Waltteri Paulaharju

ENTERPRISE ARCHITECTURE AS A QUEST FOR SIMPLICITY

JYVÄSKYLÄN YLIOPISTO
INFORMAATIOTEKNOLOGIAN TIEDEKUNTA
2022

ABSTRACT

Paulaharju, Waltteri
Enterprise Architecture as a Quest for Simplicity
Jyväskylä: University of Jyväskylä, 2022, 83 pp.
Information Systems, Master's Thesis
Supervisor: Seppänen, Ville

Enterprise architecture came into existence as a field of science and practice to solve the challenges of disintegrated, complex, and 'unmanageable' IT infrastructure in the late 1980's. Since then, much content has been added under the umbrella of EA – content that does not necessarily contribute to the original raison d'être of enterprise architecture, or at least has made it more difficult to stay focused on it throughout any EA endeavor. This literature review aims to 'strip it naked' by bringing the discussion back to the original intent and calling it *the quest for simplicity*.

Keywords: Enterprise Architecture, Simplicity, Complexity, Value-creation, Agile, Lean

TIIVISTELMÄ

Paulaharju, Waltteri
Kokonaisarkkitehtuuri pyrkimyksenä yksinkertaiseen liiketoimintaan
Jyväskylä: Jyväskylän yliopisto, 2022, 80 s.
Tietojärjestelmätiede, pro gradu -tutkielma
Ohjaaja: Seppänen, Ville

Kokonaisarkkitehtuuri syntyi 1980-luvun lopulla korjaamaan tilannetta, jossa yritysten IT-infrastruktuuri on kasvanut liian monimutkaiseksi ja kömpelöksi, eikä se enää vastaa yrityksen liiketoiminnan tarpeisiin. Viimeisten vuosikymmenten aikana kokonaisarkkitehtuurin alalle on lisätty uusi termejä, ideoita, menetelmiä ja ohjeistuksia, jotka eivät aina välttämättä edistä tuota alkuperäistä tarkoitusta. Monet lisäykset ovat ainakin tehneet entistä vaikeammaksi keskittyä siihen, mitä kokonaisarkkitehtuurilla olisi tarkoitus ratkoa: liiallista monimutkaisuutta, joka haittaa ja hidastaa yrityksen liiketoimintaa. Tämä kirjallisuuskatsaus ei pyri lisäämään kokonaisarkkitehtuurin alalle uusia tavoitteita, käsitteitä tai menetelmiä, vaan ennemminkin muistuttamaan niin tieteilijöitä kuin käytännön ammattilaisia siitä, että kokonaisarkkitehtuurin perimmäinen tarkoitus on tarjota ratkaisuja liiallisen, haitallisen monimutkaisuuden vähentämiseksi ja siten yksinkertaistaa niin liiketoiminnan prosesseja, IT-ekosysteemiä kuin työntekijöiden toimintaa ja ajattelua.

Asiasanat: Kokonaisarkkitehtuuri, Monimutkaisuus, Arvonluonti, Agile, Lean

FIGURES

TABLES

TABLE OF CONTENTS

1 INTRODUCTION

Large organizations are difficult to manage. They are multifaceted configurations of infrastructures, tools, methods, people, relationships, values, principles, rules, and objectives, among other things. The people within the organization are formed in different kinds of groups and teams with their specific practices and goals. On a higher level yet, the organization is divided into departments with a distinct set of tools, methods and processes. At this level of granularity, different types of organizational culture can be recognized, and the different 'parts' of the organization may seemingly have little in common with one another. However, regardless of their drastically different practices and styles of working, the various departments are, ideally, working towards a mutual goal, even if it may not always seem obvious. In essence, then, a large organization is a considerably diverse whole, with distinct yet interconnected 'parts', all functioning in concert to serve one or several ends. In some sense, an organization is a microcosm of sorts. Or even an organism.

Where the human body can be considered to consist of separate 'parts' such as the head, torso, arms and legs, or the brain, heart, lungs, the digestive tract and so on, with more careful consideration, it becomes increasingly difficult to distinguish where the brain ends or the heart begins. The coarse demarcations that are convenient for human communication and conceptualization are clearly just that: abstractions that provide convenience. But they are not true, in the sense that the brain or the heart are not separate from the rest of the organism. The brain extends via the spinal cord and the central nervous system to all 'parts' of the body, and distinctions between brain and heart, or brain and arm, quickly become questionable. Even further, while the human body seems to be quite separate from the 'outside world', or the environment, similar interconnections can be easily found. The most obvious ones are probably the facts that humans need to consume food and breathe air that are 'outside' the body. The nutrition that is needed for the body's development grow on and in the earth, so already an essential, basic interconnection between the human and the 'outside' world is recognized. Going even further, the food that humans consume require the

energy of the sun to develop. Without the light of the sun, humans would quickly wither away.

In the same way, in addition to what they consist of 'on the inside', organizations are connected to the environment in which they reside and operate in. First, most of the resources that the organization uses and consumes come 'from the environment'. The people that it hires as employees are nurtured, educated, and socialized in and by the environment. The raw materials that the organization uses to manufacture its products first come from the earth, whether in the form of minerals, wood, or oil, for instance. In addition, the organization makes business in the context of particular political and legal entities, such as cities and nations. They provide the organization with certain rules and guidelines by which it must conduct its operations in order to be allowed to continue. They may grant it with land on which to build a factory or a retail store. The environment also hosts other similar organizations that may have conflicting interests, which means that they must compete with each other, at least to an extent. While from a particular standpoint such competition might appear as purely 'negative', the dynamic that arises from competition can also be considered a balancing act absolutely necessary to the proper and civilized existence of each party. Countless parallels can be drawn from nature. When the balance of an ecosystem is disturbed by, for instance, the extinction of a predatory species, the population of species the predator before kept in check may now proliferate and expand freely. The expanding population will require increasing amounts of space and food to be sustained, and for a while this may be a successful endeavor. But often it so happens that, if not done by a new predator, the uncontrolled population growth results in the demise of the population. The earth is quickly scourged of nutrition, and malnourished, the species becomes more vulnerable to diseases and other existential threats. While the principles of free market usually ensure that no single entity can become too powerful or without competition, sometimes particular organizations manage to amass so much power and resources that the environment must step in to impose limitations via, for example, judicial means. Some of the most notable tech companies of the 21st century suit well as examples.

With all these factors presented, it is no wonder that large organizations are difficult to manage. It would be an understatement to say that there are a million things to consider, because in fact, there is an infinite number of things that could potentially cause disaster. Only the quirks and unique personality traits of the employees, brought together in the departments and teams of the organization, often result in completely unexpected and unpredictable situations and outcomes. Not to mention the incredibly intricate digital technologies that have become indispensable in the modern lifestyle and business.

In search for ways to understand and manage the multilateral complexity of modern organizations, the term *enterprise architecture* (EA) was conceived in the 1980s. While the exact definition and meaning of enterprise architecture is difficult if not impossible to pin down, its purpose could roughly be divided into two main streams: (1) to *understand* organizations; how they are structured and

how they operate, and (2) to *improve* these structures and operations. Some authors in the field use the term *manage* when talking about the purpose of EA, but for the sake of simplicity, it is considered to be included either in *understanding* or *improving* the organization, or both, in the context of this definition. As will be presented in the next part, a key reason for the conception of enterprise architecture was the realization that large organizations were adopting novel information technologies at a rate which was resulting in increased challenges due to the growing complexity. While the new digital tools were supposed to enhance productivity and improve business overall, misguided expansion can quickly lead to a situation where the drawbacks of increased complexity outweigh or even outright obstruct the supposed benefits. In the beginning, enterprise architecture as a practice focused primarily on conceptualizing the organization. This means developing representations such as diagrams to map out different processes and technology configurations within the organization. The aim is to create abstractions that can be utilized as discussion items in decision-making, in analysis and in improvement planning. Developing such abstractions from multiple points of view is supposed to enable different stakeholders (e.g., employees from different departments) better communicate on a given phenomenon, be it a business process, an IT infrastructure, or the supply chain of a large enterprise.

Over time, enterprise architecture has grown into a field of its own, with different frameworks, philosophies, and definitions. What was developed to be a way to understand, manage and improve complex systems has itself become a complex system, perhaps with unintended, undesirable consequences. As will be later in this thesis discovered, the literature on EA has become so voluminous that many organizations trying to benefit from the practices and principles suggested by EA practitioners find themselves entangled in the hundreds of pages of documentation and complicated methodologies. While the parallel of enterprise architecture with, well, *architecture*, is obvious – creating abstract, conceptual representations of actual complex structures and systems – enterprise architecture seems to suffer from the fact that whereas traditional architecture deals mainly with physical structures, enterprise architecture concerns enterprises, that can themselves be considered as kind of abstractions. A ten-storey building or a mile-long suspension bridge is easy to see with bare eyes. A business process, a sales department, or a supply chain, on the other hand, cannot really be seen. Yes, a warehouse from which a company dispatches its goods can well be seen, but the warehouse is not the supply chain. Similarly, the office walls, tables, and chairs that the sales representatives sit on are not the sales department. From a purely business perspective, the chairs and tables and even the office building itself are not that relevant. Much more relevant is what happens in the context of the sales department: what the salesmen and women do, who they collaborate with, how they speak, what they accomplish, and how all that relates to the other departments of the enterprise and its business objectives. All that is very fuzzy. And the practice of enterprise architecture tries to capture and conceptualise that fuzziness.

Creating abstractions of abstractions is bound to be difficult, but the potential benefits and utility are unquestionable. Recognising both the noble aims as well as the difficulties of implementing modern enterprise architecture, this thesis is primarily concerned with the challenge of unnecessary, debilitating complexity. The basic argument and rationale for this thesis is that a tool which increases the phenomenon that it was developed to reduce is working against its nature. To put this into context: if the original intent for the practice of enterprise architecture was to understand and reduce complexity in organizations, the end result of practicing it should not be increased levels of complexity. Also, if the literature and documentation on EA practices is so complicated that few dare even take up the challenge, something must have gone wrong. As will be later reported, these are real problems encountered by academics and practitioners alike. Therefore, this thesis will aim to capture some of the underlying issues related to successfully deploying EA practices as well as to map out to what extent the so-called raison d'être of enterprise architecture is 'remembered' and addressed in contemporary EA literature.

This thesis will be structured around three main themes, which are translated into the key research questions. The first two themes concern the history and evolution of enterprise architecture. Through a literature review, Part 2 aims to uncover and underline the reasons for which EA was first developed and in what kind of circumstances it took place. Part 3 presents an overview of the general streams of through in the field of enterprise architecture and its evolution through the several decades since its birth. Thus, the first two research questions are as follows:

> *RQ1: In what circumstances and for what purpose(s) did enterprise architecture emerge?*
> *RQ2: How has enterprise architecture evolved throughout the past decades?*

The third theme revolves around the idea of complexity. As it will be argued, one of the core objectives originally attributed to enterprise architecture was that of bringing order to chaos: by becoming aware of complexity, the practices of enterprise architecture are supposed to assist it practitioners to reduce unnecessary, debilitating complexity not only of IT infrastructures, but also other structural and procedural elements of a large organization. Bringing attention back to the original intent, so to speak, the third research question aims at discovering the extent to which the challenge of complexity is addressed in contemporary EA literature. The third research question is formulated as follows:

> *RQ3: How is the original purpose of EA – managing and reducing organizational complexity – addressed in the current academic EA literature?*

Answers to the third research question are sought by conducting a systematic literature review on recent academic literature on enterprise architecture. The protocol followed in the systematic literature review is described in Part 4. Part 5 presents the results of the review. A short discussion on the results follows in

Part 6. The next part, however, takes the reader back to 1980s, where the idea of enterprise architecture was first conceived, followed by Part 3, which describes the general evolution of enterprise architecture.

2 ENTERPRISE ARCHITECTURE ORIGINS AND BASIC CONCEPTS

2.1 How It All Started

> Every complex system is a changing part of a greater whole, a nesting of larger and larger wholes leading eventually to the most complex dynamical system of all, the system that ultimately encompasses whatever we mean by order and chaos – the universe itself.

This quote from the book *Turbulent Mirror: An Illustrated Guide to Chaos Theory and the Science of Wholeness* (Briggs & Peat, 1989) was used at the beginning of a paper by the National Institute of Standards and Technology (NIST; Fong & Goldfine, 1989), which could be attributed as one of the first works, if not the very first, to use the term *enterprise architecture* (p. 136). The paper, whose aim is to report on a series of workshops held about integration challenges in business and IT, starts off with a philosophical discussion on whether integration should even be an ideal to be pursued. "What is the benefit of integration?" (p. 3) ask the authors and go on to state that "chaos in business is expensive" (p. 3) and that while any efforts towards increased integration combat chaos – or disorderliness – it, too, comes at a price. Since, according to the second law of thermodynamics, the universe is in constant disintegration, to maintain integration, considerable amount of energy is required.

With this introduction, the authors go on to write of the increasing, unmanageable complexity and amount of different information technologies that companies are buying and adopting as fast as vendors are able to sell them. This dreadful situation that the authors described in 1989 is, of course, not much different in many organizations now, more than thirty years later. Since then, the amount, size and complexity of information systems has exploded, and the authors' concerns are as relevant today as they were then.

Integration, which is the main concern of the paper, is given the following dictionary definition: "The condition of being formed into a whole by the addition or combination of parts or elements;" (p. ix) and five key domains in the organizational context were recognized to require integration: (1) The integration of knowledge and data management, (2) the integration of technical and business data management, (3) the integration of systems planning, development, and maintenance tools and methods, (4) the integration of distributed, heterogeneous computing environments, and (5) architectures and standards. The workgroup on systems planning, development and maintenance tools and methods was in fact chaired by John Zachman, often credited as one of the founding fathers of EA as we today know it. In the paper's executive summary, it is bluntly stated that "[…] current information systems are dis-integrating, not integrating," and that only integration of IT systems can ensure the realization of productivity, quality, and other benefits often unquestionably attributed to information technology (p. xi).

The panel for the fifth domain discussed in the paper – *architectures and standards* – recognized five different levels of organizational architecture: (1) The business unit, (2) information, (3) information system, (4) data, and (5) delivery system. This categorization is relatively close to how, for example, TOGAF (2016) categorizes enterprise architecture today: (1) Business architecture, (2) data architecture, (3) applications architecture, and (4) technical architecture. This similarity reflects the fact that even though technology itself has evolved remarkably in more than thirty years, organizations still consist of similar elements, or at least it is convenient to use similar abstractions to describe and speak of organizations, even if many organizations operate very differently than they did a couple of decades ago.

One of the main justifications for organizing a workgroup around enterprise architectural standards, according to the authors, is that it is left to the organizations themselves to pursue and maintain integration of the systems (Fong & Goldfine, 1989). They go on to state that IT system vendors, rather than providing integration, actually feed on the disintegration of organizations by being able to sell more products and services when organizations are in a state of disorder. As companies go on spending more money on new systems and thus increasing complexity and disintegration, system providers increase their profits by contributing to the disarray. With these activities, the National Institute of Standards and Technology attempted to facilitate and define standards in the information technology domain in an attempt to aid organizations in their pursuit of integration. A direct quote from the paper further illuminates the work group's intentions in terms of standards:

> Architectures define an integrated end state vision for information technology within a specific business context. Standards are the harbingers of integration and at the same time they are an essential element of integration. Standards are the bridge among architectures, information technology, and applications management (p. 6).

As stated previously, the paper by Fong and Goldfine (1989) categorize enterprise architecture into five interrelated domains, as described in Figure 1.

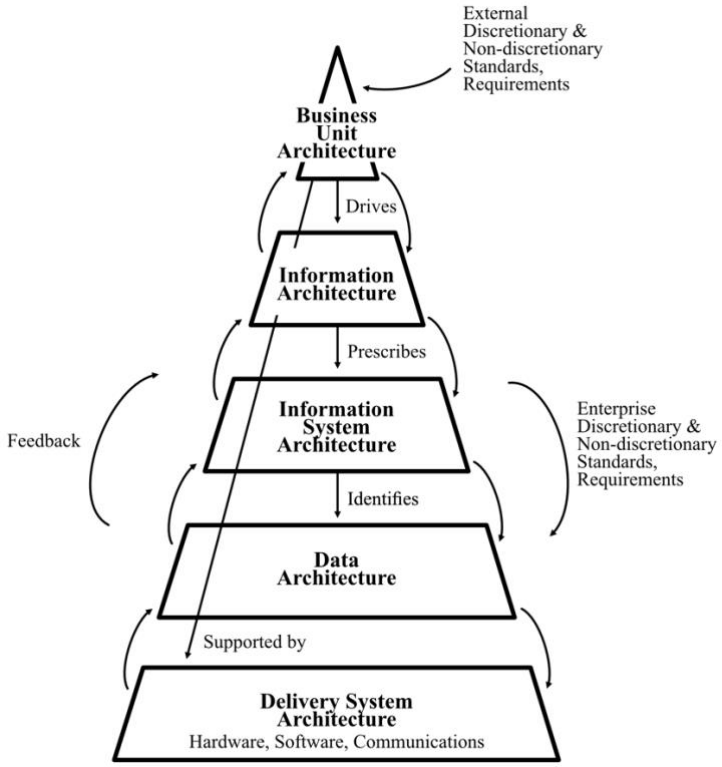

FIGURE 1 Enterprise architecture 'pyramid', reconstructed based on Fong and Goldfine (1989, p. 138).

The model presents EA as a kind of pyramid, where separate yet interrelated layers influence one another in a feedback loop, where lower levels are informed by and can be defined in relation to the higher levels. The bottom level of the pyramid, the delivery system architecture, is considered to be the foundation to the enterprise architecture. It is built based on the enterprise's business goals and objectives to best serve the organization to meet its targets.

The top level, or the business unit architecture, comprises of the organizational units, their relationships as well as, for instance, policies that affect the operation of the unit. It describes both internal and external information needs that are essential to its functioning. The next level, the information architecture, takes the information needs of the business unit and translates them into requirements for the information systems architecture, which is built to meet the above needs and to fulfil information processing requirements set by the business unit. Data architecture comprises of all the elements that have to do with data processing within the enterprise: Data models, databases, file structures, dictionaries, among others. At the base of the pyramid lies the delivery system, which, in this model, represents the technical implementation to answer to the needs of all the layers above. It consists of all the hardware and software systems

that are needed to operate the business according to the demands (Fong & Goldfine, 1989).

Some of the issues that enterprise architecture can solve are, for instance, lack of standardization across organization; poor comprehension of the big picture and the 'as is' status in decision-making; disintegrated, even conflicting information systems implemented due to insufficient communication and transparency; incongruent data management (Fong & Goldfine, 1989). Interestingly, as today one of the key problems associated with contemporary enterprise architecture is a situation where architects often use methods and create architectural definitions that are either too complex to derive benefits from or simply irrelevant to the business problems at hand, the authors state that "architectures – at whatever levels – are important only to the extent they link to and enable success in the basic mission and performance of the organization (Fong & Goldfine, 1989; p. 144)".

The authors describe the benefits of describing architectures for the different layers in the following quote:

> [It] enhances the enterprise's ability to guide decision-making, to manage change, and to communicate the organization's business goals, objectives and policies up and down its hierarchy and across its functional components (Fong & Goldfine, 1989; p. 142).

These benefits are realized first by making a clear link between information system investments and the business objectives of the enterprise. Simply by defining architectures, the authors state, the business stakeholders are forced to think about the information systems in relation to the business needs and goals. On the other hand, organization-wide architectural activities can increase and enhance communication and thus reduce siloed decision-making, disparate operational models, and disintegrated system solutions. Having defined architectural standards, an organization may develop more objective and accurate evaluation criteria for when new components, such as applications, are evaluated for investment. Finally, direct economic benefits can be materialized through, for example, defining reusable components within the organizational architecture and reducing redundant work as a result (Fong & Goldfine, 1989).

To summarize, enterprise architecture came into existence as a set of activities and resulting artifacts to relieve the increasing complexity of information systems in terms of organizations' objectives and strategy. As both organizations and information systems grew in size and complexity, a need was recognized to consciously influence and direct the entropic evolution of the mix. Rather than letting it all evolve in an uncontrolled, haphazard manner, EA was to introduce a governance mechanism and methodology to maintain at least partial control of the evolution to better fit organizational objectives.

So, in terms of the pursuit for simplicity, the original idea behind EA ticks all the boxes. First of all, simplicity is the goal in adjusting stakeholders' thinking more strongly towards the core mission of an enterprise by using EA visualizations to show logical connections between different systems and

processes within an organization. Often, different groups within an organization may lose the 'guiding star' of creating customer value in their daily work and instead of focusing on business value, a large portion of all effort is consumed with non-value-adding activities that could be either automatized or completely eliminated. In this regard, EA methods have the power to offer help in redirecting efforts within a company. Another aim towards simplicity is the focus and enhancement of communication that could be achieved through an organization-wide EA mindset. Done poorly, of course, such a mindset could contribute to increasing complexity rather than simplicity. A central challenge in large enterprises concerns the balance between strong integration and the diversity and specialization of IT systems and processes. Is it better to have wide automation and strong linkages between the systems and the resulting speed or instead loose coupling and the possibility for more specialized solutions? Which one could be considered a simple solution?

2.2 Enterprise Architecture Concepts

This part introduces the core concepts that are used in this thesis and that are essential to enterprise architecture literature in general. Because the definition of enterprise architecture itself is still today under dispute, it must be understood that also the other concepts can be offered various definitions, and thus in this thesis the aim is to give a general overview of how they are used in the literature and what they can mean.

2.2.1 Enterprise Architecture

Enterprise architecture, which is the central concept in this thesis, is used in several varying meanings in the relevant literature. Traditionally, enterprise architecture means a kind of toolset of methods and guidelines to map and direct the evolution of an organization's structure. To give an idea, the following is a definition given by Gartner, a US based technology consulting company:

> Enterprise architecture is considered a set of processes that aid organizations in translating their business vision and mission into effective enterprise-wide change through a clear understanding of its current (as-is) state and attaining a better future (to-be) state (Gartner, 2008).

By this definition, EA comprehends all the activities that are performed within a company in an effort to maintain cohesion between 'where the company is going' and 'what the company is doing.' In other words, for example, if a company wants to enter a new market, it might map out current resources and capabilities and then draw an ideal future state where the new configuration enables it to operate in that specific market. Beside new hires, the company might have to buy or build new IT systems and integrate them to the existing ecosystem, reorganize

its supply chain, train employees new skills and introduce new ways of working. Usually, this type of change benefits from various types of diagrams and other kinds of visualisations to convey the intended changes to all relevant stakeholders. This visualization is one of the main activities in EA.

Another definition for enterprise architecture is provided by Niemann (2006), where it is stated that EA is an aligned collection of plans that aim to deliver a holistic representation of an organization's IT infrastructure and business landscape, not only in its current state, but also in a desired future state. This definition differs from the previous one in that it takes the focus more on the deliverable artifacts that result from the EA processes that Gartner speak of. While Gartner emphasise "enterprise-wide change," Niemann focuses more on the static products that an architect might develop.

Traditionally, the scope of enterprise architecture is considered to cover the organization's IT infrastructure, meaning all the physical IT hardware, software, data and related services and processes that are utilised within the organization's various processes. Throughout this thesis, this definition will receive different variations depending on the considered literature. Also, the importance of making clear what is precisely meant by enterprise architecture in each instance is emphasised in this thesis.

2.2.2 EA Artifact

Commonly, different kinds of artifacts are essential in the practice and management of an organization's structure and configuration. In the simplest sense, enterprise architecture artifacts are drawings of specific processes and structures and their relations within an organization, also sometimes called architectural descriptions. Because a process is by nature more or less abstract, different ways to define and present processes are used to improve understanding and enable better communication. For example, when a customer arrives at the cashier in a grocery store to pay for his or her items, certain activities take place that enable the transaction. For instance, the customer places the items on the conveyor belt and the cashier picks them up one by one and scans them on the barcode reader. The data on the barcode is analysed by the computer's IT system which adds the item's name and price on the list of items, which will later become the receipt. When all items have been scanned, the customer pays for them either with cash or a bank card. Upon the transaction, the register system sends information to the store's stock management system as well as the customer data system. Finally, the customer packs the items into plastic bags and walks out of the store.

The previous example represents a relatively simple and straightforward business process, which nonetheless has several actors, activities, data, and IT systems involved. This process could be described with EA artifacts from different points of view and levels of granularity, depending on the need. When moving a level higher, this process could be represented as one among dozens of different but interrelated business processes within an organization. Descriptions

from different levels and perspectives usually require different types of artifacts, which are abundantly available in the relevant literature.

Kotusev (2019) studied the use of architectural artifacts in organizations and found that the four most used artifacts are (1) Solution designs, (2) Roadmaps, (3) Technology reference models, and (4) Principles. Figure 2 presents an example of a Solution design by Kotusev (2019, Appendix C).

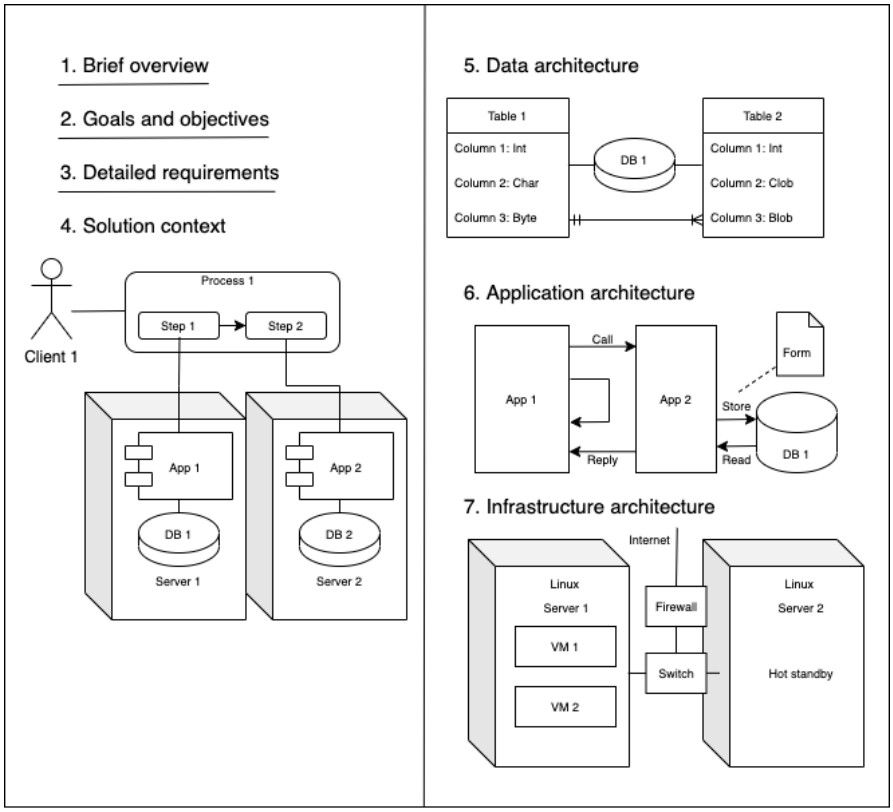

FIGURE 2 A figurative Solution design description by Kotusev (2019, Appendix C).

2.2.3 Enterprise Architecture Management

Every organization has an architecture, even if it is not acknowledged. Architecture, in this context, would of course mean the 'structure' or 'configuration' of the organization that involves many kinds of business processes aiming to create value for customers. Enterprise architecture management (EAM), then, is the conscious effort to manage the architecture. It might be as simple as a couple of guiding principles to direct IT investments, or it might be a dedicated department within an organization that actively participate in all the organization's activities to ensure coherence and integration of the architecture to support strategic business objectives both in the short and the long term.

Lange, Mendling and Recker (2016), cite Aier et al. (2011) in defining EAM as describing all the management activities that are deployed in an organization to "install, maintain, and purposefully develop an organization's EA (p. 411)". This definition can be complemented by citing The Open Group (2009), where it is

stated that EAM includes all the tools, methods, processes and responsibilities that are needed and used to manage an organization's various architectural layers in an effort to develop an integrated view of an organization.

According to Hylving and Bygstad (2019), EAM originated as a means to "clean up" an organization's IT infrastructure, and only later did business-related matters become more of an essential element of architectural work in general. In essence, EAM is just the set of activities that have to do with EA. As can be noticed, the concepts EA and EAM are by some definitions overlapping in meaning. As Gartner (2008) defines EA as a set of processes to guide organizational change and Aier et al. (2011) give a very similar definition to EAM, this thesis will use EA as an overarching concept and refrain from using EAM to avoid further confusion.

2.2.4 EA Framework

Usually, a framework is set up as a reference point for enterprise architecture development. Ready-made frameworks are presented in abundance in the literature, but often it is suggested that frameworks are adapted for each context specifically, whether it be from an existing one or from the ground-up. An EA framework can consist of, for instance, different views that should always be created when architectural changes are prepared, as well as principles and standards to guide decision-making in terms of, say, IT investments. An example of a framework is presented in Chapter 4.

Frameworks are usually the foundation for EA work. It is important to note that a framework is only relevant if an organization is consciously trying to manage and direct its architectural elements. In situations where the development of an organization's architecture is let evolve 'on its own' – in other words, when IT investments and IT infrastructure related developments, for instance, are done in isolation without any consideration to the 'big picture' – an architectural framework will be irrelevant.

2.2.5 Enterprise Transformation

When a need for radical change is acknowledged in an organization, an enterprise transformation (ET) endeavour can be initiated. Even though organizations usually go through constant change, a transformation is considered to be a fundamental shift in many aspects of the organization, not just small, incremental changes in, say, business processes or IT systems. Enterprise transformation is often prompted by a radical change in the environment, such as disruptive new technologies, political changes or abrupt changes in customer demands.

Enterprise transformation can mean an attempt to radically change a company culture in the wake of disruptive environmental influences that require a company to change its ways. Many organizations were forced to adopt a remote way of working amid the corona virus pandemic in the spring of 2020. Such a transformation did not mean just small tweaks in IT systems, but all employees,

in some companies, had to get used to working from home rather than going to the office each morning. Companies had to quickly rethink their information security policies and practices and rethink many fundamental business activities, such as customer meetings and other activities that previously had been performed 'on site'.

Besides global pandemics, situations where a company is on the brink of bankruptcy, a new CEO might be hired to perform radical activities in an effort to save the firm from demise. Major layoffs and a radical shift in business focus might be suggested and implemented, which often affects every part of an organization. Because transformations are wide and overarching, they usually affect or are enabled and driven by EA practices. If, for instance, an initiative to lower organizational hierarchy is launched, the architecture of the organization will most probably experience considerable changes.

2.2.6 Business Process Redesign

Even though not precisely a term used frequently in this thesis, it is worth noting that business process redesign (BPR) is often tightly connected to EA, since a large part of EA work is to do with business process modelling. Changes in EA almost always mean some kind of changes in business processes and can spark several individual business process redesign projects. In essence, business process redesign has much in common with enterprise architecture work and they are probably often used synonymously.

A business process is defined by Davenport and Short (1990, p. 4) as "a set of logically-related tasks performed to achieve a defined business outcome." Such processes are enabled by the different 'building blocks' of the business, such as different departments, IT systems and their interfaces, data and data analysis, governance models and company policies. In comprehensive EA projects, all these experience changes and should be taken into consideration.

2.2.7 Complexity

As established early in this thesis, enterprise architecture will be reflected in terms of its capacity to reduce and manage complexity – in other words, to cultivate simplicity in organizations. Complexity, in the context of this thesis, could be defined as that which is unnecessary and does not provide value. In a business process, for instance, complexity might be an activity that is performed which, if completely removed, would not significantly diminish the value provided by the process as a whole in terms of the business objective. Of course, often it is not as simple as that. Many times, complexity manifests as an activity that is 'slightly off', which cannot completely be removed, but instead needs to be adjusted and redesigned. An unnecessary complexity might be a phase in a business process where an approval is requested from another department by sending an email to yet another department, which then logs the request in some IT system, and so on, whereas in reality the approval decision might as well be

made in the place of origin. Such a 'detour' might add the time elapsed as well as the cost of the process significantly, while adding little or no value whatsoever.

Of course, complexity can manifest in many forms other than mere unnecessary process steps. It can be unclear, excessive documentation, it can be ten manual actions which could be automated, it can be messy code, or it can be ambiguous instructions. When speaking of enterprise architecture, there can be complexity on many levels: there is the complexity of structure and processes of large organizations, there is the complexity of architectural models and descriptions, there is the complexity of planning enterprise-wide changes, and there is the complexity of operationalised enterprise architecture projects.

Simplicity, on the other hand, could be considered to be what emerges when unnecessary complexity is dissolved. Everyone has some sort of an idea of what it means. Simplicity in thinking and action is a quality which is sometimes used synonymously with 'stupidity', and as such might not be held in high regard, as something to be pursued. At the same time, many of the greatest works of artistic and technological genius are praised precisely for their ingenious simplicity. "Simple is beautiful," as it is often said. Simple solutions to problems are often the most efficient, most cost effective and longest lasting. Those who know something about programming, for instance, and have experience in programming themselves, know that a novice programmer might type hundreds of lines of code to achieve a particular result, while an experienced coder does the same in a couple of lines of elegant code. When comparing these two different solutions, it might be that the algorithm of the novice programmer takes a hundred (or a million) times more time and consumes ten times more energy than the simple algorithm of the expert.

Simplicity is, of course, not a novel idea or something related to digital technology only. Throughout the ages, simplicity has been lauded as a kind of spiritual virtue and even a path to peace of mind. Ancient traditions have emphasized simplicity as key to a balanced life. It is said to imbue its wielder with certain type of power that cannot be attained by being busy all the time and having a thousand and one things in one's mind. And this is something that has been realized also in business. Lack of focus, complicated processes, wasted effort in non-value adding activities, complex company structures, multiple layers of hierarchy, and a wide variety of tools that promote unnecessary task redundancy and data invalidity all contribute to inefficiency and disability. A company which is hindered by complexities is at a disadvantage to its competitors that embrace low hierarchy structures, tools and systems that are fit for purpose without redundancy, focus on customer value in all activities and simple yet powerful processes that are enabled rather than impeded by the IT infrastructure and company policies. And perhaps most importantly, employees who can think in terms of simplicity and effect.

Words such as *beauty* and *elegance* are often used in conjunction with the word *simplicity*. Indeed, simple and powerful solutions, inventions, and works engineering can be described as elegant, especially when they solve the intended problem better and more cost efficiently than alternative solutions. Going back

to the EA origins, Fong and Goldfine (1989) defined the purpose of enterprise architecture as one of bringing 'order' into a disorganized, disintegrated system. In other words, simplifying a complexity that has gradually emerged as a result of lack of focus towards simplicity.

2.2.8 Summary

Figure 3 is an overly simplistic attempt to underline the relationships of the concepts presented in this part. The figure is composed of two main images: the As-is and the To-be. The former would represent the current (and overly simplified, non-standard) 'status quo' of an imaginary enterprise. The latter, on the other hand, is the desired state of the enterprise. The images themselves are EA artifacts created as part of the enterprise architecture work. The As-is diagram may or may not be based on an EA framework selected as a basis for such decisions. If the organization decides to embark on the arduous mission to transform the organization into what the To-be image represents, that undertaking could be called as enterprise transformation. If, on the other hand, the organization settles to tweak and optimize the existing business processes depicted in the As-is diagram, a business process redesign project could be initiated. The handling and storing of the artifacts, for example, could be part of the enterprise architecture management practice. Finally, as can be concluded from the two images, the organization would clearly attempt to reduce the complexity of its structures, IT infrastructure and business processes in order to attain simplicity and efficiency.

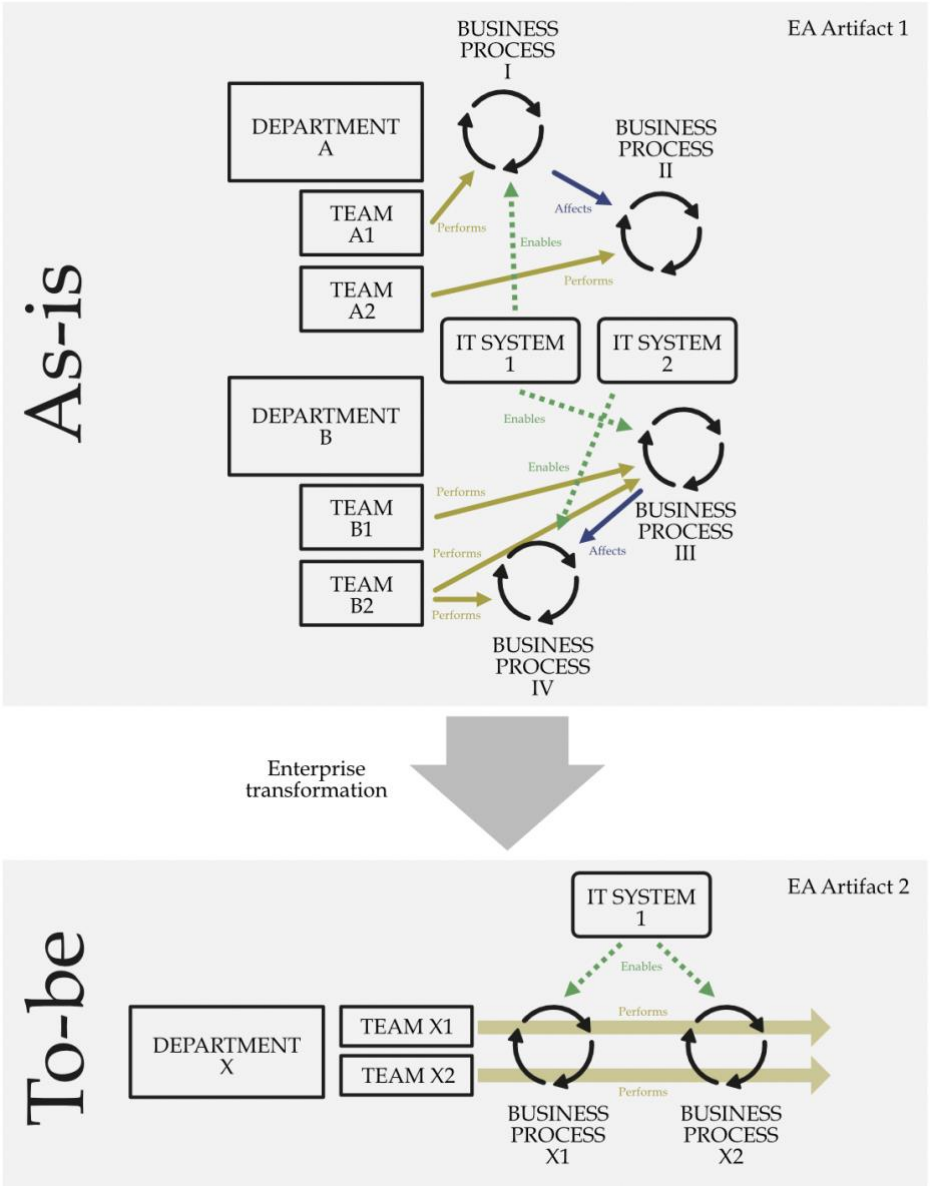

FIGURE 3 An overly simplistic, non-standard attempt to tie the relevant concepts together.

3 ENTERPRISE ARCHITECTURE EVOLUTION THROUGH THE YEARS

This chapter presents an overview of EA literature from its early years in the late 1980s to this day. It progresses in a more or less chronological order to paint a general picture of what kind of trends EA has experienced and how it relates to other ideas such as enterprise transformation or the Agile philosophy.

3.1 Laying the Groundwork for Enterprise Architecture

Since the publication of the NIST Special issue in 1989, many things have changed, especially in terms of information technology. For one, the World Wide Web was released to the public in 1991. Since then, a plethora of innovations and services have been invented that have changed the way we live and do our business. In this section, the evolution of enterprise architecture throughout the years is presented in brief.

An oft-cited body of knowledge related to enterprise architecture is the so-called Zachman Framework, which was introduced in the paper *A framework for information systems architecture* (Zachman, 1987). Even though being a highly valued reference in the enterprise architecture field, Zachman doesn't use the term 'enterprise architecture' as such in the paper, and in fact explicitly resigns from the linkage between business strategy and information systems strategy (p. 455), which is at least today often considered an essential part of enterprise architecture activities (e.g., Armour, Kaisler & Liu, 1999). The paper introduces a set of architectural deliverables that, according to Zachman (1987), are similar in any given engineering plan.

The planning starts with rough outlines on what is to be created, followed by a more detailed plan based on the future owner's requirements and needs, specified by the designer (or architect) to represent the final construct, translated then into 'contractor's plans' that guide the actual building process, supported by 'shop plans' by subcontractors for specific subcontracting deliverables. In a

railroad building project, as an example, the rough outlines would probably be a quick, inaccurate drawing of the route of the railroad on the map with the planned stations in between. Then, the route of the track would be specified in more detail to consider environmental factors and other requirements. With further input, a final 'architectural plan' would include detailed drawings and bills-of-materials of what resources in fact the construction would require. Then, engineers and constructors would create their own plans for the actual construction work of the railroad. Subcontractors also create their own plans for manufacturing and delivering their components, such as the steel rails, wood ties and other infrastructure elements to the site. Having these documentations delivered, the railroad construction could commence.

Zachman (1987) presents three different types of representations for engineering works in general to answer three questions: What, how and where. A bill-of-materials describes in more detail the components and materials the work is (or will be) composed of. Functional specifications describe the inputs and outputs of the work in relation to the processes incorporated with the work, answering the question of *how* it works. Finally, drawings such as flowcharts describe the connections between different components of the work, answering the question *where*. In the context of information systems, Zachman finds analogy in data models (what), process models (how), and network models (where).

These representations are used alongside the previously presented perspectives to in an effort to depict a proposed or existent information system as comprehensively as possible so that the various stakeholders are represented, and they can understand each other. Zachman (1987) introduces a 3x6 (later extended) matrix where columns point the type of description and rows point the perspective. In the matrix, each resulting cell presents a specific set of descriptions to be produced as a comprehensive information system architecture work. As the various descriptions represent the perspectives of different stakeholders, they are supposed to assist in communication.

A little later, Zachman (1996) complemented the framework's three questions (what, how, where) with the questions who, when and why by adding three new columns: People, time and motivation. Adding a total of 15 new types of descriptions to the model, the complete framework for information systems architecture is supposed to allow for more focused analysis of independent variables and "maintain a disciplined awareness of contextual relationship (Zachman, 1996; p. 5)."

In 1999, Armour, Kaisler and Liu published a paper in *IT Professional,* further emphasizing the rationale of enterprise architecture and tying the idea of IT architecture (or enterprise IT architecture, EITA) together with the big-picture vision of the business. To them, enterprise architecture is (or was) a set of tools, methods, and principles for managers to consciously plan and direct the evolution of their IT landscape rather than merely react to environmental changes. The authors start off by recounting a critical mistake made by organizations that take on any IT change initiative: going directly deep into the details. Introducing the enterprise information technology architecture (EITA),

Armour, Kaisler and Liu (1999) attempt to give organizations a shared context and an improved way to communicate and decide on IT investments (p. 35).

Armour, Kaisler and Liu (1999) propose that any enterprise architecting endeavor begin by defining a *framework*. Framework, according to the authors, "presents a set of models, principles, services, approaches, standards, design concepts, components, and configurations that guide the development of specific architectures" (p. 37). In other words, a framework sets certain boundaries for the enterprise architecture development by, for instance, introducing a collection of principles or rules to the work. In traditional architecture, a city-wide rule to limit building height to a maximum of six stories and 24 meters above ground gives a clear one-end constraint to the architecture project. In a particular district, for instance, only timber frames and a few preset façade colors might be allowed. In business and IT context, a framework could define some basic technical requirements to all architecting endeavors. For example, that data must be available at least 99% of the time, which would mean that system downtime can be maximum 87.6 hours per year, and that certain security standards must be implemented.

A framework must start with the business vision (Armour, Kaisler & Liu, 1999), which, on its part, influences the way in which IT is to be utilized. Once the business objectives are clear, it will be possible to start creating architectural views from different perspectives that are essential for different stakeholders. A collection of views helps stakeholders understand each other and communicate their perspective to others. Armour, Kaisler and Liu (1999) propose five views to begin with: (1) business view, (2) work view, (3) function view, (4) information view, and (5) infrastructure view. Business view informs the following three views and those three are supported by the infrastructure view. Along with views there should be architectural principles, a standards profile, and a technical reference model. These guide and focus any architectural work by providing a set of pre-set principles, standards, and references for technical solutions. All these elements together form the basis for effective communication and informed decision-making regarding IT investments and overall enterprise IT architecture development. Figure 4 (Armour, Kaisler & Liu, 1999, p. 36) depicts an example framework used to develop the enterprise information technology architecture for the US Department of the Treasury.

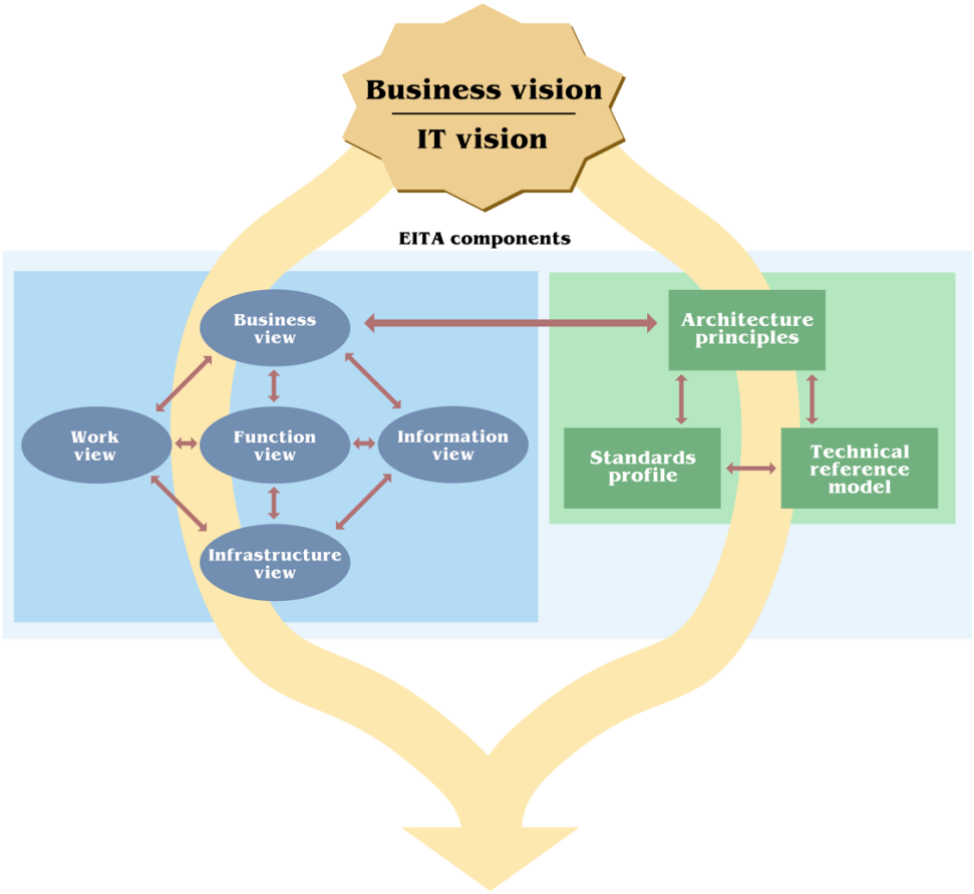

FIGURE 4 Framework for the US Dept. of the Treasury EITA (Reconstructed based on Armour, Kaisler & Liu, 1999, p. 36).

An example of the use of architectural principles is presented in the case study by Richardson, Jackson and Dickson (1990). They studied a joint venture created by the oil companies Texaco (US) and Saudi Aramco (Saudi Arabia) called Star Enterprise. The authors followed the new venture's evolution in terms of its enterprise architecture, which started by searching for a suitable architecture framework to guide the endeavour. A principle-based framework by Michael Hammer (1986; 1987) was selected as the basis for the to-be created enterprise IT architecture. According to Richardson et al. (1990), "Hammer believes that a physical information architecture is a manifestation of beliefs or principles of the organization's leadership." Thus, a set of principles were gathered for the new enterprise IT architecture. With overarching principles, the venture aimed to create a more aligned, integrated architecture than the existing one, which had arisen haphazardly as the two companies were merging their operations.

The direct benefits that were sought with the architectural transformation were, according to Richardson et al. (1990), enhanced information flow across the organization, reduced costs, and portability of software within different departments and functions. Principles are described as an overarching set of guidelines to provide context for IT related development and decision. In the paper by Richardson et al. (1990), the principles are categorised into four distinct areas: *organization*, *application*, *data*, and *infrastructure*. Table 1 presents four

samples of the principle set that was developed for the Star Enterprise architecture endeavor. Each sample belongs to one of the four different categories.

TABLE 1 Samples of Star Enterprise architectural principles and their rationale and implications as presented by Richardson et al. (1990).

Principle	**Rationale**	**Implications**
Organization All information technology professionals in each business unit will need to report either directly or indirectly to the person responsible for the information technology function at that business unit. (p. 389)	Escalating technological changes and business unit autonomy will increase the need for continuity and consistency across the information technology functions. (p. 389)	Substantial cooperation and coordination will be required among all information technology professionals in the business unit. (p. 389)
Applications Information systems planning needs to be an integral part of the strategic business planning process. (p. 390)	The business environment is characterised by increased competition, fluctuating margins, unstable markets, and compressed windows of opportunity. In order to continue to complete and exploit the small windows of opportunity for competitive advantage, it is vital that the information systems planning function be fully integrated with the business strategic planning process. (p. 390)	Information technology professionals will be more proactive in the planning process than in the past. (p. 390)
		An integrated process will ensure the alignment of the information systems plan with the business plan. (p. 391)
Data Data needs should be viewed as a corporate asset and be managed as such. (p. 393)	Data is a measure of a business activity at a point in time. A collection of data can be aggregated and transformed into information and, ultimately, into knowledge about the dynamics of a business situation. This understanding can create competitive advantage, where a business unit will have an opportunity to	Data management responsibilities must be clearly defined to guarantee effective utilisation of information throughout the corporation. (p. 393)
		Sufficient resources, including manpower, equipment, and software need to be applied to the data management functions in order to ensure the realisation of positive benefits from data utilisation. (p. 393)

	effectively exploit the situation to achieve maximum profit realisation. (p. 393)	TABLE 1 Continues A set of data management procedures needs to be developed and should be utilised throughout the corporation. (p. 393)
Infrastructure Star Enterprise needs to achieve a high level of connectivity and compatibility among all hardware, software and communication components. (p. 395)	A formalised, well integrated, and coherent infrastructure is desirable to support the operational needs of the organization. This strategy allows increased focus on business function rather than underlying technologies. Individuals will find it easier to share data, which will facilitate effective operational decision making. This kind of infrastructure will shorten application development cycles and decrease subsequent support costs. A single system image can be provided to the user, which has positive implications on training and total system cost. (p. 395)	It will be necessary to subsidise selected emerging technology in order to influence the evolutionary directions of the infrastructure. (p. 395)
		The supplier selection process will become critical in maintaining consistent infrastructure. (p. 395)
		This strategy will require a high degree of coordination and collaboration among all business units. (p. 395)
		The cost of computing will probably increase significantly when deviating from a common infrastructure. (p. 395)

The principle descriptions have been formulated in a way that directly guides development and provides a particular context for decision making. The almost imperative formulation in the description is a clear statement of how architectural development should be conducted. The *Rationale* column provides justifications for the principles by explaining, for instance, the changing market environment and its implications and how the principle will help the organization to make decisions that improve competitiveness. The *Implications* of implementing the specific principles are listed on the right-hand side column. Not only does it include the potential positive implications resulting from the principles, but also the negative implications as well as what the deployment of the principle would require of the organization in terms of, for instance, resources or new ways of working.

Contemplating everything mentioned above, it becomes clear that in the early years of enterprise architecture, the main concern has been how to align and integrate an organization's information technology ecosystem with ever increasing technological advancements and changing market environments. The EITA (enterprise IT architecture) school of architecture focuses on the conscious

direction and development of an organization's information technology assets. Questions like *how can we better communicate on IT with different stakeholders*; *how can we make better IT investment decisions that are aligned with and support the organization's objectives*; *what standards should we use to develop an effective IT ecosystem*; or *how should the IT infrastructure be situated for best operability*, color the enterprise architecture literature of that time. Ross (2003; p. 2) considers this way of thinking about enterprise architecture as the "city planning" approach, where standards and policies to guide the organization's IT infrastructure development are central. In her paper, she states that for the very reason that enterprise IT architecture has been approached from the "city planning" perspective, a great strategic potential has been left untapped.

In response to this, Ross (2003) proposed an evolutionary model on enterprise IT architecture, distinguishing four distinct IT architecture maturity stages, each with their particular benefits and challenges. The purpose for the model was, first of all, to provide a context for organizations to review their own architecture and evaluate where they stand. Secondly, as the model provides an evolutionary succession of an IT architecture, organizations may be able to better plan their actions to enhance their strategic IT competencies, or to 'reach the next level' of enterprise IT architecture, so to speak. Ross's effort is to try to figure out how organizations can create IT architectures that enable business agility and "happy surprises" rather than impose limitations on how they can operate.

The four stages are as follows: (1) Application silo architecture, (2) Standardised technology architecture, (3) Rationalised data architecture, and (4) Modular architecture. The first stage is one where distinct business needs have driven IT investments without a centrally guided strategic oversight. The second stage represents a situation where decided standards and a stronger central control have started to direct IT architecture development and investments. Rationalised data architecture, which is the third evolutionary stage in the model, is a situation where a more integrated enterprise IT architecture is complemented with process and data standardisation. Such integration could be pursued by, for instance, implementing an organization-wide ERP system. Finally, Modular architecture points to an IT-architecture environment where businesses begin to build loosely coupled, value adding innovative solutions on top of the integrated architecture to suit specific business needs and opportunities.

Central to 'advancing' on the architecture continuum is that organizations are able and willing to define the firm's core processes and make diligent, incremental changes to the enterprise IT architecture (Ross, 2003). Staying conscious of the 'as is' situation and continuously learning and adjusting are, according to Ross (2003), essential in developing an enterprise IT architecture that will gradually begin to yield strategic benefits for organizations. In a general sense, such benefits would mean the ability for an organization to develop IT-related innovations to address and spark business opportunities without undermining the achieved standardisation and integration of the enterprise IT architecture.

In 2005, William Rouse introduced the term *enterprise Transformation* in his paper *A Theory of Enterprise Transformation* (Rouse, 2005). The term and its

implications sprouted from the realisation that technological developments had profoundly changed the ways in which businesses are able to operate and compete in the marketplace. The urge to transform, in the words of Rouse (2005), follows from a recognised or anticipated value deficiency, such as decreasing revenues or declining share prices. Transformation goes beyond just integrating or standardising the organization's IT architecture. It is a fundamental, sometimes abrupt change in a business's operations, often related to the ways in which a business creates and captures value. Rouse (2005) lists three main approaches to address value deficiencies and drive transformation: (1) to improve current operational processes, (2) to change how work processes are performed, and (3) perform different work altogether. All these approaches can have considerable implications on an enterprise's architecture, and the existing enterprise architecture can either enable or hinder such transformational efforts. Rouse (2005) states that profound transformation can be achieved by influencing not just individual processes within an enterprise, but also the relationships between the processes – in other words the architecture of the enterprise.

Rouse (2005) goes beyond mere technical changes in a business's architecture by stating that a transformation may require or be initiated by a change in the organization's purpose, objectives, or functions. Thus, transformation addresses not just technical architectures such as specific IT systems, but potentially all employees and suggests radical changes to the organizational culture itself. Similar to the objectives of enterprise architecture, the author states that a key principle of transformation is to "cultivate and allocate resources so as to yield future enterprise states with high projected value with acceptable uncertainties and risk (Rouse, 2005; p. 25)." The author points to the importance of the qualities of managers in an organization to initiate and drive transformation. Rouse (2005) cites Klein (2002) and Gladwell (2006) in stating that managers' expertise, intuition, and abilities for quick and timely response are fundamental for successful transformation, before moving on to acknowledge studies (e.g., Burt, 2000; Granovetter, 2005) that emphasise the importance of social networks in managing change.

Rouse further elaborates that "weakly connected" networks (according to Granovetter (2005); Mohrman, Tenkasi, & Mohrman, 2003; Tenkasi and Chesmore, 2003) can be a more fruitful environment for new information and ideas in the wake of enterprise transformation. Granovetter (2005) gives an example of a "weak connection" as a situation where a person (voluntarily or involuntarily) associates with people outside of his or her usual relations, such as close friends, family or colleagues. Because the people are "new", there is a greater possibility for transactions of new information and ideas. "Strong connections", on the other hand, are those very friends, family members and colleagues with whom a person associates daily by default, and with whom transactions rarely spark novel ideas or new information. However, strong connections are seen as a better foundation for implementing change.

Table 2 illustrates a categorisation (by Rouse, 2005) of different types of value deficiencies that have been observed to initiate enterprise transformation. The

deficiency types are as follows: (1) Value opportunities, (2) value threats, (3) value competition, and (4) value crises. Each type describes a particular acknowledged situation of an enterprise where potential for improvement is recognised. Figure 5, on the other hand, depicts an alternative enterprise system model presented by Rouse (2005, p. 282). He defines enterprise state as a set of variables and their values at a given time by which the enterprise system can be evaluated, and its trajectory can be projected. By this description, an organization's architecture is an essential element of its state. The state of the organization gives rise to work processes that are influenced by inputs, such as investments and demand, that are 'fed' into the system. Together, then, the enterprise, through its work processes and influenced by its current state, uses these inputs to produce certain outputs, such as products and services.

TABLE 2 Different types of value deficiencies that spark enterprise transformation identified by Rouse (2005).

Type of value deficiency	Description
Value opportunities	The lure of greater success via market and/or technology opportunities prompts transformation initiatives.
Value threats	The danger of anticipated failure due to market and/or technology threats prompts transformation initiatives.
Value competition	Other players' transformation initiatives prompt recognition that transformation is necessary to continued success.
Value crises	Steadily declining market performance, cash flow problems, etc., prompt recognition that transformation is necessary to survive.

In essence, the theory of enterprise transformation presented by Rouse (2005) states that when an organization realizes a value deficiency, it must evaluate its work processes and (sometimes radically) change them to address the deficiencies. Since work processes are integrally connected to the enterprise architecture, a transformation of work processes unavoidably affects the architecture, or as Rouse (2005; p. 283) puts it: "Transformation of work processes inherently must affect the operational view of the architecture." The theory presented is important to the EA domain in the sense that it broadens the scope of transformation from a focus on IT to also include elements such as social networks and company culture. Suddenly, enterprise architecture covers much more than an organization's IT infrastructure. Enterprises are seen as socio-technical systems where cultural, psychological, social, and other human aspects are to be considered (Rouse & Baba, 2006). Optimal architectural solutions, then, simultaneously take into account more than one of these elements.

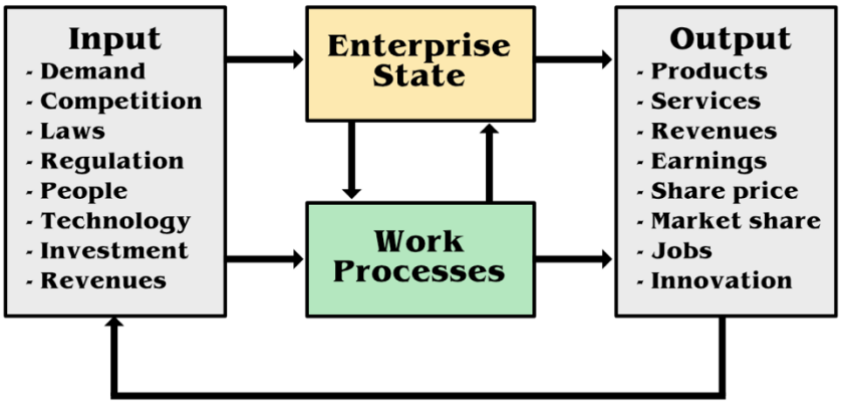

FIGURE 5 Enterprise system model (Reconstructed based on Rouse 2005, p. 282).

Purchase et al. (2011) elaborated on the concept of enterprise transformation by suggesting that enterprises focus on core competencies (and thus, work processes) that are central to their value-creation. The authors cite Parry, Mills and Turner (2010) as well as Lonsdale and Cox (2000), and Ellram and Billington (2001) in stating that to increase competitiveness in the market, companies should focus on these core competencies and go as far as to outsource the 'non-core' competencies that are less important to direct value-creation. While on one hand there is a trend towards narrower specialisation and strategic partnership with external operatives, Purchase et al. (2011) acknowledge a trend on the customers' side to increasingly seek total solutions to their needs.

In a sense, to give an example, Apple Inc. seems to have been able to capitalise on this by developing their ecosystem of hardware and software in a highly integrated and holistic manner. While Apple operates with strategic partners especially on the supply side (e.g., Investopedia.com), the company has managed to maintain its quality standards and continuously increase the control and integration of its products and services. Currently, Apple not only offers a wide variety of technology products and software developed in-house, but it also offers video and music subscription services that compete with market leaders like Netflix and Spotify, and with the recently released Apple M1 silicon, the company retained stronger control on a central element of its ecosystem: the processors. These business developments have made Apple a brand that is known for its tight integration and the resulting user experience that is often regarded as unparalleled by many of its competitors.

Another central remark that Purchase et al. (2011) make is the ascent of 'service dominant logic', which assumes the customer to be a 'co-creator of value' in the total value-creation process of any enterprise. This means, first of all, that the customer is central to the value-creation process from the very beginning. In software development, for instance, the customer (or end user) is a key contributor in the requirements analysis phase as well as during testing and even the day-to-day development process, at least by taking part in weekly or monthly reviews to analyse and test what has been developed so far and to provide

feedback for further iterations. Since the customer can manifest in a variety of forms, this can have direct implications on an organization's architecture. Simply keeping all the external stakeholders – be they customers, strategic partners or something else – 'in the loop' requires careful consideration towards the enterprise's communication systems and procedures. An enterprise's architectural configuration – and everything it entails – can have a considerable effect on how these strategic relationships with other organization's work.

At this point, it might be valuable to consider our definition of an *enterprise*. A simplistic definition would be one that considers enterprise as any organization, be it a business, an NGO, or otherwise, which can be labelled under one name, such as Microsoft, Adidas, Greenpeace, or the World Health Organization. This definition, however, quickly becomes insufficient when other stakeholders, with whom the organization might have joint interests and close collaboration, are added into the mix. On the other hand, an organization might have several enterprises within it, for example when it operates in two or more distinct markets. So perhaps enterprise should be considered more in terms of the objective. Two or more people can have a mutual objective towards which they collaborate. Irrespective of where they are affiliated, they are united in an enterprise. Thus, Apple and all its component suppliers could be thought of being united in a mutual enterprise to deliver products and services to customers worldwide. Therefore, Purchase et al. (2011, p. 19) defines *enterprise* as "a complex system of interconnected and interdependent activities undertaken by a diverse network of stakeholders for the achievement of a common significant purpose."

For the above reasons, it would be of utmost importance at the beginning of any enterprise architecture transformation process to clearly define the *enterprise* in question. What is being transformed? If the subject of transformation is not clearly defined, the entire endeavor might be a mishit from the beginning.

3.2 Towards the Maturity of Enterprise Architecture

Building on the work by Ross (2003), Bradley et al. (2011) studied the proposed enterprise architecture maturity stages and found that the more mature the architecture, the better the enterprise is able to benefit from its IT. The authors had three areas of IT value that they measured: (1) external relationship management, (2) operational costs, and (3) strategic agility. The first finding was that more mature architectures enable enterprises to use IT to communicate and collaborate with external stakeholders; to better stay up to date in data availability and information needs across organizational and application boundaries; to better leverage shared infrastructure for interorganizational communication between systems. Another key finding was that architecture maturity leads to better ability to standardise business processes and improve data transparency throughout the organization. This, according to the authors, can lead to reduced costs due to decreased data and task redundancy and the

complications that are caused by such redundancy. The third finding was that through the ability to digitize core business processes, a mature architecture enables enterprises to be more agile in entering into new markets.

Overall, the study suggest that a more mature architecture allows organizations build a more coherent, more integrated view of the enterprise, which, on the other hand, makes it possible that the architecture becomes more of an enterprise-wide competency and a shared responsibility as well as enabler for better business performance. Based on the research results, Bradley et al. (2011) give a couple of key guiding principles in enterprise architecture development. The first is to prepare for flexibility in business strategy planning. This, according to the authors, will pay off later, when unavoidable internal or external changes suggest changes to both the strategy and the architecture itself. Also, they point out that organizations should make sure to capture also complementary intermediate effects of enterprise architecture when its value is measured. By getting a comprehensive picture of where value really comes from, organizations will be better equipped to make beneficial IT investment decisions.

Rai et al. (2010) followed two organizations in their pursuit of modular architecture, and they compiled a set of lessons for anyone trying to do the same. The lessons, in a nutshell, are: (1) implement business process standards to enable total solutions for customers, (2) pursue loose coupling of systems with standardised interfaces, (3) map process dependencies to develop standardised interfaces, (4) educate stakeholders on the benefits of standardised interfaces to gain management support, and (5) implement decision criteria for IT investments to support modular enterprise architecture. With stronger integrations, one of the organization was able to better use data from different systems to drive business decision-making and make sure that key stakeholders always had access to the most up-to-date customer information. Also, thanks to standardisation, the end-to-end supply chain was better integrated, and with the help of 'plug-and-play' capabilities, the organization could improve its collaborative relationships with customers.

To modularise its enterprise architecture related to business partner collaboration, one of the case examples in the research (Rai et al., 2010) used partner interface processes (PIPs) to create loosely coupled architectures, clarify roles and activities in B2B processes, and standardise interfaces with partners. Besides PIPs, another practical but less technical change for the organization was to establish cross-functional teams to improve information flow between IT and sales and marketing. This activity can have twofold benefits: (1) business units have better support from IT and can thus plan and develop their IT systems to better suit their needs, and (2) IT personnel can act as mediators between business units and IT architects to both provide feedback and ensure that overall integration and standardisation is maintained. Standardisations in IT platforms and business processes, on the other hand, enable organizations to operate faster and with less redundancy, which can be vital in a dynamic market environment.

Valorinta (2011) adds to the literature of IT and business alignment in his paper *IT alignment and the boundaries of the IT function*. The author cites earlier

information systems studies (Luftman et al., 1993; Peppard and Ward, 1999; Chan, 2002) in emphasizing the importance of IT and business alignment for innovative IT use, optimized IT spending and overall competitive advantage. With alignment, Valorinta (2011) simply means that, in essence, the IT function is working precisely towards the overall strategic business goals of the organization rather than some ulterior or even contradictory objectives. As a potential issue the author mentions a situation where the IT professionals tinker with technical problems that are irrelevant and non-value-adding in terms of the business strategy. To add to the challenges, IT personnel might use terminology that is difficult for other stakeholders to understand.

The main contribution that Valorinta (2011) makes has to do with outsourcing. The author suggests a trend towards further outsourcing of routine IT operations, which would enable organizations to focus on their core activities. This trend, which is supposed to enable management to focus more on value-adding activities (e.g., Grover et al., 1996), should nevertheless be approached carefully, states Valorinta (2011). The reason being that outsourcing organizations can never possess the same level of domain knowledge of the business. Thus, organizations that plan for outsourcing should carefully consider the tradeoffs and critically evaluate which functions should never be outsources. When developing enterprise architecture, such outsourcing activities need to be thoroughly thought out.

In 2011, Lapalme presented three schools of thought that he had been able to discover in the enterprise architecture literature. The schools are as follows: (1) enterprise IT architecting (EITA), (2) enterprise integrating (EI), and (3) enterprise ecological adaptation (EEA). The EITA school, which was already introduced as a term by Armour, Kaisler and Liu in 1999, basically aims for effective strategy execution via the use of effective IT tools. It is seen as an approach to enterprise architecture from a strong engineering point of view, emphasizing technical competence and knowledge as well as technically 'pure' IT solutions. The second school, or enterprise integrating, is considered a more holistic approach, where systems thinking is encouraged and the aim is to understand and improve the dynamics of an organization. It is based on strong organizational collaboration to pursue organizational coherence and effective strategy implementation. Finally, the enterprise ecological adaptation school is seen as the approach to achieve organization-wide innovation and adaptation in terms of its environment. The key tenet in this school is 'system-in-environment' thinking, whereby the organization is supposed to be constantly monitoring and analysing its environment in order to coevolve with and even change the environment. This theoretical state of affairs is thought to be ideal for organizations that aim to thrive in dynamic market environments.

3.3 Enterprise Architecture as the Enabler for Agility

In the past two decades or so, organizational agility has become a term often used when addressing the pursued benefits of enterprise architecture and IT capabilities. Liu and Ramamurthy (2011) present three dimension of IT capability and two types of organizational agility. The IT capability dimensions are as follows: (1) IT infrastructure capability, (2) IT business spanning capability, and (3) IT proactive stance. The types of organizational agility are market capitalizing agility and operational adjustment agility. The authors studied the effect of IT spending on organizational agility and concluded that organizations must make IT investments in a way that increases its IT capabilities rather than just focusing on new IT as such. Improving IT capabilities, state Liu and Ramamurthy (2011), has a positive effect on organizational agility.

Citing Goldman et al. (1995), van Oosterhout et al. (2006), and Zhang and Sharifi (2000), Liu and Ramamurthy (2011) define organizational agility as:

> […] a firm-wide capability to deal with changes that often arise unexpectedly in business environments via rapid and innovative responses that exploit changes as opportunities to grow and prosper (p. 933).

A key rationale for the study was the observed fact that many organizations have an IT infrastructure that hinders rather than enables business innovations and flexible change when the market environment requires such (Attaran, 2004; van Oosterhout et al., 2006). But it is not just that large organizations are snared by inflexible legacy systems. Some may in fact invest heavily in new IT solutions but fail to take the time to integrate them and thus fully benefit from them. By developing the three dimensions of IT capability, organizations can enhance their agility in the marketplace.

IT infrastructure capability, according to Liu and Ramamurthy (2011), basically means an IT platform which is integrated and standardised, and thus allows for timely and reliable data management. This, on the other hand, makes possible decision-making based on accurate information. The second capability – IT business spanning capability – is about the tight collaboration between IT and business in an organization, which can result in better IT investments that support business strategy. Finally, the IT proactive stance capability means an active pursuit to explore new and exploit existing IT resources for better business performance and innovation. Organizations that are able to invest in such a way that enhances these capabilities will increase their competitiveness and ability to more flexibly operate in unpredictable business environments, according to Liu and Ramamurthy (2011).

Madison (2010) presents a practical perspective on agility in architecture that supports agile software development. He sees the architect as a close participant and supporter to project teams by, among other things, developing high-level as well as detailed design patterns and creating diagrams for the team's benefit, making hardware and software decisions based on corporate standards and

communicating with stakeholders on the general technical direction. Based on the principle of iteration, architectural decisions are not locked in too early, but rather they are allowed to change as more experience is gained and preliminary solutions are tested. The architect is the one who must understand the organization's business needs as well as architectural principles and standards and thus is able to keep development projects aligned and integrated with the 'big picture' of the enterprise. The architect participates in many of the key agile activities, such as sprint planning and storyboarding to provide prioritisation assistance and guidance to the team. In this way, the architect acts as a uniting medium between business and development (Madison, 2010).

Beyond software development teams, Madison (2010) ties the architectural work within organizations together by strongly advocating that unless already existing, companies should establish centralised enterprise architecture functions to facilitate collaboration between the architects working on lower levels. The key idea is that without a centralised EA, individual architects might not communicate with one another, and the work might not be aligned. The centralised EA, then, would establish standardised practises, measures, tools, and processes to tackle issues and suggests actionable solutions. Madison (2010) further elaborates that such centralisation would operate in the periphery, and still the major part of architects' work would focus on projects. In essence, governance bodies like an Architectural steering committee would create a platform for synchronous and aligned enterprise architecture development while still allowing architects time to participate in project work and enabling flexibility to develop solutions for specific needs.

Chen et al. (2014) build on the idea of business agility by zooming in on agility in business processes, as presented by Sambamurthy et al. (2003). The authors cite Tallon (2008) in defining business process agility as "the ease and speed in which firms can alter their business processes to respond to threats in their market (p. 327)". Like Liu and Ramamurthy (2011) above, Chen et al. (2014) similarly attribute a large role in business process agility to IT capabilities, especially those that by being rare, non-reproducible, and non-substitutable (Wade & Hulland, 2004) create a competitive advantage to an organization. They present a list of six distinct IT capabilities: (1) IT infrastructure, (2) IT business partnership, (3) business IT strategic thinking, (4) IT business process integration, (5) IT management, and (6) external IT linkage, in line with Bharadwaj et al. (1999) and Bharadwaj (2000).

In a nutshell, business process agility, according to Chen et al. (2014), is an organization's ability to respond to changes both internal and external by reconfiguring its resources in ways that in some way restructure and reorder its business processes. This change is ideally initiated in an effort to enhance market performance, be it by improving products or services, reducing costs or time-to-market, creating additional value to customers, acquiring talents or other resources, among other things. Agility, which in essence is the ability to adapt, is often a prerequisite for success in unpredictable, dynamic market environments. The ability to adapt, naturally, means that the organization must be able to

receive and correctly analyse and interpret information on the environment, be it internal or external. A robust and integrated IT infrastructure will enable the organization to store and access data that is coherent, relevant, and trustworthy (Duncan, 1995). In addition, together with IT management capability, a strong IT infrastructure will enable a firm to efficiently deploy new applications (Chen et al., 2014; Van Oosterhout et al., 2006).

External IT linkages, another IT capability, will enable a firm to communicate effectively within and without organizational boundaries for improved responsiveness (Chen et al., 2014; Shang & Seddon, 2002). IT business partnerships, IT business process integration, and business IT strategic thinking, on the other hand, all contribute to a stronger collaboration between the IT function and business operations (Qu et al, 2010). In summary, Chen et al. (2014) see that developing the six IT capabilities together with other organizational capabilities to increase business process agility and overall adaptability can endow firms with considerable competitive advantages in dynamic environments.

From the perspective of enterprise architecture, business process agility should be kept as a capability to be pursued and enabled. As the literature has pointed out, it is easy for organizations to ensnare themselves with careless IT investments and siloed architectures, and without conscious monitoring and 'architecting', it might be difficult indeed to achieve the level of adaptability and responsiveness required to stay competitive in markets where change is rapid and constant.

On the sentiment that "organization itself cannot be agile, but its employees can," Wendler (2014; p. 1197) suggest three themes by which the agility of an organization can be measured: (1) agility prerequisites, (2) agility of people, and (3) structures enhancing agility. Agility prerequisites are presented as, first of all, the agile values that must be embedded in the organization's culture, and secondly, technological capabilities that enable the organization to communicate effectively, share information, and utilise standardised and integrated information systems. Agile values are, for instance, encouraged experimentation and decentralised decision-making mandate at all levels of the organization (Wendler, 2016). Agility of people basically means the level by which an organization's employees live by agile values and act according to them. Factors such as education, willingness and ability to learn, and possessing multiple work-related skills are also considered important in terms of the agility of people (Wendler, 2016). In addition, the management's capability to manage change and conduct strategic IT investments are seen as a crucial element of agility by people. Then, structures enhancing agility is presented as the culture of collaboration within and across the organization's borders as well as the ability to adapt organizational structures in response to market needs (Wendler, 2014).

Based on these criteria, Wendler (2014) presents a maturity model of four stages, whereby organizational agility maturity can be described. The stages are as follows: (0) non-agile, (1) agility basics, (2) agility transition, and (3) organizational agility. As the name tells, non-agile organizations have no or only

little traces of the aforementioned agile traits. An organization with agility basics implements a few of the traits, and a part of the employees are familiar with and able to utilise agile methods and principles. Nevertheless, organizations in stage 1 are starting to recognise the benefits of agile values. The agility transition phase, then, would be a situation where the organization is for the most parts practicing agile values and its flexible structures enable rapid responses to market changes. Change towards stronger agility is welcomed and well managed and the organization supports collaboration and promotes teamwork. Finally, an organization which has achieved agility (stage 3), scores high in all domains of agility. It has established a flexible and strong enough an IT infrastructure to both enable timely, trustworthy data flow and support architectural changes when needed. Most employees practice agile methods and utilise agile principles in their work. Collaboration and cooperation are key values in the organization and people are able to adapt to changing circumstances.

In 2016, Wendler further emphasised the need for agility especially for organizations operating in the IT and software industries, where new technologies, fierce competition and other dynamic elements require the ability to quickly adapt to market needs. The author cites Abrahamsson, Conboy, and Wang (2009) as well as Ågerfalk, Fitzgerald, and Slaughter (2009) in stating that a key blocker for achieving agility is a lack of holistic approach. In other words, it is not enough to have a couple of development teams practicing agile methods, but rather, agility must be kept as an ideal in every part of organizational development, such as company culture, IT infrastructure and technology, competent workforce, change management and decentralized decision-making abilities as well as responsiveness to customer demands.

To redefine enterprise architecture for this century, Korhonen et al. (2016) make an attempt to shift the perspective of the field to look at enterprises more like living system than, say, an engineering construct, such as a railroad network, a building or a vehicle. This means that however strong controls are established to consciously direct architectural development, there are always factors that cannot be accounted for and therefore change that 'happens of itself'. Korhonen et al. (2016) see that enterprise architecture has become a field which, against its own ideals, might in fact encourage silos, which can result in power struggles and unhealthy boundaries between stakeholders. Then, as changes are implemented in one 'silo', unpredictable, often harmful changes happen in other parts of the organization. To combat these trends, Korhonen et al. (2016) suggest that, indeed, enterprise architecture is to be considered an organization-wide responsibility which aims at collaboration and innovation and innovation sharing within and without the organization.

Furthermore, starting from the notion that enterprise architecture can be seen as a "means to inform, guide, direct, and constrain the decisions taken by human beings within organizations (p. 272)," Alzoubi and Gill (2020) suggest agile enterprise architecture (AEA) as a way to increase an organization's agility. Basically, AEA takes traditional enterprise architecture and imbues it with agile principles, such as decreasing the amount of formal documentation, utilizing

lean and effective communications tools across teams and departments to facilitate architectural understanding, and enable the scaling up of agile development. Architectural descriptions are created and developed on a 'just-in-time' basis to avoid too much up-front planning (Alzoubi & Gill, 2020). Incorporating agile principles into architectural work aims to enable effective enterprise change by the way of developing and communicating key requirements, models and principles (Alzoubi & Gill, 2020).

In 2018, Hosiaisluoma et al. published a paper describing their vision of a modern, lightweight version of EA practice: The Lean Enterprise Architecture Development (LEAD). Like many others, Hosiaisluoma et al. start with the common observation that the purpose of EA often remains vague and its benefits are left unrealized. To combat this issue, the authors strive towards a more simplified EA practice with the following benefits: a better customer-centricity and effective value creation; clearly defined capabilities; multidisciplinary teams; change towards more open, innovative and collaborative culture based on trust, transparency and openness; agile and lean thinking and a service driven approach; improved visibility of development across organization; focus on smaller development targets such as services to enhance idea-to-production pipeline. They cite Dybå (2000) and Nerur (2005) in stating that imbuing agile thinking into EA taps into the idea that challenges in an unpredictable world can be addressed by relying on the creativity of people rather than planned processes. LEAD revolves around a central idea called the Value-Delivery chain. The aim is that organizations structure their processes more strongly around customer needs and business value creation. Hosiaisluoma et al. state that organizations should align their capabilities around this value-chain to realise the benefits of architectural integration and customer focus. This means relentless focus on customer experience, which means a customer perspective of his or her experiences with the organization's services. Customers' needs are front and center in everything an organization does and the architecture is developed around this idea.

LEAD is organized around a Value-Delivery chain, which is an integrated 'pipeline' for all customer and business driven demands. The pipeline gathers the relevant capabilities of an organization around a well-defined process for value-creation. The process starts with a demand, which can come from customer needs, strategic goals, regulation, or market shifts and arising technologies, among other things. These demands are handed over to the Demand Management team, which takes ownership of the demands and duly handles them by, for example, creating preliminary concepts or prototypes of them. Then, Portfolio Management evaluates these concepts and assigns them to relevant development queues. Development teams, using agile methodologies, then realise these concepts into products or services. Finally, the realized products and services are deployed into use to be operated by IT operations (Hosiaisluoma et al., 2018). The aim of the pipeline is to abolish or at least diminish the boundaries that exist between (often siloed) departments and organizational units.

Integrating different functions along a single pipeline is supposed to improve customer-centricity and enable stronger collaboration and visibility.

LEAD comes with the Lean Enterprise Architecture Framework (LEAF), which consists of three main components: (1) Management, which includes the 'metadata' of the organization, such as mission statements, capabilities, principles, governance models and business models; (2) Value Delivery Chain, which is the central idea in Lean Enterprise Architecture Development and is in essence the rough outline by which end-to-end IT development processes should be modeled to create customer value; and (3) Architectural Landscape, which is the repository for architectural artifacts of different types and levels (Hosiaisluoma, 2018). The landscape in the LEAD model combines 'as is' and 'to be' architectures, such as current business services, processes and applications, and planned services, among others. However, Hosiaisluoma emphasizes that the purpose of the repository is not to devolve the EA practice into the traditional 'ivory tower' function, where grandiose plans are created separately from the rest of the organization and irrespective of practical business-driven needs. Instead, 'as is' and 'to be' views are to be made sparingly, when in specific instances it is seen as beneficial. The point is to follow the mentality 'just in time' rather than 'just in case', meaning that architectural artifacts are developed on a need-basis, when the value for the work is clear.

Lean and agile principles are the cornerstone of LEAD, so for instance collaboration and overall visibility are emphasized as essential elements. Lean, according to Hosiaisluoma et al. (2018), is the aim to maximise customer value and minimise waste. To achieve this, an excellent value creation process must be in place that puts the customer needs first. As an agile methodology, LEAD incorporates practices such as sprints, agile meeting practices, backlogs and other relevant tools and methods to EA. Also, the authors state that popular frameworks such as SAFe, IT4IT, ITIL, DevOps and Scrum are applicable with LEAD.

3.4 Enterprise Architecture in Practice

As has been discovered in the previous sections of this thesis, based on literature, a key element of enterprise architecture are the various artifacts that are to be created as part of the 'architecting process'. Dozens of different types of artifacts with several different categorisations are suggested by literature, and one may question, to what extent all those artifacts have real value in practice. The same question was asked by Kotusev (2019), who studied real organizations and their enterprise architecture practices to find out whether all those artifacts mentioned in the literature have practical use and value. Kotusev cites Abrahamson (1991, 1996) and Gibson and Teson (2001) in stating that a large portion of the artifacts suggested in enterprise architecture publications are not based on empirical research or findings, but are rather the brainchildren of consultancies, 'gurus' and other fashion-setters based upon anecdotal evidence. In another paper by

Kotusev (2017), it is shown that many of these artifacts are often merely assumed to be valid without having been validated by research. Continuing even further, Kotusev (2019) states that many of the artifact lists provided by different sources (e.g., Bernard, 2012; DoDAF, 2007; Spewak & Hill, 1992; TOGAF, 2011) do not clearly define any actual use cases for the artifacts.

The findings by the study suggest that the strict classifications suggested by literature (e.g., business, application, information and technology artifacts) have little value for the artifacts used in practice, since the artifacts used are strongly interconnected and are meaningless without one another. In light of these findings, Kotusev (2019) highlights the notion that enterprise architecture, rather than being a single, monolithic description, is actually a diverse set of descriptions developed for very different use cases in different circumstances. Thus, he suggests an alternative definition for enterprise architecture:

> EA is a collection of special documents (EA artifacts) describing various aspects of an organization from an integrated business and IT perspective intended to bridge the communication gap between business and IT stakeholders, facilitate information systems planning and thereby improve business and IT alignment (Kotusev, 2019, p. 112).

With these notions on enterprise architecture literature as a reference point, this section presents some literary examples, where enterprise architecture methods were implemented to achieve practical benefits and drive real change in organizations.

Tamm et al. (2015) present the case of 'RetailCo', an Australian retail company embarked on a business transformation endeavor through enterprise architecture. The company, which was reported to be one of two major retailers in Australia, had (at the time of writing) annual revenues of $30 billion and more than 150,000 employees. The reported transformation endeavor started in 2001 and ended in 2007. The starting point was that an enterprise architecture function did exist, but it didn't have a clear mandate and the work focused mostly on strategic planning that rarely resulted in any practical value for the company. A major restructuring of the IT function was done, vacating all 2000 IT positions for re-applying by the employees and adding almost the same number of new positions. The CIO of the company decided to shift the working principles of the IT function more towards a customer-service and delivery focus instead of focus on inward issues; more towards a business solutions mindset instead of a technology mindset; and more towards a "buy" skillset instead of building IT systems in-house (Tamm et al., 2015).

Then, in an effort to change the 'ivory tower' syndrome of the enterprise architecture function, the CIO involved solutions architects to work more directly together with project managers on IT projects. The aim was to provide direct support and guidance on architecting matters, so that projects could benefit from the enterprise architecture function instead of each project making their separate decisions irrespective of the 'big picture'. In addition, particular governance bodies were set up to provide a platform for communication and collaborative

decision-making. The enterprise architecture standards council developed organization-wide IT principles, guidelines, and best practices. The project architecture review group made decisions on deviations to the architecture guidelines that projects requested. In addition to these, an innovation group was set up to explore and experiment with new technologies to possibly be integrated into the infrastructure (Tamm et al., 2015).

Seven organization-wide IT principles were eventually defined to guide the transformation endeavor: (1) shifting from a business unit focus towards a process focus, (2) simplifying the IT platform whenever possible, (3) renewing and consolidating the organization's IT, (4) buying IT rather than building, (5) collaborating with two vendors on a single solution when possible, (6) transparency and accountability, and (7) making the project manager more powerful. These and other changes were reported to result in three key benefits for the organization: (1) decision-making processes concerning IT became more effective, (2) projects that were launched as part of the wider transformation endeavor were delivered with better success, and (3) the resulting digital business platform enabled a stronger strategic capability (Tamm et al., 2015).

Another example is presented by Madison (2010) who, rather than presenting a comprehensive case study, draws upon his own experience to highlight some practical steps that organizations can take to improve their architecting activities. As stated earlier in this thesis, Madison proposes companies to establish a centralised enterprise architecture structure, if only to facilitate communication between the individual architects working in different parts of the company. Then, going to a more detailed level, Madison would place the architect into IT development projects to work tightly on the development of new solutions and collaborate especially with the Product owner in agile teams. The architect brings in understanding of the wider organization so that when organizational or technological boundaries are addressed, optimal solutions can be developed while maintaining coherence and integration. The architect is able to turn business objectives and organizational architecting directions into actionable goals for the development team. In addition, according to Madison (2010), the architect communicates to keep all stakeholders aware of the current architectural state, measures solutions by their scalability, maintainability, extensibility, and their adherence to standards, as well as makes decisions on appropriate software and hardware for each specific purpose.

Hosiaisluoma et al. (2018) report initial experiences and findings of the LEAD methodology in the city of Vantaa, Finland, which started to implement the LEAD ideas and practices. The management of the IT governance body in the city wanted to replace their current EA practices with a more understandable, leaner way of operating to reduce siloed departments and a general lack of visibility of their enterprise development. The role of EA in the city's IT organization was not clear, and the benefits of enterprise architecture in general were not felt to be realizing. As a result, LEAD was implemented, which resulted in the deployment of many of the LEAD elements, such as the Demand Management team, the Lean Manager to oversee the EA pipeline, agile and lean

principles, a new EA visualization tool, the Lean Enterprise Architecture Framework, and LEAD performance metrics.

One year in, it was reported that the city realized that the Demand Management function was too heavy and rigid for their needs. Since LEAD was developed precisely to be modified on a need-basis, it didn't cause critical problems to modify it. The number of participants in the Demand Management was reduced and design meeting length was reduced, so as to better fit the needs of the city and enable even more agility.

Another interesting thing mentioned is that with the deployment of LEAD, enterprise architecture as a term has gradually been replaced with a more relentless focus on customer value. Hosiaisluoma et al. (2018) report that due to the Finnish law change in 2011, which forced governmental entities implement EA, the very term enterprise architecture had become a sort of curse word. So, in the respect that LEAD emphasizes stronger customer-centricity and value-creation focus, the implementation can be seen successful. In fact, as Madison (2010) suggested, the word 'enterprise' in enterprise architecture could be completely dissolved and instead simply use the word 'architecture', because in the end, it is difficult or even impossible to distinguish between different types and levels of architecture. Ultimately, what an organization should indeed be interested in is the way in which is created value to its customers. A company can indeed create amazing value to its customers even without ever having used or thought of the word 'architecture', even less the word 'enterprise'.

3.5 Summary of the Findings

As a conclusion, it is clear that enterprise architecture literature as well as its practice are colourful and cover a wide range of organizational aspects and issues. And it is probably for this very reason that EA can be difficult to comprehend. One comes to ask questions like: "Are we speaking of an attribute of an organization? Or are we instead speaking of some sort of practice related to such attributes? Or more yet, are we speaking of some kind of drawings and diagrams?" And it seems that the answer is that it depends.

However, the key takeaway is that EA, whatever the definition, is related to enabling the effective functioning of an organization in terms of conducting business. As a practice, EA aims to provide a set of tools for organizations to improve their performance, traditionally by prescribing visualization methods to enhance communication and point out problem areas to be improved. By developing descriptions of organizational structures and processes, particular points of view can be conveyed to facilitate understanding. As a simple example, a traditional architect could take up the blueprint of a shopping center and draw projected flows of people within the building in a discussion where a decision should be made about the location of info points. An enterprise Architect might draw a picture of how customer order information moves through different

departments, what kind of activities are performed on the information, where it is stored, and what kind of transformations it undergoes.

With this example we get to the burning question: What is the ultimate goal of EA activities? It is one thing to draw diagrams of a business process from a dozen different perspectives, but another thing to have clear in mind the ultimate objective of such activities. In the literature, several ideals are mentioned as the goals of EA: *integration*, *agility*, *flexibility*, *adaptability*, *standardization*, and many more. This thesis proposes to use an alternative word to describe the objective of EA without imposing too much limitation or sacrificing the contents of the other concepts: *simplicity*.

Even though simplicity is not a precise synonym to integration, agility, or flexibility, it can be considered an enabler or even a prerequisite for those qualities. It is difficult for an organization to be agile or flexible without a certain level of simplicity, not only in its IT infrastructure, but also in the thinking and behaviour of its employees. Even the most elegant IT ecosystem loses its benefits if its users use it in overly complicated ways. On the other hand, an overly complex IT system's value can be increased by simplifying the way it is used. In the same vein, the limitations of a rigid organizational structure or IT infrastructure could be at least partially bypassed by addressing the practices and thinking of employees.

Certainly, for a small café it will be considerably easier to remain simple compared to a multinational Fortune 500 company with offices in a hundred countries. But it certainly is not so that complexity must always increase in par with scale. A central challenge in scaling up is keeping focus on activities, processes and tools that actually contribute to the enterprise's value-creating mechanisms. This focus needs to be kept in mind also when aiming for simplicity. From a business point of view, a simple solution or process is not very valuable if it solves the wrong problem. In this sense, any improvement endeavour should begin with describing the issue to be addressed. Simplifying a process or IT system that is unnecessary to begin with does not help. It should be discarded altogether. Processes and IT systems that are essential to how the business creates value are the ones that require and deserve our attention.

4 RESEARCH METHOD

This systematic literature review is undertaken in order to answer the third research question: *How is the original purpose of EA – managing and reducing organizational complexity – addressed in the current academic EA literature?* The aim is to review the most recent enterprise architecture literature in terms of their stance on the reason of existence for the field, which, in this thesis, follows the rationale mentioned in the NIST article (Fong & Goldfine) from 1989, that is, that EA came into being to address the increasing complexity of organizational IT infrastructure, to manage and control the evolution of the infrastructure as well as to ultimately and ideally simplify it – to reduce complexity that does not contribute to the success of the goals of the organization.

The literature review roughly accommodates the methodology laid out by Okoli (2015). To exercise proper scientific rigor for a systematic literature review, he suggests eight general steps: (1) identifying the purpose of the literature review, (2) drafting protocol and training the team, (3) applying practical screen, (4) searching for literature, (5) extracting data, (6) appraising quality, (7) synthesizing studies, and (8) writing the review. The next section will briefly explain what Okoli (2015) means by these eight steps.

Naturally, embarking on any academic research endeavor, it is reasonable (and quite necessary) to be clear on the reason and purpose for conducting such research, no matter what the subject. A great effort can go to waste if, say, a time-consuming literature review is conducted without clear purpose, which will most probably affect the quality and applicability of the study and its results. To avoid this, Okoli (2015) emphasizes the importance of laying out the purpose as well as the goals of the research. This will, among other things, help the researcher focus on what is most important and direct the study in a way that will most likely result in some kind of benefit to society, be it practical, theoretical, or both.

After the researcher(s) is clear and explicit on the purpose for the study, a protocol should be drafted to be able to fulfill the prerequisites of a *systematic* literature review, which are, among others, reliability, validity, reproducibility, and comprehensiveness. This step is especially important, of course, for studies

that involve more than one researcher, and thus Okoli (2015) adds that proper training of the research team needs to be conducted to ensure consistency.

Applying a practical screen, according to Okoli (2015), means creating rules for inclusion (and exclusion) when searching for literature to be analysed. Since initial search results can amount to hundreds or even thousands of individual papers, it is of tremendous importance to have proper screening rules to be able to find the material that is conducive to the study and filter out those that provide little or no value to it.

The fourth step in Okoli's (2015) methodology is the literature search. In this phase, selected search terms are used to search relevant databases for literature that will be used in the review. The search terms usually consist of a set of keywords and their relationships as well as other potential specifications such as a timeframe, language selection, and perhaps a standard for which publication platforms are accepted for the review. The search terms must be as explicit as possible to ensure repeatability of the process (Okoli, 2015).

When the papers to be included in the study have been identified, the next step is to extract from them the information that is relevant to the research (Okoli, 2015). The data extraction protocol should also be explicitly laid out, and its importance grows the more there are researchers participating in the extraction process.

Even though a great portion of irrelevant search results have been filtered out during the previous phases, upon closer inspection more irrelevant papers might be recognized. According to Okoli (2015) the researcher(s) should continue evaluating the quality and relevance of the selected papers during and after data extraction. Based on this evaluation, the researcher(s) can make decisions whether individual papers still prove relevant to the study.

Then, the researcher(s) perform the synthesis, which means that the gathered data is somehow consolidated and reconciled in a way that results in valuable and relevant information in terms of the research question(s) (Okoli, 2015). Okoli (2015) states that researchers need to make decisions on how the synthesis is conducted: whether the synthesis is performed quantitatively or qualitatively, or as mix of both.

Finally, of course, the research report is written, and the findings of the literature review are reported. Okoli (2015) emphasizes that in addition to the findings, it is essential to also report the research method as explicitly as possible in order to maintain transparency of the process and enable reproducibility.

In the following part, the research method used in this study is reported in detail, following the order presented by Okoli (2015), since that was the methodological reference used in this systematic literature review.

4.1 Purpose of the Study

As was observed in the background research on enterprise architecture conducted for this literature review, enterprise architecture emerged in the late

1980s to 'deal with' the increasing complexity of organizations' IT systems and landscapes. Enterprise architecture is touted as the 'thing' that organizations need when such complexity becomes a debilitating factor in terms of their business goals. However, throughout the years the field of enterprise architecture has been graced with a plethora of new ideas, new methodologies, recommendations, tools, frameworks, concepts, and other 'stuff' that all contribute to EA becoming increasingly difficult for others but EA professionals to understand. This difficulty can then result in the adoption of 'EA' in organizations without a clear understanding about what it should be used for, what are the expected benefits, and when and where potential benefits can be expected to manifest. These and other factors may bring about a situation where enterprise architecture is introduced in an organization with the intention to 'fix' structural or systematic complexity, with the eventual outcome that the existing complexity is only further aggravated.

This study set out to find out how and to what extent the challenges of complexity are addressed in academic EA literature. In this context, complexity does not only point to the complexity of an organization's IT ecosystem or organizational structure or processes, but also the potential complexity of enterprise architecture itself, which may complicate its utilization in said organizations. Dubbed *the quest for simplicity*, the objective was to analyse whether the original intent of EA, laid out by, among others, the NIST paper (Fong & Goldfine, 1989) and John Zachman (Zachman, 1987) in the 1980s, is still relevant and thus duly addressed today in the EA literature. The objective of EA, paraphrased for the purpose of this study, is how to utilize the tools and methods proposed in the EA literature to address, manage, and decrease debilitating complexity in organizations.

4.2 Research Protocol

Because this literature review was conducted by only one person, ensuring consistency of methodology was easier than it would have been in the case of two or more researchers. However, since *simplicity* and *complexity*, the main topics of interest for this study, are relatively broad concepts, it was known that finding relevant papers that fulfil the purpose of this study would require a clear protocol and framework. The problem certainly was not that the number of total papers was low. Rather, quite the opposite.

Material was searched from five databases: ACM DL, IEEExplore, Web of Science, Scopus, and AIS eLibrary with the following keywords: "enterprise architecture" in document title; and "complexity", "complex", "simplicity", "simplification", and "simplify" anywhere in the document. The databases and keywords are presented in Table 3.

TABLE 3 Databases and keywords used in the literature search

Databases	Keywords
ACM DL, IEEExplore, Web of Science, Scopus, AIS eLibrary	In title: ["enterprise architecture"] In entire document: ["complexity" OR "complex" OR "simplicity" OR "simplification" OR "simplify"]

4.3 Practical Screen

The criterion for early selection was that (1) the article is peer-reviewed, (2) the article is written in English, (3) the article is published in a journal of at least level 2 by the Finnish Publication Forum (Julkaisufoorumi) classification. The search was limited to the timeline between 2010 and 2021. These criteria were selected mainly for two purposes: first, to ensure good quality studies to be included in the study, and secondly, to limit the number of studies to be included in this thesis only to those most relevant and good quality in order to keep the workload sensible, taking into account that this is a Master of Science thesis.

4.4 Literature Search

The initial search resulted in a total of 257 journal publications. Upon filtering the results based on abovementioned criteria and having removed duplicates, the remaining number of articles was 70. After reading the abstracts and using a keyword search (the same keywords as used in the database search) on the articles, a further 37 articles were discarded. In the majority of cases the reason for disqualification was that their subject matter was clearly not contributive to the study or because the keyword search did not result in supportive material for this study. The criterion for selection at this stage was that the article had to address complexity as an issue clearly and explicitly, either in organizational context or in the context of EA use, implementation and pursuit of value. It may be worth noting that 'complexity' as a keyword was by far the most numerous. The remaining number of articles to be thoroughly studied was 33. The keywords from the root 'simple' were notably less used in the papers. For instance, 'simplification' was used in only 7 papers, and the word 'simplicity' only in 4 papers. On the other hand, the word 'complexity' appears in every article selected. The literature review process is visualized in Figure 6.

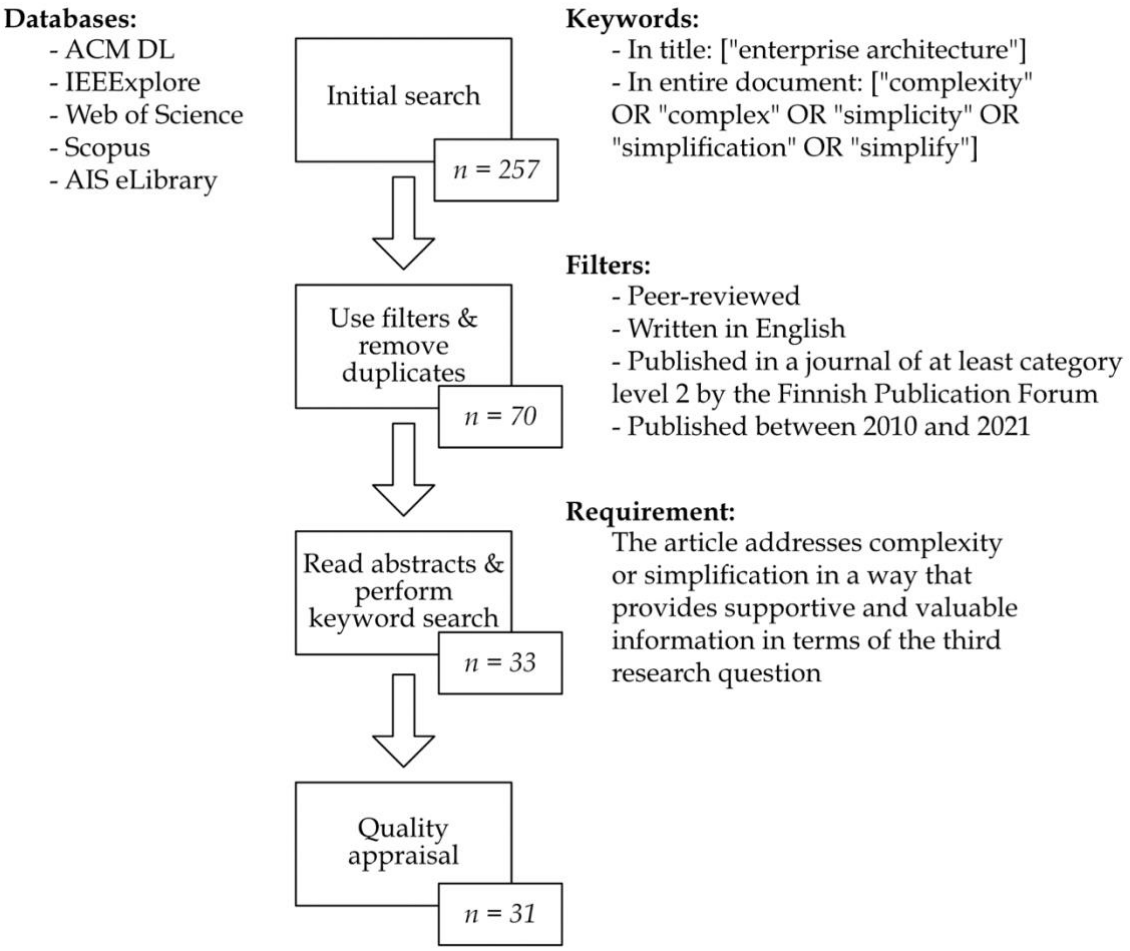

FIGURE 6 The literature search process

4.5 Data Extraction

Due to the breadth of the research topic, a qualitative, thematic data analysis will be performed in order to reveal the state of current EA literature in terms of management and reduction of complexity. To achieve this, data was extracted from the selected material by, first of all, studying the papers, and then, by analysing and recording that information which relates to the research question. Out of the data, several central topics emerged, and those topics are presented in detail further on in this paper.

4.6 Quality Appraisal

During the data extraction process, the collected data was evaluated by its relevance and value in terms of the research question. If the paper, upon further analysis, did not provide any valuable information in the effort to answer the

research question, it was discarded. In this phase, two more articles were discarded due to the fact that, even though they passed the initial screening and included at least some of the searched keywords, they did not contain any original contribution in regard to the research questions. Both articles that were discarded contained the keyword 'complex', but in both instances it was only briefly used in the introductory literature review when referencing other studies by stating the benefits or use cases of enterprise architecture in general. Thus, the final set of papers was 31.

4.7 Synthesis

The synthesis was conducted by capturing relevant information from the articles with three questions: (1) What is the central theme of the article?, (2) What is the role of EA (or EAM) according to the article?, and (3) What is the article's attitude towards complexity? All of the articles answered to the first question, most (28) answered to the second question and around half (16) provided answers to the third question. These answers were then synthesized into general categories to provide comparable, analysable data. The results of the analysis are presented in the next part.

5 RESULTS

The results of the systematic literature review are presented here. As said, the synthesis was structured by introducing three questions at the synthesis part to capture the relevant information in terms of the research question, which is:

> How is the original purpose of EA – managing and reducing organizational complexity – addressed in the current academic EA literature?

The questions presented at the synthesis phase were the following:

(1) What is the central theme of the article?

(2) What is the role of EA (or EAM) in terms of *complexity* according to the article?

(3) How is *complexity* presented in the article?

The first question aims to capture the general trains of thinking in current EA literature where complexity is addressed. This is intended to help connect the discussion and analysis on complexity to the larger whole of enterprise architecture and understand what types of topics are populated by the discourse on complexity in EA. The second question is at the core of the third research question of this study. It aims at capturing to what extent and in what way organizational complexity is seen as an issue to be addressed by the practice of enterprise architecture and related activities. The third question is probably fuzzier than the previous two, and it resulted in relatively inconsistent and hardly comparable answers. In addition, only 16 of the 31 articles were interpreted as providing an answer to the question. Even though the scientific relevance of the results to the third question may be weak, they will nonetheless be reported in this thesis in order to offer potentially valuable information for practitioners. Also, the results might provide fruitful themes for further research.

As a motivation, it might be beneficial to point out that complexity is in fact seen as an issue, and it is explicitly stated in several of the selected articles. When it comes to complexity in the context of large enterprises and enterprise architecture, complexity manifests in various forms: there is the complexity of

large organizations and their processes and structures, complexity of the market environment, complexity of technology and information systems, complexity of enterprise architecture methodologies and artefacts, and complexity of enterprise architecture projects. From this perspective, EA is proposed both as a medicine to repair problems resulted from complexity as well as an additional burden which itself can increase the burden of complexity in organizations. Table 4 presents several citations from the selected research articles that address complexity as an issue from different points of view.

TABLE 4 Complexity as a threat and challenge

Article	**Complexity challenges**
Schmidt, C., & Buxmann, P. (2011)	"Within the last decades, corporate information technology (IT) environments have approached considerable degrees of complexity. As a consequence, IT has become increasingly difficult to manage resulting in high costs and poor flexibility." (p. 168)
Lapalme, J., Gerber, A., Van der Merwe, A., Zachman, J., De Vries, M., & Hinkelmann, K. (2016)	"Today, and for the foreseeable future, organizations will face ever-increasing levels of complexity and uncertainty." (p. 103)
Bernaert, M., Poels, G., Snoeck, M., & De Backer, M. (2016).	"EA approaches are often experienced as complex, over-engineered, and difficult to implement." (p. 782)
Kotusev, S., & Kurnia, S. (2021).	"[…] excessive complexity can render EA artifacts incomprehensible for their stakeholders, make them virtually unusable, and eventually become disastrous for an EA practice." (p. 285)
Kurnia, S., Kotusev, S., Shanks, G., Dilnutt, R., Taylor, P., & Milton, S. K. (2021).	"Finally, we argue that the EA discipline generally suffers from an inadequate, overly simplistic terminology incommensurable with the complexities of real-world EA practices. For example, popular terms widely used in the literature such as "EA management", "EA programs", and even "enterprise architecture" itself seemingly fail to capture the meaning of disparate activities constituting EA practice and EA artifacts used as part of them." (p. 690)

5.1 The Articles' Approach Toward Complexity

This section further presents results that were discovered to the question 'How is *complexity* presented in the article?' As has been stated, in the context of enterprise architecture, complexity can be understood in several different ways and found in various levels. In an organization, there might not only exist complex processes and IT systems, but employees may actually use simple and

fundamentally effective tools in overly complex ways, which undermines the value of the tools and processes. In addition, methodologies prescribed to manage complexity, such as those proposed by enterprise architecture, can themselves turn out to be so complicated that they are impossible to utilize. And if they are indeed used and operationalized, organizations may find them between a rock and a hard place when a great deal of resources have been expended to produce complex diagrams and models which no one knows how to utilize to create real change. Thus, it might be valuable to present some of the different points of view that are presented in the selected research papers for this literature review.

In answering to the question 'How is *complexity* presented in the article?', a total of 7 different points of view were identified. The points of view are as follows: (I) Organizational complexity is seen as a key contributor to IT project failure, (II) Structural complexity on one level creates complexity on other levels as well, (III) IT complexity causes operational risks, (IV) Organizational complexity might not contribute to EA adoption, (V) EA frameworks are too complex for SME's or a new EA model is needed, (VI) Complex organizations benefit most from EA, and (VII) EA itself does not reduce complexity, but only when it is operationalized into EA projects. The results are presented in Table 5. It is to be noted that not all articles provided explicit answers to the question, and some articles presented multiple points of view.

TABLE 5 The research articles' perspective on complexity in terms of EA

Point of view	**Count**	**Articles**
Organizational complexity is seen as a key contributor to IT project failure	4	Stroud, R. O., Ertas, A., & Mengel, S. (2019); González-Rojas, O. (2017); Lapalme, J., Gerber, A., Van der Merwe, A., Zachman, J., De Vries, M., & Hinkelmann, K. (2016); Mamaghani, N. D., Madani, F. M., & Sharifi, A. (2012)
Structural complexity on one level creates complexity on other levels as well	1	Chen, H. M., Kazman, R., & Perry, O. (2010)
IT complexity causes operational risks	2	Schmidt, C., & Buxmann, P. (2011); Kreuter, T., Kalla, C., Scavarda, L. F., Thomé, A. M. T., & Hellingrath, B. (2021)
Organizational complexity might not contribute to EA adoption	1	Ahmad, N. A., Drus, S. M., & Kasim, H. (2020)
EA frameworks are too complex for SME's / a new EA model is required	6	Bernaert, M., Poels, G., Snoeck, M., & De Backer, M. (2016); Kaushik, A., & Raman, A. (2015); Kotusev, S., & Kurnia, S. (2021); Gong, Y., & Janssen, M. (2019); Azevedo, C. L., Iacob, M. E., Almeida, J. P. A., van Sinderen, M., Pires, L. F., & Guizzardi, G. (2015); Kotusev, S. (2018)
Complex organizations benefit most from EA	2	Gong, Y., & Janssen, M. (2019); Tamm, T., Seddon, P. B., Shanks, G., & Reynolds, P. (2011)

TABLE 5 Continues

EA itself does not reduce complexity, but only when it is operationalized into EA projects	2	Gong, Y., & Janssen, M. (2019); Rahimi, F., Gøtze, J., & Møller, C. (2017)

5.2 Research Paper Topics

This part aims to answer the first question presented at the synthesis phase: What is the central theme of the article? It presents the emerging themes from the selected EA literature. This might help in broadening the scope of consideration for both academics and practitioners in the field of EA, and to understand which types of topics address the issue of complexity. Of course, each article presented their own research questions and problems to be tackled, and in this thesis only very broad and general categorisations were made to be able to present somewhat comparable data. Thus, the themes emerging in the literature were divided into seven distinct categories: (I) Service-oriented-Architecture or some other custom architectural model, (II) Managing EA projects or EA operationalization, (III) EA or EAM value to organizations, (IV) EA modeling, (V) Success factors in EA or major challenges, (VI) Assessing architectural complexity, and (VII) EA adoption. The topics are briefly and generally presented in the following section.

(I) **Specific architectural model**. Seven (7) of the selected articles discussed either Service-oriented-Architecture or developed and/or presented a new architectural model. Often, the rationale was that existing or traditional models do not fit for purpose in specific circumstances and environments. Thus, Bernaert et al. (2016) for instance, present the CHOOSE EA metamodel for small and medium sized enterprises (SMEs).

(II) **Managing EA projects or EA operationalization**. A total of 7 articles discuss EA in its operationalized form. Since operationalizing enterprise architecture often means large, wide-scale changes in most if not all parts of an enterprise, it offers academics and practitioners alike a fruitful and interesting research opportunity from the point of view of various fields, such as psychology, change management, and systems science.

(III) **EA or EAM value to organizations**. As was presented in the early parts of this thesis, academics and practitioners alike sometimes face challenges in identifying the benefits of enterprise architecture for organizations, and for that reason it is of continuous interest in academic literature. 6 articles in the set address or study EA's or EAM's value and benefits to organizations.

(IV) **EA modeling**. Models are an essential part of enterprise architecture, and in fact, many authors posit that models *are* enterprise architecture (see Rahimi et al., 2017). 4 articles studied EA models. The research angles include, among others, automatic model generation and trying to facilitate models' usability by reducing their complexity.

(V) **Success factors in EA or major challenges**. Success factors or major challenges in EA were studied in 4 papers. Related to EA benefits, EA operationalization, and the fact that projects are often large and complex, considerable attention has been paid to factors that either enable or challenge such endeavors.

(VI) **Assessing architectural complexity**. 2 articles focus on ways to measure and assess the complexity of EA solutions. The articles focus on trying to measure EA proposals already during design phase in order to improve chances of success and avoid critical mistakes.

(VII) **EA adoption**. Finally, one article studies the factors that affect EA adoption in public sector organizations.

Both (I) Specific architectural model and (II) Managing EA projects or EA operationalization were discussed in 7 articles each. The second most addressed topic was (III) EA or EAM value to organizations with 6 articles. EA modeling (IV) and Success factors or major challenges in EA (V) were both discussed in 4 papers. Assessing architectural complexity (VI) was the topic of 2 articles and one article addressed EA adoption (VII). The results are presented in Figure 7.

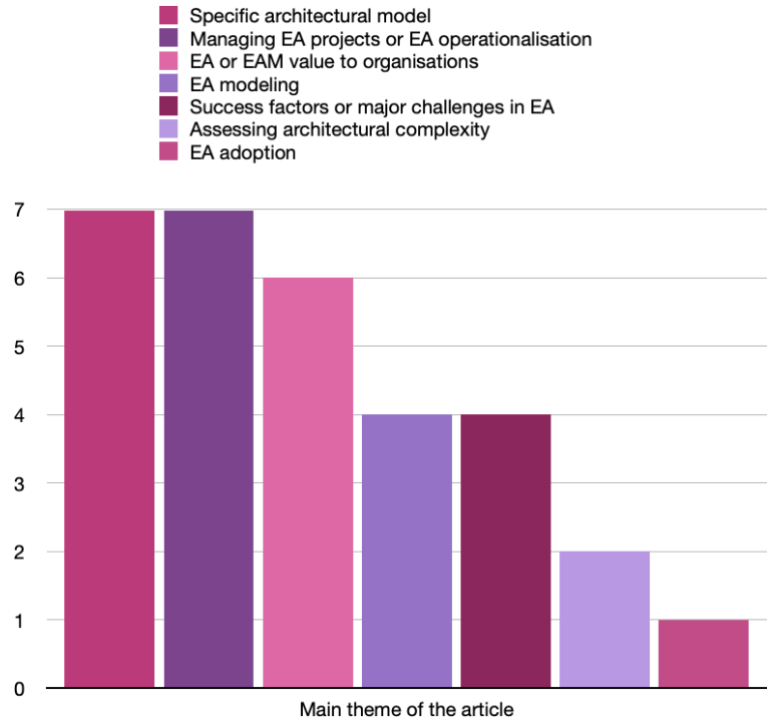

FIGURE 7 Main themes of the selected research articles

5.3 The Role of Enterprise Architecture in terms of Complexity

The keyword 'complexity' was found in all the selected articles, and all the articles were interpreted as providing an answer to the question of EA's role in organizations in relation to complexity. The discussion mainly revolves around two different viewpoints. First, a great deal of the articles (21), either directly or indirectly by referencing previous research, state that it is the objective of EA (or EAM, for that matter) to help reduce complexity in organizations, be it in regard to their IT landscape or more broadly speaking. Related to the previous, a little less than half of the articles state that EA modeling exists so that organizations can understand the complexity within their organizations and to communicate on it better with the help of models. In a handful of instances, the author points out that indeed, EA modeling helps in identifying the problematic areas and based on that information, they can plan and operationalize the EA to initiate dedicated projects or programs to make the changes needed to 'cope with' the complexity or, in other words, simplify.

One article which studied Service-oriented-Architecture (SoA), stated that implementing a SoA can help organizations reduce complexity. This, of course, relates to the operationalization of EA, where the configuration of an organization is changed through a dedicated program. Even further, one article, which presented a mathematical method to evaluate a planned architecture's complexity in the design phase, emphasized that organizations could reap considerable benefits by assessing to-be architecture plans already during the design phase to avoid costly mistakes. The results to this question are presented in Figure 8. Table 6 presents a handful of selected citations from the research articles.

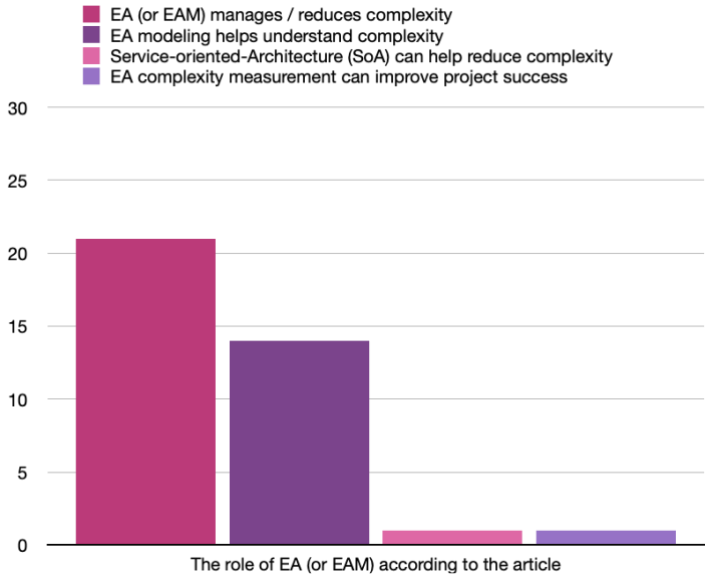

FIGURE 8 The role of EA in terms of complexity, according to the selected research articles

These results do not, of course, prove that in general, enterprise architecture is deployed for the primary purpose of either reducing or 'coping with' complexity, since 'complexity' itself was used as a keyword for the literature search. Instead, the results highlight, first of all, that complexity is still considered a somewhat relevant issue in the context of EA and that EA and related activities can and are supposed to help in either understanding or reducing organizational complexity. For practitioners, of course, the most valuable information is what all this means to their utilization of EA in general.

TABLE 6 The relationship between enterprise architecture and complexity, according to the literature.

Article	**EA in terms of complexity**
Banaeianjahromi, N., & Smolander, K. (2019)	"Enterprise architecture (EA) is widely employed to reduce complexity and to improve business–information technology (IT) alignment." (p. 877)
Hylving, L., & Bygstad, B. (2019)	"Enterprise Architecture Management (EAM) aims to deal with the complexities of information technology (IT) solutions and to achieve more organizational agility." (p. 14)
Lapalme, J., Gerber, A., Van der Merwe, A., Zachman, J., De Vries, M., & Hinkelmann, K. (2016)	"Enterprise architecture (EA) is a practice and emerging field intended to improve the management and functioning of complex enterprises and their information systems." (P. 103)
Alwadain, A., Fielt, E., Korthaus, A., & Rosemann, M. (2016)	"Organizations use Enterprise Architecture (EA) to reduce organizational complexity, improve communication, align business and information technology (IT), and drive organizational change." (p. 39)
Ajer, A. K. S., Hustad, E., & Vassilakopoulou, P. (2021)	"Enterprise architecture (EA) is a systematic way of designing, planning, and implementing process and technology changes to address the complexity of information system (IS) landscapes." (p. 610)
Franke, U., Cohen, M., & Sigholm, J. (2018)	"Enterprise architecture (EA) has been established as a discipline to cope with the complex interactions of business operations and technology." (p. 698)
Gong, Y., & Janssen, M. (2019)	"EA is seen as offering ways to steer and guide the design and evolution of an enterprise. It provides an overview of the IT landscape to enable the de- sign of strategy implementation at a more detailed level. In this sense, the level of complexity of an EA model will reflect the level of complexity of the organization's IT environment." (p. 5);
Lange, M., Mendling, J., & Recker, J. (2016)	"To deal with the complexity of their corporate IT environments, many organizations employ enterprise architectures (EAs)." (p. 411)

TABLE 6 Continues

Rahimi, F., Gøtze, J., & Møller, C. (2017)	"We found that the EA function was mainly responsible for helping the organizations operationalize and plan one major IT objective: reducing the IT landscape's complexity by eliminating duplicated and less efficient services." (p. 133)

5.4 Key Findings for EA Practice

This part presents significant findings that emerge out of the analysed literature in terms of dealing or reducing organizational complexity with enterprise architecture.

In order to simplify conceptualization, enterprise architecture is divided into two primary types of activity in this thesis: descriptive and operationalized. Descriptive EA, in this thesis, would mean those activities that focus on developing and maintaining various types of descriptions, not only of the current architectural situation, but also models and designs of potential to-be architectures. Operationalised EA, on the other hand, would point to those activities that aim to make modifications on architectural elements, such as IT systems, departments, or other organizational elements, possibly based on descriptive EA artifacts. This may not be the most conventional division, especially since in the EA literature it is often spoken of enterprise architecture (EA) and enterprise architecture management (EAM) (Schmidt & Buxmann, 2011; Hylving & Bygstad, 2019), or descriptive EA and prescriptive EA (e.g., Gong, 2019; Haki & Legner, 2021), for that matter.

The first thing that is worth mentioning – and which should be more or less obvious by now – is that enterprise architecture becomes more relevant and potentially more valuable the bigger and the more complex the enterprise in question. This is noted by, for instance, Schmidt and Buxmann (2011), Gong and Janssen (2019) as well as Tamm et al. (2011). In fact, Bernaert et al. (2016) studied different EA frameworks in their suitability for and capability of providing value to small and medium sized enterprises, and the conclusion was that many of the existing mainstream EA frameworks are too complicated for such companies. To address this, Bernaert et al. (2016) developed their own EA metamodel for SME's called the CHOOSE metamodel, which, according to the authors, contain only the absolutely essential elements, first, to simplify EA for smaller enterprises, and second, to capitalize on that which provides the most value to organizations. Their contribution to the EA field might well sprout further important contributions in clarifying and simplifying enterprise architecture without reducing its value.

Related to the previous, Kotusev and Svyatoslav (2018) studied the use of EA (mainly forms of TOGAF) in real-world organizations, and found that the used frameworks were too complicated as-is, and thus many of the organizations either simplified the methodologies for their specific use or used the framework

only for idea-generation. These findings underline the purpose of this literature review in that while EA in theory has its place in organizational development, existing models and frameworks do not often deliver on their promises. Adding to that, Kotusev and Kurnia (2021) studied the underlying rationale and theoretical basis for the existence of enterprise architecture, and concluded that "the core meaning of an EA practice is still poorly understood," (p. 277). The authors cite Ross et al. (2006) in stating that often it may be the case that the development of architectural drawings may lead organizational actors into a false sense of progress in terms of managing and reducing organizational complexity. This, on the other hand, emphasizes the importance of making a differentiation between EA activities that focus on designing and developing models (descriptive EA) and EA activities that are directly aimed at making concrete improvements in organizational elements (operationalized EA).

Even the most elaborate EA drawings and models are useless unless they lead to action or changed behavior. In response to this, Kotusev and Kurnia (2021) conclude that organizations should pay attention to the complexity and understandability of their EA artifacts, and that they should include in their artifacts only the most essential elements required for decision-making. Not only should organizations pay attention to what they include in their models, Gong and Janssen (2019) propound that organizations must always consider which models and descriptions are worth designing in the first place. They note that in EA literature the importance of modeling every aspect of an organization as a part of the EA practice is emphasized, and that this very suggestion often leads to considerable wasted effort. This remark points to the importance of making clear the objective of each particular EA undertaking.

Azevedo et al. (2015) made their contribution to simplify EA representations in their study to simplify ArchiMate modeling constructs. They make the argument that modeling organizational capabilities and resources, which has been recognized as an important activity in management, should be better integrated into EA work. They make practical recommendations on the modeling semantics of the ArchiMate modeling language, which is intended to simplify and clarify overall EA modeling work. Their paper should be of interested to practitioners who use the ArchiMate language and seek to improve and simplify their models for increased value. Continuing further on the topic of EA modeling, Holm et al. (2014) emphasise the importance of architectural models in uncovering organizational and environmental complexities and making them more manageable and to facilitate communication about them. Recognising the considerable workload of developing such models, they go on to propose (and develop) a method to automatically generate architectural models of IT landscapes. Such methods should, of course, be reconciled with the previous notions of modeling only that which can provide valuable information and facilitate action for improvements.

As stated, in this thesis EA is categorized into two modes: descriptive and operationalized EA. Ajer, Hustad and Vassilakopoulou (2021) discuss the latter in their paper, where they studied a Norwegian hospital, where increasing

complexity led to the adoption of EA practices. During the study, architectural plans were translated into dedicated EA projects to implement desired changes in the hospital. The researchers were especially interested in how the top-down-mandated EA 'logic' was going to be received by the different departments with their own, specific operational 'logics.' The explicit finding was that the operationalization of EA resulted in various tensions and the original approaches had to be modified along the way. An implicit finding was that clear communication and the consideration of all key stakeholders and their points of view are vital in implementing architectural changes.

Rahimi et al. (2017) investigated the EA function in 8 case companies and found that in many of them, enterprise architecture was essential in suggesting and planning initiatives to reduce complexity of IT landscape. In other words, descriptive EA aims at operationalizing EA by locating areas of improvement and initiating programmes or projects to address those issues. González-Rojas, López and Correal (2017) propose that organizations do not rush to implement their enterprise architecture plans. Instead, they suggest assessing different EA proposals already at the design phase in order to understand the level of complexity that they would introduce. By measuring the complexity of EA designs early, the authors state that implementation projects can be better controlled in terms of their scope, time and budget, and that the most complexity-introducing EA elements can be identified and duly addressed. González-Rojas et al. (2017) use the term structural complexity measure introduced by Sessions (2011) and propose a model for evaluating the complexity of specific EA elements at four levels: (0) project roadmap, (1) the difference between the 'as-is' and 'to-be' architectures (gap analysis), (2) the detailed design of the 'to-be' architecture, and (3) the design of the solution architecture. The process for calculating complexity is detailed in depth in their paper.

In speaking of the rationale for enterprise architecture as a practice in general, Lapalme et al. (2016) emphasise that the systems and processes that EA intends to deal with are often so complex that they cannot really be completely understood and 'figured out.' Decisions must be made without knowing all the variables, since they are basically always infinite. Based on these arguments, Lapalme et al. (2016) emphasise that EA designs should place the human in the center. Humans, in the words of the authors, are those who ultimately deal with and carry the consequences of complexity. The authors draw the different between processes that are suitable for machines and those that are designed with human nature in mind. Processes that are based on standardization and compliance, according to Lapalme et al. (2016), go against the need to adapt quickly and responsively, and are not optimal for human workers in complex environments. Instead, processes that allow for flexibility and creativity and a sense of meaning would be more suitable in organizations that operate in highly unpredictable and complex environments.

In fact, Lapalme et al. (2016) urge academics and practitioners inspect enterprise architecture in a new light in terms of its influence to organizations. Taking a more holistic approach to EA, the authors place more emphasis on

considerations such as an enterprise's impact on society at large, how it manages to provide meaningful work to its employees, and what kind of contribution it makes to its environment in terms of, for instance, protecting the environment, reducing poverty, and so on. Lapalme et al. (2016) propose practitioners to widen their lenses by considering theories and concepts such as design thinking, social shaping of technology, and open systems theory. In doing so, the authors state, EA practitioners can assist their respective organizations to better adjust to highly complex and unpredictable environments by focusing on empowering people and defining success to be more than merely the bottom line.

To conclude, a much-talked architectural model, the so called Service-oriented-Architecture (SoA), was mentioned several times in the source material for this study, and thus it deserves a spot in this section. Chen, Kazman and Perry (2010) present SoA as potential solution to increase an organization's ability to adapt to changes cost-effectively. The authors mention SoA's key principles as loose coupling, reuse of services, open standards for interoperability and dynamic orchestration of services. These principles, according to Chen, Kazman and Perry (2010), should enable an enterprise to nimbly manage and adjust their services and dynamically configure resources in changing environments. SoA, according to the authors, requires practitioners, such as architects and developers, to widen their understanding of how the organization operates in terms of, for instance, business models and communication, and to collaborate beyond their silos. Table 7 presents selected citations from the research articles, highlighting specific methods or tools that organizations may work with in addressing complexity.

TABLE 7 Methods and activities suggested in the literature to address complexity.

Article	**EA activities to address complexity**
Oscar González-Rojas (2017)	"[…] measuring the complexity at different decomposition levels of a complex system such as an EA is critical to assess the impact of design changes before implementing them." (p. 1280)
Chiprianov, V., Kermarrec, Y., Rouvrais, S., & Simonin, J. (2014)	"The competitive market forces organizations to be agile and flexible so as to react robustly to complex events. Modeling helps managing this complexity." (p. 963)
Mamaghani, N. D., Madani, F. M., & Sharifi, A. (2012)	"As technologies develop and organizations become complex, there is a need to design Enterprise Architecture model based on organization's needs to respond to all requirements in an integrated manner." (p. 231)
Franke, U., Cohen, M., & Sigholm, J. (2018).	"Enterprise architecture descriptions using class diagrams, use case diagrams, activity diagrams, etc. can help giving engineers, architects, and other enterprise decision makers an under- standing of the complex interactions of business operations, technical systems supporting them, information

TABLE 7 Continues

	technology, information flows, life cycles, etc. needed to make better decisions." (p. 708)
Bui, Q. Neo (2017)	"For example, deploying architectural descriptions such as reference models can reduce complexity and, thus, lead to lower maintenance costs and shorter development time, which can increase revenue. The architectural descriptions are a benefit logic that increases the success of EA." (p. 127)
Foorthuis, R., Van Steenbergen, M., Brinkkemper, S., & Bruls, W. A. (2016)	"Being able to align business and IT and integrate processes and systems enables the organization to increase productivity and quality, while standardization and deduplication results in more efficiency. The capability to control complexity and increase standardization also mitigates risks, resulting in an increased ability to achieve both project and organizational goals." (p. 555)

6 DISCUSSION

> I say, let your affairs be as two or three, and not a hundred or a thousand; instead of a million count half a dozen, and keep your accounts on your thumb nail. In the midst of this chopping sea of civilized life, such are the clouds and storms and quicksands and thousand-and-one items to be allowed for, that a man has to live, if he would not founder and go to the bottom and not make his port at all, by dead reckoning, and he must be a great calculator indeed who succeeds. Simplify, simplify.

Henry David Thoreau (Walden, 1854)

The idea for this thesis was first sparked when, in my work, I was able to be part of an enterprise architecture and business process redesign project and witness first-hand the difficulty of managing one. The project, which involved dozens of direct stakeholders from several international departments, really gave me an idea of how challenging it can be only to try to figure out how complex business processes at present play out. Different business stakeholders might have drastically varying views of what in fact happens during, say, an order-to-delivery process. And they might have considerably different objectives, motives and preferences, too.

It also does not help if the organization has relatively strict bureaucratic rules and strong hierarchy for decision-making. If decisions that directly influence operations are made by people who have little or no understanding of those very operations, what might result is, first, an even deeper mess, and second, stark resistance by those who perform the operative work. Such decisions could simply mean that a particular information system is chosen over other options. If the decision is made by an executive who does not have first-hand experience of the work that the system is used for, the result can be a tool which, on paper, "can do everything," but in practice, does many things poorly, and even more poorly than the previous system.

Enterprise architecture often involves dozens of such decisions! Organizations that 'do' enterprise architecture are most often large and complex,

and thus the problems that need fixing are also complex – and in some instances, the complexity itself is considered the main culprit.

While conducting this literature review, I stumbled upon a research paper recently published in Nature by Adams et al. (2021). Called *People systematically overlook subtractive changes,* the article presents a study where people perform additive rather than subtractive actions in situations where both achieve the same result. For instance, the participants had to achieve symmetry in figures drawn on a squared grid either by 'colouring' cells or 'decolouring' them. Across various research settings, additive choices were considerably more common (percentages of subtractive choices ranged between 2% to 30%).

The researchers give several speculative explanations to this tendency: additive actions may be easier for people to process; the ideas of 'higher' and 'more' might be – consciously or unconsciously – associated with ideas of 'better' and 'positive'; societal norms and culture may place more value tangible contributions more than subtractive ones; people feel more valuable with 'more' than 'less'; possibilities to add are often (at least seemingly) more plenty than to remove; and we might have the idea that designed things are already reduced to a minimum.

Whether or not this specific study is generalisable beyond the research settings, it nevertheless offers food for thought also in the context of enterprise architecture. If, indeed, humans tend to 'add' rather than 'subtract' even in situations where subtraction would A) be cheaper and B) result in a long-term cost-efficient and effective solution in terms of the original objective, it would indicate that the challenges that EA methods deal with are more psychological than, say, structural. If, when a problem arises, the tendency is to fix it by *adding*, be it a new IT system or a new rule or law, rather than, for example, trying to use existing tools or indeed, removing a rule or law, it is no wonder that organizations struggle with unmanageable complexities.

The same goes, of course, for the tools used to address the problem of complexity, namely enterprise architecture. As has been discovered in this thesis, the methods proposed by EA academics and practitioners often provide little value due to the fact that they are so complex that few can understand what to do with them. The medicine seems to have, at least to some extent, become bothered by the same condition that it tries to cure.

While it is unquestionable that models and descriptions, call them enterprise architecture or not, are necessary in understanding and communicating 'what goes on' in a large enterprise, the key question is what you do after that. Do you go on solving the obvious issues, bottlenecks, inefficiencies, and growing pains by adding something or by removing something? In many situations, the line between complexity and simplicity culminates in the answer to that question. "Simplify, simplify," wrote Henry David Thoreau almost two centuries ago. Perhaps it is worth thinking about his words next time you are presented with such a dilemma.

6.1 Limitations

Without a doubt, this literature review only scratches the surface of enterprise architecture literature and the field at large. As stated before, the purpose of this review was not to 'figure out' EA, but rather to provide a brief overview of what has been written before and what kind of topics and ideas revolve around the field. This thesis does not solve the problems and challenges that organizations face today with their ever-increasing complexities and difficulties in remaining lean, agile and, yes, simple. It perhaps also fails in providing enough practical, real-life examples of EA use and implementation to offer a clear picture of what EA means in the daily operations of organizations and how it affects their employees. As for the systematic literature review, there are obvious resource limitations due to the fact that this is a master's thesis and thus the scope must be kept reasonable. With more time, a larger set of literature with a wider array of keywords could have been included in the literature search process, and the publication standard could have been lowered to include a larger body of literature.

However, by providing an overview of how complexity is addressed and where it resides in the context of enterprise architecture, this study may enable practitioners and academics alike to better understand underlying challenges in enterprise architecture and its implementation.

6.2 Implications for Practice and Research

While this thesis does not solve the problems of organizations, it hopefully reminds both practitioners and academics of the importance of keeping focus on what really matters in business context: those processes and tools that are fundamental to core mission. In the worst-case scenario, enterprise architecture can only add to the complexity that companies already suffer from by introducing a whole collection of new concepts, ideas, practices, and tools. Another key message is that even the most elaborate plans to restructure, organize, and simplify can be undermined by the human factor: if employees continue implementing complicated thinking and activities with simplified systems and structures, no amount of structural simplification or 'leanification' will help. An example could be that of data quality and related practices: a simple, powerful information system is usually only as good as the quality of the data that it contains. The full benefits of a new, streamlined, integrated and automated IT ecosystem will be tarnished by the negligent users who do not take care that the data fed into the system is valid, reliable and 'clean'. People might simply be unwilling to participate in any change endeavor and instead continue performing the same, ineffective, and non-value-adding practices regardless of the possibility of a more effective way enabled by new tools. The same goes for corporate policies, bureaucracy, and governance: if these are not simplified

together with tools and processes, usually the value derived is diminished. For these reasons, both academics and practitioners should also consider the 'grassroots' level and its implications to EA practices so that the noble efforts of EA practitioners are not undermined by 'unforeseen' factors happening on the ground level. In fact, a speculative suggestion in this thesis is that those working with enterprise architecture might hugely benefit from considering human psychology and human tendencies in addition to and in conjunct with structural issues.

For such reasons, an interesting subject for further research would be to unite psychological theories and research more strongly with those of enterprise architecture. As it has been stated many times over, a recognized issue with the practice of enterprise architecture is that it sometimes turns into an activity where high-flying professionals draft magnificent pictures and plans with little or no practical utility. Considering this with the findings presented in Nature (Adams et al., 2021), perhaps a key to turning enterprise architecture around is to start thinking it more as a democratic development rather than a kind of tyranny, where one person or a handful of people make big decisions once or twice a year that result in enterprise-wide shockwaves. Since it is undoubted that the practices, structures and processes of an enterprise evolve not only through the big decisions made in the executive suite, but also through the small decisions that all the employees make every day, maybe it's reasonable to start thinking enterprise architecture more as a capability and responsibility of every single employee rather than an activity 'done' by a few 'enterprise architects.'

To study such phenomena, researchers could try to pin down the extent to which architectures and processes of large enterprises evolve organically 'beyond' the attention and reach of those meant to guide its evolution. For example, longitudinal studies could record the status quo of an enterprise's structure and processes at time A, and after some time (perhaps in several years) analyse how the processes and structures have changed compared to the original state, and whether the changes were consciously directed or 'organic.' Consciously initiated changes should be relatively easy to recognize based on formal documentation created on decisions and projects. The organic changes, while probably more difficult to recognize, are however interesting and in some instances possibly even more significant than those based on explicit decisions. Such research could yield interesting data from various perspectives. For instance, it could present situations where "this is what should be happening" drastically differs from "this is what is actually happening," and the magnitude of undocumented, unmandated and informal 'architecting' could be analysed. Whether such research would or should result in some grand paradigm shift in the field of enterprise architecture will not be speculated in this paper.

Another possible research topic could be one where a comparison is made between enterprise architecture or business process solutions that are designed based on A) using a detailed 'as-is' architecture as the foundation and focusing on making incremental improvements 'on-top' of it, and B) ones that are designed on a clean slate, so to speak, where existing limitations (technological

or structural) are disregarded. In other words, such a study could potentially shed light on whether the existence and strong consideration of an 'as-is' description limits the recognition of novel, creative, effective, and simple ideas and solutions in comparison to the situation where designers are allowed to freely conjure 'the best solution' for a given problem. Of course, the fact is that every organization *has* various limitations, and they need to be duly addressed, but at the same time, basing one's thinking heavily on the details of an existing process, for example, might limit and hinder the extent to which revolutionary (but valid nonetheless) ideas. Future research could, then, study both the pros and cons of such methodologies, for example by having those involved with enterprise architecting or business process redesign develop architectural or process descriptions first by looking at the 'as-is' description (trying to identify bottlenecks, redundancies and so forth), and later by 'setting them free' of the limitations of the status quo and instead developing the 'ideal solution.'

7 CONCLUSION

This literature review set out to inspect the field of enterprise architecture, its many facets and especially the ways in which it is supposed to aid organizations become better in what they do. *The quest for simplicity* was set as an underlying objective for EA and EA was reflected in terms of its ability to help organizations become simpler in their operations – or at least to address the challenges that unnecessary complexity imposes. This review provides a fresh perspective on how to approach the field of enterprise architecture and reminds both practitioners and academics that the original, implicit reason for EA's existence was to offer a way for organizations to simplify their operational practices and structural configurations. Therefore, academics and practitioners alike should be careful not to add even more complexity to organizational structures and processes by conceiving new vague and unnecessary words and practices only for the sake of 'doing EA.'

This literature review presented the concept of enterprise architecture and other related concepts, such as architectural frameworks and enterprise transformation as well as some of the general trends in relevant literature during the past three decades. The literature review set out to uncover the origins of the idea of EA, what it was meant to solve, how it evolved throughout the years and from context to context, what kind of criticism has been raised towards the notion of EA as well as what kind of practical uses and benefits it has. In addition, this thesis set out to reflect EA in terms of the pursuit for simplicity and managing complexity in organizational structures, business operations and employee activities and thinking. The research questions were as follows:

1. *In what circumstances and for what purpose(s) did enterprise architecture emerge?*
2. *How has enterprise architecture evolved throughout the past decades?*
3. *How is the original purpose of EA – managing and reducing organizational complexity – addressed in the current academic EA literature?*

Even though this review was not intended as one to crystallise the idea of EA and 'figure it out', it must be stated that even after reading hundreds and

hundreds of pages on the subject, the whole idea of enterprise architecture remains vague in the author's mind. One main reason for this is probably the fact that the concept of *enterprise architecture* can mean many different things, depending on the context and the person using it. It can mean the entire 'configuration' of an organization, it can mean a function within an organization, it can mean the descriptive 'drawings' of an organization's structures and processes, it can even mean something that is done, an activity. Then, these use cases themselves have an infinite number of variations, depending on the specific nuances and subtleties of the context.

What can be concluded, however, is that the simple, basic motivation for any company to consider the questions posed by EA is the following: the desire to improve business. Now, there are countless ways a company can achieve this. If we consider a simple example of a café: the owner might try to improve the business by switching to another coffee bean supplier. She might hire a charismatic, customer-friendly barista. She might change the furniture and the lighting in the café. She might initiate a marketing campaign to get new customers and boost her brand. She might start serving a soup lunch on weekdays. In such a context, the idea of enterprise architecture would sound a little silly. Even though the café is an enterprise for sure, and it even has an architecture of sorts, enterprise architecture as a concept makes little sense.

But when we speak of a larger firm, which has offices in several countries, where employees and teams from these different countries need to collaborate frequently, maybe on a daily basis, and where the products or services the company creates require the input of different departments, various teams and a collection of different types of tools and resources, EA becomes more relevant. The company might have the simple goal of controlling unchecked spending on new digital tools, such as different collaboration platforms or resource-planning systems. The first thing to do might be to make a list of all the software that have been bought or licensed, analyse all the overlapping functionalities and make a plan to streamline (or simplify) the selection by terminating licenses on software that can be replaced by ones that are owned and that have other functionalities also. As a simple example, it might not provide any additional value to the company to have two distinct email services. Thus, to clean up and simplify its 'architecture', the company might discontinue one email service and make all its employees use the remaining one.

So, in one sense, enterprise architecture is about simplicity. Getting back to the beginning of this thesis, in the words of Fong & Goldfine (1989), the aim is to bring order to the disorder resulting from entropy, or the phenomenon of the world getting continuously more disorganized. But at the same time, musing the history of EA, it seems that somewhere along the road this drive towards simplicity has been lost, or at least partially covered in dirt. What would happen, if we were to bring five EA consultant to the café of our previous example? They would start speaking of TOGAF, of EAM and different frameworks, of diagrams and the importance of standardization and integration. Of course, it sounds ridiculous, but this might actually be the situation in many organizations: a lot of

fancy words that do not fit for purpose, and do not contribute to *the quest for simplicity*.

Reading through the literature, one might come to wonder whether many of the ideas presented there are actually capable of inducing such simplicity. It certainly doesn't sound reassuring when practitioners and academics alike often lament that EA is typically difficult to understand and that the entire practice feels out of place. If we, for the sake of an example, consider the law change in Finland in 2011 that made it mandatory for governmental entities take up the practice of EA. Now consider a Finnish municipality that has never heard of enterprise architecture, and all of a sudden, they have to deal with frameworks, diagrams, landscapes, views and dozens other ideas that traditionally come with the 'EA package.' One can only imagine what happens when all this content is poured into an organization's operations undigested and with improper preparation or coaching.

As a countermeasure to ending up in a situation even more complicated than before an idea arises that perhaps the best course of action would be to start from the ground up: beginning by making absolutely clear what the actual challenges and problems are, and more importantly, do they contribute to the core value-creating processes? "What are the most value-creating tools, processes, and activities? What actually are our main objectives and goals, our mission? What can we improve? Where are the bottlenecks? How can we be *even more simple*?" For sure, taking up the practice of EA in whatever form without clearly stating the reasons for it will only introduce more complexity than simplicity. But then, if an organization is clear on its target, clear on its challenges and failings, and clear on what it wants to become, carefully and consciously practiced enterprise architecture can certainly be worth the effort in trying to reach its next evolutionary stage.

REFERENCES

Abrahamson, E. (1991). Managerial fads and fashions: The diffusion and rejection of innovations. *Academy of Management Review*, 16, 586–612.

Abrahamson, E. (1996). Management fashion. *Academy of Management Review*, 21, 254–285.

Abrahamsson, P., Conboy, K., Wang, X. (2009). "Lot's done, more to do": The current state of agile systems development research. *European Journal of Information Systems*, 18(4), 281-284.

Adams, G. S., Converse, B. A., Hales, A. H., & Klotz, L. E. (2021). People systematically overlook subtractive changes. Nature, 592(7853), 258-261.

Ahmad, N. A., Drus, S. M., & Kasim, H. (2020). Factors that influence the adoption of enterprise architecture by public sector organizations: an empirical study. *IEEE Access*, *8*, 98847-98873.

Aier, S., Gleichauf, B., and Winter, R. (2011). Understanding Enterprise Architecture Management Design – An Empirical Analysis. *10th International Conference Wirtschaftsinformatik. Association for Information Systems*, Zurich, Switzerland.

Ajer, A. K. S., Hustad, E., & Vassilakopoulou, P. (2021). Enterprise architecture operationalization and institutional pluralism: The case of the Norwegian Hospital sector. *Information Systems Journal*, *31*(4), 610-645.

Alwadain, A., Fielt, E., Korthaus, A., & Rosemann, M. (2016). Empirical insights into the development of a service-oriented enterprise architecture. *Data & Knowledge Engineering*, *105*, 39-52.

Alzoubi, Y. I., & Gill, A. Q. (2020). An Empirical Investigation of Geographically Distributed Agile Development: The Agile Enterprise Architecture is a Communication Enabler. *IEEE Access*, 8, 80269–80289.

Armour, F. J., Kaisler, S. H., & Liu, S. Y. (1999). A big-picture look at enterprise architectures. *IT professional*, *1*(1), 35-42.

Attaran, M. (2004). Exploring the relationship between information technology and business process reengineering. *Information & management*, 41(5), 585-596.

Azevedo, C. L., Iacob, M. E., Almeida, J. P. A., van Sinderen, M., Pires, L. F., & Guizzardi, G. (2015). Modeling resources and capabilities in enterprise architecture: A well-founded ontology-based proposal for ArchiMate. *Information systems*, *54*, 235-262.

Banaeianjahromi, N., & Smolander, K. (2019). Lack of communication and collaboration in enterprise architecture development. *Information Systems Frontiers*, *21*(4), 877-908.

Beck K., Beedle M., Van Bennekum A., Cockburn A., Cunningham W., Fowler M., Grenning J., Highsmith J., Hunt A., Jeffries R., Kern J. (2001). The agile manifesto.

Bernaert, M., Poels, G., Snoeck, M., & De Backer, M. (2016). CHOOSE: Towards a metamodel for enterprise architecture in small and medium-sized enterprises. *Information systems frontiers*, *18*(4), 781-818.

Bernard, S. A. (2012). An introduction to enterprise architecture (3rd ed.). *Bloomington*, IN: AuthorHouse.

Bharadwaj, A. (2000). A resource-based perspective on information technology capability and firm performance: an empirical investigation. *MIS Quarterly* 24(1), 169–196.

Bharadwaj, A., Sambamurthy, V., and Zmud, R. (1999). IT capabilities: theoretical perspectives and empirical operationalization. *Proceedings of the 19th International Conference on Information Systems*, pp 378–385, Helsinki, Finland.

Bradley, R., Pratt, R., Byrd, T., & Simmons, L. (2011). The Role of Enterprise Architecture in the Quest for IT Value. *MIS Quarterly Executive*, 10(2).

Briggs, J., & Peat, F. D. (1989). *Turbulent mirror: An illustrated guide to chaos theory and the science of wholeness.* HarperCollins Publishers.

Bui, Q. (2015). Increasing the Relevance of Enterprise Architecture through" Crisitunities" in US State Governments. *MIS Quarterly Executive*, *14*(4), 3.

Bui, Q. (2017). Evaluating enterprise architecture frameworks using essential elements. *Communications of the association for information systems*, *41*(1), 6.

Burt, R. S. (2000). The network structure of social capital. *Research in organizational behavior*, *22*, 345-423.

Chan, Y.E. (2002). Why Haven't We Mastered Alignment? The Importance of the Informal Organization Structure. *MIS Quarterly Executive* 1(2): 97–112.

Chen, H. M., Kazman, R., & Perry, O. (2010). From software architecture analysis to service engineering: An empirical study of methodology development for enterprise SOA implementation. *IEEE Transactions on Services Computing*, *3*(2), 145-160.

Chen, Y., Wang, Y., Nevo, S., Jin, J., Wang, L., & Chow, W. S. (2014). IT capability and organizational performance: the roles of business process agility and environmental factors. *European Journal of Information Systems*, 23(3), 326-342.

Chiprianov, V., Kermarrec, Y., Rouvrais, S., & Simonin, J. (2014). Extending enterprise architecture modeling languages for domain specificity and collaboration: application to telecommunication service design. *Software & Systems Modeling*, *13*(3), 963-974.

Davenport, T. H., & Short, J. E. (1990). *The new industrial engineering: information technology and business process redesign*.

Department of Defense Architecture Framework. (2007). *The DoDAF architecture framework* (Version 1.5, Vol. II: Product Descriptions). Arlington County, VA: Department of Defense.

Dybå, T. (2000). Improvisation in small software organizations. *IEEE Software*, Vol 17, No. 5, pp 82–87.

Ellram, L., Billington, C. (2001). Purchasing leverage considerations in the outsourcing decision. *European Journal of Purchasing & Supply Management* 7:15–27.

Fong, E. N., & Goldfine, A. H. (1989). Information management directions: The integration challenge. *NIST Special publication*, *500*, 167.

Foorthuis, R., Van Steenbergen, M., Brinkkemper, S., & Bruls, W. A. (2016). A theory building study of enterprise architecture practices and benefits. *Information Systems Frontiers*, *18*(3), 541-564.

Franke, U., Cohen, M., & Sigholm, J. (2018). What can we learn from enterprise architecture models? An experiment comparing models and documents for capability development. *Software & Systems Modeling*, *17*(2), 695-711.

Gibson, J. W., & Tesone, D. V. (2001). Management fads: Emergence, evolution, and implications for managers. *Academy of Management Executive*, 15, 122–133.

Gladwell, M. (2006). *Blink: The power of thinking without thinking*. Little, Brown and Company.

Goldman, S. L. (1995). *Agile competitors and virtual organizations. Strategies for enriching the customer*. New York: Van Nostrand Reinhold.

Gong, Y., & Janssen, M. (2019). The value of and myths about enterprise architecture. *International Journal of Information Management*, *46*, 1-9.

González-Rojas, O., López, A., & Correal, D. (2017). Multilevel complexity measurement in enterprise architecture models. *International Journal of Computer Integrated Manufacturing*, *30*(12), 1280-1300.

Granovetter, M. (2005). The impact of social structure on economic outcomes. *Journal of economic perspectives*, 19(1), 33-50.

Grover, V., Cheon, M.J. and Teng, J.T.C. (1996). The Effect of Service Quality and Partnership on the Outsourcing of Information Systems Functions. *Journal of Management Information Systems* 12(4): 89–116.

Haki, K., & Legner, C. (2021). The mechanics of enterprise architecture principles. *Journal of the Association for Information Systems*, *22*(5), 1334-1375.

Hammer, M. (1986). *Dispersion and Interconnection: Approaches to Distributed Systems Architecture. PRISM (Partnership for Research in In- formation Systems Management) Final Report*, Index Group, Inc. and Hammer and Company, Cambridge, MA, 1986.

Hammer, M. and Mangurian, G.E. (1987). The Changing Value of Communications Technology. *Sloan Management Review* (28:4), pp. 65-71.

Holm, H., Buschle, M., Lagerström, R., & Ekstedt, M. (2014). Automatic data collection for enterprise architecture models. *Software & Systems Modeling*, *13*(2), 825-841.

Hosiaisluoma, E., Penttinen, K., Mustonen, J., & Heikkilä, J. (2018). Lean enterprise architecture method for value chain based development in public sector. *ECDG 2018 18th European Conference on Digital Government* (p. 86). Academic Conferences and publishing limited.

Hylving, L., & Bygstad, B. (2019). Nuanced responses to Enterprise architecture management: Loyalty, voice, and exit. *Journal of Management Information Systems*, 36(1), 14-36.

Investopedia (2021). 9 Major Companies Tied to the Apple Supply Chain. Retrieved 10.11.2021 at: *https://www.investopedia.com/articles-/investing/090315/10-major-companies-tied-apple-supply-chain.asp*.

Josey, A. (2016). *TOGAF® Version 9.1-A Pocket Guide*. Van Haren.

Kaushik, A., & Raman, A. (2015). The new data-driven enterprise architecture for e-healthcare: Lessons from the Indian public sector. *Government Information Quarterly*, *32*(1), 63-74.

Klein, G. (2003). *Why Developing Your Gut Instincts Will Make You Better at What You Do*. Currency, New York, 2002.

Korhonen, J. J., Lapalme, J., McDavid, D., & Gill, A. Q. (2016). Adaptive enterprise architecture for the future: Towards a reconceptualization of EA. *2016 IEEE 18th Conference on Business Informatics* (CBI) (Vol. 1, pp. 272-281).

Kotusev, S. (2017). Different approaches to enterprise architecture. *Journal of Enterprise Architecture*, 12(4), 9–16.

Kotusev, S. (2018). TOGAF-based enterprise architecture practice: an exploratory case study. *Communications of the Association for Information Systems*, *43*(1), 20.

Kotusev, S. (2019). Enterprise architecture and enterprise architecture artifacts: Questioning the old concept in light of new findings. *Journal of Information Technology*, 34(2), 102–128.

Kotusev, S., & Kurnia, S. (2021). The theoretical basis of enterprise architecture: A critical review and taxonomy of relevant theories. *Journal of Information Technology*, *36*(3), 275-315.

Kreuter, T., Kalla, C., Scavarda, L. F., Thomé, A. M. T., & Hellingrath, B. (2021). Developing and implementing contextualised S&OP designs–an enterprise architecture management approach. *International Journal of Physical Distribution & Logistics Management*, 51(6), 634- 655.

Kurnia, S., Kotusev, S., Shanks, G., Dilnutt, R., Taylor, P., & Milton, S. K. (2021). Enterprise Architecture Practice under a Magnifying Glass: Linking Artifacts, Activities, Benefits, and Blockers. *Communications of the Association for Information Systems*, *49*(1), 34.

Lange, M., Mendling, J., & Recker, J. (2016). An empirical analysis of the factors and measures of Enterprise Architecture Management success. *European Journal of Information Systems*, *25*(5), 411-431.

Lapalme, J. (2011). Three schools of thought on enterprise architecture. *IT professional*, 14(6), 37-43.

Lapalme, J., Gerber, A., Van der Merwe, A., Zachman, J., De Vries, M., & Hinkelmann, K. (2016). Exploring the future of enterprise architecture: A Zachman perspective. *Computers in Industry*, *79*, 103-113.

Lapkin, A., Allega, P., Burke, B., Burton, B., Bittler, R. S., Handler, R. A., James, G. A, Robertson, B., Newman, D., Weiss, D., Buchanan, R., and Gall, N. (2008). Gartner clarifies the definition of the term 'enterprise architecture'. Research, *Gartner*.

Lange, M., Mendling, J., & Recker, J. (2016). An empirical analysis of the factors and measures of Enterprise Architecture Management success. *European Journal of Information Systems*, 25(5), 411– 431.

Lonsdale, C., Cox, A. (2000). The historical development of outsourcing: the latest fad? *Industrial Management & Data Systems*. 100(9):444–450.

Luftman, J.N., Lewis, P.R. and Oldach, S.H. (1993). Transforming the Enterprise: The alignment of business and information technology strategies, *IBM Systems Journal* 32(1): 198–221.

Lu, Y., & K. Ramamurthy. (2011). Understanding the link between information technology capability and organizational agility: An empirical examination. *MIS quarterly*, 931-954.

Madison, J. (2010). Agile architecture interactions. *IEEE software*, *27*(2), 41-48.

Mamaghani, N. D., Madani, F. M., & Sharifi, A. (2012). Customer oriented enterprise IT architecture framework. *Telematics and Informatics*, *29*(2), 219-232.

Medini, K., & Bourey, J. P. (2012). SCOR-based enterprise architecture methodology. *International Journal of Computer Integrated Manufacturing*, *25*(7), 594-607.

Mohrman, S. A., Tenkasi, R. V., & Mohrman Jr, A. M. (2003). The role of networks in fundamental organizational change: A grounded analysis. *The Journal of Applied Behavioral Science*, *39*(3), 301-323.

Nerur, S., Mahapatra, R., Mangalaraj, G. (2005). *Challenges of migrating to agile methodologies*. CACM, pp 72– 78.

Niemann, K. (2006). *From Enterprise Architecture to IT Governance: Elements of Effective IT Management*. Vieweg, Wiesbaden, Germany.

Okoli, C. (2015). A guide to conducting a standalone systematic literature review. *Communications of the Association for Information Systems*, *37*(1), 43.

Purchase, V., Parry, G., Valerdi, R., Nightingale, D., & Mills, J. (2011). Enterprise Transformation: Why are we interested, What is it, and What are the challenges? *Journal of Enterprise Transformation*, 1(1), 14-33.

Parry, G., Mills, J., Turner, C. (2010). Lean competence: integration of theories in operations management practice. *Supply Chain Management: An International Journal* 15(3):216–226.

Peppard, J. and Ward, J. (1999). Mind the Gap': Diagnosing the relationship between IT organization and the rest of the business, *Journal of Strategic Information Systems*. 8: 29–60.

Qu, W. G., Oh, W., & Pinsonneault, A. (2010). The strategic value of IT insourcing: an IT-enabled business process perspective. *The Journal of Strategic Information Systems*, *19*(2), 96-108.

Rahimi, F., Gøtze, J., & Møller, C. (2017). Enterprise architecture management: Toward a taxonomy of applications. *Communications of the Association for Information Systems*, *40*(1), 7.

Richardson, G. L., Jackson, B. M., & Dickson, G. W. (1990). A Principles-Based Enterprise Architecture: Lessons from Texaco and Star Enterprise. *MIS Quarterly*, 14(4), 385–403.

Ross, J. W. Creating a Strategic IT Architecture Competency: Learning in Stages. *MIS Quarterly Executive* (2:1), 2003, pp. 31-43;

Ross, J. W., Weill, P., & Robertson, D. (2006). Enterprise architecture as strategy: Creating a foundation for business execution. Harvard business press.

Rouse, W.B. (2005). A theory of enterprise transformation. *Systems Engineering*. 8, 4, 279– 295.

Rouse, W. B., & Baba, M. L. (2006). Enterprise transformation. *Communications of the ACM*, 49(7), 66-72.

Rai, A., Venkatesh, V., Bala, H., & Lewis, M. (2010). Transitioning to a Modular Enterprise Architecture: Drivers, Constraints, and Actions. *MIS Quarterly Executive*, 9(2)

Sambamurthy, V., Bharadwaj, A., & Grover, V. (2003). Shaping agility through digital options: Reconceptualizing the role of information technology in contemporary firms. *MIS quarterly*, 237-263.

Schmidt, C., & Buxmann, P. (2011). Outcomes and success factors of enterprise IT architecture management: empirical insight from the international financial services industry. *European journal of information systems*, *20*(2), 168-185.

Sessions, R. (2011). The Mathematics of IT Simplification. White paper. ObjectWatch, Inc. Available online: http://object watch.com/resources.

Shang, S., & Seddon, P. B. (2002). Assessing and managing the benefits of enterprise systems: the business manager's perspective. *Information systems journal*, *12*(4), 271-299.

Spewak, S. H., & Hill, S. C. (1992). *Enterprise architecture planning: Developing a blueprint for data, applications and technology*. New York, NY: Wiley.

Stroud, R. O., Ertas, A., & Mengel, S. (2019). Application of cyclomatic complexity in enterprise architecture frameworks. *IEEE Systems Journal*, *13*(3), 2166-2176.

Tallon, P. P. (2008). Inside the adaptive enterprise: an information technology capabilities perspective on business process agility. *Information technology and management*, *9*(1), 21-36.

Tamm, T., Seddon, P. B., Shanks, G., & Reynolds, P. (2011). How does enterprise architecture add value to organizations? *Communications of the association for information systems*, *28*(1), 10.

Tamm, T., Seddon, P. B., Shanks, G., Reynolds, P., & Frampton, K. M. (2015). How an Australian Retailer Enabled Business Transformation Through Enterprise Architecture. *MIS Quarterly Executive*, 14(4).

Tenkasi, R. V., & Chesmore, M. C. (2003). Social networks and planned organizational change: The impact of strong network ties on effective change implementation and use. *The Journal of Applied Behavioral Science*, *39*(3), 281-300.

The Open Group (2009). *TOGAF Version 9 Enterprise Edition*. Van Haren Publishing, Zaltbommel, the Netherlands.

The Open Group Architecture Framework (2011). *TOGAF Version 9.1. Reading*, UK: The Open Group.

Toppenberg, G., Henningsson, S., & Shanks, G. (2015). How Cisco Systems used enterprise architecture capability to sustain acquisition-based growth. *MIS Quarterly Executive*, *14*(4), 151-168.

Valorinta, M. (2011). IT alignment and the boundaries of the IT function. *Journal of Information technology*, 26(1), 46-59.

Van Oosterhout, M., Waarts, E., & van Hillegersberg, J. (2006). Change factors requiring agility and implications for IT. *European journal of information systems*, 15(2), 132-145.

Wade, M., & Hulland, J. (2004). The resource-based view and information systems research: Review, extension, and suggestions for future research. *MIS quarterly*, 107-142.

Wendler, R. (2014). Development of the organizational agility maturity model. In 2014 Federated *Conference on Computer Science and Information Systems* (pp. 1197-1206).

Wendler, R. (2016). Dimensions of organizational agility in the software and IT service industry: insights from an empirical investigation. *Communications of the Association for Information Systems*, 39(1), 21.

Womack, J. P., & Jones, D. T. (1997). Lean thinking—banish waste and create wealth in your corporation. *Journal of the Operational Research Society*, 48(11), 1148-1148.

Zachman, J. A. (1987). A framework for information systems architecture. *IBM systems journal*, *26*(3), 276-292.

Zhang, Z., & Sharifi, H. (2000). A methodology for achieving agility in manufacturing organizations. *International Journal of operations & Production management*.

Ågerfalk, P. J., Fitzgerald, B., Slaughter, S. A. (2009). Flexible and distributed information systems development: State of the art and research challenges. *Information Systems Research*, 20(3), 317- 328.

APPENDIX 1 ARTICLES IN SYSTEMATIC LITERATURE REVIEW

Ahmad, N. A., Drus, S. M., & Kasim, H. (2020). Factors that influence the adoption of enterprise architecture by public sector organizations: an empirical study. *IEEE Access*, *8*, 98847-98873.

Ajer, A. K. S., Hustad, E., & Vassilakopoulou, P. (2021). Enterprise architecture operationalization and institutional pluralism: The case of the Norwegian Hospital sector. *Information Systems Journal*, *31*(4), 610-645.

Alwadain, A., Fielt, E., Korthaus, A., & Rosemann, M. (2016). Empirical insights into the development of a service-oriented enterprise architecture. *Data & Knowledge Engineering*, *105*, 39-52.

Azevedo, C. L., Iacob, M. E., Almeida, J. P. A., van Sinderen, M., Pires, L. F., & Guizzardi, G. (2015). Modeling resources and capabilities in enterprise architecture: A well-founded ontology-based proposal for ArchiMate. *Information systems*, *54*, 235-262.

Banaeianjahromi, N., & Smolander, K. (2019). Lack of communication and collaboration in enterprise architecture development. *Information Systems Frontiers*, *21*(4), 877-908.

Bui, Q. (2015). Increasing the Relevance of Enterprise Architecture through" Crisitunities" in US State Governments. *MIS Quarterly Executive*, *14*(4), 3.

Bernaert, M., Poels, G., Snoeck, M., & De Backer, M. (2016). CHOOSE: Towards a metamodel for enterprise architecture in small and medium-sized enterprises. *Information systems frontiers*, *18*(4), 781-818.

Bui, Q. (2017). Evaluating enterprise architecture frameworks using essential elements. *Communications of the association for information systems*, *41*(1), 6.

Chen, H. M., Kazman, R., & Perry, O. (2010). From software architecture analysis to service engineering: An empirical study of methodology development for enterprise SOA implementation. *IEEE Transactions on Services Computing*, *3*(2), 145-160.

Chiprianov, V., Kermarrec, Y., Rouvrais, S., & Simonin, J. (2014). Extending enterprise architecture modeling languages for domain specificity and collaboration: application to telecommunication service design. *Software & Systems Modeling*, *13*(3), 963-974.

Foorthuis, R., Van Steenbergen, M., Brinkkemper, S., & Bruls, W. A. (2016). A theory building study of enterprise architecture practices and benefits. *Information Systems Frontiers*, *18*(3), 541-564.

Franke, U., Cohen, M., & Sigholm, J. (2018). What can we learn from enterprise architecture models? An experiment comparing models and documents for capability development. *Software & Systems Modeling*, *17*(2), 695-711.

Gong, Y., & Janssen, M. (2019). The value of and myths about enterprise architecture. *International Journal of Information Management*, *46*, 1-9.

González-Rojas, O., López, A., & Correal, D. (2017). Multilevel complexity measurement in enterprise architecture models. *International Journal of Computer Integrated Manufacturing*, *30*(12), 1280-1300.

Haki, K., & Legner, C. (2021). The mechanics of enterprise architecture principles. *Journal of the Association for Information Systems*, *22*(5), 1334-1375.

Holm, H., Buschle, M., Lagerström, R., & Ekstedt, M. (2014). Automatic data collection for enterprise architecture models. *Software & Systems Modeling*, *13*(2), 825-841.

Hylving, L., & Bygstad, B. (2019). Nuanced responses to Enterprise architecture management: Loyalty, voice, and exit. *Journal of Management Information Systems*, *36*(1), 14-36.

Kaushik, A., & Raman, A. (2015). The new data-driven enterprise architecture for e-healthcare: Lessons from the Indian public sector. *Government Information Quarterly*, *32*(1), 63-74.

Kotusev, S. (2018). TOGAF-based enterprise architecture practice: an exploratory case study. *Communications of the Association for Information Systems*, *43*(1), 20.

Kotusev, S., & Kurnia, S. (2021). The theoretical basis of enterprise architecture: A critical review and taxonomy of relevant theories. *Journal of Information Technology*, *36*(3), 275-315.

Kreuter, T., Kalla, C., Scavarda, L. F., Thomé, A. M. T., & Hellingrath, B. (2021). Developing and implementing contextualised S&OP designs–an enterprise architecture management approach. *International Journal of Physical Distribution & Logistics Management*, 51(6), 634- 655.

Kurnia, S., Kotusev, S., Shanks, G., Dilnutt, R., Taylor, P., & Milton, S. K. (2021). Enterprise Architecture Practice under a Magnifying Glass: Linking Artifacts, Activities, Benefits, and Blockers. *Communications of the Association for Information Systems*, *49*(1), 34.

Lange, M., Mendling, J., & Recker, J. (2016). An empirical analysis of the factors and measures of Enterprise Architecture Management success. *European Journal of Information Systems*, *25*(5), 411-431.

Lapalme, J., Gerber, A., Van der Merwe, A., Zachman, J., De Vries, M., & Hinkelmann, K. (2016). Exploring the future of enterprise architecture: A Zachman perspective. *Computers in Industry*, *79*, 103-113.

Mamaghani, N. D., Madani, F. M., & Sharifi, A. (2012). Customer oriented enterprise IT architecture framework. *Telematics and Informatics*, *29*(2), 219-232.

Medini, K., & Bourey, J. P. (2012). SCOR-based enterprise architecture methodology. *International Journal of Computer Integrated Manufacturing*, *25*(7), 594-607.

Rahimi, F., Gøtze, J., & Møller, C. (2017). Enterprise architecture management: Toward a taxonomy of applications. *Communications of the Association for Information Systems*, *40*(1), 7.

Schmidt, C., & Buxmann, P. (2011). Outcomes and success factors of enterprise IT architecture management: empirical insight from the international financial services industry. *European journal of information systems*, *20*(2), 168-185.

Stroud, R. O., Ertas, A., & Mengel, S. (2019). Application of cyclomatic complexity in enterprise architecture frameworks. *IEEE Systems Journal*, *13*(3), 2166-2176.

Tamm, T., Seddon, P. B., Shanks, G., & Reynolds, P. (2011). How does enterprise architecture add value to organizations? *Communications of the association for information systems*, *28*(1), 10.

Toppenberg, G., Henningsson, S., & Shanks, G. (2015). How Cisco Systems used enterprise architecture capability to sustain acquisition-based growth. *MIS Quarterly Executive*, *14*(4), 151-168.