility [Lee et al., 2002; Wang and Strong, 1996]. These dimensions suggest that in order to improve Information Availability and quality, the purpose of the information needs to be considered (e.g., the measure of timeliness can be substantially different in strategic and operational decision-making).

For the purposes of the discussion below, it is useful to consider that the information underpinning an organisation's knowledgebase consists of "*what/who"* (i.e., data about an organisation's clients, suppliers, and transactions) and "*how"* (organisational processes) type of data. Information systems normally focus on storing the "*what/who"* information. The "*how"* information about processes is less often explicitly and systematically captured. To an extent, it is embedded in the information systems that support these processes (through customisation and integration) and captured in the related configuration specification documents. However, these detailed technical descriptions are interpretable only by technical specialists and, therefore, cannot be readily used by organisational decision-makers.

How Does EA Improve Information Availability?

EA has the potential to improve both the information about an organisation's processes, as well as data about its clients, suppliers, and business transactions. The improved information about organisational processes primarily flows directly from EA. Through the business and system analysis performed as part of the EA planning, previously undocumented information about the organisation's processes may be captured [Bernard, 2005]. The whole-of-enterprise analysis approach may even reveal interdependencies or inefficiencies that were previously not only undocumented, but also unknown. This information will be captured in the current state documentation of EA and will help to enhance and retain organisational knowledge about its processes. Even if the EA vision and roadmaps are later not followed, this documentation in itself may prove valuable for informing organisational decision-making:

> P2.1a: A high-quality EA is likely to improve Information Availability about the organisation's resources.

In contrast, improved availability of information about business transactions, customers, and vendors is primarily contingent on the enactment of EA plans. This information is normally captured in an organisation's databases. EA can help to improve the availability of this information by guiding the building of an improved operating platform that, in turn, provides better information to decision makers in the organisation. First, EA has been suggested to improve the sharing of information through more carefully planned integration between the organisation's information systems [Boh and Yellin, 2006; Ross et al., 2006; Spewak and Hill, 1992]. In addition to identifying and helping to standardise the interfaces and messaging between different applications, EA may also facilitate information sharing by advocating common data definitions and structures [Boh and Yellin, 2006; Spewak and Hill, 1992]. Second, as will be discussed in the following section, an EA-guided operating platform is likely to have lower complexity and fewer components, contributing to increased reliability of the operating platform [Pereira and Sousa, 2004; Ross et al., 2006]. This has a positive impact on information accessibility. Finally, by identifying and helping to reduce the number of redundant data stores, EA may also have a positive impact on data accuracy [Venkatesh et al., 2007].

> P2.2a: An operating platform guided by a high-quality EA is likely to improve Information Availability from the organisation's transactional and analytic data stores.

Organisational Benefits from Information Availability

Information is widely recognised as a key organisational asset. Access to better information—when coupled with enhanced capabilities to interpret that information—may serve as an important source of competitive advantage [Davenport and Harris, 2007; Davenport et al., 2010]. For example, improved information about the customers and the marketplace enables better targeted product development, sales, and marketing efforts [Davenport and Harris, 2007], leading in turn to increased revenues. Based on this literature, it is posited in EABM that firms with higher Information Availability are likely to achieve greater organisational benefits (P2b).

Resource Portfolio Optimisation

Resource Portfolio Optimisation is defined as the extent to which an organisation leverages its existing resources, invests in resources that target performance gaps, and minimises unnecessary investments in duplicated resources. Resources can be defined as "all assets, capabilities, organisational processes, firm attributes, information, knowledge, etc. controlled by the firm" [Barney, 1991, p. 101]. In relation to EA, three types of resources are primarily of interest: human resources, IT, and organisational processes. Optimisation could, therefore, involve the removal of duplicated or non-value-adding technology or human resources, and/or replacing them with resources that are more efficient in assisting with the achievement of organisational goals.

How Does EA Help to Optimise the Resource Portfolio?

EA can help to identify areas where either resource gaps or overlaps occur and to provide recommendations on how to improve on the existing state [Bernard, 2005; Pereira and Sousa, 2004]. While it is likely that areas of underinvestment make themselves known through the related business impact, areas of overinvestment may be much less visible. If each business unit with similar needs invests in its own systems, the costs incurred are likely to be significantly higher than when using a single, shared system. However, if the systems are working fine and the costs are manageable, the organisation may remain unaware of the opportunity for cost cutting by leveraging economies of scale.

EA planning involves not only the definition of a future vision, but also an analysis of the current state. By looking across the verticals and horizontals of an organisation, current resource overlaps will become apparent [Boh and Yellin, 2006]. Existing studies suggest that EA, therefore, contributes to building a more standardised IT platform with fewer technologies, leading in turn to simplified interfaces, higher reliability through reduced operating platform complexity, and lower maintenance and support costs [Boh and Yellin, 2006; Hjort-Madsen, 2006; Richardson et al., 1990; Ross et al., 2006; Spewak and Hill, 1992; Venkatesh et al., 2007].

EA may also help to promote the decoupling of monolithic systems to smaller components, which facilitates both reuse as well as flexibility of reconfiguring or replacing the components as required [Janssen and Hjort-Madsen, 2007; Ross et al., 2006]. Componentisation helps in optimising the resource portfolio by reducing the overlaps between individual components and simplifying the replacement of components that no longer meet business needs or are more costly to maintain than newer alternatives. Also, the knowledge about the purpose and interdependencies of the components captured in EA documentation makes the replacement process considerably easier and less risky [Iyer and Gottlieb, 2004]. Finally, the awareness about the components, the stage of their lifecycle, and business impact can also help to better channel investments to resources with the highest value potential in the case of financial constraints [Segars and Grover, 1996].

Through the business analysis that precedes the evaluation of the IT systems, EA can also contribute to the identification of suboptimal business processes and use of human resources [Bernard, 2005; Boh and Yellin, 2006; Pereira and Sousa, 2004]. It has also been suggested that as a result of the enterprise-wide optimisation, the organisation may be able to shift the focus of its business processes from a department- or business-unit centric view to increased customer-focus, as it gains the ability to share a single view of its customers across the different organisational units [Ross et al., 2006; Venkatesh et al., 2007].

It is necessary to note that while EA plans may have a direct positive on the benefit enablers discussed earlier (Organisational Alignment and Information Availability), the benefits from Resource Portfolio Optimisation are contingent on the implementation of these plans, or at least parts of it:

> P3a: An operating platform guided by a high-quality EA is likely to have increased Resource Portfolio Optimisation.

Organisational Benefits from Resource Portfolio Optimisation

The organisational benefits from Resource Portfolio Optimisation mainly relate to reduced costs and higher efficiencies, which translate to a better return on investment from the organisation's resources. Process optimisation, an aspect of Resource Portfolio Optimisation, has been found to have the potential to not only deliver substantial cost savings, but also to improve quality and reliability of product and service delivery [Davenport and Short, 1990; Hammer and Champy, 1994; Harrington, 1991]. Based on this literature, it is posited in EABM that firms with higher Resource Portfolio Optimisation are likely to achieve greater organisational benefits (P3b).

Resource Complementarity

Resource Complementarity is defined as the extent to which the organisation's resources synergistically support the pursuit of its strategic goals. The resource-based view (RBV), a well-established and widely accepted theoretical perspective in strategic management, posits that the basis for a firm's sustained competitive advantage comes from its control of a set of resources which are rare, valuable, inimitable, difficult to substitute, and relatively immobile [Barney, 1991]. While it is very difficult to find individual resources that meet these criteria, once embedded in organisational processes in *unique combinations* with other resources, these desirable characteristics become easier to achieve [Brynjolfsson and Saunders, 2010; Grant, 1996]. A major difficulty in imitating complex resource configurations stems from causal ambiguity, i.e., it may not be clear which components or interactions underpin the system's success [Lippman and Rumelt, 1982; Reed and DeFillippi, 1990].

Therefore, the competitive advantage of organisations tends to rely not on individual resources but on unique combinations of complementary resources. The mechanism which helps to make use of these combined resources is sometimes referred to as capabilities—human-based skills and processes that enable an organisation to deploy other resources in order to achieve desired goals [Amit and Schoemaker, 1993]. Capabilities are developed over time through the creation, exchange, and retention of information, and are grounded in the skills, knowledge, and processes of the organisation. Therefore, they cannot be readily sourced from the market [Amit and Schoemaker, 1993].

There is a subtle but important difference between Organisational Alignment and Resource Complementarity in the EABM. Organisational Alignment (Porter's [1996] "first-order fit") relates to *shared understanding and simple consistency* between the activities of the organisational units and the corporate strategy. Resource Complementarity (Porter's [1996] "second-order fit") occurs when resources synergistically *reinforce* each other. These reinforcing effects coupled by the difficulty in imitating such combinations, lead to different organisational benefits from the two benefit enablers.

How Does EA Improve Resource Complementarity?

The primary mechanism through which EA helps an organisation to improve Resource Complementarity is through the identification of the potential enterprise-wide synergies, and by providing recommendations on how to leverage these synergies. In one of the most influential articles on RBV, Prahalad and Hamel [1990, p. 89] suggest that the fragmentation of resources is inevitable if proper measures are not taken to ensure complementarity, and that the key mechanism in ensuring complementarity is the development of "a corporatewide strategic architecture that establishes objectives for competence building. A strategic architecture is a road map of the future that identifies which core competencies to build and their constituent technologies." The importance of EA in enabling increased Resource Complementarity has also been later discussed by King [1995].

Many of the mechanisms through which EA may help to enhance Resource Complementarity are similar to those discussed in relation to Resource Portfolio Optimisation. Both depend on the organisation-wide analysis and identification of resources and their interdependencies. Both benefit from the reduction of overlaps between resources achieved through componentisation. However, while the primary focus of Resource Portfolio Optimisation is on reducing *redundancy* related to resource duplication and overlaps and improving the quality of these resources, Resource Complementarity focuses on leveraging *synergies* between the resources and combining them in ways that enhance performance and are difficult for competitors to replicate. As noted by Henderson and Clark [1990], improvements in a system can stem from either the introduction of superior components (component innovation) or an enhanced reconfiguration of components (architectural innovation). Resource Portfolio Optimisation focuses on the former, whereas Resource Complementarity focuses on the latter. Therefore, in proposing the EABM, resource complementarity and optimisation are treated as two distinct benefit enablers.

Similarly to Resource Portfolio Optimisation, the achievement of Resource Complementarity is contingent on the implementation of EA:

> P4a: An operating platform guided by a high-quality EA is likely to have increased Resource Complementarity.

Organisational Benefits from Resource Complementarity

As discussed above, the major organisational benefit from Resource Complementarity is potential competitive differentiation from achieving a mutually reinforcing resource configuration that is difficult to replicate [Brynjolfsson and Saunders, 2010]. The exact tangible benefits from Resource Complementarity are dependent on the competitive strategy of the organisation, which determines the desirable resource configuration to pursue. It has been suggested that the three key ways in which organisations can compete are a focus on (1) operational excellence (reliable, conveniently accessible, and low-cost products/services), (2) customer intimacy (highly personalised products and services), or (3) product leadership (innovative, "state-of-the-art" products/services) [Treacy and Wiersema, 1993]. For a company pursuing operational excellence, the result of Resource Complementarity could be a superior cost position, achieved through combining resources in a way which cuts overheads to a minimum while retaining the desired product/service standards. On the other hand, a company pursuing a customer-intimate strategy would want to make sure that its resources complement each other in a way that delivers a single view of the customer, helps to gather superior customer information and feedback, and ensures consistency of customer service organisation-wide. Based on this literature, it is posited in EABM that firms with higher Resource Complementarity are likely to achieve greater organisational benefits (P4b).

Contextual Factors and the Value Potential of EA

An important question related to understanding how EA leads to organisational benefits is whether all organisations can expect to get similar value from EA, or whether benefits vary from organisation to organisation based on contextual, i.e., internal or environmental, factors. Both an analysis of the four benefit enablers in EABM, as well as existing EA research, suggest that some organisations under some circumstances are better positioned to benefit from EA investment.

For example, it has been suggested that larger organisations with more complex IT environments may expect to benefit more from EA than those whose operating platform is relatively simple and well-understood [Bernard, 2005]. The benefit enablers discussed earlier appear to support this proposition. First, large and more complex organisations are likely to have a more diverse resource portfolio. This means that they may be able to derive more benefits from Resource Portfolio Optimisation. Second, large organisations with complex structures are more likely to experience problems with alignment, increasing the potential impact of the Organisational Alignment benefit enabler.

The quality of the existing operating platform is another factor suggested in earlier research to affect the extent of potential benefits from EA [Bernard, 2005]. For example, high redundancy or quality issues provide larger potential gains from Resource Portfolio Optimisation. Also, the performance gaps may leave more opportunities for improvements in Information Availability.

Another important contextual factor discussed by Ross et al. [2006] is the organisation's operating model. According to Ross et al., a firm's operating model is determined by two independent choices—the level of desired standardisation (commonality of processes and systems), and integration (sharing of data) across the organisation. The authors mention that organisations with low levels of standardisation and integration can benefit from EA if they choose to standardise or integrate certain aspects of their foundation [Ross et al., 2006, pp. 56–57]. It is implicit in this argument that the higher the level of desired standardisation and/or integration, the higher the extent of potential benefits that an organisation can expect from EA. In terms of the EABM, standardisation is closely related to Resource Portfolio Optimisation, and integration to both Information Availability and Organisational Alignment.

Spewak and Hill [1992] argue that the higher the rate of organisational change, the greater the benefits from EA. This is probably based on the claim that EA can improve an organisation's flexibility and change capability. Both Resource Portfolio Optimisation and Information Availability help to explain why organisations undergoing larger changes can benefit more from EA. Understanding of the interdependencies of processes and IT systems (an aspect of Information Availability) becomes more essential when an organisation needs to start making changes to these components. Also, the fewer interdependencies and components there are (i.e., the more optimised the resource portfolio), the cheaper and less risky it is to make changes to the environment.

There are also environmental factors, which may affect the extent of potential benefits from EA. For example, the legislation and regulations governing a particular industry can be an important factor. In some cases EA may simplify compliance [Ross et al., 2006; Winter and Fischer, 2006], whereas in others it can even be mandatory (e.g., Clinger-Cohen Act in the USA), making EA an "organisational benefit" *per se*. The information intensity of a given industry appears also likely to affect the extent of potential benefits from EA. Specifically, Information Availability is more critical for organisations that rely heavily on information in providing products or services to their customers or for whom information *is* the key product or service they provide.

V. LIMITATIONS AND OPPORTUNITIES FOR RESEARCH

This study has taken a step towards improving the understanding of how EA leads to organisational benefits through a careful review of the EA literature and by identifying relevant theoretical explanations from established IS and management theories. We hope that the Enterprise Architecture Benefits Model and related discussion provides useful insights for both academics and practitioners interested in EA, and serves as a platform for future studies on EA benefits. Some suggested opportunities for future research are presented below, discussed in the light of the EABM and other findings of this study.

Possibly the most important shortcoming in existing research on EA benefits is the lack of rigorous empirical validation of the benefit claims. For example, of the fifty studies analysed as part of the systematic review, forty-one made EA benefit claims, while only six provided some empirical evidence to support the claims. The current study has taken a step towards improving the theoretical explanation of the benefit claims. The next important step would be to explore whether empirical evidence supports the nine propositions. Both qualitative studies that explore the proposed relationships in-depth, as well as quantitative studies to test the proposed relationships based on a broader sample would be beneficial. A further line of enquiry would be to explore the interrelationships between the

benefit enablers. For example, could Resource Complementarity be an outcome of Organisational Alignment and Resource Portfolio Optimisation? Does Information Availability lead to Resource Portfolio Optimisation and Organisational Alignment?

A challenge faced in this study arose from the interdependencies between factors. Therefore, another useful theme for future study is the grouping of the different benefit enablers. Is the EABM complete? Are there factors beyond those identified in the EABM that should be added to the benefit enablers? Are there better ways to group the benefit enablers? Although we performed a careful analysis, as explained in Section II, there is no theoretical basis for concluding that the model is complete. While the EABM is in our opinion a considerable advance over the existing explanations of how EA leads to organisational benefits, both further empirical and conceptual work could undoubtedly help to improve on this first attempt.

An important question that has so far not been well-addressed is the impact of EA on the operating platform. An empirical study focusing on this question, preferably quantitative or using a multi-case approach, may, therefore, be another potential avenue for research. While it has been suggested that certain benefits flow directly from EA, regardless of implementation, the very limited discussion of these benefits offers another interesting line of empirical enquiry. A quantitative study looking at how often EA plans get implemented, and how often they get used in organisational decision-making, even if not implemented, could provide useful insights on this question.

Another important and promising theme for future research is the question: What are the key factors that affect the extent of potential benefits an organisation can expect from EA? Although a number of organisational and environmental factors that affect benefits have been suggested, no study appears to have systematically compared the different factors. This leaves open the question of whether all of the mentioned factors are important, or whether some have a higher impact than others.

Finally, while this study has proposed some potential approaches for the assessment of EA quality, further studies could contribute by substantially enhancing and validating the quality measures. Comparing the accuracy of different measures and measurement approaches, and identifying those that provide the best cost-accuracy balance would not only benefit academic studies on EA, but may also provide useful insights for organisations in evaluating the quality of their EA efforts.

From an academic perspective, finding answers to the questions above would help to explain why organisations find EA to be useful, what kind of organisations may benefit the most from EA, and if and how EA is superior to alternative, shorter-term or narrower-scope planning approaches. From a practical perspective, the answers would enable organisations to understand what benefits they might realistically expect from EA, to assess whether these are relevant to them, and accordingly to make better-informed decisions on the appropriate level of investment in EA. This may also give organisations an improved basis for justifying the EA investment choices—an issue with which many organisations are currently struggling [Obitz and Babu K, 2009].

VI. CONCLUSION

Through a careful review of EA literature and related academic theory, this study has proposed an enhanced explanation of how EA leads to organisational benefits. The EA Benefits Model posits that it is through improvements in Organisational Alignment, Information Availability, Resource Complementarity, and Resource Portfolio Optimisation that EA leads to organisational benefits. These benefits may include lower costs, higher strategic agility, and a more reliable operating platform. It appears that large organisations with a complex IT environment, whose business model favours high levels of organisation-wide standardisation and integration, can expect to benefit the most from EA.

This study has also provided some recommended opportunities for future research to improve the understanding of the role and value of EA. In particular, empirical studies to test and enhance the proposed EABM, to develop a better understanding of the role of EA in guiding the operating platform, to study the extent to which EA plans are used in organisational decision-making, and to explore the contextual factors that affect the value of EA for different organisations would help to enhance the current state of knowledge. Such studies would lead to better understanding of the value potential of EA, and of how organisations can maximise the likelihood of deriving these potential benefits.

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Editor's Note: The following reference list contains hyperlinks to World Wide Web pages. Readers who have the ability to access the Web directly from their word processor or are reading the article on the Web, can gain direct access to these linked references. Readers are warned, however, that:

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APPENDIX 1: STUDIES ANALYSED IN THE SYSTEMATIC LITERATURE REVIEW

Table A1 presents a summary of the fifty studies that were analysed as part of the systematic literature review. The table lists the publications, their total and average citation counts, and the key theme(s) covered. The last column indicates whether or not EA benefit claims were presented in the study and if yes, whether empirical evidence (**), or references (*) were provided to support these claims.

Table A1: Publications Analysed in the Systematic Literature Review

Study	Citation count		Primary themes				EA benefit claims
	Total	Avg. annual	Planning	Artefacts	Benefits	Success factors	
Alhanasiadis [2008]	6	6.0					✓
Ambler et al. [2005]	28	7.0	✓	✓		✓	✓
Armour et al. [1999]	29	2.9	✓	✓		✓	
Barnett et al. [1994]	34	2.3		✓			✓
Bernard [2005]	32	8.0	✓	✓	✓		✓
Bernus and Nemes [1996]	56	4.3		✓			✓
Bernus et al. [1996]	92	7.1	✓	✓			✓
Bernus et al. [2003]	50	8.3	✓	✓			✓
Braun and Winter [2005]	23	5.8		✓			✓
Carlock and Fenton [2001]	30	3.8	✓	✓		✓	✓
Chen et al. [1997]	38	3.2	✓	✓			
Chen et al. [2008]	5	5.0		✓			✓
Cummins [2002]	85	12.1		✓			
El Sawy et al. [1999]	103	10.3					
Guijarro [2007]	23	11.5		✓			✓
Harmon et al. [2001]	35	4.4	✓	✓		✓	✓
Hay [2003]	36	5.1	✓	✓			
Hoque [2000]	69	7.7		✓		✓	✓
Humphries et al. [1999]	33	3.3	✓	✓			✓
Iyer and Gottlieb [2004]	35	7.0		✓			✓ (*)
Janssen and Hjort-Madsen [2007]	14	7.0				✓	✓ (**)
Johnson et al. [2004]	29	5.8				✓	
Johnson et al. [2007]	23	11.5		✓			✓
Jonkers et al. [2003]	43	7.2		✓			✓
Jonkers et al. [2004]	47	9.4		✓			✓
Kaisler et al. [2005]	25	6.3		✓		✓	✓
Kosanke et al. [1999]	104	10.4		✓	✓		✓ (**)
Lankhorst [2005]	125	31.3		✓			✓
Liles and Presley [1996]	31	2.4		✓			
Lindström et al. [2006]	18	6.0			✓		✓ (*)
McGovern et al. [2004]	59	9.8	✓	✓		✓	
O'Rourke et al. [2003]	48	8.0	✓	✓		✓	✓
Pereira and Sousa [2004]	36	7.2	✓	✓			✓ (*)
Peristeras and Tarabanis [2000]	50	5.6		✓			✓
Perks and Beveridge [2003]	42	7.0	✓	✓	✓		✓
Pulkkinen [2006]	17	5.7	✓	✓			✓ (**)
Richardson et al. [1990]	44	2.3			✓	✓	✓ (**)
Ross and Westerman [2004]	46	9.2			✓		✓ (**)
Ross et al. [2006]	59	19.7	✓	✓	✓	✓	✓ (**)
Ruh et al. [2001]	233	29.1		✓		✓	✓
Schekkerman [2006]	108	21.6		✓		✓	✓
Spewak and Hill [1992]	190	11.9	✓	✓		✓	✓
Tapscott and Caston [1993]	64	5.8	✓			✓	
Vernadat [2007]	10	5.0		✓			✓
Wegmann [2003]	59	9.8	✓	✓			✓
Whitman et al. [2001]	25	3.1		✓		✓	✓ (*)
Winter and Fischer [2006]	29	9.7		✓			✓
Woods and Mattern [2006]	39	13.0		✓	✓	✓	✓
Youngs et al. [1999]	35	3.5		✓			✓
Zachman [1997]	94	7.8		✓	✓		✓
Total: 50 studies	**2588**		**19**	**42**	**9**	**18**	**41**

APPENDIX 2: HOW DOES EA DELIVER BENEFITS?

The five diagrams below present an overview of some of the existing explanations of how EA leads to organisational benefits. It is important to note that in none of the five cases was a diagrammatic summary (e.g., in the form of a research model) presented by the original author(s). Figures A2.1–2.5 rely on the analysis of the verbal discussion and explanations, and may, therefore, not entirely accurately and/or completely capture the original authors' thinking. However, we have aimed to provide as impartial and precise overview of the claims made in the original five studies as possible. The purpose of these diagrams was to assist in obtaining a concise overview of the EA benefit-related claims and proposed explanations about how EA leads to benefits. We believe that these diagrams may provide useful summaries and reference for future studies and, therefore, have included them in this report.

The solid arrows in the diagrams represent explicitly stated associations and dotted arrows represent associations that were strongly implicit in the authors' arguments.[12] For example, Figure A2.4 is an attempt to summarise the EA benefit claims from Ross et al. [2006]. It shows a process model consisting of twenty-three concepts (represented as boxes) arranged in five columns. The left-most two columns in Figure A2.4 present Ross et al.'s [2006] key argument, which says that an organisation's operating model should determine its enterprise architecture, which, in turn, should guide the building of its foundation for execution (i.e., the operating platform). The middle column in Figure A2.4 summarises Ross et al.'s arguments, presented on pp. 94–99 of their book, that organisations with an appropriate foundation for execution have higher levels of componentisation and reuse, standardisation and reduction of technologies, increase in shared IT services, and increased business-IT alignment. Moving right one column, eight IT-related benefits are shown (e.g., increased IT responsiveness and reduced development time) that Ross et al. claim on p. 2 and pp. 94–99 ultimately lead to greater senior management satisfaction with IT and greater ROI from IT. Finally, at the far right are business benefits, such as strategic agility and better operational excellence, that Ross et al. claim flow from EA, and which it is asserted on p. 2, ultimately lead to greater profitability. Connections between these business benefits and IT benefits in the previous column are strongly implicit in the discussion on p. 100 of Ross et al. [2006].

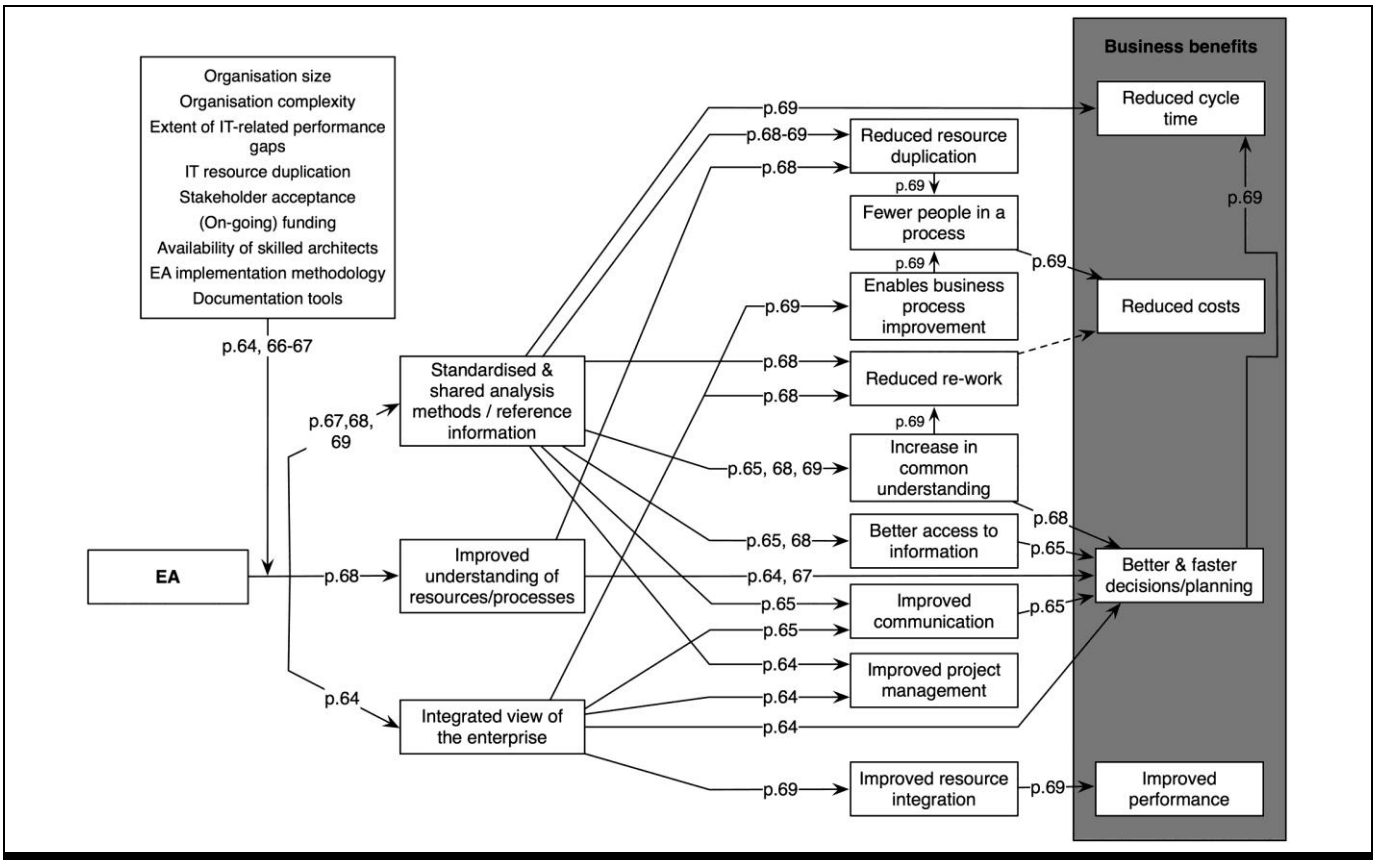

Figure A2.1. Adapted from Bernard [2005]

[12] Although these associations may vary in importance and strength, it is difficult to make finer distinctions due to the lack of detailed explanations.

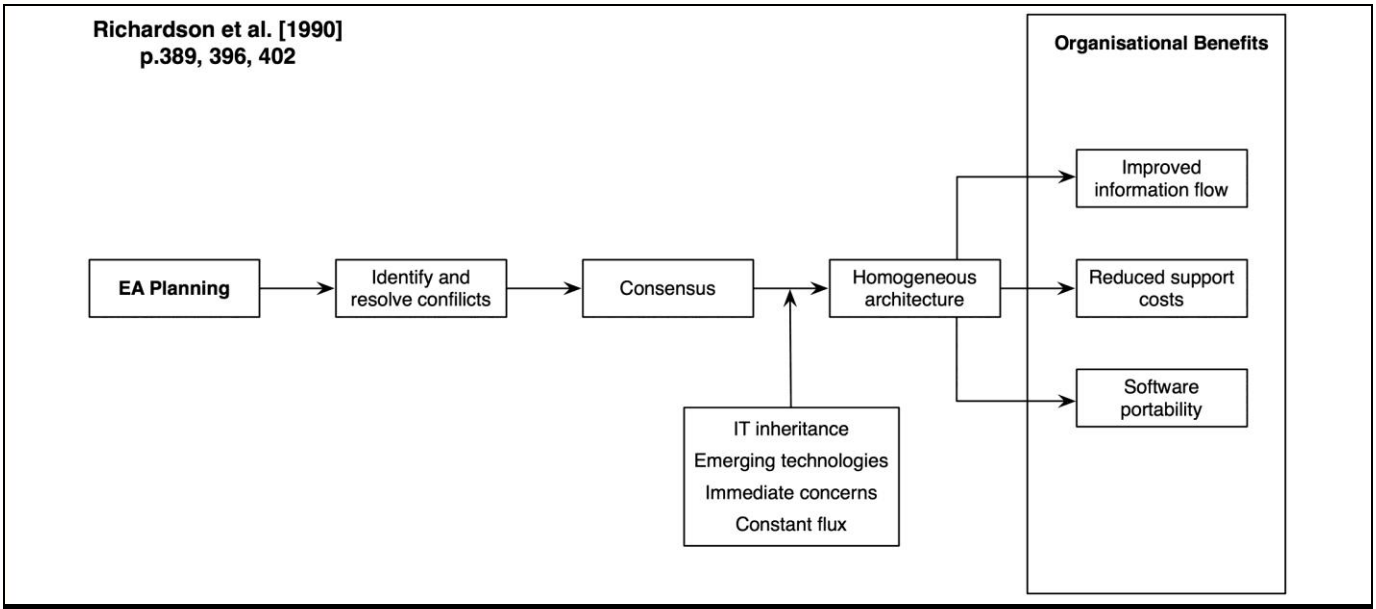

Figure A2.2. Adapted from Richardson et al. [1990]

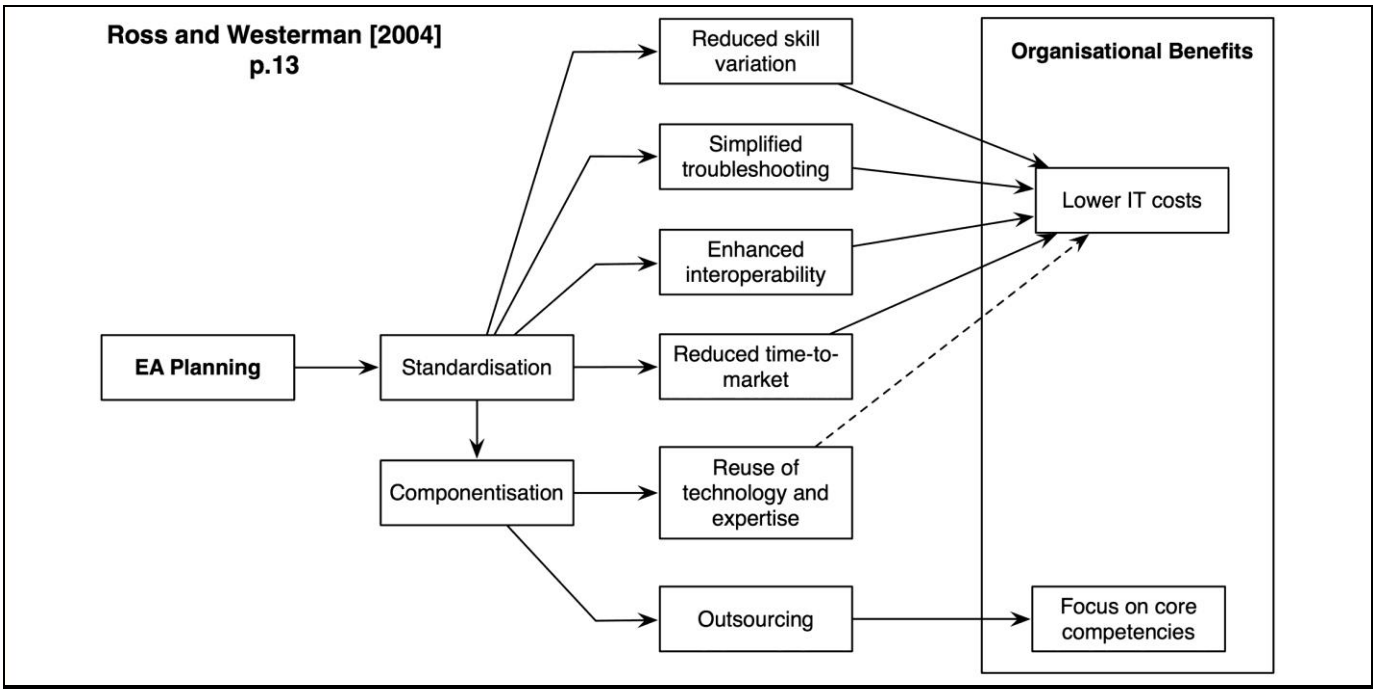

Figure A2.3. Adapted from Ross and Westerman [2004]

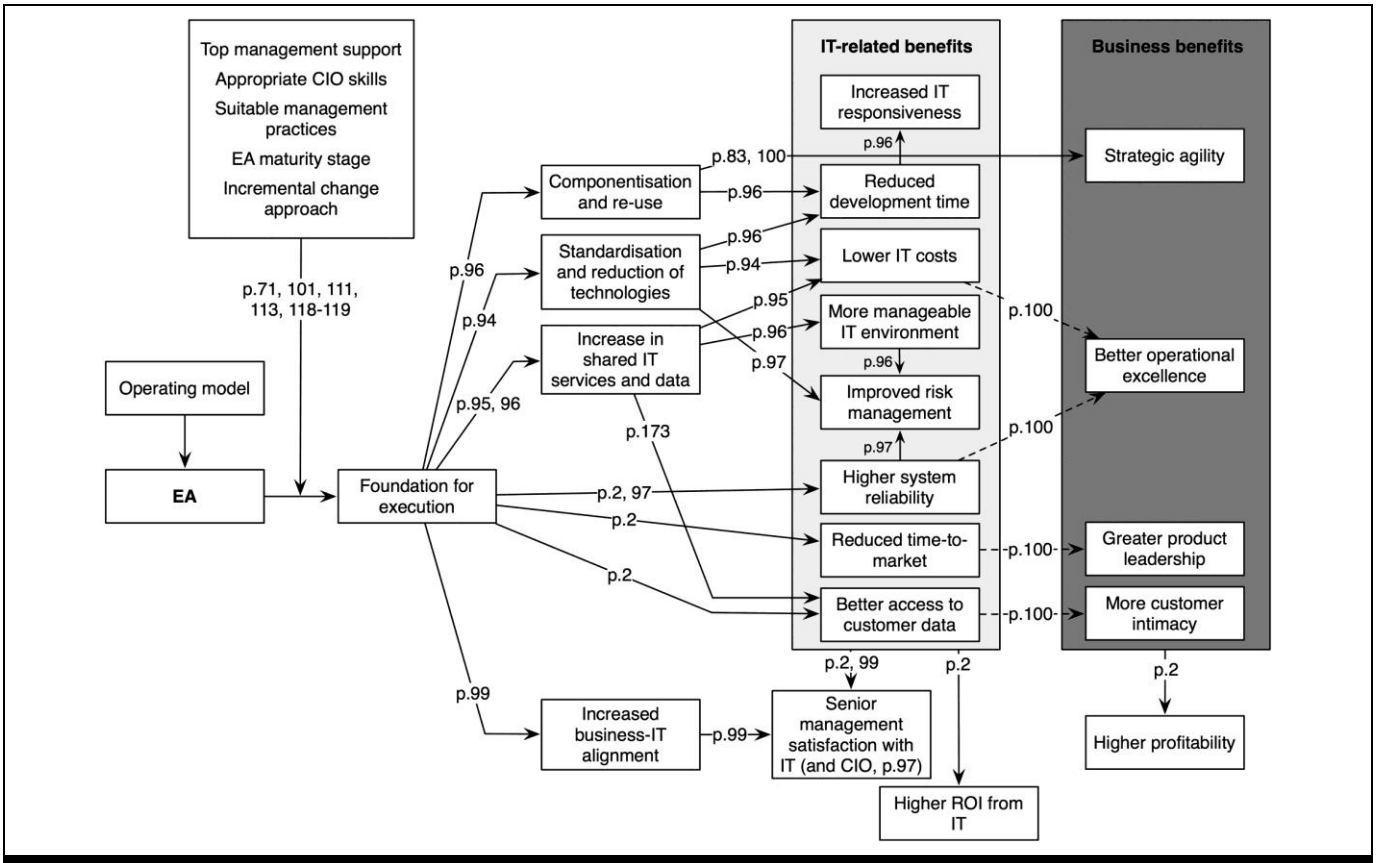

Figure A2.4. Adapted from Ross et al. [2006]

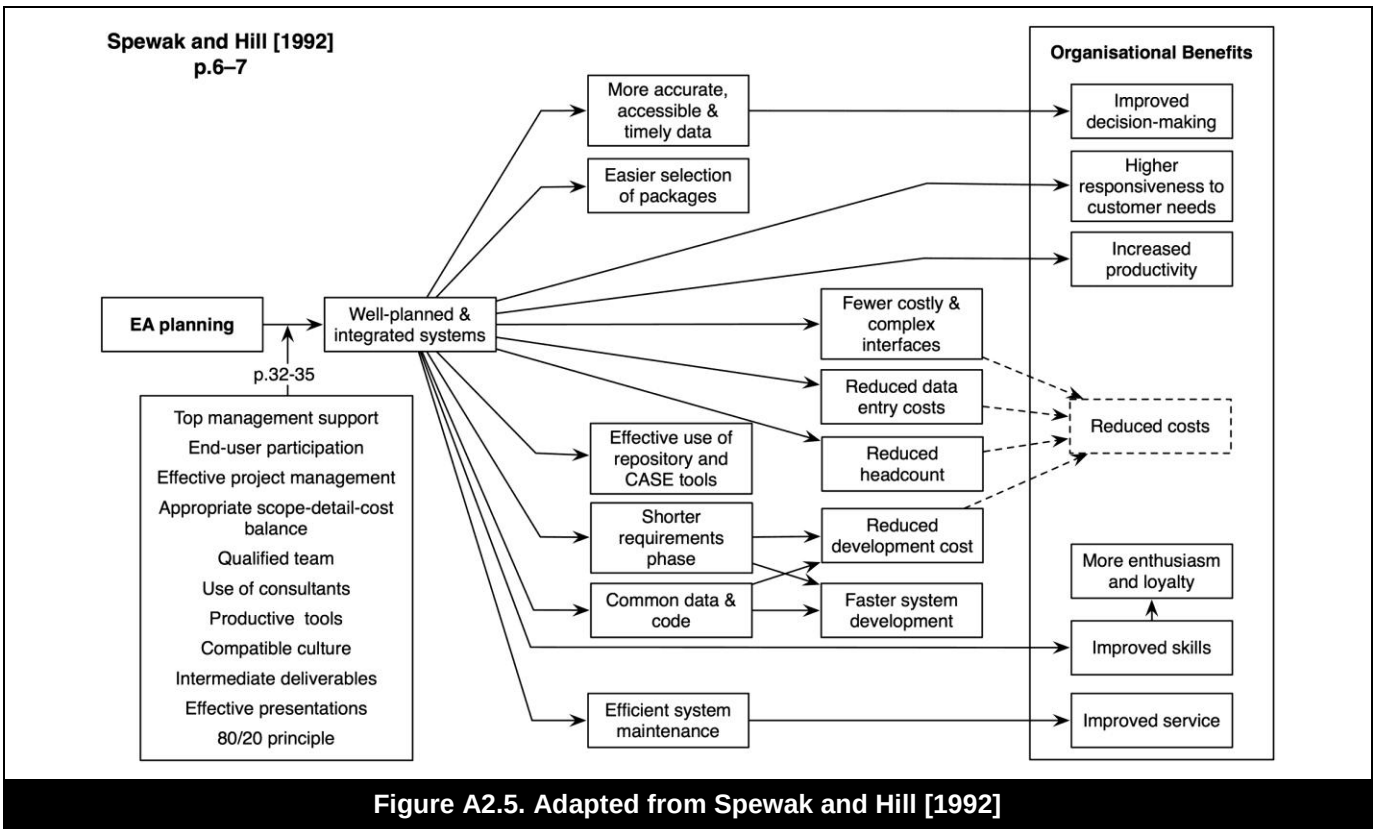

Figure A2.5. Adapted from Spewak and Hill [1992]

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