Investigation of the Lack of Common Understanding in the Discipline of Enterprise Architecture

by

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Einsten A. (1979), Comment je vois le monde, *Flammarion*

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Investigation du problème de manque de compréhension commune au sein de la discipline d'Architecture d'Entreprise

Patrick SAINT-LOUIS

RÉSUMÉ

Malgré l'intérêt grandissant qui s'est manifesté dans la discipline d'Architecture d'Entreprise durant ces dernières années, cette discipline souffre d'un manque de compréhension commune parce que ses chercheurs et pratiquants utilisent des approches et terminologies différentes pour décrire la discipline, son application, sa méthodologie, ses processus ou ses livrables. Très peu d'études ont effectué une profonde analyse de l'ampleur de cette situation, mais ces études présentes des biais méthodologiques. Cette thèse a justement pour objectif de faire davantage de lumière sur le manque de compréhension commune qui existe au sein de la discipline d'AE en appliquant des approches et techniques méthodologiques connues. Pour atteindre cet objectif, cette thèse est subdivisée en trois études complémentaires qui traitent chacun un aspect spécifique. En effet, la première étude réalise une cartographie systématique de la littérature qui a permis d'identifier et de classifier des sources de variétés dans la littérature qui sont susceptibles de causer le manque de compréhension commune qui existe au sein de la discipline d'AE. Ensuite, la deuxième étude réalise une revue systématique de littérature qui a utilisé des concepts de la discipline de terminologie et des techniques de l'analyse thématique afin d'identifier des sources d'implicitation, d'incomplétude, de complexité et d'incohérence dans les définitions de l'AE qui sont susceptibles de causer le manque de compréhension commune qui existe au sein de la discipline d'AE. Enfin, la troisième étude réalise un sondage d'opinion avec des professionnels de l'AE, qui est analysé à l'aide des techniques d'analyse de données, afin d'identifier l'existence de différentes conceptions majeures des professionnels de l'AE concernant les entreprises et leurs personnels. Les résultats de cette thèse contribuent à une meilleure connaissance du manque de compréhension commune au sein de la discipline d'AE et donnent de meilleures possibilités pour pouvoir désormais adresser ce problème. Ces résultats fournissent également des directions significatives aux chercheurs qui auront à étudier le même problème ou à appliquer les mêmes approches et techniques méthodologiques considérés. Pour continuer à faire de la lumière sur ce problème de manque de compréhension commune au sein de la discipline d'AE, cette thèse recommande aux chercheurs et pratiquants de la discipline d'AE de supporter davantage les études descriptives et expérimentales qui priorisent la pratique de l'AE (évolution de l'AE, évaluation de l'AE, rôle des pratiquants de l'AE, conceptions des pratiquants, etc.), d'accorder davantage d'attention aux définitions de l'AE qu'ils fournissent dans leurs prochaines publications, et d'intégrer toutes les conceptions de l'AE au sein d'une référence commune, même si ces conceptions semblent être divergentes, voire conflictuelles parfois.

Mots-clés: enterprise architecture, systematic mapping study, systematic literature review, opinion survey, systems thinking

Investigation of the lack of common understanding in the discipline of Enterprise Architecture

Patrick SAINT-LOUIS

ABSTRACT

Despite growing interest in the discipline of Enterprise Architecture (EA) around the world in recent years, EA suffers from a lack of common understanding because researchers and practitioners do not use a shared approach and terminology when describing EA, its application, methodology, process or outcomes. A few studies have conducted a deep analysis on the extent of this situation but they all have methodological limitations. The objective of this thesis was to fill this gap in applying well know methodological design and techniques to shed some light on the lack of common understanding in the discipline of EA. To achieve this objective, this thesis is subdivided in three complementary studies which treat each a specific aspect. The first study conducts a Systematic Mapping Study and identifies, and classifies, sources of variety in the literature which could be on the basis of the lack of common understanding in the discipline of EA. The second study conducts a Systematic Literature Review using concepts from the academic field of terminology and thematic analysis techniques and identifies sources of implicitness, incompleteness, complexity and incoherence in the definitions of EA which could be on the basis of the lack of common understanding. The third study conducts an opinion survey with EA practitioners analyzed with the help of exploratory data analysis techniques, and identifies different EA practitioners' major worldviews regarding organizations and the people within them. The findings of this thesis contribute to a better knowledge of the lack of common understanding in the discipline of EA and provide a better possibility to deal with this lack, as implication for practitioners. These findings also provide relevant directions to researchers for future studies concerning this topic or using the methodological design and techniques applied. To continue clarifying the characteristics of the lack of common understanding of EA, this thesis recommends both researcher and practitioner to support more descriptive and experimental research which prioritize the practice of EA (EA evolution, EA measurement, practitioners' role, practitioners' worldviews, etc.), to pay more attention to the definition of EA they provide when they produce a new article, and to integrate all ways of approaching EA into a shared reference, even if they seem to be divergent and conflictual sometimes.

Keywords: enterprise architecture, systematic mapping study, systematic literature review, opinion survey, systems thinking

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LIST OF ABREVIATIONS

EA	Enterprise Architecture
IT	Information Technology
HCA	Hierarchical Clustering Analysis
MCA	Multiple Correspondence Analysis
SLR	Systematic Literature Review
SMS	Systematic Mapping Study

INTRODUCTION

Information Technology (IT) started as a simple tool used to save and organize data in organizations but has become today an indispensable strategic and competitive weapon, used to conduct routine administrative tasks, and to guide decision-making in organizations (Hugoson, Pessi, & Magoulas, 2011). Therefore, managing IT has also become a priority for contemporary organizations which regularly encounter challenges meeting their IT needs. Several researchers have stated that Enterprise Architecture (EA) is the emerging discipline that can help organizations meet the challenges of managing IT and business (Jonkers et al., 2006) ; (Simon, Fischbach, & Schoder, 2013) and which is crucial to survive in the current increasingly dynamic environment full of interruptions and change. This is probably the reason why there has been a growing interest in the discipline of EA for several years. This growing interest can easily be seen when considering the increase in published scientific papers on EA, and in the increase in conferences, workshops and training dedicated to EA around the world.

Despite the growing interest, EA suffers from a lack of common understanding because researchers and practitioners do not use a shared approach and terminology when describing it, its application, process or outcomes. Such a situation negatively impacts EA and hinders the discipline from becoming more mature as a "generally accepted" profession or as a "legally recognized" field (Walrad, Lane, Jeffrey, & Hirst, 2014). Several studies have highlighted the lack of common understanding in the discipline of EA and its negative impacts, even if it is not their primary focus. But only a few studies have conducted a deep analysis on the extent of the situation by identifying and describing the characteristics of the major EA schools of thought (Doucet, Gotze, Saha, & Bernard, 2008) ; (Lapalme, 2012) ; (Korhonen & Poutanen, 2013) ; (Preez, Merwe, & Matthee, 2014). Those studies offer relevant insights but they all have methodological limitations hence providing either a biased or incomplete picture. Consequently, there is still a need for investigation of the lack of common understanding in the discipline of EA; this thesis aims to satisfy this need.

More precisely, this thesis is an exploratory study conducted with the objective to provide in-depth insights concerning different worldviews held by academics and practitioners about EA as well as insights concerning important characteristics of those worldviews. To achieve this objective, this thesis includes three complementary studies that each investigates a specific aspect of the lack of common understanding in the discipline of EA, and the underlying worldview divergences. The findings of each study informs the next one, hence building on each other.

The first study intends to explore and discuss the factors in the literature that can play a role in the challenge concerning the existence of many ways of approaching EA. Accordingly, the study conducts a Systematic Mapping Study using articles published from 1990 to mid-2018 in major engineering, computer science, and management journals. The contribution of the findings of this study lies in the organization of the EA literature according to three major questions concerning 'who' has published in the literature, 'where' is their affiliate organization located, and 'what' are their publications about. The study helps to identify sources of variety in the literature that could be factors contributing to the lack of common understanding in EA. The study also provides a more structured knowledge about this lack to practitioners and stakeholders, and also propose relevant directions for future research.

The second study intends to analyze the explicit definitions of EA extracted in major engineering, computer science, and management journals in order to identify and classify their different parts and provide clarifications concerning the extent of their differences. Accordingly, the study conducts a Systematic Literature Review using concepts from the academic field of terminology and thematic analysis techniques. The contribution of the study stems from the novel approach used to analyze the EA definitions by subdividing them into elementary parts, guided by linguistics models, as to only compare similar elementary parts before making generalizations. This study provides knowledge about sources of implicitness, incompleteness, complexity and incoherence that could be factors contributing to the lack of common understanding in the discipline of EA. The study also provides a better understanding

concerning the extent of the differences between the definitions of EA in the literature, as well as relevant directions for future research, including the third study of this thesis.

The third study is an exploratory qualitative survey based investigation which intends to identify and characterize the different major worldviews held by EA practitioners regarding the organizations and the people within them. Accordingly, the study conducts an opinion survey designed according to models about ontological and epistemological assumptions. Exploratory data analysis techniques, particularly multiple correspondence analysis and hierarchical clustering analysis, are used to analyze the data collected. This study provides a better knowledge of the lack of common understanding in the discipline of EA, and encourages dialogue concerning EA and belief systems. The contribution of the study stems from both its findings about the worldviews in the community as well as the novel methodology used to identify and characterize the worldviews.

In conclusion, the findings of this thesis come from the application of well-known research methodology designs and techniques. These findings contribute to a better knowledge of the lack of common understanding in the discipline of EA and provide a better possibility to deal with this lack, as implication for practitioners. These findings also provide relevant directions for future research.

The rest of this thesis report which will detail the findings and their discussion is structured as follows: the research background, including the research problem and the research questions, are presented in Chapter 1. The research methods applied to examine the research questions are presented in Chapter 2. The findings of the examination of the research questions and their discussions are respectively presented for each of the three studies of this thesis in Chapter 3, 4 and 5. A general discussion of the three studies is presented in Chapter 6. Then, the limitations of the three studies and field for future work are presented in the section of conclusion.

CHAPTER 1

LITERATURE REVIEW

1.1 Origin and evolution of Enterprise Architecture

According to many authors, the publication of the article titled «A Framework for Information Systems Architecture» by J.A. Zachman in 1987 in the IBM Systems Journal is considered as the pioneer of the discipline of EA (Urbaczewski & Mrdalj, 2006) ; (Sessions, 2007) ; (Kang, Lee, Choi, & Kim, 2010) ; (Tamm, Seddon, Shanks, & Reynolds, 2011) ; (Hugoson et al., 2011) ; (Magoulas & Hadzic, 2012) ; (Simon et al., 2013). They claim that Zachman laid out both the challenge and the vision of Enterprise Architecture in that paper. Since this starting point of EA, this discipline has garnered considerable attention from practitioners and academics. Various other frameworks have been created. The most popular frameworks are described in the following section.

1.1.1 The Zachman framework

The Zachman framework is a «taxonomy» for organizing architectural artefacts, including design documents, specifications, and models, that takes into account both the artefact targets and particular issue addressed (Sessions, 2007). It is a six-by-six matrix representation, with six interrogatives in the columns (what, how, when, who, where, why) and six transformational views in the rows (planner's view, owner's view, designer's view, builder's view, integrator's view, to the user's view) which describe actions, including identification, definition, representation, specification, configuration, and instantiation. The intersection between these interrogatives and transformations forms the basis for a comprehensive description of the entire enterprise (Sessions, 2007).

This Zachman framework focuses on constructing the views of an enterprise. But it does not provide a process or methodology to create architecture or an architectural description. In fact,

some limitations reported concerning this framework includes: (1) a lack of alignment between the models in the twenty-six cases, because each case is presented in a separate document without a formal alignment ; (2) a formal definition, meta-model or ontology in order to define the semantics of the concepts ; (3) and the static vision of the time which is the subject of a particular modelling which did not differentiate the present situation (As Is) and the future (To Be) for the evolution of the organizations. However, the Zachman framework has inspired many other subsequent EA frameworks, such as the TOGAF or the FEA framework (Bui, 2012).

1.1.2 The Open Group Architecture Framework

The Open Group Architecture Framework (TOGAF) was introduced to the public by The Open Group in 1995 and based on the Technical Architecture Framework for Information Management (TAFIM) of the U.S. Department of Defense. TOGAF is "*a detailed method and a set of supporting tools*" (Van, 2011) that can be used to develop or apply EA. It is a detailed method and a set of supporting tools for developing EA. The core of the TOGAF framework is an Architectural Development Method (ADM), a step-by-step approach to develop (Bui, 2012).

The TOGAF Standard (2011) has a well-defined common vocabulary, compliant products, and recommended standards to assist the process of EA implementation. This framework provides: (1) a good guidance in the methodology process with consistent documentation (2) the possibility to adapt the methodology process (3) a link between all the models and the steps of the methodology process (4) the possibility to guide the tools selection through the needs, instead of the imposition of specific tools. Some limitations reported concerning this framework includes: (1) a lack of architecture integration (2) a lack of formal recommendations concerning the choice of consultants, tools and modelling technic (3) a lack of documentation and appropriate methodology process in order to guide the strategic or organizational alignment (Tamm et al., 2011).

1.1.3 The Department of Defense Architecture Framework

The Department of Defense Architecture Framework (DoDAF) started in 1990 under the name Command, Control, Communications, Computers, and Intelligence (C4ISR). "*DoDAF is the overarching, comprehensive framework and conceptual model enabling the development of architectures to facilitate the ability of Department of Defense managers at all levels to make key decisions more effectively through organized information sharing across the Department*" (US Department of Defense, 2010). It was built on three particular sets of views including the operation, the system and the technical standards. In addition to the previous views there is a fourth view, which is the « all view » that plays the role of a dictionary used to define the terms and to provide the context, the summary, or the overview-level information (Urbaczewski & Mrdalj, 2006).

DoDAF is used to visualize and understand the architectural complexities using simple tables, text, and graphics (Cameron & Mcmillan, 2013). This framework provides the descriptions of final products, as well as the guidance and the rules for consistency. It ensures a common denominator for comparing and integrating families of systems or systems of systems, and for interoperating and interacting architectures.

1.1.4 Federal Enterprise Architecture Framework (FEAF)

Federal Enterprise Architecture Framework (FEAF) was developed by the US Chief Information Officers (CIO) Council. Some authors indicate that it was developed in 1990 (Cameron & Mcmillan, 2013) while some others indicate 1998 (Bui, 2012). However, this framework is focused on the integration of various disparate architectures that exist in several US federal agencies, in order to optimize the service for the customers and the people by enabling them to access better, faster and in a more cost-effective way the information. FEAF "*supports planning and decision-making through documentation and information that provides and abstracted view of an enterprise at various levels of scope and detail*" (US Federal Government, 2013).

FEA is characterized by (1) a segment or incremental approach focuses on developing architectures for major cross-cutting business areas (2) a set of reference models which provide taxonomy and ontology for IT resources (3) a categorization of the architectures into enterprise architecture, segment architecture, and solution architecture (4) the utilization of a performance improvement lifecycle that centers on architecture (results-oriented architecture) (5) and an assessment framework that assess the maturity of EA program (Urbaczewski & Mrdalj, 2006).

1.1.5 The Gartner Framework

The Gartner Framework's principles are the following : (1) a top-down discipline that has business strategy as trigger for business, information, and technology development (2) any solution that requires business, information, and technology components to interoperate in support of business capabilities (3) the development of a future state architecture before the current state is documented, as well as a road map to transform the current state to the future state architecture (4) architecting is only a small part of the job, and the good architect needs also strategizing, communicating, leading and governing (4) EA is not the end in itself, but it is one of several strategic planning disciplines that organizations should practice to align their technology with their business strategy (Urbaczewski & Mrdalj, 2006).

Gartner's EA method does not have a concrete guidance like the other frameworks. It contains any taxonomy and its methodology is flexible depending on the needs of its clients. Instead, it operates on several EA principles and work with its clients to develop a framework that fit their needs. It focuses on a good governance structure to develop and link EA with other strategic initiatives.

In addition to the previous frameworks, there are a number of other frameworks, such as the Treasury Enterprise Architecture Framework (TEAF) (Urbaczewski & Mrdalj, 2006) and the CISR Framework (Bui, 2012). The frameworks presented previously are amongst the most popular EA frameworks. Academia and practitioners usually provide comparisons between the

fundamental elements of the EA frameworks, including their goals, inputs and outcomes (Cameron & Mcmillan, 2013). In fact, the main observation that the comparisons of the EA frameworks provide is that their methodologies are quite different from each other, in both the goals and the approaches. For example, some frameworks propose guidelines, while others provide specific methodologies and aspects to follow (Urbaczewski & Mrdalj, 2006). The best choice for many organizations is the mix of many frameworks (hybrid approach), in a way that works well (Sessions, 2007). In this case, each framework is used for a specific and particular aspect or benefit. For example, according to the 146 responses of the survey conducted in (Cameron & Mcmillan, 2013), 54% of 263 respondents describe their organization's EA framework approach as hybrid. The TOGAF Standard elements are mainly used as a process for building the technology layer, the Zachman for taxonomy, the Gartner for business architecture, the FEAF for reference models and segment architecture, and the DoDAF for governance (Cameron & Mcmillan, 2013).

1.2 Research Problem and Justification

Despite growing interest in the discipline of EA around the world in recent years, this field suffers from a lack of common understanding. Table 1.1 shows how some authors have described this lack.

Table 1.1 Expression of the lack of common understanding in the discipline of EA

Description	Reference
Lack of 'common terminology' and publication findings based on interpretation of implicit statements, rather than on 'scientific evidence.'	(Schöenherr, 2008)
Lack of 'shared meaning' and the existence of 'a plethora of terminology'. Existence of many ways to approach EA.	(Lapalme, 2012)
Lack of 'shared vocabulary' and 'a consensus definition.' The discourse is still rather incoherent and fragmented.	(Korhonen & Poutanen, 2013)
Lack of 'common understanding' and 'methodological consistency.'	(Simon et al., 2013)
Lack of 'common definitions' and 'perspectives' and the existence of many schools of thought.	(Federation of Enterprise Architecture Professional Organizations, 2013)
Lack of 'shared meaning' and 'interpretation.'	(Preez et al., 2014)
Lack of 'shared understanding' of organizational applications.	(Rahimi, Gøtze, & Møller, 2017)

In fact, there are various definitions of EA itself in the literature and there is an absence of agreement on these definitions (Mentz, Kotzé, & Van der Merwe, 2012) ; (Bidan, Rowe, & Truex, 2012) ; (Korhonen & Poutanen, 2013). Additionally, there is fragmented knowledge in the literature concerning the successful application of the discipline of EA and its real outcomes (Lange, Mendling, Recker, Lange, & Mendling, 2016).

Consequently, many negative impacts related to the various ways to approach EA in the literature avoid this discipline becoming more mature as a "generally accepted" profession or as a "legally recognized" field (Walrad et al., 2014). For example, confusion concerning the responsibilities of EA practitioners can occur as a negative impact, especially when EA team members are not aware of the underlying perspectives behind the different meanings of EA. Such a situation can also prevent co-operation and collaboration between EA practitioners, stakeholders and other participants and even conflicts can occur. Without shared meaning and

common foundations, universal training can also be difficult to be offered in the discipline of EA.

Several studies have mentioned the lack of common understanding in the discipline of EA and have discussed regarding its negative impacts, even if it is not their primary focus. But only a few studies have conducted a deep analysis on the lack of common understanding in the discipline of EA (Doucet, Gotze, Saha, & Bernard, 2008) ; (Lapalme, 2012) ; (Korhonen & Poutanen, 2013) ; (Preez, Merwe, & Matthee, 2014). Those studies offer relevant insights on the extent of this lack by identifying and describing the major EA schools of thought. But these studies did not apply a rigorous methodology to conduct their analysis and support their findings and interpretations, and then have methodological limitations. Consequently, there is still a need for deeper investigation of the lack of common understanding in EA. And this thesis aims exactly to fill this gap.

1.3 Related Work

Only a few works were conducted with the aim to shed light on the lack of common understanding in the discipline of EA, whereas the literature frequently continues to report this lack. In fact, the literature of EA is much more focused on the operational side while the structural side of the discipline seems to be neglected. In other words, most of the studies are focused on building and evaluating frameworks, models and design. For example, a few formal Systematic Mapping Studies (SMS) and Systematic Literature Reviews (SLR) exist on EA. However, the following works are among the few studies which have tried to evaluate the general evolution of the whole discipline of EA or a specific aspect of this discipline through the analysis of its literature.

(Simon et al., 2013) conducted a state-of-the-art review from 1987 to 2010 in order to investigate the collaboration of scholars in EA management via co-authorships and its impact on the diffusion of their contributions. Their study also investigated the main EA research

streams, their interlink and the major works to be assigned to these streams. Additionally, their study investigated the focus concerning specific dimensions of EA research content (layer, methodology, task, lifecycle). Their findings have supported that "*a common EA definition and consistent EA terminology are still far from being a reality*".

(Carneiro Ramos & de Sousa Jr., 2015) used bibliographic analysis standard tools to study EA within the public administration from 1999 to 2014, and investigated the publishers and their subject areas, the authors of the publication, the correlations among the keywords, the definitions of EA in public administration, government EA programs around the world, and so on. Their findings have supported that there are various terms to designate EA in the literature, as well as various definitions, including "*those which are focusing on organization activities and those which are focusing on the technical scope of organization*".

(Rasti, Raouf Khayami, & Sanatnama, 2015) conducted a systematic literature review on EA in the public sector from 2005 to 2014, which investigated the main topics of the EA publications, their themes, their geographical distribution, the research methods used, and the number of citations. Their study proposes a framework to analyze EA research topic through eight categories, including: "*overview, usage, modelling, framework, security, management, evaluation and service oriented architecture*". Their findings have confirmed there is an increasing interest in the discipline of EA over the years, especially on the categories modelling and usage, while there is less attention to the categories management, security and evaluation.

(Dang & Pekkola, 2017) conducted a general systematic literature review on EA from 2000 to 2015 which investigated the publishers of the papers and their topic, the authors and the country of their affiliated organizations. Their study supports that there is no globally agreed definition of EA which is often understood as "*a taxonomy, a methodology, a master plan, or these three simultaneously*". Their findings have shown there is no single strong research stream on EA in the public sector, and consequently there is insufficient knowledge on "*EA development, implementation or adaptation, their challenges and best practices*".

As part of the previous studies which present some findings related to the lack of common understanding in the discipline of EA found through the analysis of the literature, the next sections present the major works which have mainly focused on this lack. These studies have conducted a deep analysis on the extent of this lack by identifying and describing the characteristics of the major EA schools of thought.

(Doucet, Gotze, Saha, & Bernard, 2008) analyzed the evolution of EA in organization and stated that current EA tends to reduce itself to Information Technology, at times with a strong business focus while EA is in reality much more than that. Their study proposed a taxonomy of EA including three independent but not mutually exclusive modes or concepts which are: "*Foundation Architecture, Extended Architecture, and Embedded Architecture*", and represent a progression in thought and practice of EA. Their findings provided a matrix that shows the distinguishing characteristics of the three modes, including the strategic drivers (why to conduct, apply… EA?), the locus of control (who leads EA program?), the metrics (how EA is measured?), and the benefits and outcomes (what does EA provide?) of each mode.

(Lapalme, 2012) conducted a literature review and stated that there is a plethora of terminology and a lack of shared meaning in the discipline of EA. Its study proposed three major schools of thought underlying the literature on EA, including "*the Enterprise IT Architecting school, the Enterprise Integrating school, and the Enterprise Ecological Adaptation school*". Its findings provided a matrix showing the differences between the three schools of thought through the description of their characteristics, such as their motto, objectives, concerns, principles and assumptions, skills, challenge, insights, and limitations.

Based on the three modes of EA (Doucet et al., 2008), the previous three schools of thought (Lapalme, 2012), and other ontological and epistemological assumptions, (Korhonen & Poutanen, 2013) reviewed the existing EA typology and stated that the discipline of EA is still immature and incoherent, and its literature is rather fragmented and lacking a shared vocabulary. Their study confirmed that a tripartite approach to EA exists and then architectural work should be separated into three different interlinked architectures, including "*the technical,*

the socio-technical, and the ecosystemic architectures". Their findings provided information showing the differences between the three architectures which each have their own scope and require their own methods and tools.

(Preez et al., 2014) conducted a survey with EA authors, practitioners, academics, and consultants, and reaffirmed the existence of the previous three EA schools of thought (Lapalme, 2012). Their study also identifies an additional four schools of thought, and then presented a total of seven major schools of thought in the discipline of EA. Their findings provided the characteristics of each of the identified schools of thought through the description of their characteristics, such as their motto, objectives, concerns, principles and assumptions, skills, challenge, insights, and limitations.

However, as indicated previously, none of the major works which have mainly focused on the lack of common understanding in the discipline of EA applied a rigorous methodology to conduct their analysis and support their findings and interpretations. For example, (Doucet et al., 2008) only presented the three modes of EA without indicating where they come from. In the same line of ideas, (Lapalme, 2012) proposed a short list of authors who correspond to each of the three schools of thought on EA but did not provide enough information concerning the literature review process. Also, (Korhonen & Poutanen, 2013) indicated that each of the three interlinked architectures is based on different ontological and epistemological assumptions, but did not provide information concerning their correspondence to the EA literature or practice, nor the analysis process. Finally, (Preez et al., 2014) conducted a survey which is biased because it asked respondents to answer following existing EA frameworks, models, and maturity stages, without taking into account the underlying assumptions behind these frameworks and models. Consequently, there is still a need for deeper investigation of the lack of common understanding in EA. And this thesis aims exactly to fill this gap.

CHAPTER 2

RESEARCH APPROACH AND ORGANIZATION OF DOCUMENT

2.1 Introduction

This thesis is conducted with the objective to satisfy the need for deeper investigation of the existing lack of common understanding in the discipline of EA in using well-known scientific methods which can ensure the validity and reliability of the findings. To achieve this objective, this thesis is subdivided in three complementary studies which treat each a specific aspect of the lack of common understanding in the discipline of EA. This structure provides better possibility to explore the extent of the lack of common understanding in the discipline of EA because the findings of each study informs the next one, hence building on each other. The next sections introduce these three complementary studies conducted in this thesis and justify their relevance.

2.2 Objectives and Research Questions of the First Study

The first study intends to identify and classify some major elements that might influence the lack of common understanding in the discipline of EA. These elements include for example the extent of the focus of authors/researchers on EA, the sectors in which they are evolving, the academic disciplines in which they have studied, the countries where their affiliated organizations are located, the subject areas of the journals/publishers of their publications, and the way they have approached EA and its practitioners.

To achieve this purpose, this study conducts a Systematic Mapping Study (SMS) using articles published from 1990 to mid-2018 in major engineering, computer science, and management journals. The research question addressed in this study concerns three main aspects including "the people who have conducted research, written publications or published in EA", "the

country where their affiliate organization have been located" and "the focus of the EA publications". This research question is formulated as follows:

"Who" has published in the EA literature? "Where" is their affiliate organization located? "What" are their publications about; and how the characteristics of the three previous aspects of the EA literature might influence the existing lack of common understanding in the discipline of EA?

A first version of this study which analyzed 171 EA publications from 1990 to 2015 was presented and published in the 2016 IEEE 20th International enterprise distributed object computing workshop (Saint-Louis & Lapalme, 2016). A final version which analyzed 257 EA publications from 1990 to mid-2018 has been submitted to a journal and was accepted for publication.

2.3 Objectives and Research Questions of the Second Study

The second study intends to analyze the explicit EA definitions extracted in major engineering, computer science, and management journals in order to identify and classify their different parts and provide clarifications concerning the extent of their differences.

To achieve this purpose, this study conducts a Systematic Literature Review (SLR) using concepts from the academic field of terminology and thematic analysis techniques. The definitions are subdivided into several similar parts in order to analyze them in depth and compare them before making generalizations. The research question addressed in this study concerns a specific aspect related to the differences between the EA definitions and the characteristics of their differences. This research question is formulated as follows:

"What is the extent of the differences between definitions of EA and how can these differences be characterized?"

A first version of this study which analyzed 145 explicit EA definitions was presented and published in the 2016 IEEE 21th International enterprise distributed object computing workshop (Saint-Louis, Morency, & Lapalme, 2017). A final version which analyzed 160 explicit EA definitions has been submitted to a journal and is under review process.

2.4 Objectives and Research Questions of the Third Study

The third study intends to identify and characterize the EA practitioners' major worldviews regarding the organizations and the people within them and compare them with existing EA belief typologies.

To achieve this purpose, an opinion survey is conducted according to models from systems thinking, particularly the world hypotheses, the system of systems methodologies, and the Cynefin framework. Exploratory data analysis techniques, particularly multiple correspondence analysis and hierarchical clustering analysis, are used to analyze the data collected. The research question addressed in this study concerns the opinions, beliefs, and conceptions of professionals practicing EA regarding what an organization is, how the agreement between the members of an organization is, and how an EA function might conduct its work. This research question is formulated as follows:

"What are the major worldviews of professional practicing EA and the relationships between them?".

A version of this study which surveyed 73 EA practitioners has been submitted to a journal and is under review process.

2.5 Research Contribution

This thesis conducted three complimentary studies to address a problem which has not been studied clearly yet, which is the lack of common understanding in the discipline of EA. Consequently this thesis is an exploratory study which aims to "*gather preliminary information that will help define a more precise problem and suggest hypotheses*"(Babbie, 2007) and "*establish priorities, develops operational definitions and improve the final research design*" (Shields & Rangarjan, 2013).

Given the fundamental nature of this thesis which is an exploratory study, its main scientific contribution is to provide significant insights and indications concerning "what" the lack of common understanding in the discipline of EA is (aspects), "why" this lack has existed (characteristics), and "how" this lack is manifested (impacts). Specifically, each of the three studies conducted in this thesis brings a particular contribution according to its objective, as presented in the next section.

In terms of scientific contributions, this thesis provides:

- more structured knowledge that helps to identify and categorize potential factors contributing to the differences in the EA literature (study 1);
- a relevant demonstration of applying the mapping study (study 1);
- more structured knowledge that helps to identify and categorize potential factors contributing to the differences in the EA definitions (study 2);
- the application of a novel analysis approach, guided by linguistics models, to analyze EA definitions (study 2);
- more structured knowledge that helps to identify and categorize many potential concepts that distinguishes EA practitioners' worldviews (study 3);
- a novel analysis approach of categorizing worldviews, via the strategy to create the survey questionnaire, to organize the responses, and to apply exploratory data analysis techniques to analyze them (study 3);

- more structured knowledge that helps to conduct forward investigations (studies 1, 2 and 3).

In summary, the findings of this thesis come from the application of well-known methodology design and techniques. These findings contribute to a better knowledge of the lack of common understanding in the discipline of EA and provide a better possibility to deal with this lack, as implication for practitioners. These findings also provide relevant directions to researchers for future studies concerning this topic or using the methodological design and techniques applied. For example, these findings may help practitioners identify EA worldviews with which they may find it appropriate to work. These findings may also help the EA practice community to be more tolerant and open to all EA practitioners, even if their worldviews are different than others. And these findings may help researchers find appropriate publications or methodological strategies for future research.

CHAPTER 3

AN EXPLORATION OF THE MANY WAYS TO APPROACH THE DISCIPLINE OF ENTERPRISE ARCHITECTURE

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3.1 Introduction

Contemporary organizations regularly encounter challenges meeting their Information Technology (IT) needs, be it a simple tool with which to save and organize data, an indispensable strategic and competitive weapon, or unique routine administrative tasks, such as decision-making that needs fulfilling (Hugoson et al., 2011). According to some researchers, Enterprise Architecture (EA) is the discipline and practice that emerged in order to help organizations meet these challenges (Federation of Enterprise Architecture Professional Organizations, 2013) in order to survive in an increasingly dynamic environment full of interruptions and change.

EA has generated growing interest in recent years, as shown by the numerous scientific articles published by EA researchers and practitioners, EA conferences organized around the world, and new frameworks built to improve EA practice. But researchers and practitioners have described a serious lack of common understanding in EA. This study intends to identify the elements in the literature that can play a role in this challenge that EA is facing. To achieve this objective, this article systematically selected and reviewed the EA literature by following a few research questions.

The research problem and literature review are presented in section 2. Section 3 presents the research questions and the methods applied to examine these questions. The results and their discussions are presented in sections 4, 5 and 6. And sections 7 and 8 present some discussions concerning the findings and useful directions for future work.

3.2 Background

EA literature lacks uniformity of definition as well as a description of the term 'enterprise architecture' itself (Mentz et al., 2012). The definitions of EA vary in terms of 'scope and purpose' (Lapalme, 2012). This situation can create misunderstanding and conflict regarding the role and responsibility of professionals practicing EA, especially when EA team members are not thoroughly conscious of the extent of the lack of common understanding in EA. It can also be hard to collaborate with stakeholders and other participants in such situations. Similarly, this makes it hard to provide standard and universal training to future EA practitioners. EA researchers can face difficulty effectively sharing their findings and generally being understood.

Such problems represent a few complications experienced by researchers and practitioners. This is why some have reported that EA is an '*immature practice'* (Preez et al., 2014) ; (Simon, Fischbach, & Schoder, 2014) suffering from a '*lack of common terminology*' (Schöenherr, 2008) and '*shared meaning*' (Lapalme, 2012), and EA literature is facing a challenge of '*fragmented discourse*' (Korhonen & Poutanen, 2013). As a matter of fact, this issue concerning the terminological differences in EA has been mentioned in the publications of many researchers, even if it is not the main focus of their work. Others have investigated this issue more thoroughly and came to more accurate conclusions. To achieve this, they reviewed and analyzed the EA literature and surveyed researchers and practitioners (Simon et al., 2014); (Carneiro Ramos & de Sousa Jr., 2015) ; (Mykhashchuk et al., 2011). In a similar way of identifying various terminology and perspectives in EA, some previous works affirm the existence of 3 *schools of thought* in EA (Lapalme, 2012). This work has compared EA to an

Indian parable which describes how 6 blind men who touched an elephant for the first time perceived it very differently— depending on the part of the body they happened to touch. This comparison contributes to awareness-raising conversations concerning the various ways of approaching EA, and therefore allows for the opportunity for EA to become more mature as a field through the establishment of a common structure.

Even though a large number of studies have mentioned this lack of common understanding in EA, only a few of them have realized a deeper investigation of the problem and employed a rigorous methodology to conduct their analysis (Federation of Enterprise Architecture Professional Organizations, 2013) ; (Schöenherr, 2008) ; (Lapalme, 2012) ; (Korhonen & Poutanen, 2013) ; (Preez et al., 2014). A few formal Systematic Mapping Studies (SMS) and Systematic Literature Reviews (SLR) also exist on EA. Moreover, the rest of this section presents some existing literature reviews on EA.

In fact, (Simon et al., 2013) conducted a state-of-the-art review from 1987 to 2010 in order to investigate the collaboration of scholars in EA management via co-authorships and its impact on the diffusion of their contributions. They also investigated the main EA research streams, their inter-link and the major works to be assigned to these streams. And finally, they investigated the focus concerning specific dimensions of EA research content (layer, methodology, task, lifecycle).

On the other hand, (Carneiro Ramos & de Sousa Jr., 2015) used bibliographic analysis standard tools to study EA within the public administration from 1999 to 2014, and investigated the publishers and their subject areas, the authors of the publication, the correlations among the keywords, the definitions of EA in public administration, government EA programs around the world, and so on.

On the other hand, (Rasti et al., 2015) conducted a systematic literature review on EA in the public sector from 2005 to 2014, which investigated the main topics of the EA publications, their themes, their geographical distribution, the research methods used, and the number of

citation.

On the other hand, (Dang & Pekkola, 2017) conducted a general systematic literature review on EA from 2000 to 2015 which investigated the publishers of the papers and their topic, the authors and the country of their affiliated organizations.

However, none of the previous literature reviews focused on the whole discipline of EA and its lack of common understanding. Consequently, there is a need for literature reviews which further our understanding of this lack. This investigation is intended as an input that might contribute to fill this gap (Saint-Louis & Lapalme, 2016), by conducting a Systematic Mapping Study (SMS) (B. A. Kitchenham, Budgen, & Pearl Brereton, 2011) using articles published from 1990 to mid-2018 in major engineering, computer science, and management journals.

3.3 Research method

3.3.1 Introduction to SMS

A frequent approach used to review and analyze literature in order to '*realize a complete overview of a research area*' is Systematic Mapping Study (SMS). SMS can contribute by finding '*whether research evidence exists or not'* (Kai Petersen, Feldt, Mujtaba, & Mattsson, 2008). When research evidence exists on a topic, SMS can also provide indicators of its reliability. The process involves performing a systematic classification of literature and its interpretation. The categories generated with this systematic classification are based on pertinent data that includes, for example, information concerning the authors and publications—*such as authors' names, authors' affiliations, authors' country, publication sources, publication type, and publication chronology*—and information concerning the research design and research techniques employed to conduct studies and generate the findings (B. A. Kitchenham et al., 2011). The outcome of an SMS provides mainly a complete list of

publications on the topic area investigated, presented in the form of classification where distinct categories are identifiable (Kai Petersen, Vakkalanka, & Kuzniarz, 2015).

Systematic Literature Review (SLR) is another methodology that has frequently been used to review and analyze the literature of a field in order to provide relevant directions for future investigations. But SMS and SLR do not analyze the literature in the same way. SMS can help to structure a research area, while SLR can help to gather and synthesize evidence (Kai Petersen et al., 2015). SMS frequently answer a large amount of research questions. For example, this study includes 9 research questions. To achieve this, SMS '*collects data from the literature with sufficient detail and summarizes them with respect to many defined categories,*' whereas SLR examines to what extent the research findings of each publication are consistent or inconsistent in order to '*answer only a few specific research questions*' (B. A. Kitchenham et al., 2011). However, the results of a previous SMS can be extremely useful in order to determine appropriate areas for conducting a relevant SLR (B. A. Kitchenham et al., 2011).

3.3.2 Motivation to Conduct an SMS

A systematic examination like SMS can greatly help identify elements from which the many ways to approach EA have originated, or simply the existing different ways to approach EA. In fact, the use of SMS as a rigorous methodology to conduct this study will enhance its data selection, its data extraction, and its analysis process. The use of SMS will also increase the reliability of this study's findings.

3.3.3 Definition of Research Questions

According to the guidelines of (B. A. Kitchenham et al., 2011) and (Kai Petersen et al., 2015), the first task of SMS is to '*define the research questions'.* The research questions indicate the

scope of the study and specify what aspect it takes or does not take into account (B. A. Kitchenham et al., 2011).

This SMS investigates the following 9 research questions, classified in 3 categories as enumerated in Table 3.1. The intent is to identify the different ways to approach EA, to investigate which characteristics contribute to the existence of these different ways to approach EA, and to understand how the EA community has become aware concerning this situation.

Table 3.1 Research questions and rationales

Category	#	Research Questions	Rationales
Who? Investigates information concerning people who have conducted research, wrote publications or published in EA.	RQ1	What is the publication intensity of EA researchers/authors ?	Explore how the intensity of publications of the researchers/authors can contribute to the lack of common understanding in the discipline of EA.
	RQ2	What is the occupation of E A researchers/authors ?	Explore how the spheres of activity of EA researchers/authors can contribute to the lack of common understanding in the discipline of
	RQ3	What are the patterns concerning the choice of publication venues ?	Explore how publishing choices and patterns about EA research can contribute to the lack of common understanding in the discipline of EA.
	RQ4	What are the academic disciplines in which EA researchers/authors have studied?	Explore how the background of EA researchers/authors can contribute to the lack of common understanding in the discipline of EA.
Where? Investigates information concerning the location of people who have conducted research and wrote publications in EA.	RQ5	Where are the affiliated organizations of main article authors located ?	Explore how the language and the country/continent where the affiliation organization of the authors is located can contribute to the lack of common understanding in the discipline of EA.
What? Investigates information concerning what the EA publications are about.	RQ6	What are the most common topics developed ?	Explore how topics of focus concerning EA publications can help identify factors that might influence the lack of common understanding in the discipline of
	RQ7	What perspectives on EA do the articles adopt?	Identify the different ways to approach EA in the literature, according to the overall context and focus in a given article.
	RQ8	What perspectives about EA professionals a represent ?	Identify the different ways to approach the professionals practicing EA, according to their mission, competence, and knowledge, as presented in the literature.
	RQ9	To what extent do authors/researchers discuss the lack of common understanding within EA discuss?	Understand how the EA community has become aware of the existence of multiple ways to approach EA and why shedding light on this challenge is urgent.

3.3.4 Conducting the Search for Primary Studies

The second task is to create a data search strategy that can help to '*identify and locate reliable data sources which can be used to extract the information to be analyzed* (B. A. Kitchenham et al., 2011) ; (Kai Petersen et al., 2015).'

Because this study intends to provide a broad view of the discipline of EA, all the publications corresponding to EA should be significant to be analyzed. With the objective to keep this research to a manageable size, only publications which explicitly mention EA or EA practitioners in their title were taken into account. The following search strings were appropriate to search publications:

'enterprise architecture' OR 'enterprise architectures' OR 'enterprise architect' OR 'enterprise architects' — in the Title.

Search was operated in the following electronic libraries: Compendex, Inspec, Scopus, IEEE, AIS and Google Scholar. These electronic libraries were considered because according to some previous searches, they are the libraries which have returned most of the major scientific publications with the article type selected and the search keywords used. They are also the libraries which are considered among the most relevant ones (Dybå, Dingsøyr, & Hanssen, 2007).

Table 3.2 presents the number of articles returned by each of the electronic libraries consulted. Google scholar was often consulted for additional search and to download the full text of the articles.

Table 3.2 Number of articles returned by the electronic libraries

Electronic library	Number of articles found	Particularity
Compendex	141	
Inspec	220	
Scopus	241	*Language: cannot be specified*
IEEE Xplore	16	*Language: cannot be specified* *Type : Journal & Magazine*
AIS electronic Library	135	*Language: cannot be specified* *Type : cannot be specified*
Google Scholar	458	*Language: cannot be specified*

3.3.5 Screening articles based on Inclusion/Exclusion Criteria

The third preoccupation of this SMS is to select only relevant data sources corresponding to the identified search strategy (B. A. Kitchenham et al., 2011) ; (Kai Petersen et al., 2015). In fact, the results of each digital library were exported into BibTex (.bib) files. Software usable for SLR and SMS (StArt) were used in order to upload these data. After examining the titles, abstracts, introduction and conclusions of the identified articles, duplicate articles, and articles without the aforementioned terms corresponding to EA research or practice were removed.

In addition, at the start, the articles selected were only those that were downloadable on the Internet with a license from the authors' affiliate libraries. However, other measures were also used when possible, in order to find copies of the articles, such as loans between university libraries and email contact with the authors of non-downloadable works.

With the objective to keep this research to a manageable size, '*researchers can search only a targeted set of publications as data sources, and then restrict themselves to only one (1) publication type for example*' (B. A. Kitchenham et al., 2011). This explains the choice to

select only Journal articles as data sources. Moreover, peer-reviewed articles were selected in order to stay focused on more professionally executed research.

Table 2.3 summarizes the complete criteria used in order to include the appropriate data sources before the search, and after reading the title, introduction, conclusion. The exclusion criteria correspond to the values that are different from those indicated in this table.

Because this study does not map a particular aspect on EA but aims to gather information concerning the lack of common understanding in the discipline of EA, all the journal articles available which have met the condition indicated in Table 3.3 were included and no quality assessment stage was conducted.

Table 3.3 Inclusion criteria

#	Criteria	Values for inclusion
1	Duplication	Non duplicate articles
2	Language	English
3	Publication date	From 1990 to 2016
4	Document type	Journal articles
5	Document access	Full-text downloadable on the Internet or sent from the authors, in a most common format like .doc or .pdf Or hard copies found via loans between university libraries
6	Correspondence	Studies corresponding to the field of discipline of Enterprise Architecture or its practitioners
7	Sources	Scientific publications (instead of practitioner contributions)
8	Format	Publications with citations and references (instead of marketing material)

3.3.6 Data extraction, Analysis and classification

Another important preoccupation of SMS is to ‘create a classification scheme’ (Kai Petersen et al., 2008). Capturing ‘the state of the art’ in EA practice and research is the objective of our scheme. Because this study intends to have findings which really describe the situation of EA, it was not important to create a predefined classification scheme. A multifaceted classification scheme was consequently developed gradually, depending on the characteristics of the data collected.

In fact, the first author read entirely each article at least once, during which relevant data were collected. Most of the data collected were extracted as found, without any specific interpretation, in a MS Excel spreadsheet, in order to be able to format them automatically and to create the corresponding categories. The first author classified each article and applied a test-retest approach. The final classification was formally discussed many times with the second author.

After the publication of a first version of this study, many modifications were made to improve the study, including additional articles were analyzed. The data extraction process was realized by another person in accordance with a data extraction protocol that includes the categories found in the previous version, as presented in Table 3.4.

Table 3.4 Summary of the data extraction protocol

#	Data extracted	Description	Source
1	ID	*A unique number used to identify each article.*	*Increase of 1 from the last assigned number*
2	Title	*The title of the article.*	*Information provided from the electronic libraries*
3	Authors	*The authors of the article.*	
4	Publication Year	*The year of publication of the article.*	
5	Journal	*The journal which has published the article.*	
6	Author affiliation	*The author's affiliation institution.*	
7	Publisher	*The publisher of the article.*	
8	Author sector	*The sector of activities where the authors evolved.*	*The "Author Affiliation" category is considered to determine this information.*
9	Academic disciplines	*The study area in which the 1st author has studied [when author sector is Academia].*	*The "Author Affiliation" category is considered to determine this information.*
10	Subject area	*The subject areas of the journal which have published the article.*	*The "Publisher" category is considered to find this information on the Internet.*
11	Country	*The country where the 1st author's affiliation institution is located.*	*This information is extracted from the article or the "Author affiliation" category is considered to find this information on the Internet.*
12	Continent	*The continent where the 1st author's affiliation institution is located.*	*The "Country" category is considered to determine this information.*
13	Language	*The first language of the country where the 1st author's affiliation institution is located.*	*The "Country" category is analyzed to determine this information.*
14	Topic	*The main topic addressed in the article.*	*The abstract, introduction, and conclusion of the article have been read and analyzed to determine this information. When this information cannot be found in the previous parts of the articles indicated, the whole article has been read.*

Table 3.4 Summary of the data extraction protocol (next)

#	Data extracted	Description	Source
15	EA presence	*Presence of Enterprise Architecture in the article. (Some articles include enterprise architecture only in their title)*	*Search with keywords such as: "enterprise architecture" and "ea" are conducted in the article to determine this information.*
16	EA definition	*Presence of explicit or implicit definitions of Enterprise Architecture (or derived explicit terms as Enterprise Architecture Management) in the article.*	
17	Notification of lack	*Presence of notification concerning the lack of common understanding and terminology in EA in the article.*	*The abstract, introduction, and conclusion of the article have been read and analyzed to determine this information. And/or Search with keywords such as: "common", "shared", "meaning", "definition", "lack", "understanding", "terminology", "agreement"… are conducted in the article to determine this information.*
18	Other denominations of EA	*Other terms used to designate EA in the article.*	*The abstract, introduction, and conclusion of the article have been read and analyzed to determine this information. When this information cannot be found in the previous parts of the articles indicated, the whole article has been read.*
19	EA focus	*The focus of EA as presented in the article.*	
20	EA practitioner	*The way to approach the practice of EA.*	*The "EA Focus" category is considered to determine this information. The abstract, introduction, and conclusion of the article have been read and analyzed to determine this information. When this information cannot be found in the previous parts of the articles indicated, the whole article has been read.*

The last task of this SMS — without considering the report — is to '*analyze and interpret the data extracted*' in the articles (B. A. Kitchenham et al., 2011) ; (Kai Petersen et al., 2015). As can be seen in the column source of Table 3.4, the data extraction of certain information to

collect required some analysis and attribution to a category. Furthermore, after collecting all the necessary information, various processes of data processing, such as validation, sorting, analysis, and classification were applied in order to summarize the data collected. In the next sections we present the different categories found, their occurrences, and their similarity/dissimilarity compared to the other categories.

3.3.7 Validity evaluation

In terms of descriptive validity, the data extraction protocol used to extract and derive data from the articles allow the data extraction process to be objective because this process can be always reexamined.

In terms of theoretical validity, appropriate studies could not be identified during the search for primary studies (Kai Petersen et al., 2015). To reduce the number of articles that have been missed, an additional search was conducted. In fact, few SMS exists on EA, yet it was not possible to compare the articles identified for this mapping study to others. But it was possible to compare these articles to those identified for an SLR which intended to summarize the existing work done in EA from 2005 to 2014, found with the strings “enterprise architecture” either in the title, abstract or keywords. However, eight new articles — found in (Rasti et al., 2015), in which an SLR intended to summarize the existing work done in EA from 2005 to 2014, — were added in the current study. Another strategy to reduce the bias was to conduct additional searches on Google Scholar and thus 10 articles were added. As a result, 257 articles were selected for examination. Table 3.5 presents the number of articles selected at each phase of the selection process.

Table 3.5 Evolution of the number of articles selected

Step	**Number of articles added**	**Number of articles removed**
Search	279	
Application of the inclusion/exclusion criteria		11
Document access		21
Validity evaluation	19	
Data extraction		9
Total number of articles selected	257	

Concerning the validity of the data extraction process, the articles were classified individually by two persons, but their classification was then reviewed and discussed. The first author also applied a test-retest approach. Table 3.6 presents a publication timeline of the 257 articles selected for examination.

Table 3.6 Publication timeline of the articles selected for examination

Year	References
2018	(Franke, Cohen, & Sigholm, 2018), (Alzoubi, Gill, & Moulton, 2018), (Zhang, Chen, & Luo, 2018), (Yamamoto, Olayan, & Morisaki, 2018), (Shaanika & Iyamu, 2018), (Wikusna, 2018), (Haghighathoseini, Bobarshad, & Sagha, 2018), (Graeme, Gloet, Someh, Frampton, & Tamm, 2018), (Masuda, Shirasak, Yamamoto, & Hardjono, 2018)
2017	(Rahimi et al., 2017), (Dang & Pekkola, 2017), (Nikpay, Ahmad, & Kia, 2017), (Bondar, Hsu, Pfouga, & Stjepandi, 2017), (Nikpay, Ahmad, Rouhani, Naz, & Shamshirband, 2017), (Karim, Demian, Anumba, & Baldwin, 2017), (Sjöberg, Ab, & Hause, 2017), (Vallerand, Lapalme, & Moïse, 2017), (Ariawan, Putra, & Sudarma, 2017), (Kotusev, 2017b), (Ruldeviyani, Wisnuwardhani, & Sucahyo, 2017), (E. I. Niemi & Pekkola, 2016), (Alshammari, 2017), (Bui, 2017), (Nogueira, Romero, Espadas, & Molina, 2013), (Alaeddini, 2017), (González-rojas, López, & Correal, 2017), (E. Niemi & Pekkola, 2017), (Martin, Emmenegger, & Hinkelmann, 2017), (Kotusev, 2017a), (Hazen, Bradley, Bell, In, & Byrd, 2017)
2016	(Hinkelmann et al., 2016), (Foorthuis, van Steenbergen, Brinkkemper, & Bruls, 2016), (Bernaert, Poels, Snoeck, & De Backer, 2016), (Sedivy & Borkovec, 2016), (Alwadain, Fielt, Korthaus, & Rosemann, 2015), (Lapalme et al., 2016), (Pia Närman, Johnson, & Gingnell, 2014), (Banaeianjahromi & Smolander, 2016), (Safari, Faraji, & Majidian, 2016), (Vargas, Boza, et al., 2016), (Dam, Lê, & Ghose, 2015), (Poorebrahimi, Razavi, & Razavi, 2016), (Vargas, Cuenca, Boza, Sacala, & Moisescu, 2016), (Lee, Oh, & Nam, 2016), (Behrouz & Fathollah, 2016), (Lange et al., 2016), (Azaliah, Bakar, Harihodin, & Kama, 2016), (Silva & Técnico, 2016), (Nam, Oh, Kim, Goo, & Khan, 2016), (Olsen & Trelsgård, 2016), (Lecturer & Lumpur, 2016), (Tow, Joseph, & Frank, 2006), (Dinis, 2016), (Eskandari & Nabiollahi, 2016), (Carter, Moorthy, & Walters, 2016)
2015	(Fasanghari, Amalnick, Taghipour Anvari, & Razmi, 2015), (Fritscher & Pigneur, 2015), (Carneiro, Sousa, Haussler Carneiro, & Timóteo de Sousa, 2015), (Kaushik & Raman, 2015), (Rouhani, Mahrin, Nikpay, Ahmad, & Nikfard, 2015), (Qumer Gill & Atif Qureshi, 2015), (Gill, 2015), (Rouhani, Mahrin, Shirazi, Nikpay, & Rouhani, 2015), (Ghatrei, 2015), (Muhammad & Khan, 2015), (Shaanika & Iyamu, 2015), (Bernus, Noran, & Molina, 2015), (Naranjo, Sanchez, & Villalobos, 2015), (Dokhanchi & Nazemi, 2015), (Rocha & Ferrugento, 2015), (Rijo, Martinho, & Ermida, 2015), (Candra, Erika, & Hudiarto, 2015), (Azevedo et al., 2015), (Vargas, Boza, Cuenca, & Ortiz, 2015)
2014	(Simon et al., 2014), (Barenji, Hashemipour, & Guerra-Zubiaga, 2015), (Alwadain, Fielt, Korthaus, & Rosemann, 2014), (Akhigbe, Amyot, & Richards, 2014), (Tambouris, Kaliva, Liaros, & Tarabanis, 2014), (Gomez, Sanchez, Florez, & Villalobos, 2014), (Per Närman, Buschle, & Ekstedt, 2014), (Gill, 2014), (Walrad et al., 2014), (Meyliana & Budiardjo, 2014), (Plataniotis, Kinderen, & Proper, 2014), (Shaanika & Iyamu, 2014), (Plataniotis, De Kinderen, & Proper, 2014), (Chelliah, 2014), (Pia Närman, Franke, König, Buschle, & Ekstedt, 2014), (Sajid & Ahsan, 2014), (Boone, Sarah, Bernaert, Maxime, Mertens, 2016), (Meyer & Helfert, 2014), (Chiprianov, Kermarrec, Rouvrais, & Simonin, 2014), (Iacob et al., 2014), (Ilin & Anisiforov, 2014), (Hazen, Hanna, & Hall, 2014), (Löhe & Legner, 2014), (Atasheneh, Harounabadi, & Mirabedini, 2014), (Hazen, Kung, Cegielski, & Jones-Farmer, 2014), (Cohen, 2014), (Pessi, Hugoson, Magoulas, & Hadzic, 2014), (Aier, 2014), (Bijarchian & Ali, 2014), (Farwick, Schweda, Breu, & Hanschke, 2014), (Houser, 2014), (Lawall, Schaller, & Reichelt, 2014), (Carter, Moorthy, & Walters, 2014)
2013	(Federation of Enterprise Architecture Professional Organizations, 2013), (Korhonen & Poutanen, 2013), (Simon et al., 2013), (Alwadain, Fielt, Korthaus, & Rosemann, 2013), (Fu-Sheng, Huan, & Yong, 2013), (Lehong, Dube, & Angelopoulos, 2013), (Berrada & Bounabat, 2013), (Sutherland, 2013), (Kandjani, Wen, & Bernus, 2013), (Rajabi, Minaei, & Ali Seyyedi, 2013), (Clarke, Hall, & Rapanotti, 2013), (Alaeddini & Salekfard, 2013), (Kamoun, 2013), (Helfert, Doucek, & Maryska, 2013), (Abraham, Tribolet, & Winter, 2013), (Per Närman, Holm, Ekstedt, & Honeth, 2013), (Marahel, Harounabadi, & Mirabedini, 2013), (Sembiring, Triono, & Sahri, 2013), (Zheng & Zheng, 2013),
2012	(Lapalme, 2012), (Mentz et al., 2012), (Zandi & Tavana, 2012), (Lakhdiss & Bounabat, 2012), (Rouhani & Nikpay, 2012), (Magoulas & Hadzic, 2012), (Quartel, Steen, & Lankhorst, 2012), (Holm, Buschle, Lagerström, & Ekstedt, 2012), (Burkett, 2012), (Janssen, Klievink, Janssen, & Klievink, 2012), (Najafi & Baraani, 2012), (Foorthuis, Hofman, Brinkkemper, & Bos, 2012), (Liu, Li, & Huang, 2012), (Rajabi & Abade, 2012), (H. A. Smith, Watson, & Sullivan, 2012), (Ali AlSoufi, 2012)

Table 3.6 Publication timeline of the articles selected for examination (next)

Year	References
2012	(Bradley, Pratt, Byrd, Outlay, & Wynn, 2012), (Scherer & Wimmer, 2012), (Tambouris, Zotou, Kalampokis, & Tarabanis, 2012), (Rodrigues & O'Neill, 2012), (Lê & Wegmann, 2013), (Rouhani & Kharazmi, 2012), (Medini & Bourey, 2012), (Janssen, 2012), (Kalampokis, Tarabanis, Tambouris, & Zotou, 2012), (Per Närman, Holm, Höök, Honeth, & Johnson, 2012), (Giachetti, 2012), (Alsoufi, 2012), (Cui & Weston, 2012), (Ali & Elnaz, 2012)
2011	(Hugoson et al., 2011), (Shah & Golder, 2011), (Razavi, Aliee, & Badie, 2011), (Marques, Borges, Sousa, & Pinho, 2011), (Kamogawa & Okada, 2011), (Per Närman et al., 2011), (Sasa & Krisper, 2011), (Engelsman, Quartel, Jonkers, & van Sinderen, 2011), (Tamm et al., 2011), (Mikaelian, Nightingale, Rhodes, & Hastings, 2011), (Glazner, 2011), (Khayami, 2011), (Rosen, 2011), (Bradley, Pratt, Byrd, & Simmons, 2011), (Dube & Dixit, 2011)
2010	(Zandi & Tavana, 2010), (Marich, Schooley, & Horan, 2010), (Kang, Lee, & Kim, 2010), (J. M. Harrell & Sage, 2010), (Kang, Lee, Choi, et al., 2010), (Bruls, Steenbergen, Foorthuis, Bos, & Brinkkemper, 2010), (Booch, 2010), (J. Harrell & Sage, 2010a), (Jahani, Javadein, & Jafari, 2010), (Ghani, Lee, Juhn, & Jeong, 2010), (Kamogawa, 2010), (J. Harrell & Sage, 2010b), (Rai, Venkatesh, Bala, & Lewis, 2010), (Iyamu, 2010)
2009	(Shirazi, Rouhani, & Shirazi, 2009), (Lagerström, Franke, Johnson, & Ullberg, 2009), (Khan & Gangavarapu, 2009), (Schuck, 2010), (P. Smith & Harris, 2009), (Gøtze, Christiansen, Mortensen, & Paszkowski, 2009), (Huang et al., 2009), (Velitchkov, 2009), (Kemp, 2009), (Mame De Vries & Van Rensburg, 2017)
2008	(Schöenherr, 2008), (Møller, Chaudhry, & Jørgensen, 2008), (M de Vries & van Rensburg, 2008), (Doucet et al., 2008), (Wilbanks, 2008)
2007	(Goudos, Peristeras, & Tarabanis, 2007), (Gammelgård, Simonsson, & Lindström, 2007), (Riempp & Gieffers-Ankel, 2007), (Chatterji, 2007), (Oster et al., 2007), (Chae, Choi, & Kim, 2007), (Johnson, Lagerström, Närman, & Simonsson, 2007), (Gregor, Hart, Martin, Gregor, & Hart, 2007), (Kummer, 2007), (Braun & Winter, 2007), (Hamlett, 2007), (Pulkkinen, Naumenko, & Luostarinen, 2007), (Goethals, Lemahieu, Snoeck, & Vandenbulcke, 2007), (Guijarro, 2007), (Shah & El Kourdi, 2007), (Strano & Rehmani, 2007), (Cardwell, 2007)
2006	(Lindström, Johnson, Johansson, Ekstedt, & Simonsson, 2006), (Wilkinson, 2006), (Konkol & Kiepuszewski, 2006), (Kambhampaty & Chandra, 2006), (Kozina, 2006), (Zuiderhoek, Otter, Bos, & Brinkkemper, 2006), (Garg, Kazman, & Chen, 2006), (Goethals, Snoeck, Lemahieu, & Vandenbulcke, 2006), (Balabko & Wegmann, 2006), (Rico, 2006), (Assimakopoulos & Riggas, 2006), (Kim et al., 2006), (Subramanian, Chung, & Song, 2006), (Jonkers et al., 2006), (Ylimäki & Halttunen, 2005), (Boh & Yellin, 2006), (Choi, Kang, Chae, & Kim, 2008)
2005	(Ohren, 2005), (Parsons, 2005), (Ylimäki & Halttunen, 2005)
2004	(Vassilios Peristeras & Tarabanis, 2004), (van Buuren, Jonkers, Iacob, & Strating, 2004), (Bellman & Rausch, 2004), (M. M. Lankhorst, 2004), (Hoogervorst, 2004), (North, North, & Benade, 2004), (Central, 2004), (Mohajerani & Moeini, 2004), (Jonkers, Lankhorst, Buuren, Hoppenbrouwers, & Bonsangue, 2004)
2003	(Noran, 2003), (Bernus, 2003), (Ribeiro-Justo & Karran, 2003), (Morganwalp & Sage, 2003)
2001	(F. J. Armour & Kaisler, 2001)
2000	(V Peristeras & Tarabanis, 2000), (Boster, Liu, & Thomas, 2000)
1999	(F. J. Armour, Kaisler, & Liu, 1999b), (Fingar, 1999), (F. J. Armour, Kaisler, & Liu, 1999a)
1997	(Zachman, 1997)
1990	(Richardson, Jackson, & Dickson, 1990)

In terms of repeatability, the current paper reports all the necessary details the SMS process followed, which will make possible a repeat of the study.

3.4 Findings

3.4.1 Contextualization of the findings

3.4.1.1 Distribution of the articles over the years

The 257 journal articles selected for examination were published over approximately 21 years, between 1990 and mid-2018. The year 2018 is absent in Figure 1 because the search was conducted in mid-2018, and so it was not possible to include all the EA journal articles published during this year. In effect, only 9 articles were found for this year.

The distribution of the articles, as presented in Figure 3.1, demonstrates an absence of publications for the years 1991 to 1996, 1998, and 2002. Compared with the number of published articles in other disciplines as new as EA, the number of EA articles published over the years is few. However, this graph is still useful as it shows how EA has gained interest over the years.

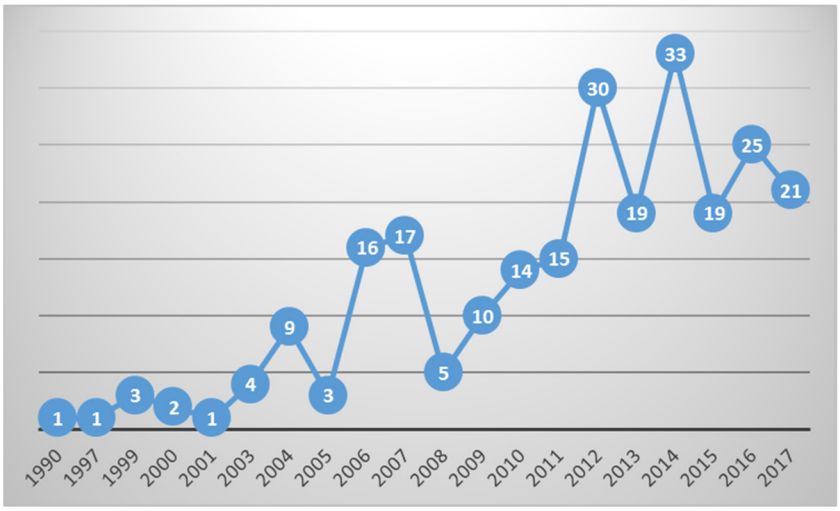

Figure 3.1 Journal article distribution by the publication year

3.4.2 Quantitative findings

3.4.2.1 What is the experience of EA researchers/authors?

Approximately 568 first and corresponding authors, including both researchers and practitioners, have contributed to the selected articles. Approximately 9% of these authors contributed between 3 and 7 articles, as presented in Table 3.7.

Table 3.7 List of authors who have contributed to more than 2 articles

#	Authors	Occurrence		#	Authors	Occurrence
1	Närman, Per	7				
2	Tarabanis, K.	7		26	Choi, Youngwan	3
3	Ekstedt, Mathias	6		27	Fielt, Erwin	3
4	Johnson, Pontus	6		28	Foorthuis, Ralph M.	3
5	Holm, Hannes	5		29	Franke, Ulrik	3
6	Kim, Kwangsoo	5		30	Harrell, J.M.	3
7	Nikpay, Fatemeh	5		31	Hazen, Benjamin T.	3
8	Rouhani, Babak Darvish	5		32	Hinkelmann, Knut	3
9	Brinkkemper, Sjaak	4		33	Kaisler, Stephen H.	3
10	Gill, Asif Qumer	4		34	Korthaus, Axel	3
11	Iyamu, Tiko	4		35	Lagerstrom, R.	3
12	Jonkers, Henk	4		36	Lapalme, James	3
13	Kang, Dongwoo	4		37	Lee, Jeongsoo	3
14	Lankhorst, Marc M.	4		38	Liu, Simon	3
15	Tambouris, E.	4		39	Magoulas, Thanos	3
16	Ahmad, Rodina Binti	3		40	Mahrin, Mohd Naz'ri	3
17	Alwadain, Ayed	3		41	Pekkola, Samuli	3
18	Armour, Frank J.	3		42	Peristeras, V.	3
19	Bernus, Peter	3		43	Pessi, Kalevi	3
20	Bos, Rik	3		44	Quartel, Dick A.C.	3
21	Boza, Andrés	3		45	Rosemann, Michael	3
22	Bradley, Randy V.	3		46	Sage, A.P.	3
23	Buschle, Markus	3		47	Shaanika, Irja	3
24	Byrd, Terry Anthony	3		48	Simonsson, M.	3
25	Chae, Heekwon	3		49	Snoeck, Monique	3

Approximately 65% of the authors published only one of the articles. It would seem then that EA literature lacks publications from experienced researchers in the discipline.

3.4.2.2 What is the occupation of EA researchers/authors?

Figure 3.2 presents the occupation of the authors.

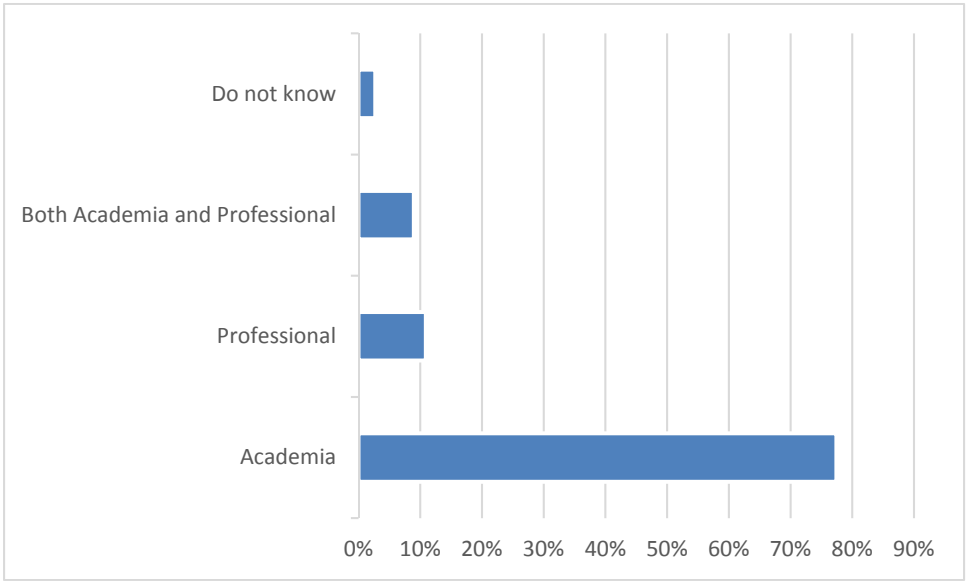

Figure 3.2 Occupation of the authors

As seen in Figure 3.2, approximately 77% of the first and corresponding authors of the articles are ‘students or professors’ who come from schools, universities, faculties, institutes, research centres or laboratories.

Approximately 11% of these authors are ‘professional practitioners’ who come from private or public organizations, such as research agencies, government agencies and consulting firms.

Approximately 9% of these authors of the articles come from ‘both professional organizations and academia institutions,’ and their research is based on partnerships between industry and academia.

Finally, because of a lack of information in the articles concerning the affiliation institution and no possibility of finding it on the Internet, the affiliation of 3% of these authors is considered as ‘unknown’.

A large majority of the articles selected derive from the academic world. This is to be expected because this study includes only scientific articles. But why have these articles presented many different ways to approach the discipline of EA as demonstrated in the following sections? It would seem then that EA lacks agreed references to follow in the academic world.

3.4.2.3 What is the focus of EA Publishers/Editors?

The selected articles were published across approximately 132 journals. Approximately 23 of these journals published 43% of the articles (as presented in Table 3.8) and represent the most significant publications, at 3 to 10 articles each. The editors and publishers of these journals include Taylor & Francis, Elsevier, Cutter Consortium, Springer Frontiers and IEEE, which are among the most well-known ones in the academic sector.

Journals may cover numerous subject areas. For example, one of the journals has 37 subject areas. The blank cells in Table 3.8 indicate cases in which it was not possible to find information concerning the subject area of the corresponding journal.

The classification of subject areas shows that a large majority of the journals correspond to subject areas related to Information Technology (i.e.: computer science). It would seem that EA lacks editors/publishers dedicated specifically to EA publications.

Table 3.8 List of Editors/Publishers that contributed to more than 2 articles

Journal	Publisher/Editor	Total	Subject Area
IT Professional Magazine (listed as "IT Professional")	IEEE Computer Society	11	Computer Science
Enterprise Information Systems - EIS	Taylor & Francis	10	Computer Science
Information Systems Frontiers	Frontiers	9	Computer Science
Software and Systems Modeling - SoSyM	Springer	8	Computer Science
			Mathematics
Lecture Notes in Business Information Processing	Springer	6	Business, Management and Accounting
Government Information Quarterly	Elsevier	6	Social Sciences
Information Systems and e-Business Management - ISeB	Springer	5	Computer Science
Communications of the Association for Information Systems	AIS Electronic Library	5	Computer Science
Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)	Springer	5	Computer Science
			Mathematics
Cutter IT Journal	Cutter Consortium	4	Computer Science
International Journal of Computer Integrated Manufacturing	Taylor & Francis	4	Computer Science
			Engineering
Expert Systems with Applications Journal	Elsevier	4	Computer Science
			Engineering
Information Knowledge Systems Management Journal	IOS Press	4	

Table 3.8 List of Editors/Publishers that contributed to more than 2 articles (next)

Journal	Publisher/Editor	Total	Subject Area
International Journal of Information System Modeling and Design	IGI Publishing	4	Business, Management and Accounting
			Computer Science
International Journal of Computer Science Issues - IJCSI	International Journal of Computer Science Issues – IJCSI	4	Computer Science
			Mathematics
Annual Reviews in Control Journal (listed as "Annual Reviews in Control")	Elsevier	3	Computer Science
			Engineering
Applied Soft Computing Journal	Elsevier	3	Computer Science
IFIP Advances in Information and Communication Technology	Springer	3	Decision Sciences
Journal of Object Technology	EtH Zurich	3	Computer Science
Journal of Systems and Software	Elsevier	3	Computer Science
MIS Quarterly Executive	Indiana University's Kelley School of Business	3	Economics, Econometrics and Finance
World Scientific and Engineering Academy and Society Journals	World Scientific and Engineering Academy and Society (WSEAS) Press	3	
International Journal of Advanced Manufacturing Technology	Springer	3	Computer Science
			Engineering

3.4.2.4 What are the academic disciplines in which EA researchers/authors have studied?

The first authors of 87% of the selected articles came from academia. When considering the department, faculty, institute or laboratory where they conducted the research published in these articles, three (3) main categories of study were identified.

- Information Technology (IT): this category includes articles which indicate that the first authors are studying in Information and Communication Technology. It also includes authors who is studying in corresponding fields, like Informatics, Information Systems, Software, Computer Science, or Computer Engineering;

- Social and Human science (SS): this category includes articles which indicate that the first authors are studying in social fields like Administration, Management, Business, Economics, Communication Logistics or Marketing;

- Specific area of engineering (SE): this category includes articles which indicate that the first authors are studying in a precise field of engineering different than Information Technology and its corresponding fields. Authors of this category are studying, for example, in Operation Research Mechanical, Electrical, System and Industrial. This category also includes the names of study that mixed several specific fields of engineering, like, Industrial Information, Supply Chain Management, Mines-Telecom and Control Systems;

The absence of enough information concerning the study area of the first authors of some articles was a reason to consider the following other categories in addition to the previous ones.

- Non-identified areas of engineering (E): this category includes articles which indicate that the first authors are studying in a general name of study that might refer to several other specialized engineering fields. Some examples of the names of study put in this

category are: the Faculty of Technology Engineering and Environment, the Faculty of Science and Engineering, the Department of Computer Science and Engineering and the Faculty of Technology and Engineering;

- Other (O): this category includes articles which indicate that the first authors are studying in a field different than IT, engineering and social sciences, as presented in the previous categories. This category includes 2 authors, one who is studying in a School of Medicine and the other in a Center of Forest Studies.

- Absent (ABS): this category includes articles which do not indicate enough interpretative information concerning the study area of the first authors. When this situation occurs, sometimes it is possible to find the study area of the authors on the Internet, in their other publications. But other times it is not possible to find this information.

Figure 3.3 presents the previous categories concerning the academic disciplines in which EA researchers/authors have studied, including a category N/A (non-applicable) for first authors who are not affiliated with an academic institution (professional) or when their sector of activities is absent.

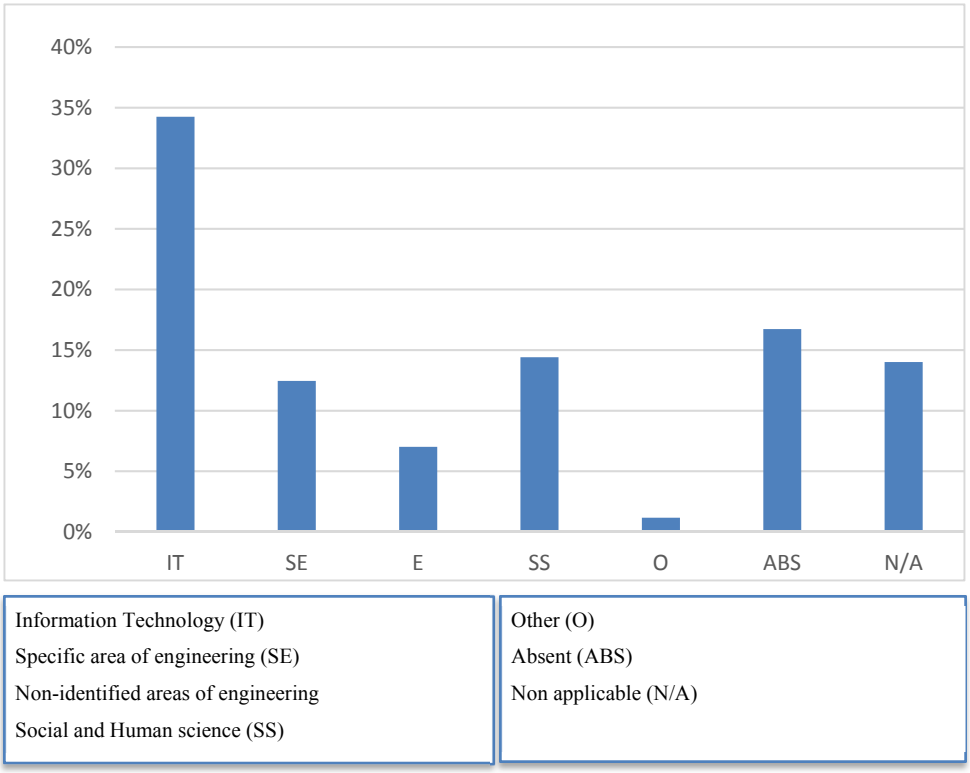

Figure 3.3 Academic disciplines in which EA researchers/authors have studied

3.4.2.5 Where are the affiliated organizations of the first EA researchers/authors located?

The article distribution by country of publication shows that the affiliated institutions of the first authors are located in 46 countries. This also shows that a large majority of the articles come from institutions located in Europe, which published approximately 48% of them. America (all of North America + South America) published 11% of the articles and Asia published 30%. Finally, Africa and Oceania published the smallest number of articles, with respectively 7% and 4%.

Table 3.9 presents the countries that published more than 2 articles between 1990 and 2018. The empty cells in this table mean there is no publication which corresponds to the matching

years and countries. This table also shows the increasing interest manifested in EA everywhere, with an accent in America and Europe. Particularly in the following countries: the USA, Iran, Australia, Sweden, and the Netherlands, which published approximately 46% of the selected articles.

When comparing these findings to the study area of the first authors, it shows that approximately 46% of the researchers who are studying in a Social Sciences area come from an academic institution located in Europe. In fact, European academic institutions seem to be showing more and more focus on this area of study.

Table 3.9 List of countries by publication occurrence

Country	Year / Occurrences																					
	1990	**1997**	**1999**	**2000**	**2001**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**Total**
USA	1		3	1	1		2	1	4	4	1	4	6	4	3		5		1	3		44
Iran							1					1	2	2	5	3	1	4	4	1	1	25
Australia						3				2				1	1	2	1	3	1	2	2	18
Sweden									1	2		1		2	3	1	4		1	1	1	17
Netherlands		1					4		1				1	1	4		1		1			14
South Korea									2	1	1		4						1			9
Malaysia															1		1	2	2	2		8
Germany										1					1	1	2		1	1		7
Greece							1		1	1					2		2					7
South Africa							1				1	1				1				2	1	7
Switzerland									1	1						1	2	1	1			7
Canada										1					2		1		1	1		6
Finland								1		1									1	3		6
Portugal														1	1			2	2			6
Belgium									1	1		1					1		1			5
China															2	2					1	5
Indonesia																1	1			2	1	5
Spain									1	1						1			2			5
United Kingdom						1				1				1	1	1						5
India									1					1			1	1				4
Japan													1	1							2	4
Saudi Arabia																1	1		1	1		4
Colombia																	1	1		1		3
Denmark											1	1								1		3

3.4.2.6 What are the most common topics addressed in the articles?

The title of an article is the first clue to the topics addressed in this article. In order to have a broader view of the topics addressed in the selected articles, the most repetitive single words in their titles were used to create the *word cloud* presented in Figure 3.4. From 'enterprise' at 268 occurrences, 'architecture' at 214 occurrences, to 'management' at 22 occurrences, and 'strategy' with 4 occurrences, this word cloud supports the previous hypothesis concerning the increasing interest of Social Science departments in EA. Especially when observing how some words related to management, like 'decision,' 'structures,' and 'strategy' are more and more present in the titles of the articles.

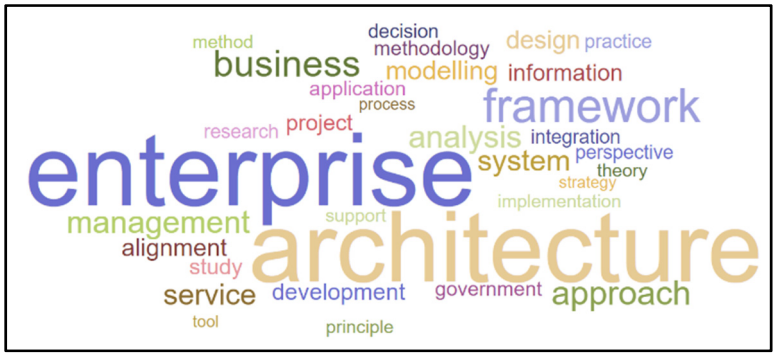

Figure 3.4 Word cloud with the titles of the articles

After reading and analyzing the abstract, introduction, and conclusion of the articles (at the very least) the following categories presented in Figure 3.5 were identified in accordance with the main topic addressed in each of them.

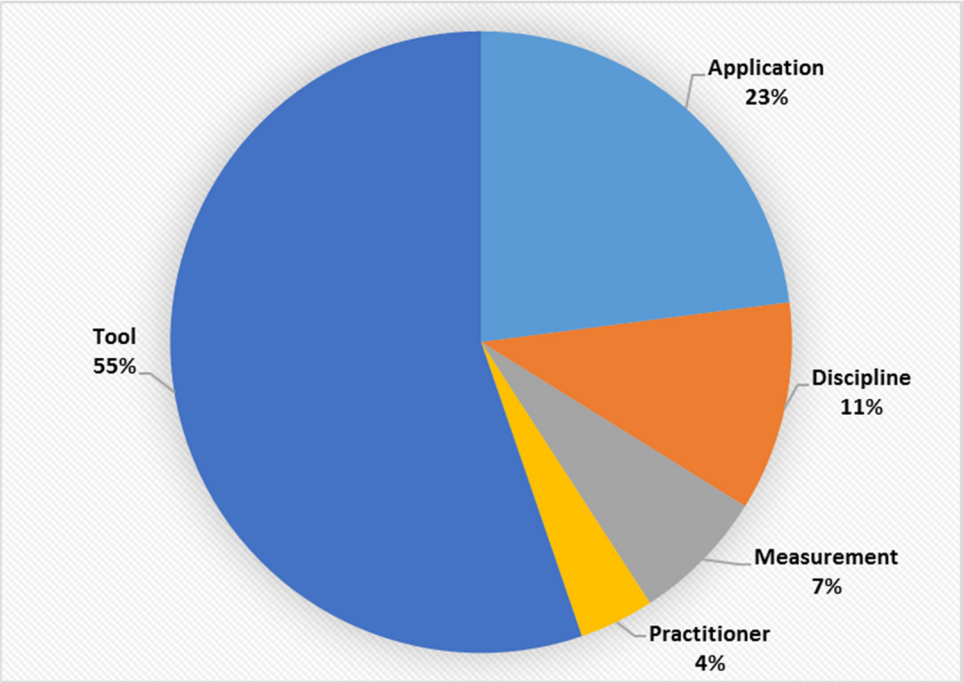

Figure 3.5 Topics addressed in the articles

EA-Tools: this category includes articles whose central aim is to study the tools developed for EA-professional to achieve EA objectives, and the tools developed for an organization according to an EA approach. The particular contexts that compose this category are focused on descriptions, languages, patterns, and architecture modelling. Some EA-models and EA-Frameworks have also been developed or evaluated in this category.

EA-Application: this category includes articles in which the central aim is to describe a specific use of EA which accomplishes a beneficial activity for the progress of an organization. It also includes articles whose objective is to provide a group of specific steps to follow when an EA strategy must be built, controlled and maintained. The particular contexts that compose this category are focused on the principles that guarantee a successful application of EA, the

maturity of EA practice, findings of how to get the most value from EA, and successful decision-making.

EA-Discipline: this category includes articles whose central aim is to describe EA as a discipline and a practice in order to make its importance clear. In fact, the particular contexts that compose this category are focused on EA practice, challenges, roles, benefits, and comparison to other fields. Some other articles of this category addressed the steps required to help EA become a recognized profession. In this category, many other publications have been reviewed to analyze and summarize the EA literature. The present article can be classified into this category.

EA-Measurement: this category includes articles whose central aim is to evaluate and demonstrated the performance and maturity of EA. In fact, the particular contexts that compose this category are focused on aligning business and IT, compliance, return on investment, and long-term financial improvement capabilities.

EA-Practitioner: this category includes articles whose central aim is to highlight the mission and role of EA-practitioners. The particular contexts that compose this category are focused on exploring the development and improvement of EA skills, and the strategies applied to achieve their mission.

This section shows how the EA community is focused on studying the development of new tools, and the optimization and analysis of existing tools (frameworks, models…).

3.4.3 Qualitative findings

3.4.3.1 How do the articles approach Enterprise Architecture?

Approximately 18% of the articles contain the term 'Enterprise Architecture' only in their title. Many of the articles explicitly used other terms to designate EA, like Information Technology, Information Systems Research, Organizational Modelling, Enterprise System Architecture, Architectural Approach, and Enterprise Computing.

Many of the selected articles do not include any explicit or implicit EA definition. Researchers start talking directly about EA in these articles as if EA is a standard discipline, words, or term that everyone is supposed to understand the established meaning of. Others of the selected articles do not provide personal definitions of EA but define it with one or several reference citations. Finally, just a few of the selected articles provide personal definitions of EA composed by the authors themselves, with their own words.

The significant importance of definitions in the identification of a discipline cannot ever be understated. In fact, the first question practitioners or researchers naturally ask whenever they engage with a subject for the first time is always: "*what is this subject I am examining?*" (Mentz et al., 2012). And the answer to such a question is a definition. Because of this, it is crucial to understand the meaning of EA from one article to another in order to allow people to be able to identify EA among other disciplines.

However, after reading the articles and looking at the associations they made with EA in their main sections, the following categories were extracted:

- Technological context (84%) - The analysis, design, planning, implementation, and other activities related to practicing EA are only focused on the 'technological context' of the organization. This category includes the conception of technological components, their evaluation, their alignment with the business, and others. "*This*

school is techno-economic in that it aims to reduce IT costs through technology reuse and eliminating duplicate functionality" (Lapalme, 2012).

- Socio-technological context (9%) - The analysis, design, planning, implementation and other activities for conducting EA are not focused only on the 'technological context' of the organization, but also on its 'socio-cultural context.' This category includes the management of people who are developing and using the technological components of the organization and their integration and participation in the decision-making process. Some references present this context as a topdown approach: "*Traditional enterprise architectures are based on topdown approach. They emphasized on consistency throughout the organization and will involve all levels of employees*" (Vella, Chattopadhyay, & Mo, 2009). It is to say that "*enterprise architecture is not only an IT issue, but a strategic and organizational challenge*" (Nota, Bisogno, & Saccomanno, 2018).

- Eco-technological context (2%) - The analysis, design, planning, implementation and other activities for conducting EA are not only focused on the 'technological and social context' of the organization, but also on the 'ecosystem context.' This category includes the relationships an organization has with its environment: other organizations, the community, the government, the environment, the ecosystem, the standards (requirements, specifications, guidelines...), etc. "*Enterprise architecture should be able to cope with the fast changing business environment with ever changing needs and relations with the customer an boundaries*" (Chattopadhyay & Mo, 2010).

5% of the articles were not considered for this classification because they too explore the lack of common understanding in the discipline of EA, and present many similar ways of approaching the discipline without weight placed on one over another.

Table 3.10 presents an example corresponding to each category of focus. This does not imply that the authors of the cited references always work within the same context. The classification presented only corresponds to cited articles. Also, none of these three (3) contexts should be considered above the others.

Table 3.10 Examples of the focus of EA

Focus	Example	Reference
Technological Context	This article presents a conceptual component to address the common public administrative '*problematic of matching a citizen's needs with accessible public services*'. This IT component follows a "*Governance Enterprise Architecture model*" and consists of a citizen's needs received as input, and a group of public administrative services provided as output. This set of services satisfy the need by employing semantic technologies and by using a public administrative service model. The proposed system architecture includes different elements, which are an application server (Apache Tomcat), a reasoner (Pellet) and a Web Ontology Language file that represents a knowledge base. The end users use a common Internet browser to access the application. The use of EA in this article contributed to building a component that is often the focus in the technological context. This study does not treat questions related to the socio-cultural aspect of the people who are developing and will use this component.	(Goudos et al., 2007)
Socio-Technological Context	This article presents a case study realized in a public-sector organization. This study shows how the decision-making process of an EA development allows people to participate. In fact, the staff at all echelons and departments of this organization are involved and are free to express varied points of view concerning the business and technical concerns. Executives (senior management) take into consideration proposals from the staff, stakeholders, managers and program components. Many communication ways to share business documents, as well as to share understanding and knowledge across this public-sector organization, were used. As part the technological aspect of EA presented in this study, it also underlines how stakeholder and staff involvement at all echelons and departments enables the improvement and agreement of the strategic orientations, work plans and other.	(Gregor et al., 2007)
Eco-Technological Context	This article describes a strategy to focus on business and process information that are necessary in order to achieve wood supply and forest management. This strategy is developed in an organization that operates in wood pulp production. A lot of people who do not share a direct relationship with the organization were actively involved during the development of this strategy, such as business experts, Information Technology managers, forest and plant supply planners, operation planners, forest certification experts, and other. The objective of this strategy is also to achieve intercompany collaboration with the adoption of similar business process architectures and concepts. *This strategy and the participants involved in its development show how EA is not only limited to the direct beneficiary of the organization, but also considers its environment, like compliance with standards (i.e. certification experts), the ecosystem (i.e. forest planners), society (i.e. other organizations) and more.*	(Marques et al., 2011)

3.4.3.2 How do the articles approach the professionals who practice enterprise architecture?

In addition to the previous observations concerning the context of EA on which the articles focused, they do not describe in the same way the role, mission, knowledge or competence of EA-practitioners. In fact, in accordance with the different way to approach the practice of EA, as observed in the articles, the following categories were extracted:

- A ‘specialist’ or an ‘investigator’ who can imagine and understand the needs of an organization, the problems it is facing, and the perspectives it is following in order to find and implement the best manner to satisfy or resolve them with IT. These enterprise architects think they can help organizations choose the best solutions to meet their needs (Garg et al., 2006).

- An ‘integrator’ who has the ability to join all the stakeholders together with their understandings of the needs, perspectives and problems of their organization. These enterprise architects believe that IT alone cannot be an effective solution, but the participation and the motivation of the stakeholders in the decision-making process is crucial, and that effective solutions can be achieved through communication, negotiation, and collaboration, for example (Shaanika & Iyamu, 2015) ; (Gregor et al., 2007).

- A ‘facilitator’ capable of facilitating a good understanding of the needs of an organization, the problems it is facing, and the perspectives it is following through the adaptation of these elements with the environment. Potential solutions must be adapted to the environment of the organization. These enterprise architects do not only focus on the internal environment of the organization, as the previous category does. Instead they believe that the organization can also be greatly impacted by the external environment (other organizations, the community, the government, the environment, the ecosystem, the standards…), and vice versa. In fact, these enterprise architects think

that IT and the social context of the stakeholders of the organization must also be accompanied by organizational adaptation to the outside world in order to take the lead in innovation and sustainability (Marques et al., 2011).

3.4.3.3 To what extent are the EA researchers/authors aware of the lack of common understanding?

As mentioned early in this article, there is an increasing number of authors who have described a lack of common understanding in the discipline of EA. The analysis of the articles conducted in this study reveals that many of these authors are aware of a challenge caused by the existence of different, and even divergent, understandings of EA. One author explains, for example, that "*EA is still a challenging concept"* because there is no universal worldview in EA, but several definitions of EA exist and there are various perceptions (Janssen, 2012). Another explains "*EA lacks semantics,"* and that people cannot have an exact and common understanding of EA (Kang, Lee, Choi, et al., 2010).

Some other articles are more to-the-point and affirm for example that EA suffers from ambiguous definitions of what it is or is supposed to be. Another highlights "*an absence of any consensus"* concerning what EA is or supposed to do and how it is supposed to function (J. M. Harrell & Sage, 2010). Yet another indicates "*a lack of theoretical foundation, definition, or common understanding"* among researchers who have published in EA (Sayeb, Ayba, & Ghezela, 2015). Still others address this issue by questioning the differences between the approaches of Enterprise Architects. For example, (Walrad et al., 2014) explains how there are an increasing number of Enterprise Architects, *"but there is no universally accepted baseline of standards and knowledge to ensure consistent service.*" And (Strano & Rehmani, 2007) explains how variation and contradiction identified in the EA definitions within the literature *"further complicates the challenges of defining the role"* of EA practitioners.

Despite this increasing number of authors who have reported a lack of common understanding in the discipline of EA, few of them proposed to fully investigate, understand or resolve this challenge. However, certain studies try to generate new ways of approaching EA based on several existing definitions and concepts of EA. Certain other studies try to demonstrate how some ways of approaching EA corresponds or not to the practice of EA.

Finally, another significant consideration that the articles analyzed in this study reveals is the consequences of the lack of common understanding in the value of EA. Is it clear that the use and usability of EA may fully depend on *"how it is understood, defined and scoped*" (Shaanika & Iyamu, 2014). In effect, without the presence of concise and precise description concerning the roles that can achieve architecture success, *"architects may be viewed as providing no specific value*" for organizations (Kamoun, 2013).

3.5 Discussions

3.5.1 Discussions concerning the findings

Concerning the distribution of the articles over the years, the articles selected for this mapping study do not represent the total number of journal articles published in EA from 1990 to 2018. This is because of the limitation of the inclusion criteria applied, the duplication of some of the articles, and the articles that are non-downloadable. Moreover, this study includes only a portion of the articles published in 2018 because the search was conducted in mid-2018. But comparisons with the articles selected in some SLR concerning a general summarizing of EA (Rasti et al., 2015) — there are no other SMSs concerning a general summarizing of EA literature to be considered — show that a large majority of the published journal articles were considered in this study and then the sample is representative of the total number of publications (population).

Taking into account the previous precision, observing the distribution of the articles over the years provides useful insight into how young EA still is. For example, the highest number of journal articles published in 2014 is 33. Without a doubt, this number is small compared to the number of published articles in the field of Software Engineering for example, which is also a recent discipline of study. This argument is not intended to declare that the discipline of EA is not generated growing interest. In contrast, as indicated in the beginning of this study, the growing number of EA publications over the years, the growing number of practitioners and researchers involved in EA research, and the growing number of conferences and training organized for EA are a perceptible proof of it evolution. The various topics that have been developed in EA literature and the diverse approaches and techniques that have been used to investigate these topics can also be considered as a concrete sign of the evolution of EA.

Concerning the experiences of EA researchers/authors who have published in EA **(RQ1)**, when analyzing the fact that approximately 65% of authors included have published only one of the articles, it seems that a large majority of the authors of EA literature are not experienced researchers in EA. This leads us to ask why EA researchers do not become mainly focused on EA? Are there some EA researchers/authors who mainly work on EA as their area of specialization? Do EA researchers/authors consider EA as a sub-branch of other main disciplines, or as a separate branch derived from other disciplines?

Concerning the occupation of the authors **(RQ2)**, they are predominantly students/researchers and professors/researchers, because a large majority of them are affiliated with an academic institution. A specific restriction in academic research is that new observations and argument must regularly derive from existing references. Because of this obligation, maybe there would not be so many ways of approaching EA in the literature if EA authors had agreed references to follow. This raises numerous questions, such as: do EA researchers/authors have agreed and standard references to follow, including for example definition, terminology, and worldview? Why have academic authors/researchers have so many ways to approach the discipline of EA? It would be interesting to know how many of the articles are written by students/researchers with their supervisors, and how many are written only by professors/researchers, in order to

evaluate which of these two scenarios present more variations (i.e. definition, terminology, and worldview) compared to existing references.

Concerning the academic disciplines in which researchers have studied **(RQ3),** at least 3 categories —Information Technology, Specific areas of Engineering, and Social and Human sciences — were found. Undoubtedly, each of the fields from which the discipline of EA has originated has a different worldview including different ways of perceiving and facing real-world problems and procuring results. What is the impact of the world view of each of these fields on the final approach that authors provide to EA?

Concerning the focus of the Publishers/Editors of the EA-publications **(RQ4)**, there is an absence of enough journals and editors/publishers dedicated specifically to EA. In fact, the institutions which have published the most articles are the well know publishers that often have disciplines related to IT as main subject areas. Because there are not enough publishers dedicated specifically to EA, the articles are also published here and there through various journals.

The analysis of the subject area of the institutions which have published the EA papers also shows how the Social Sciences are more and more represented in EA even though a large part of the research is conducted by researchers that have studied in IT and an Engineering area, and published by editors/publishers with a subject area and category related to the same disciplines.

Concerning the location of the first author's affiliated organization **(RQ5)**, English is only the official language of 38% of the countries where the affiliated organizations of the first author are located, while only articles written in English were selected in this study. Because of this, would it be reasonable to consider sufficient knowledge of the English language to also be a factor favouring the existence of different ways to approach EA in the literature? Furthermore, it would be necessary to confirm the authors' languages in order to support such a hypothesis.

Despite the fact that 17% of these articles are written by first authors from the USA, only 11% of these articles are from the American continent. In fact, European researchers/authors — 48% of the articles are written by first authors from Europe — seem to have taken control of the leadership of the EA discipline (Preez et al., 2014).

Approximately 47% of the researchers who are studying in a Social Sciences area come from a European academic institution. When observing that the majority (60%) of the articles with unknown study areas of the first author (absent 17%) also come from the European continent, it is possible to imagine that the authors of these articles are also studying in Social Sciences. If so, this will increase this category of authors who are studying in Social Science (14%) which is actually lower than the authors who are studying in IT and an Engineering area (54%). This supports the previous observation which indicated that the Social and Human Sciences are more and more represented in EA. The word cloud shown in Figure 3.4 **(RQ6)** is further evidence which supports that the managerial context of the organization is more and more considered in EA research, even when the technological context is dominant. In effect, this aspect can be observed in the increasing use of certain words even in the titles of the articles which explicitly refer to Social and Human Sciences.

Another aspect concerning the most common topics addressed in the articles **(RQ6)** concerns how the evaluation of the utilization of EA tools, either newly developed or previously existing, have been neglected in the literature of EA. It seems that there is a lack of relevant directions for future studies in EA. In effect, the majority of the publications are focused on building and studying EA tools developed to apply EA or tools derived from an EA application (EA tools 55%). But without a complete and up-to-date understanding of the practice of EA (EA-Practitioner 4%) — including the role of EA practitioners, their worldviews, and their needs, for example — how will it be possible to create appropriate tools for them? Without clear evaluation (EA-Measurement 7%) of the performance of the existing tools — including the characteristics to measure and their importance, the metrics and the standards, for example — how will it be possible to continually improve their creation and use? Conducting more literature analyses (i.e.: systematic literature reviews, systematic mapping studies, and content

analyses) intended to study the state-of-the-art of EA or to explore specific challenges concerning EA could help provide relevant directions for future studies. For example, this could help researchers to avoid fundamental work on EA tools when several existing tools have not been applied (EA Application 23%) or evaluated yet. In effect, the practical aspect of EA must also play a more important role in EA research through the realization of more descriptive and experimental research which uses explicitly corresponding research methods such as opinion surveys, discourse analysis, participatory action research, and design science research, for example.

Concerning the ways that the articles approach EA **(RQ7)**, the original data collected without any interpretation prove the existence of the lack of common understanding in the discipline of EA. The various definitions provided to explain what EA is, what value EA is supposed to provide organizations, how EA is supposed to be applied, and the various other terms used to designate EA are some examples. The indication of this lack of common understanding in the discipline of EA in more and more articles, as seen in the findings, has demonstrated how EA researchers/authors are aware of this lack **(RQ9)**. Now, this challenge must be studied in depth in order to find more tangible findings that can help to better address it. The characteristics and assumptions discussed in the previous sections represent precisely some important characteristics which can be taken into account in order to study this lack of common understanding. Answers to the different questions generated would be very useful for a better understanding of the origins of this lack. However, these characteristics — complemented by others — are not required to be analyzed individually. Many other questions must be asked in order to relate them, and many other questions must be asked concerning the methodological techniques that will allow us to find the appropriate answers. For example, the fact that more publications are focused on EA tools can be caused by the choice of the publishers to publish mainly articles in this category rather than the others. Just as it can be caused by the academic discipline in which EA practitioners have studied.

The categories found concerning how the articles approach EA **(RQ7)** which are the '*three major ways of approaching EA*' (technological, socio-technological, and eco-technological)

are based the '*three modes of EA*' (Doucet et al., 2008), the '*three schools of thought on EA*' (Lapalme, 2012) and the '*three distinct interlinked architectures*' (Korhonen & Poutanen, 2013). The difference in this study is that each of these categories is presented only according to the information extracted from the articles (contexts of the focus and the tasks). This means that other interpretation did not take place in order to provide a full description of each category (scope, assumption limit…). At the first observation, it seems that the way of approaching EA is strongly connected to the discipline in which the first author has studied (technological context → IT areas; socio-technological context → engineering areas; eco-technological context → social and human sciences). But the findings do not confirm such an assumption because an overwhelming majority of articles correspond to the technological context.

On the other hand, the three ways the articles approach professionals practicing EA (specialist, integrator, and facilitator) **(RQ8)** derive from the previous ways of approaching EA. Because a large portion of the articles focused on building, they have presented EA practitioners as specialists who can create, modify and optimize (i.e.: tools, processes, principles, documentations, and strategies) without involving all the stakeholders in the decision-making process to be sure to understand their needs and motivations (internal environment), as well as the interest of the whole community (external environment).

Building a codebook — including the specific words, expressions, and wording — which identifies the particularity of the articles placed in each of the ways of approaching EA and its practitioners could be an appropriate method (content analysis) to validate these findings.

3.5.2 Implications for Research

A large number of studies reported that many ways of approaching EA exist, even if it is not their main focus. In fact, only a few studies are completely dedicated to investigating this lack of common understanding in the discipline of EA. Until this moment, the studies which are completely dedicated to study this lack of common understanding in the discipline of EA do

not use a rigorous investigation and thus based their findings on primary studies selected and analyzed without following specific criteria. Therefore, a survey was also conducted on this topic. But this survey used the existing models and did not leave enough opportunity to draw a complete picture of the state of the art of EA.

The situation described above shows that validity and reliability are mostly missing in the investigations which address lack of common understanding in the discipline of EA, and also more investigations must be conducted. In this context, the contribution of this study is manifold.

First, it represents one of the few studies which address this problem of lack of common understanding. It confirms some previous findings and provides new insights which can be taken into account for future studies on the same and corresponding topics.

Second, compared to the few previous studies on this topic, this is the first one which analyzes the literature with rigour in accordance with the guidelines of the well-known scientific method, which is Systematic Mapping Study (SMS). This allows this study to show greater validity and reliability that researchers should consider going further. This study also provided significant insights for future research on the same topic. In fact, within the findings or even in the discussions, many new considerations which require deeper investigations were made. For example, the experiences of EA researchers, and the impact of the authors' first languages, or the discipline on which they studied, on the lack of terminology.

Third, compared to the few previous SMS in the discipline of EA concerning other topics, this study provides some new observations that can complete the existing state-of-the-art of EA as described in the literature. For example, no previous SMS on EA has focused on the number of articles published by each EA-author/researcher, the academic disciplines in which they have studied, or their occupation when publishing. No previous SMS on EA had focused on the subject areas of the publishers of the EA-publications, or on the occurrences of certain words in the publication titles. But even the importance of such subjects in the context of this

study, as it can be seen the findings concerning them should also be considered to show a complete presentation of the state-of-the-art of EA. Researchers could also use this information as a starting point to summarize the EA literature with all the important details.

Fourth, compared to many previous Systematic Mapping Studies which their predefined classification schemes in advance, this study has generated categories which emerged progressively during the data extraction. This method provides better opportunity to summarize the entire content of the sources analyzed without losing the details.

3.5.3 Implications for Practice

The lack of common understanding in the discipline of EA can create misunderstandings and conflicts regarding the role and responsibility of professionals practicing EA. Especially when EA team members are not thoroughly conscious of the lack of common understanding in the discipline of EA and the extent of the existing differences. It can also be hard to collaborate with stakeholders and other participants in such situations. Similarly, it can be hard to provide standard and universal training to future EA practitioners. And researchers can face difficulty when sharing their research findings and generally being understood.

The previous studies concerning the lack of common understanding have presented the most popular schools of thought on EA, while the current study has focused on the extraction of the details which can help to differentiate and link these schools of thought. This means that the information collected and analyzed in this study is at a lower level and thus can be more meaningful for practitioners. In fact, this study is useful to help professionals practicing EA to be conscious of the existence of many different contexts, which could otherwise prevent EA professionals from having common terminology, understanding, and perspective. This study could open many ways to help them become more tolerant of each other and collaborate better.

Taking into account the consideration of the previous sections, it is evident that this study could also help the administration staff of the organization to better know the kinds of EA professionals they need, depending on what the organization want to achieve. This study could also help human resources to be better able to evaluate candidates according to the need of the organization. In the same line of thinking, this study could motivate the integration of all the existing perspectives in the EA academic programs, in order to provide universal training to future practitioners.

However, one point to be clarified is the importance of each of the ways of approaching EA, without any superiority of one over another, even if they seem to be divergent and conflictual sometimes. The objective is to understand the underlying assumptions of the different perspectives, beliefs and worldviews underlying the many ways of approaching EA and its practitioners in order to integrate them all into a shared reference. This will allow us to take them all into account when conducting research, elaborating tools, organizing training, creating job offers, implementing EA plans, projects or processes and more. In effect, this will allow enterprise architects and researchers to better collaborate even if they have different ways of approaching EA.

3.6 Conclusion

This study conducted a Systematic Literature Review and analyzed two hundred and fifty-seven (257) journal articles published from 1990 to mid-2018 with the aim to identify, explore and classify elements that might influence the existing lack of common understanding in the discipline of EA. The findings confirm that the extent to which the authors/researchers are focused on EA, the sectors in which they are evolving, the academic disciplines in which they have studied, the countries where their affiliated organizations are located, the subject areas of the journals/publishers of their publications, and the way they have approached EA and its practitioners, were identified as sources of variety which could be at the basis of the existing lack of common understanding in the discipline of EA.

A limitation to note is that this study analyzed only journal articles in order to keep it to a manageable size. Despite this limitation, the contribution of this study — which is the first systematic mapping study on the lack of common understanding in the discipline of EA—is the organization of the EA literature according to three major questions concerning ‘who’ has been published in the literature, ‘where’ they have been located, and ‘what’ their publications are about. This helps to better identify sources of variety which could be on the basis of the lack of common understanding in the discipline of EA, and provides practitioners and stakeholders a better understanding of this challenge. This also provides relevant directions for future studies. Due to this limitation, future studies on this topic must include other relevant data sources, such as conference articles, book chapters, and more, and use other reliable methods, such as systematic literature reviews, content analyses, surveys, and case studies.

CHAPTER 4

EXAMINATION OF EXPLICIT DEFINITIONS OF ENTERPRISE ARCHITECTURE

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4.1 Introduction

Despite growing interest in EA, this field is facing a lack of common understanding. Indeed, the literature presents various ways to approach EA (Lapalme, 2012) and these various perceptions or understandings of EA are not always complementary or nuanced, but are sometimes in opposition. Various definitions of the word 'enterprise architecture' itself exist and there is no agreement on these definitions. This situation may create confusion and conflict concerning the purpose of EA, the way to practice it, and the benefits it provides to organizations. This may also result in a lack of co-operation between professionals practicing EA (Simon et al., 2013).

Many studies have reported this lack of common understanding in the discipline of EA. But few studies have focused on exploring the nature of this lack. The aim of this exploration of the explicit EA definitions found in Scientific Journals is to identify the most important characteristics in order to classify their similarities and dissimilarities. We used Systematic Literature Review (SLR) (B. Kitchenham & Charters, 2007) as a well-defined methodology to achieve this objective.

In fact, the rationale of this study can be summarized in the following questions: "If the different perspectives expressed in the definitions of EA are not known, how can people assess

the extent of their differences and address this issue? Further, if the definitions are not divided into several similar parts in order to analyze them in depth and compare them according to appropriate methodologies, such as SLR, how can the reliability of the findings can be ensured?" The most important contribution of this study is its focus on opening directions for future research concerning the lack of common understanding in the discipline of EA.

The rest of this article follows the following structure. We present the context of this study and the literature review in section 2, and the research questions and research design in section 3. In sections 4 and 5 we present and discuss the results of this. We describe the limitations and the contributions of this study, as well as directions for future works, in section 6.

4.2 Literature review

4.2.1 Context of this Study

Despite growing interest in EA, many researchers and practitioners have described the existence of a lack of "*common understanding,"* (Schöenherr, 2008) *"common terminology,"* (Lapalme, 2012) *and "shared meaning*" (Korhonen & Poutanen, 2013) in EA. The existence of various definitions of enterprise architecture and the absence of agreement on these definitions are considered an important issue, because while some of these existing definitions are complementary, others are in opposition (Korhonen & Poutanen, 2013). In fact, although several people worldwide have been actively practicing EA, different and divergent points of view with regard to the significance of the word 'enterprise architecture' itself exist. And no universally agreed *"baseline of knowledge*" exists yet (Walrad et al., 2014).

4.2.2 Related Work

Few works were conducted with the aim to shed light on the lack of common understanding in the discipline of EA (Saint-Louis & Lapalme, 2016), whereas the literature continue to report this lack. The following works are among those that have addressed this problematic as their main focus.

126 references which include journal articles, conference articles, proceeding articles, books, and websites, produced by researchers and practitioners from 1987 to 2008, were investigated by (Schöenherr, 2008). The results show that the majority of these references do not present a definition of EA. The majority of the definitions cited in these references are not elaborated by their authors but come from other publications. The definitions that were found were classified as one of three different approaches: technology-driven, system-driven, and method-driven.

Alwadain et al. (Lapalme, 2012) have affirmed that the definitions of EA in the literature are not clear "in terms of scope and purpose". Three major "ways of approaching EA" have been suggested within this work. Each of these ways of approaching EA has its own characteristics, including a specific definition of EA, concerns, assumptions, and limitations.

Based on the *"3 modes"* of EA (Doucet et al., 2008), the "*3 schools of thought"* (Lapalme, 2012) and other publications (Korhonen & Poutanen, 2013) affirms that architectural works include three different interconnected architectures that are "*the technical architecture, the socio-technical architecture, and the ecosystemic architecture.*" These architectures correspond to distinct ontological and epistemological assumptions. Each of them requires its specific methods and tools, and is self-regulated.

However, the studies which focus on a lack of common understanding in the discipline of EA do not use a systematic methodology to guide their investigations. Foorthuis et al. (Shah & Golder, 2011) indicate that some well-recognized organizations, such as the Open group, Microsoft, and IBM, have been working on defining EA, and has also presented work focusing

on the problems of defining EA (Rahimi et al., 2017). However, to date no study has essentially investigated the definitions of EA with the objective to illustrate the importance of this issue. Therefore, this study aims to provide a serious elaboration on the problem of defining EA that can be used to reach a broader understanding of EA, as well as provide relevant new research perspectives.

4.3 Research method

4.3.1 Introduction to SLR

According to the objective of this study which aims to provide deeper insights concerning the terminology problem and areas for future studies, we selected Systematic Literature Review (SLR) as an appropriate methodology. An SLR is a kind of secondary study which applies a well-defined methodology that ensures the identification, analysis and interpretation of available evidence corresponding to a particular research question. The identification, analysis and interpretation must be realized in a manner that is unbiased and reproducible (B. Kitchenham & Charters, 2007).

The guidelines of (B. Kitchenham & Charters, 2007) were followed to realize this investigation. These guidelines have divided the process to conduct SLR into 3 major steps. These steps include planning, realizing, and reporting the review. The following sections describe the most important information concerning the planning and realization. This article is the report.

4.3.2 Planning of the Review

The planning of the review comprises its justification, the elaboration and description of the research questions, and the development of the review protocol. The previous section already

justifies the importance of this study. We used a primary report developed by one of the authors as predefined protocol which indicates the planning information to undertake the study. It was not necessary to realize a complex protocol because as indicated in the next sections, the search process, the data extraction and the analysis processes, of this study are "*relatively straightforward*" (B. Kitchenham & Charters, 2007). We present the research questions in the next section.

4.3.3 Research questions and sub-questions

The main research question is the following: "What is the extent of the differences between definitions of EA and how can these differences be characterized?*"*

In order to answer the main research question, we divided it into 5 particular sub-questions corresponding to the common parts of EA definitions, and the classification and evolution of EA definitions. Table 4.1 presents these sub-questions.

Table 4.1 The research sub-questions

#	**Sub-questions**
I	What is being defined in the definitions of EA?
II	What is the level of agreement of the authors with regard to the EA definitions they provide?
III	What are the general categories of things in which EA could be placed?
IV	What aspects of EA do the definitions focus on?
V	What does the evolution of definitions of EA look like?

4.3.4 Execution of the review

The execution of the review comprises the identification of available references, the study selection, the study quality assessment, and the data extraction and synthesis. We present these steps in the next sections.

4.3.4.1 Identification of Available References

Conducting an SLR is a time-consuming process for a single researcher, such as a PhD student, and could easily miss the deadline of its research project (Woodall & Brereton, 2006). Authors can restrict themselves to a particular type of data sources which are most appropriate to address their research questions (B. Kitchenham & Charters, 2007). In effect, we conducted this step with the aim to keep the search process to a manageable size, and to ensure that the selected references include mature studies. This is why we selected only peer-reviewed journals and used a "*relatively straightforward*" search process. The underlying assumption is that mature EA studies have certainly been published in journals, and these journals also include the major findings presented or detailed in other types of scientific publication.

In order to search the journals, we consulted three relevant electronic sources that are Compendex, Inspec, and Scopus. We selected these electronic libraries because they cover most of the major scientific publications corresponding to EA. In fact, some previous searches justify that these electronic libraries return the most relevant results with the paper type selected and the search strings used. Their results also include the majority of those provided by IEEE and AIS electronic library.

The search strings used and adapted to each of the electronic library are: "enterprise architecture" OR "enterprise architect" OR "EA" in the title of the publication.

4.3.4.2 Study Selection

The most important elements to achieve the selection of primary studies are the inclusion and exclusion criteria which are the following:

- Language: English (a large majority of scientific research are published in English)
- Date of Publication: 1987 to 2016 (according to the literature, the first EA publication was introduced in 1987, even it did not literally use the word 'enterprise architecture')
- Document type: journal paper (to keep the study in a managerial size)

The exclusion criteria oppose the inclusion criteria and include additional criteria we took into account to examine the articles found with the electronic libraries. In fact, after inspecting the titles and abstracts of the articles, we removed those that have been written in a language other than English. We also removed those with enterprise architecture or ea in their title that do not refer to the discipline of EA (i.e.: an article titled "EA-based optimization of hybrid T-slot…"). And finally, we removed those that are not available for free download on the Internet, via the library of our affiliation institution. However, 95% of the articles were downloadable for free on the Internet.

The first authors (students) worked separately to verify the application of the inclusion/exclusion criteria. The included and excluded references were discussed with the third author (advisor) (B. Kitchenham & Charters, 2007).

4.3.4.3 Study Quality Assessment and Data Extraction

The "quality instruments" used to assess the study quality are usually checklists of factors to be estimated (B. Kitchenham & Charters, 2007). Within this study, the most important factor that assumes the quality assessment of a selected article corresponds to the presence of one or more explicit definitions of EA within this article. Because of this, the study quality assessment was performed during the data extraction process. Searches were conducted on the whole

content of each article in order to find definitions of EA. And we classified the articles without a minimum of one explicit definition of EA, and extracted the explicit definitions when there are. We (first authors) executed the data extraction process separately and compared the results for validation. We discussed disagreements until finding mutual agreement.

In fact, when the verb between the defined element (i.e.: enterprise architecture, EA…) and the definition itself (i.e.: a discipline…) explicitly indicates an intention of giving meaning, the definition is considered as explicit. For example, explicit definitions come in the following forms: "EA is…; EA refers to...; EA is considered as…; a reference describes EA as…." While implicit definitions, for example, come in the following forms: "EA provides a set of principles…; EA is especially used as; EA can be used to…"

Even if the objective was to keep the study to a manageable size, to assure the study quality, additional searches were realized online in order to verify how the EA definitions extracted are representative. To achieve this objective, available other references that analyzed or identified a list of the most common EA definitions were consulted in order to verify if these definitions were similar to those found within this study. For example, the definitions analyzed in (Rahimi et al., 2017) were consulted. The previous study is one of the few studies that analyzed many EA definitions with the objective to explain "what EA means", even if this activity was not the objective of the whole study. The majority of the EA definitions found in (Rahimi et al., 2017) was already included in the definitions previously extracted in our database. However, 8 new explicit definitions found within this study were added in our database. Some definitions available on Wikipedia were also consulted. Some other available on Aris Community web pages and others were also consulted. The Aris Community web pages propose people to vote for the EA definitions that correspond to their understanding.

It turns out more than 70% of the definitions consulted are similar to those analyzed. Because some of the definitions different than those included in our database are not explicit definitions or because we cannot find exact references for them, we did not consider them within this study. But this exercise demonstrates how a large majority of the definitions found in journals

have derived from some reference EA authors and books, such as (M. Lankhorst, 2009) ; (Ross, Weill, & Robertson, 2008) ; (Schekkerman, 2004) ; and (Zachman, 1997), even there are some modifications sometimes in their structure, but almost the same words and terms are used. This also confirms that the extracted EA definitions are representative regarding to the definitions provided by the major professional institutions in EA, as IEEE, Cap Gemini, Forrester, Gartner Group, MIT Center for Information Systems Research, The US government Federal Chief Information Officer (CIO), the ArchiMate Foundation, the US Federal Enterprise Architecture Framework, and the Open Group Architecture Framework (TOGAF). As a result, the definitions selected remain representative of those used by both practitioners and researchers.

As a result, we analyze several explicit EA definitions that were extracted in journal articles and additional sources. Table 4.2 presents the evolution of references from their identification to the study quality assessment stage, in terms of the number of articles selected and explicit definitions found.

Table 4.2 Evolution of the number of articles and definitions

Steps	**# of articles**	**# of definitions**
Studies retrieved from online databases	784	
Studies after excluding duplications	469	
Studies after excluding irrelevant (used to extract EA definitions)	305	
Studies with explicit EA-definitions	101	177
Number of explicit EA-definitions found after revision		152
Number of explicit EA-definitions found after adding additional EA-definitions	102	160

4.3.4.4 Data synthesis

Given the aim to examine each part of EA definitions individually before making generalizations, the division process of the definitions followed models from the field of terminology. The main objective of the field of terminology is to study words, expressions and terms and the context of their use, according to their particular meanings. Because of this, the definition of a concept must be known in order to be understandable. In fact, definition provides a description of the properties of a word, expression, or term and specifies relations between many defining elements. Definition gives an explanation of the meaning of a word, expression, or term and indicates what aspect that makes it different than others. However, terminologists have also been facing issues concerning how definition must be structured and what models of definition to follow (Blanchon, 1997).

According to (Hurley, 2000), a definition includes 2 distinct parts which are the "*definiendum*" and the "*definiens*". The word or group of words to be defined is the definiendum. The word or group of words that provide the definition is the definiens (Hurley, 2000). According to (Seppälä, 2005), a definition includes 3 distinct parts which are the "*word to define*", "a *generic element",* and one or many "*specific elements".* Attention has been paid to the generic element within this model because it connects the word to define to a more general concept that represents the first indicator concerning the general category of things in which could be placed a word to define. The conceptual scope of the generic element is provided by the specific elements, and it sheds light on the difference between one generic element to another. Another part mentioned in the literature of the field of terminology is the "*copula*" which is the verb that links the word to define with the generic elements. This copula is important because it can indicate the objective of the definition provided (explication, citation…) for example (Seppälä, 2005).

Figure 4.1 presents the final framework used to break down the extracted definitions of EA which is based on the different parts of a definition presented in the previous sections "*plus some additional parts that we judge important to be considered*". With this division of the

definitions in different parts, it became possible now to find similarities and dissimilarities between them by comparing equivalent parts. This will prevent the proverbial apple and orange comparison issue. In effect, we used this framework in order to analyze each definition. We used detailed feedback from the second author and reviewers in order to revise and structure the results. We also realized a test-retest process (B. Kitchenham & Charters, 2007) in order to ensure the consistency of the categorization provided.

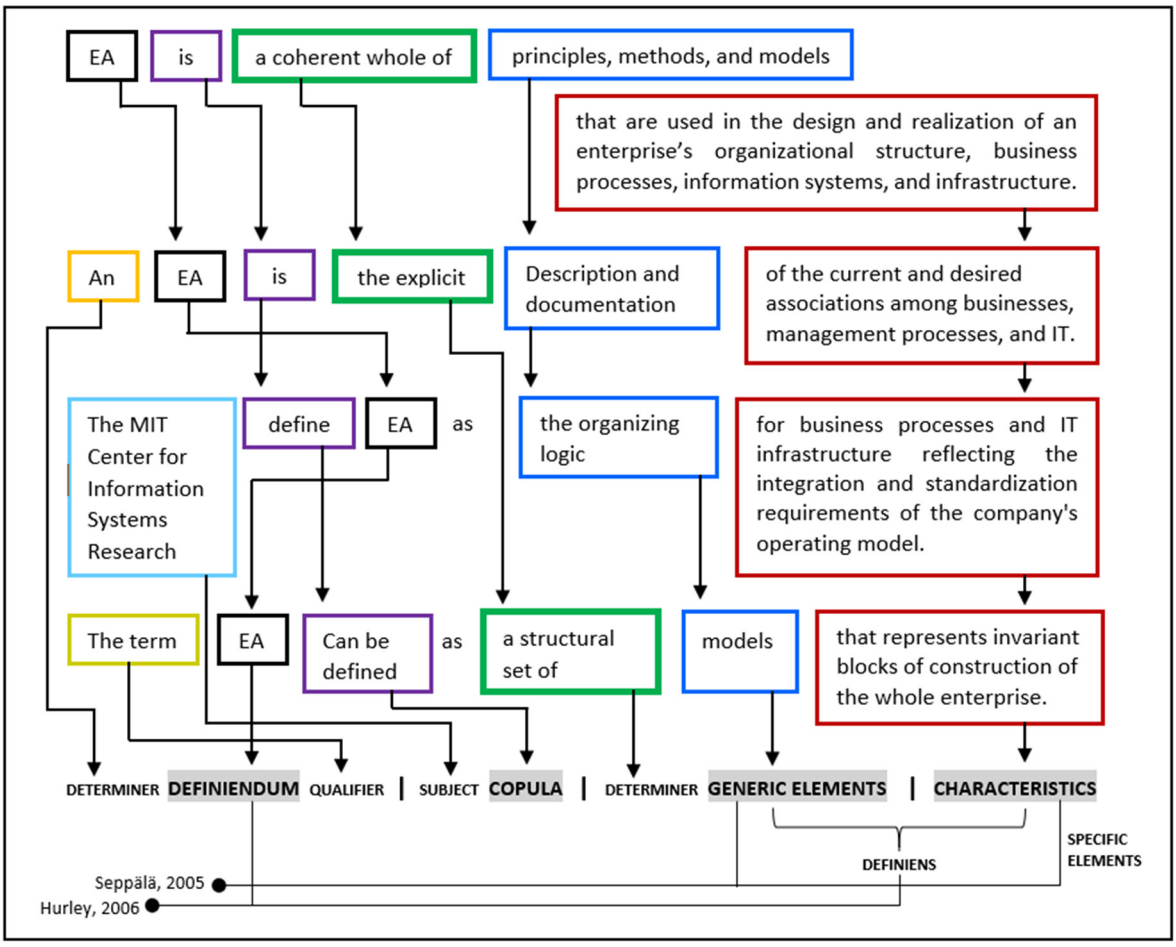

Figure 4.1 Individual parts of EA-definitions

The individual parts of EA definitions considered within this study and presented previously in Figure 4.1 include the following parts:

- The "*Determiner of the definiendum", which* describes the definiendum.
- The "*Definiendum", which* represents the word to define.
- The "*Qualifier" of the definiendum, which* limits the meaning of the definiendum.

- The "*Copula",* which indicates how the rest of the definition presents the meaning of the *word to define,* and then the agreement of an author to the definition she/he has provided.
- The "*Subject of the copula"*, which indicates the publication where the definition is originated, when applicable.

- The "*Generic element",* which indicates what class or group, the *word to define* belongs to when thought of as a generalized element.
- The "*Determiner of the generic element",* which indicates the essential particularity of the generic element.

- The "*Characteristics" of the generic element,* which present more distinguishing details useful to differentiate the generic element among others.

4.4 Findings

4.4.1 What is being defined in the definition of EA?

The *definiendum* represents the *word to define*. In the context of this study, the definiendum is supposed to refer to the word "Enterprise Architecture". But this is not the only word used as definiendum in the extracted definitions of EA. In fact (Gartner, 2008) affirmed that definitions of EA have two focuses because the literature usually describes EA as either a "verb" or

"noun". The importance of such evidence is that it can be taken into account to identify whether the definitions intend to describe the same thing, even they apparently refer all to "enterprise architecture."

An/the Enterprise Architecture – Enterprise Architectures. When an indefinite or a definite article (an/the) play the role of the *determiner for the definiendum,* authors consider EA as a noun. It represents a set of specific output or deliverables (i.e.: standards, models, principles, requirements …) that EA practitioners must deliver to the organization (Gartner, 2008). To achieve this objective, practitioners are supposed to focus more on the realization of pre-defined output which can be in the form of a guideline or roadmap that organization can follow in order to achieve its strategic imperatives. EA is often described as a project in this context (Nikpay, Ahmad, & Rouhani, 2016) ; (Balabko & Wegmann, 2006). On the other hand, practitioners are supposed to focus less on their daily improvement, as well as on action-oriented tasks. Some authors also use an explicit plural form of EA that corresponds to the same category which considers EA as a set of specific output or deliverables. The following definitions are some examples:

"An enterprise architecture (EA) can be viewed as the IT unit's contribution to successful execution of a firm's dominant logic" (H. A. Smith et al., 2012).

"The Enterprise Architecture refers to a comprehensive description of all of the key elements and relationships that constitute an organization" (Kang, Lee, Choi, et al., 2010).

"*Enterprise architectures (EAs) are considered promising means to align the required changes in corporate strategy and business processes with an increasingly complex IT landscape*" (Löhe & Legner, 2014).

Enterprise Architecting. When *the definiendum* is presented without a *determiner,* authors consider EA as a verb and refers to "e*nterprise architecting*". In this context, EA is much more focused on achieving the strategic imperatives of an organization through a continuous process which includes events, changes, activities, and actions that are continuously occurred, evolved,

and executed. To achieve this objective, EA practitioners are supposed to focus more on *"communicating, creating, and improving"* (Gartner, 2008) structures and decisions which can help to better manage and adapt the organization day by day. We did not use "Enterprise architecting" as a search string within this study because the intention is to analyze only explicit definitions of EA. However, one definition found in the articles used the verb form of EA as shown in the following definition.

> *"Enterprise Architecting (EA) is the process of developing enterprise Information Technology architecture"* (F. Armour, Kaisler, & Huizinga, 2012).

The term/concept Enterprise Architecture. Another reason for elucidation concerning the nature of "enterprise architecture" becomes apparent when this word is preceded by a *qualifier*. We found 2 distinct qualifiers in the extracted definitions which are "term" and "concept". The following definitions are some examples:

> *"The term enterprise architecture can be defined as a structural set of models that represents invariant blocks of construction of the whole enterprise"* (Nogueira et al., 2013).
>
> *"The concept of EA refers to the alignment of information, technology, standards, process, policy and framework of an enterprise with the goals and strategies of the enterprise as a whole to achieve the required level of standardization, integration, consistency and compliance (Van Grembergen & De Haes, 2009)"* (Kaushik & Raman, 2015).

The Advanced English Oxford Living Dictionaries define a term as "a word or phrase used to describe a thing or to express a concept, especially in a particular kind of language or branch of study" (Stevenson & Brown, 2005). According to this definition, when authors specify EA as a term as seen in the previous examples, it could indicate that they consider the 2 words "enterprise" and "architecture," as a single unit. Then EA can correspond to a technical term which is a word that refers to a particular meaning within a particular discipline. Mentioning this context is worth to identify whether all definitions view the words enterprise and

architecture as a single unit or not. For example, one of the extracted definitions has defined EA as follows:

> "*Enterprise architecture or architecture for short is a systematic and structured instrument to provide direction to the development of the ICT landscape and provide a holistic view at the organization*" (Janssen et al., 2012).

Perhaps the word "enterprise" refers to a *noun* in the previous definition. Like this, it can easily be put aside as the definition did. In fact, in this context the expression "enterprise architecture" probably means "*architecture within an enterprise*". Then it is possible to just say *architecture for short*. On the other hand, it would certainly not be possible to put the word "enterprise" aside in the expression "enterprise architecture" if this word was considered as a *verb*, with the meaning *"to undertake an enterprise, or something hazardous or difficult,"* as indicated in the Advanced English Dictionary based on WordNet (Miller, 1995). In this context, "enterprise architecture" would refer to *"undertaking architecture"*.

However, using a qualifier in order to indicate that EA refers to a concept or a term does not bring more understanding related to the nature of the expression "enterprise architecture" or the words "enterprise" and "architecture". But it provides some information that could indicate for example whether EA is a discipline, an architecture in an enterprise, a practicing architecture… Even if this information can also be interpreted in a different way.

Another formulation of the *definiendum* (enterprise architecture, enterprise architectures, enterprise architecting, architecture…) is when it is not accompanied by any *determiner* (indefinite or definite articles, plural form…) or *qualifier* (as a term, a concept…). In this context, it is more difficult to have an idea concerning the nature and the meaning of the expression "enterprise architecture". But 80% of the identified definitions are in this form where authors use directly "enterprise architecture" or "EA". We call this form of definiendum a "*neutral form"* because in the context of this study it does not give the opportunity to examine

the definiendum as a single unit, without considering the other parts of a definition. The following definitions are some examples of the neutral form of definiendum:

"Enterprise architecture is the instrument that establishes the enterprise structure. It does so by conceptually modelling the business and IT solutions as an assembly of parts such as processes, functions and infrastructure, that work together in a coherent and well-defined way" (Foorthuis et al., 2016).
"EA is a multi-disciplinary approach that enables enterprises to anticipate or react to necessary business or technical changes" (Balabko & Wegmann, 2006).

4.4.2 What is the level of agreement of the authors with regard to the EA definitions they provide?

The *copula* represents the word or verb that links the *definiendum* to the rest of the definition. According to the International Organization for Standardization (ISO 704-2000), *"identify a concept and differentiate it from others"* are the main roles of a definition. Meyer and Helfert (Seppälä, 2004) clarify these roles with 4 aspects on which a definition may focus: *"describe, explain, detail or delimit a concept"*. They also indicate some final objectives of these 4 aspects which are, for example: "*the differentiation of concepts, the identification of terms, the confirmation of the existence of a concept, and the establishment of synonymy between linguistic units.*"

The objectives of a definition can greatly help to identify its particular functions. But because this study intends to analyze only explicit definitions of EA, the function of the definitions analyzed is limited. In fact, the copula is a linking verb. This means a verb that simply connects the subject (definiendum) with the words that provide information concerning the subject (generic element), in indicating only a condition or relationship rather than actions. Accordingly, we classified the linking verbs of the definitions following the distance taken by an author—in terms of level of agreement—with regard to the definition he or she has

provided. We found the categories affirmation, explanation, and citation, as described in the next sections.

Affirmation. Within this category, the *linking verb* seems to express the author's point of view regarding EA, even if a reference is cited with the definition. Also, the linking verb tense which is the present simple explicitly indicates the truth of what EA is. And finally, the verb tense also specifies enough guarantee that there is only one definition of EA, which is the one provided. The linking verbs found within this category are structured in the form: *"EA… is/are, refers to, represents".* Some other forms, like "*we define… EA*" are also included within this category of copula. Some corresponding examples are given in the following section.

"A widely adopted approach providing the required conceptual understanding of an enterprise as well as the way IS facilitates its business processes, is Enterprise Architecture (EA)" (Alwadain et al., 2014).

"*We define Enterprise Architecture as a systematic approach that organizes and guides design, analysis, planning, and documentation activities in an enterprise*" (Gøtze et al., 2009).

Some other definitions found within this category do not use a verb, to express the truth of what EA is. In fact, they use the preposition *"as"* or just a *"comma"* to introduce their definition, as shown in the following examples:

"Enterprise Architecture (EA) as a discipline that manages large amount of models and information about different aspects of the enterprise, can support decision making on enterprise-wide issues" (Razavi et al., 2011).

"Enterprise Architecture, a discipline with roots back to the 1980s, […]" (Meyer & Helfert, 2014).

Explanation. Within this category, the *linking verb* does not often seem to express the author's opinion regarding EA as seen in the previous section, even if any reference is cited with the

definition. But the linking verb of this category does imply a general opinion. It also implies that some conditions must be met for the definition in order to really work. Also, the linking verb tense which is the past tense or present perfect do not explicitly indicate the truth of what EA is. And finally, the verb tense does not also specify enough guarantee that there is only one definition of EA, which is the one provided. Rather, the definition provided seems to simply refer to one of several others. The linking verbs found within this category are structured in the form: *"EA… is viewed as, can be viewed as, could be considered as, is considered as, is defined as, can be defined as, has been defined as, has become, has emerged as"*. Another verb which taken place before the copula can also be considered in order to place a definition within this category of copula. Some corresponding examples are given in the following section.

"An enterprise architecture (EA) can be viewed as the IT unit's contribution to successful execution of a firm's dominant logic" (H. A. Smith et al., 2012).

"It is suggested that EA is an approach for controlling the complexity and constant changes in the business environment of an organization, enabling a real alignment between the business vision, business requirements and information systems" (Ylimäki & Halttunen, 2005).

Another form of definition found within this category has used a personal pronoun before the copula that indicates how the given definition seems not to be the only one, even the author believes it is—as shown in the following examples:

"[…] we perceive enterprise architecture as the normative means to direct enterprise transformations" (Nakakawa, Van Bommel, & Proper, 2011).

Citation. Within this category, the linking verb and its tense do not influence the distance—in terms of level of agreement—authors take toward their given definitions of EA, because one or many references are clearly mentioned as the proprietary of these definitions. In this context, it is hard to understand whether authors agree or not with their referenced definitions because

their points of view are not clearly given about this. A corresponding example is given in the following section.

> *"Although there are different perspectives to describe EA (Niemann, 2006) ; (Ross et al., 2006) ; (Simon et al., 2014) ; (Winter and Fischer, 2006) ; (Zachman, 1987), they all explain EA as a strategic instrument to control and manage the complexity in an organization through structured description of the enterprise and its relationships"* (Banaeianjahromi & Smolander, 2016).

4.4.3 What are the general categories of things in which EA could be placed?

The basic natural answer—instead of explaining the details—in response to someone asking: *"What is EA?"* represents the generic element. In fact, the generic element connects the word to define (definiendum) to a "*more general concept"* in specifying the category of things to which EA belongs (Kahane, 1974). The function of the *generic element* in a definition represents a key role, because it is naturally essential to categorize something to be able to compare it to other things in the same category—or a different one—in order to understand its particular traits. But authors have very little flexibility with the *generic element* because it includes only one or more single words. Also, these words must have a predetermined and clear meaning and consequent description in the dictionary and among daily conversations. Even if the author has the opportunity to explain the context of the *generic element* in the rest of the definition (the characteristics), the *generic element* itself plays an essential role in the reader's first impression of the meaning of the word being defined. However, it was difficult to classify some of the generic elements without investigating the rest of the definition (for example, the actions executed by the generic element, its function…) in order to understand the context of its use. Finally, we found the following five (5) categories presented in the next sections.

Deliverable. The *generic elements* classified within this category refer to a product realized within an organization which describes, schematizes, plans, guides and controls its operations,

for example. This product can be a tool for the structuration of the organization or its activities. It can also be a deliverable to be used to realize the previous mentioned tool. The priority is on the kind of product (software, planning, models, procedure …) that will be delivered in this context. This category of *generic element* includes the following words: *"analysis, architecture, artifacts, blueprint, classification, definition, description, documentation, design, information base, logical structuring, method, model, output, plan, procedure, representation, program, representation, roadmap, solution, and strategy."* A corresponding example is given in the following section.

"*An enterprise architecture (EA) is the explicit description and documentation of the current and desired associations among businesses, management processes, and information technology (IT)"* (Chae et al., 2007).

Tool. The *generic elements* classified within this category refer to artifacts or tools practitioners used to realize the deliverables presented in the previous category or to carry out actions corresponding to EA contexts. The priority is on the tool itself in this context. And this tool does not correspond to those that have been created by the EA function of the organization. But they can be a standard commercial product usable by any organization in order to produce deliverables. This category of generic element includes the following words: *"tool, framework, instrument, principles, method and model".* A corresponding example is given in the following section.

"EA [...] which can be defined as a coherent whole of principles, methods and models that are used in the design and realisation of an enterprise's organisational structure, business processes, information systems and infrastructure" (Quartel et al., 2012).

Process. The *generic elements* classified within this category refer to a set of activities, or stages to be realized in order to accomplish specific outcomes—including deliverables—corresponding to EA contexts. Contrasting with the previous category deliverable, here the priority is on the realization and the management of the task to be accomplished

(communication, decision-making, sociocultural aspects…), but not only on its planning or guidance. The focus here is on the type of process. This category *generic element* includes the following words: *"alignment, mechanism, organization, process."* A corresponding example is given in the following section.

> *"Gartner (2012) defined enterprise architecture as the process of translating business vision and strategy into effective enterprise change by creating, communicating and improving the key requirements, principles and models that describe the enterprise's future state and enable its evolution"* (Zheng & Zheng, 2013).

Thinking. The *generic elements* classified in this category refer to the ability of the functioning mind to consider, form, or have an opinion, ideas, memories, thoughts, etc., about how an organization and its environment works. This can be useful in the decision-making process in order to take enlightened decisions in the context of EA. The focus here is on the type of thinking. This category of *generic element* includes for example the following words: *"concepts, understanding, vision"*. A corresponding example is given in the following section.

> *"Enterprise architecture is an integrated and holistic vision of a system's fundamental organization, embodied in its elements (people, processes, applications, and so on), their relationships to each other and to the environment, and the principles guiding its design and evolution"* (Candra et al., 2015).
>
> "The OPEN GROUP supposes that EA is something about understanding different elements of an enterprise, and how these elements are interrelated" (Liu et al., 2012).

People. The *generic elements* classified in this category refer to the people who have been concerned with EA within an organization through their involvement in the aspects corresponding to EA. In this context, the focus is on the people and not in their ability to conceive or pilot outcome, or in the tools they used or produced, as in the previous categories which are focused on a specific aspect of people. Only one of the selected definitions that corresponds to this category. However, because this study intends to present a complete

examination of EA definitions, it is necessary to consider it as it is. The corresponding definition is given in the following section.

> *"Enterprise Architecture (EA) refers to the group of people responsible for modeling and then documenting the architecture"* (Shirazi et al., 2009).

Discipline and practice. The *generic elements* classified within this category refer to a study area which corresponds to learning, research and practice of EA. In this context, the focus is on the kind of research or practice field that EA is. Disciplines and practices should encompass all previous categories, but the *generic element* alone does not provide enough information to deduce it. This category of *generic element* includes the following words: *"approach, discipline, foundation, practice, fields, system of systems."* A corresponding example is given in the following section.

> *"Enterprise architecture (EA) is a practice and emerging field intended to improve the management and functioning of complex enterprises and their information systems"* (Lapalme et al., 2016).

In addition to the generic elements presented above, some others are not sufficiently explicit to be classified in the previous categories. We grouped these definitions in a category of *unclassified generic element*. Some corresponding examples are given in the following section.

> *"EA […] It is also an indispensable means for enterprises to gain competitive advantage through IT."* (Fu-Sheng et al., 2013).
>
> *"Enterprise Architecture (EA) is an approach used to provide decision support based on organization-wide models"* (Holm et al., 2012).

4.4.4 What aspects of EA do the definitions focus on?

The characteristics of a definition are also called specific elements, traits, or distinguishing details. The central aim of the characteristics is to "*specify the conceptual scope"* of a generic element (Seppälä, 2004). In fact, usually the characteristics provide detailed information which is necessary to differentiate concepts from each other. We then classify the characteristics according to the relationship they have with the generic elements, or with the whole essence of the definition (Seppälä, 2004).

To achieve this objective, we conducted first an investigation concerning which of the traditional 5 W questions—with "How" added—the *characteristics* answer in order to detail the distinguishing traits of the *generic element*. Some corresponding examples are given in the following section.

What*. "Enterprise Architecture (EA) as a strategic information asset base, which defines the business, the information necessary to run the business, the technologies necessary to support the business operations, and the transitional processes necessary for implementing new technologies in response to the changing needs of the business"* (Morganwalp & Sage, 2003).

How. *"Indeed, the Anglo-Saxon world has proposed the enterprise architecture as an efficient* ***solution*** *in terms of modeling business, organizations and enterprise processes"* (Sayeb et al., 2015).

Why. *"An EA is a governance instrument intended to facilitate the translation from corporate strategy to daily operations"* (Foorthuis et al., 2012).

Where. *"EA has tended into a holistic management of information systems in organizational approaches"* (Banaeianjahromi & Smolander, 2016).

Who. *"Enterprise Architecture (EA) refers to the group of people responsible for modeling and then documenting the architecture"* (Shirazi et al., 2009).

When. *"Enterprise Architecture, a discipline with roots back to the 1980s, is […]"* (Meyer & Helfert, 2014).

However, the *characteristics* of most of the definitions answer more than one of these questions at the same time. Many of the *characteristics* include more than one clause. But in order to completely examine and understand the role of the characteristics of a definition—and the role of the whole definition—we considered secondly each clause individually. This exercise allows to group all significant *characteristics* into different categories according to the context they put forward to define EA. We found the following categories.

Function. The *characteristics* classified within this category focus on the purpose and role that EA plays in an organization. Some of these purposes and roles are described in a very explicit way as something useful (beneficial) that EA brings to an organization, in mentioning, for example, the capacity to: "*enable business strategy*," "*facilitate the translation from corporate*

strategy to daily operations," "*achieve alignment between business and technology*," "*improve enterprise communications*," and "*emphasize interoperability and data sharing.*" Some of the other mentioned benefits show a general scope, and are not clearly described such as the ability to: "*achieve organizational performance goals*," "*describe an enterprise*," "*attempt to integrate, govern and analyze enterprise elements*," "*be significant to the enterprise management and development functions.*"

Principle. The *characteristics* classified in this category focus on a rule, belief, or conception concerning the function of a complex system and organization used in EA. Some examples of the principles mentioned in the extracted definitions are: "*holistic way*," "*elements of internal and external business environment,*" and "*an assembly of parts that work together in a coherent and well-defined way*".

Components. The *characteristics* classified within this category focus on the parts of an organization on which the function or the principles of EA have an effect. "*Goals*," "*visions*," "*strategies*," "*governance*," "*business*," "*organizational structures*," "*tasks*," "*activities*," "*information systems*," "*technological infrastructure*," and "*environment*" are some examples of the components mentioned in the extracted definitions.

Type. The *characteristics* classified in this category focus on the type of discipline EA is. "*Model-based IT and business management*," "*system of systems*", and "*enterprise systems engineering*" are some examples of the type of discipline mentioned in the extracted definitions.

History. The *characteristics* classified within this category focus on the year range corresponding to a significant event which happens in EA which is important to be included in its definition.

Some corresponding examples for the previous categories are given in the following section.

*"Enterprise Architecture, a discipline with roots back to the 1980s[*1]"* (Meyer & Helfert, 2014).

*"Enterprise architecture is a model-based IT and business management[*2] discipline"* (Per Närman et al., 2012).

*"Moreover, Bernard describes EA as the analysis and documentation of an enterprise in its current and future states[*3] from an integrated strategy, business, and technology perspective[*4]"* (Lee et al., 2016).

*"Enterprise architecture (EA) is a new approach that organizations should practice to align[*5] their business strategic objectives with information and communication technology(ICT)[*6]"* (Najafi & Baraani, 2012).

*[*1] History [*2]Type [*3]Principle [*4]Components [*5]Function [*6]Components*

Figure 4.2 presents a thematic tree of EA definitions which is a summary of the breakdown of the extracted definitions and the different categories found for each part of this breakdown, as detailed in the previous sections.

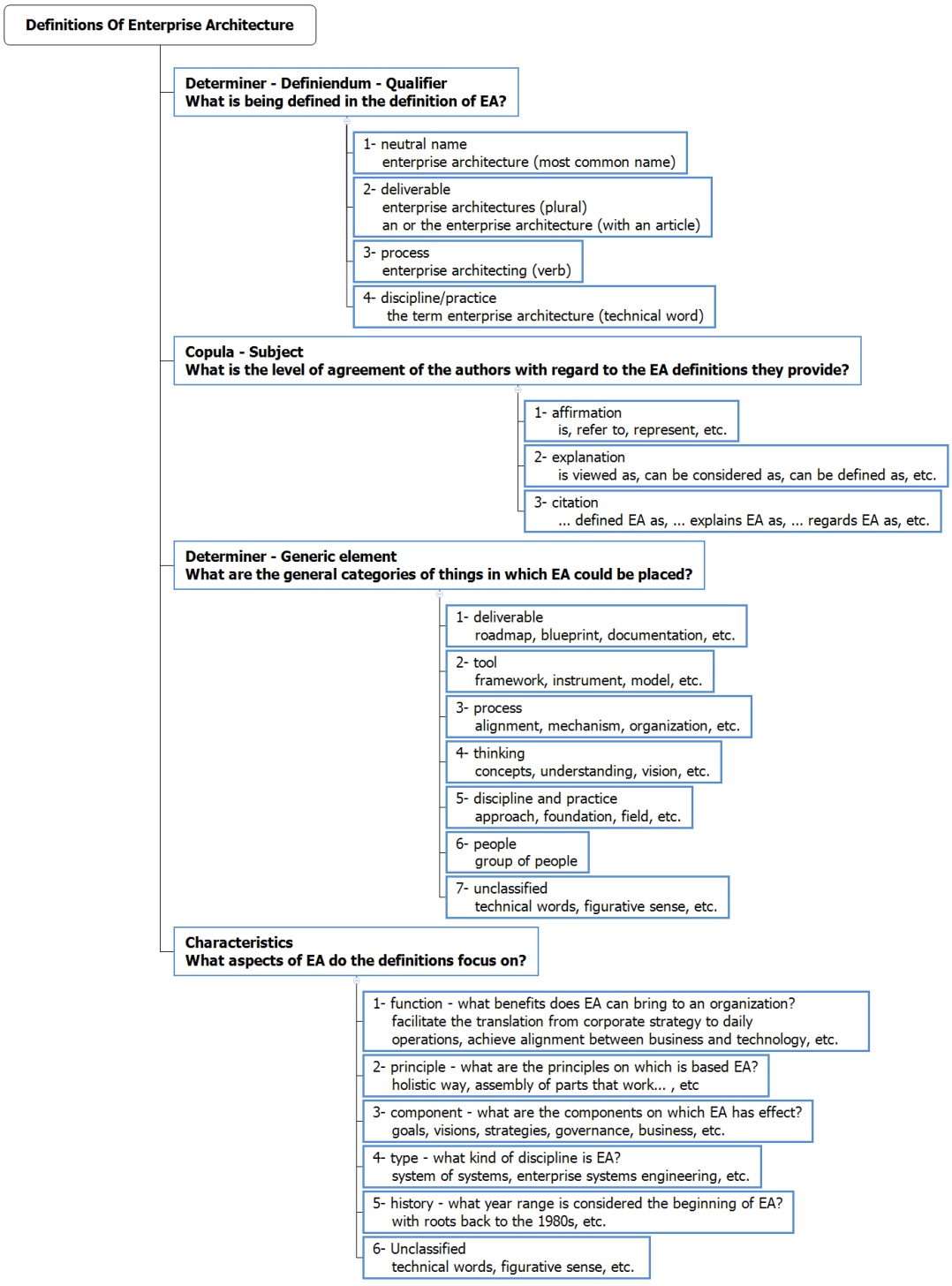

Figure 4.2 Thematic tree of EA definitions

4.4.5 What does the evolution of definitions of EA look like?

The investigation of the similitude between the EA definitions analyzed provides another good insight that can be used to understand the lack of agreed-upon definition in EA. In fact, the original definitions (originating from a specific source) are regularly modified over time when other authors use them in their articles, with or without a citation. While some of the modifications do not have an effect on the meaning of the definition, other changes greatly affect the meaning of the definition. For example, as part of an article (an/the) placed before EA, some definitions that use EA as a noun are very similar to others that used EA as a general word (singular form, without a/the). Figure 4.3 presents the evolution of the most repeated definitions to provide a better idea concerning this issue.

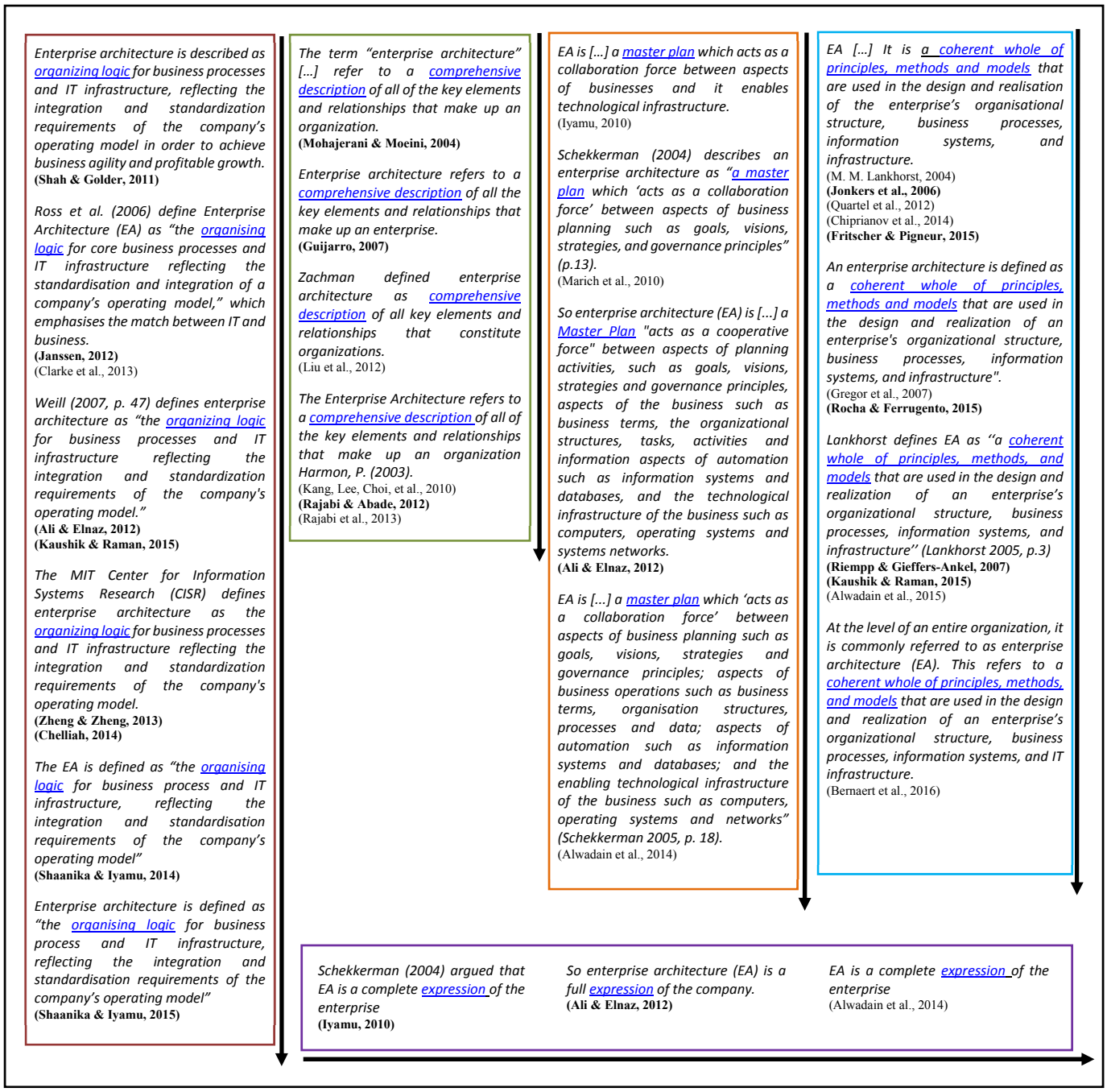

Figure 4.3 Evolution of some EA-definitions

4.5 Discussion

Considering the investigation of the *definiendum* which does not always present EA in the same way—as a noun, or a verb, in singular and plural form, as a term, a concept, or a general word (neutral)—it seems there is no agreement with regard to the nature of the words "enterprise" and "architecture" or the expression "enterprise architecture". In fact, how these two words or this expression could be describing as the same thing if people do not understand or used them in the same way? In fact, how is it possible to know whether EA definitions are talking or not about the same thing—the same EA—with the existence of many definiendum (verb vs noun vs neutral…) which refer to EA?

Considering the investigation of the *copula,* which provides good insight concerning whether an author agree or not with the definition she/he provides (affirmation, explanation, citation), it is clear there is no type of accepted knowledge representation in EA. In fact, approximately 20% of the 160 definitions extracted in the articles mention clearly one or more references as the proprietary/ies of their definition. Twelve percent of them are explanations and sometimes present references with their definitions. Another observation that corresponds to this information is that an article does not obligatory includes just one definition. Many of the selected articles include more than one definition. Often, these definitions are not necessarily complementary, as well as they do not obligatory have the same scope, as mentioned in (Lapalme, 2012). However, approximately 42% of the 305 articles that satisfy the selection criteria do not include a definition to introduce EA. This observation has incited to ask how academia and practitioners are comfortable to describe what EA is.

Considering the investigation of the *generic elements* which provide good insight concerning the class of things in which EA can be placed, it is obvious that there are different perceptions of EA (deliverable, tool, process, people, discipline) and the elements that compose each of these perceptions are not always complementary. Some of these perceptions may, however, be complementary. For example, when an author describes EA as a discipline/practice while another one describes it as a tool, it is understandable because tools have usually been used for

practicing a discipline. On the other hand, it is completely different when an author describes EA as a process while another one describes it as an outcome, because an outcome is the deliverable of a process. One can often say that the work of EA within an organization could be conducted completely by consultants who provide guidelines, roadmaps, and plans for the deliverables, which the organization can execute in its own way, while someone else is saying that EA work must be conducted by a team of professionals who are permanent fixtures in the organization in order to avoid focusing only on plans, and making sure to focus also on the execution of these plans and their role in the regular decision-making and management of human relationships (process).

Considering the analysis of the definitions' *characteristics*, it has become even more obvious that there are different perceptions of EA. This analysis shows what kind of information (What? How? Why? Where? Who? When?) the authors want to provide with their definition. Should all the traditional 5 W questions (and the added "How" question) have to be answered in order to provide a complete definition? Also, the difference between the elements of the different categories (function, principle, components, type, and history) found to be the focus of the definitions shows what aspect of EA the definitions put forward in order to describe it. Further, the elements that compose each of the perceptions of the characteristics sometimes lacking similarities. For example, while some elements in the category principle refer to a *holistic* vision of the organization, others refer to a *reductionist vision*. This is the same thing when some elements of the category principle present EA as a discipline or practice which intervenes on *well-defined components* of the organization, while others talk about *complexity* that does not always allow a component to be well defined.

Considering the importance of the differences presented in the different parts of the EA definitions, it is necessary to mention that, in an individual context, some of the definitions found in the EA literature are implicit, incomplete, complex, and incoherent.

- Implicit, because the words used to describe "EA" in these definitions are technical words, or intended to be understood in a figurative sense. That is to say, it's possible

for people to interpret these definitions differently. The following definitions are examples:

> *"Zachman regards enterprise architecture as the determinant of survival in the Information Age in order to deal with increased complexity and change of enterprises"* (Hinkelmann et al., 2016).
>
> *"Schekkerman (2004) argued that EA is a complete expression of the enterprise"* (Iyamu, 2010).

- Incomplete, because these definitions alone cannot provide a complete description of what EA is, even if the words used are not meant in the figurative sense. The following definition is an example:

> *"The EA is a base of strategic information asset, which defines the mission, the information needed to carry out the mission, the technology required to perform the mission, and the transition process of the implementation of new technologies in response to the evolving of the mission"* (El Haloui, Kriouile, & Kriouile, 2015).
>
> One might ask, "What mission?"

- Complex, because the structure of these definitions does not facilitate easy reading and understanding. The number of generic elements present in the definition, the presence of one or more qualifiers or determiners along with the definiendum, the generic elements and the linking verb, and the use of many clauses in the definitions' characteristics can contribute to the complexity of these definitions. The following definition is an example:

"EA is a complete expression and a general schematization of an enterprise works as a cooperator in different aspects of working schedules (i.e. purposes, strategies, viewpoints, governmental beliefs),working activities (i.e. working relationships, the organization of enterprises, duties, activities and information), aspects of control and guidance (i.e. information systems and data bases), and infrastructure of making able which have work technology (i.e. computers, working systems, networks)" (Rouhani & Kharazmi, 2012).

- Incoherent, because the different parts (definiendum, copula, generic element…) of these definitions seem to be incompatible. The following definitions are examples:

"EA is a discipline that analyzes the services offered by an enterprise and its partners to the customer, the services offered by the enterprise to its partners and the organization of the enterprise itself and of its IT " (Lê & Wegmann, 2013).

The generic element discusses a discipline while the characteristics show a tool…
Maybe it would be different with another structure, like:

"a discipline that provides a set of principles, methods, models and tools used to analyze the services…"; or "*EA is a technical mechanism which defines the role of the business, information, technical and application architectures that best enable the business needs of the enterprise, and it provides the migration plan which moves the enterprise from the current to the future architecture*" (Tatnall, 2013).

Technical mechanism as a generic element refers to a process that often focuses on actions. But the characteristics seem to relate instead to deliverables, such as plans, instead of focusing on the process moving the enterprise from a current to a future architecture.

Considering all the observations described in the previous sections, it is not surprising how several researchers and practitioners affirm that EA holds a fragmented literature. As can be seen, there are important differences between EA definitions and sometimes these differences can become divergences. Moreover, an evocation of the existence of many perspectives in EA is usually used to introduce many of the definitions. To deal with this problematic, some authors avoid giving a new definition of EA or do not present only one definition, but a mixture of referenced definitions.

However, from a person to another, individual understandings of the significance of EA can vary. As a result, confusion, misunderstanding and conflicts can easily arise because of the existence of various EA definitions. In this context, it can be hard to structure an EA baseline of knowledge and to identify the mission and responsibility of each type of EA practitioners (Lindström et al., 2006). It can also be hard to identify the advantages organizations gain in practicing EA because from one perspective to another one these advantages can be understood differently (Foorthuis et al., 2016). And how the advantages EA brings to an organization can be measured (Nikpay et al., 2016) when there is no common understanding concerning what is being measured? This problematic of non-agreed understanding of EA can also be challenging for academic or professional researchers because their findings of their studies can be understood as they are. In fact, "*without a common structure and a core theory",* consider EA as a "*legally recognized and generally accepted*" (Walrad et al., 2014) study and practice area will always be complicated. EA team members must be clear concerning the definitions of EA, even if there are many perspectives, in order to be able to communicate, collaborate (Banaeianjahromi & Smolander, 2017), and reasonably well work together. All the perspectives must contribute in order to achieve this objective.

Finally, it is worth mentioning that the purpose of this investigation is different than evaluate or indicate what the structure or the content of best EA definitions is. In a general way, this investigation does not also have the objective to specify how to structure a formal terminological definition. Moreover, the field of terminology itself *"seems facing many theoretical and methodological challenges"* (Seppälä, 2005) concerning how to build a

definition. Also, analyzing only the definition of EA extracted in an article does not generate enough information to identify the perspectives of "EA" reflected in the whole article. It would not be surprising to see that the perspectives presented in the article as a whole differ from the perspectives reflected by the definition of EA it provides. In fact, according to some conversations with several authors in the context of this research, maybe authors do not always pay enough attention to the definition they provide for EA in their research reports. Some of the definitions analyzed within this study also demonstrate this. The section that presents the evolution of EA definitions provides good insight concerning this situation. This study wants to intervene precisely in this context. Both researcher and practitioner could take this investigation into account in order to pay more attention to the definition of EA they provide when they produce a new article in the EA literature. As in any other field, the definition of "EA" plays an important role because it represents the first thing people look at when they want to understand what "EA" is.

On the other hand, even when the authors are aware of the perspectives reflected by the definitions of "EA" they provide, the purpose of this investigation is still not to indicate what the best definition of EA is.

In summary, the EA community seems to face the same challenge the Strategy and the Management communities faced in the past. Multiple perspectives, including incompatible ones, were described in the literature of these communities many decades ago. But a meta-analysis of the situation was conducted in order to provide insights to the situation. As a result, some important findings and creations have contributed to providing a much deeper comprehension of these assumptions. The “Theory X and Theory Y model” (McGregor, 1957) for management, as well as the “ten strategy schools of thought” (Mintzberg, Ahlstrand, & Lampel, 1998), are among the key findings and creations. Even if differences and divergences still take place within those communities today, but there is a much deeper comprehension of the surface underlying assumptions which cause the description of many perspectives in the literature.

Similarly, the EA community has already started to address this situation in scientific way (Lapalme, 2012) ; (Korhonen & Poutanen, 2013) ; (Preez et al., 2014) ; (Saint-Louis & Lapalme, 2016) ; (Saint-Louis et al., 2017) ; (Rahimi et al., 2017). But to date, it is clear that the studies that have prioritized to address the problematic related to the existence of various perspectives in EA do not seem to be commonly accepted yet. A meta-analysis of this problematic must continue to be conducted.

However, the existence of various definitions of EA does not represent a problem because it also provides a broader view that covers all aspects of the discipline. The problem is how these various definitions are used in order to conduct research intended to provide a much deeper and unified understanding of EA.

4.6 Conclusion

This study used the methodology proposed by the Systematic Literature Review in order to selected 102 journal articles from different digital libraries. 160 definitions of EA were extracted from these articles and additional sources. Based on concepts from the discipline of terminology, we have broken down each definition into many parts in order to be compared. This strategy facilitates deeper analysis of EA definitions and provides an in-depth understanding of the extent and nature of their differences.

Many differences and divergences between the definitions of EA were found, and sometimes their nature is significant. In fact, the results of this investigation show how some of the definitions found in the EA literature are implicit, incomplete, complex, and incoherent. This situation indicates how it is urgent to take all the existing EA perspectives into account in order to structure them into a common reference, and in turn make EA a more mature discipline.

In terms of contributions, this study provides to practitioners and researchers more structured knowledge that helps to identify and categorize potential factors contributing to the differences

in the EA definitions. This could help to pay more attention when providing a new definition of EA. This study also provides a novel analysis approach to researchers, guided by linguistics models and thematic analysis, to analyze definitions and conduct forward investigations.

This study also provides knowledge to practitioners concerning the different perspectives that exist in the discipline of EA. In fact, the results of this study provide more knowledge to organizations in order to help them choose the EA definitions that are more appropriate to them. It is evident that an organization that is focused on the process to conduct EA will consider "enterprise architecting" more appropriate to designate EA. While another organization which is focused on the specific deliverables that EA can provide - such as planning, roadmaps and process design - will find more appropriate to talk about "an or the enterprise architecture" or "enterprise architectures." This will also help them to hire corresponding team members and consultants, according to their appropriate EA definitions. The perspectives indicated in the EA definitions which are appropriate to an organization will also influence the tools that the EA practitioners of this organization will use to achieve or conduct EA. In summary, the different EA perspectives found in the EA definitions analyzed in this study will provide more knowledge to EA practitioners in order to help them identify the definitions that are more appropriate to their own EA perspectives.

In terms of limitations, only explicit definitions were considered within this study. It would be interesting to calculate the inter-coder agreement coefficient, such as Krippendorf alpha (B. Kitchenham & Charters, 2007), during the classification process of each part of the definitions in order to increase the validity of this study. According to the citations and original sources of each definition, it would also be interesting to draw attention to the existing liaisons between the definitions in order to evaluate the evolution of the lack of agreed definitions. Another interesting step could be the classification of the definitions according to other aspects such as underlying epistemological, ontological, and praxeological belief systems in order to better highlight their similarities/dissimilarities. It would also be interesting to compare the belief systems shown in the whole content of each article and the belief systems shown in the definitions provided in order to evaluate their degree of coherence. The proposed analysis

model can also be converted into computer software and be used to further analyze terminological definitions in any other field.

CHAPTER 5

IDENTIFICATION OF THE MAJOR ENTERPRISE ARCHITECTURE PRACTITIONERS' WORLDVIEWS

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5.1 Introduction

The discipline of Enterprise Architecture (EA) suffers from a lack of common understanding and terminology (Schöenherr, 2008). Different meanings of EA may be found in the literature (Mentz, Kotzé, & Van der Merwe, 2012) ; (Bidan, Rowe, & Truex, 2012). In addition, there is little knowledge available concerning the successful use of EA and its related outcomes (Lange et al., 2016).

This lack has several negative impacts. For example, confusion and conflicts concerning the responsibilities of EA practitioners can occur, especially when EA team members are not aware of the various perspectives concerning the different meanings of EA. Such a situation can also prevent collaboration between EA practitioners, stakeholders and other participants. It will also be difficult to provide universal training to future practitioners in the absence of shared meaning and common foundations (Saint-Louis & Lapalme, 2016).

Several authors have discussed the lack of common understanding and terminology regarding EA and its impact on their studies, even if it is not their primary focus. A few studies have tried to shed some light on the extent of the situation by identifying and describing the major EA schools of thought (Lapalme, 2012) ; (Korhonen & Poutanen, 2013) ; (Preez, Merwe, & Matthee, 2014). Those studies offer relevant insights but they all have methodological

limitations. This study aims to fill this gap. The contributions of this study are twofold. Firstly, it contributes knowledge by identifying and characterizing more preciously the worldviews of EA practitioner compared to previous studies. Secondly, it makes a methodological contribution about the study of EA worldviews: how to collect data and analyse it such a way to minimize the biases of the researchers conducting the study.

The rest of this article is structured as follows: the research background is presented in the next section, followed by the methodology. The subsequent section presents the findings. Then, discussions concerning the findings and the contributions are presented. The last section covers the conclusion, limitations, and field for future work.

5.2 Research Background

To explore the lack of common understanding in EA, (Doucet, Gotze, Saha, & Bernard, 2008) proposed a taxonomy of EA including three independent but not mutually exclusive modes which represent progression in thought and practice of EA. Their study provides a matrix that shows the distinguishing characteristics of the three modes, including the strategic drivers (why to conduct, apply… EA?), the locus of control (who leads EA program?), the metrics (how EA is measured?), and the benefits and outcomes (what does EA provide?) of each mode.

(Lapalme, 2012) proposed three major schools of thought underlying the literature on EA. The study provides a matrix showing the differences between the three schools of thought through the description of their characteristics, such as their motto, objectives, concerns, principles and assumptions, skills, challenge, insights, and limitations.

Based on the three modes of EA (Doucet, Gotze, Saha, & Bernard, 2008), the previous three schools of thought (Lapalme, 2012), and other ontological and epistemological assumptions, (Korhonen & Poutanen, 2013) have proposed a tripartite approach to EA. In effect, (Korhonen & Poutanen, 2013) have affirmed that architectural work should be separated into three

different interlinked architectures which each have their own scope and require their own methods and tools.

Based on the three schools of thought (Lapalme, 2012), (Preez et al., 2014) conducted a survey with authors, practitioners, academics and consultants, and presented seven major beliefs in EA. This reaffirms the existence of the previous three EA schools of thought, but also identifies an additional four schools of thought. The characteristics of each of the identified schools of thought will be described at the end of the findings section.

However, none of the previous studies employed a rigorous methodology to conduct their analysis and support their findings and interpretations. For example, (Doucet et al., 2008) only present the three modes of EA without indicating where they come from. In the same line of ideas, (Lapalme, 2012) proposes a short list of authors who correspond to each of the three schools of thought on EA but does not provide enough information concerning the literature review process. Also, (Korhonen & Poutanen, 2013) indicate that each of the three interlinked architectures is based on different ontological and epistemological assumptions, but do not provide information concerning their correspondence to the EA literature or practice, nor the analysis process. Finally, (Preez et al., 2014) conducted a survey which is biased because it asks respondents to answer following existing EA frameworks, models, and maturity stages, without taking into account the underlying assumptions behind these frameworks and models. Consequently, there is evidently a need for deeper investigation of the lack of common understanding in EA and this study aims to satisfy this need.

This study has two goals. First, it empirically identifies and characterizes the EA practitioners' major worldviews regarding the organizations and the people within them and compare them with the existing EA belief typologies. Second, it provides significant directions to researchers through the rigour of the survey strategy followed, the data analysis techniques used, and the methodological questions raised.

5.3 Research method

5.3.1 Theory and Research Questions

A worldview is "*a basic set of beliefs that guide*" (Creswell, 2015) the understanding of EA practitioners regarding the nature of the organizations and the people within them. EA practitioners have described or applied EA differently because they do not share the same worldviews. To identify the major "concepts" (elements) of each EA worldview and their "characteristics" (particularities), the three following models related to epistemological or ontological assumptions were used.

The first model, the World Hypotheses, classifies how people account for the world they live in and perceive events (Pepper, 1942). This model proposes four basic perceptions including 'Formism, Mechanism, Contextualism and Organicism.' The common properties of 'Formism and Mechanism' provide an analytic approach according to which "*a whole system is reducible to its parts, which are basic.*" The common properties of 'Contextualism and Organicism' provide a synthetic approach according to which "*a whole system is basic and cannot be reduced to its parts*". On the other hand, the common properties of 'Contextualism and Formism' provide a dispersive approach according to which "*Facts are not related by assumption but when they are found to be so. Chance is accepted and order is not categorical.*" The common properties of 'Mechanism and Organicism' provide an integrative approach according to which "*Facts are related by assumption. Chance is denied and order is categorical.*"

In summary, this model provides three of the "concepts" of the worldviews surveyed in this study, including "future, operations, and vision", as presented in Figure 5.1.

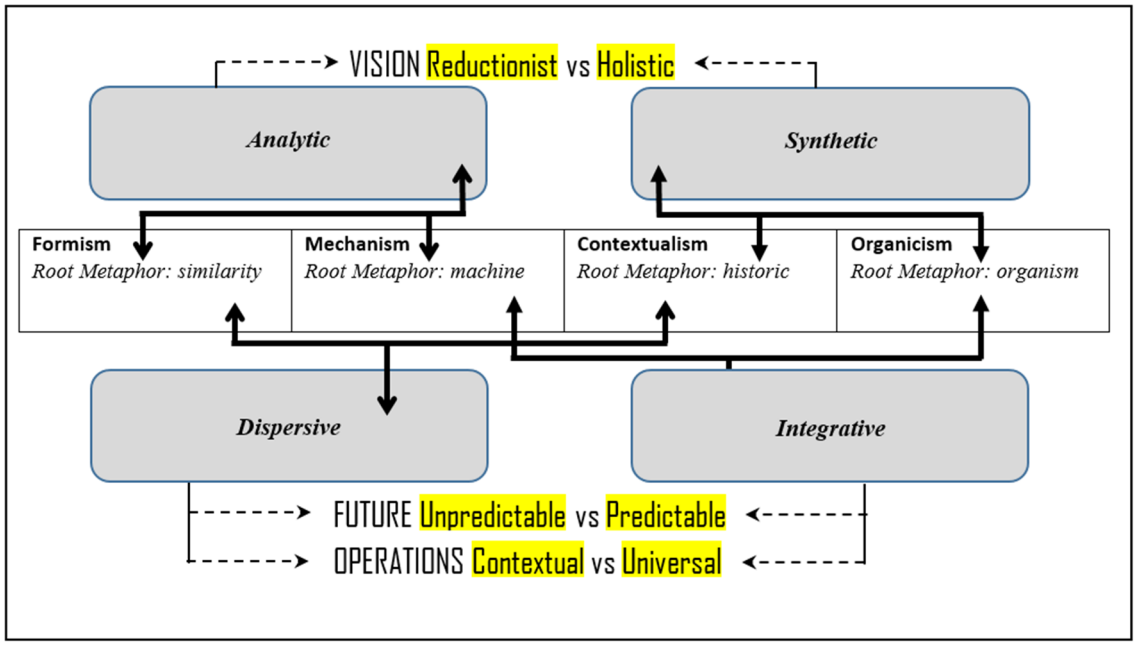

Figure 5.1 Concepts derived from the World Hypotheses

The second model, the System of Systems Methodologies, is for classifying problem situations and problem solving methodologies within a system (Jackson and Keys, 1984). This model proposes two basic system contexts including "Simple" and "Complex." The "Simple" context corresponds to "*a system which includes a few subsystems which do not mutually influence each other very,*" and the "Complex" context corresponds to "*a system which includes a large number of subsystems which mutually influence each other very much.*" Furthermore, this model proposes three basic participant contexts including "Unitary, Pluralism and Coercive." In the "Unitary" context, the participants share "*similar values, beliefs and interests" within a system.* In the "Pluralism" context, the participants share "*different values and beliefs, even if their basic interests are compatible.*" In the "Coercive" context, the participants share "*conflicting values and beliefs, and few interests.*"

In summary, this model provides three of the "concepts" of the worldviews surveyed in this study, including "decision-making," "people's concerns," and "system", as presented in Figure 5.2.

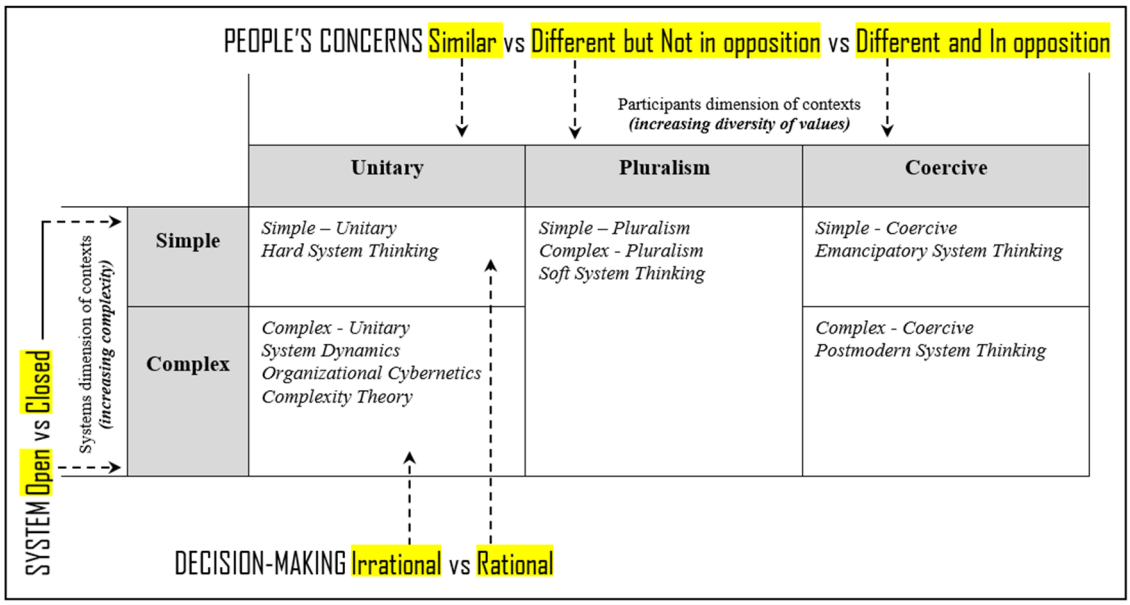

Figure 5.2 Concepts derived from the System Of Systems Methodologies

The third model, the Cynefin Framework, is for classifying the dynamics of situations, decisions, perspectives, conflicts, and changes within a system, (Kurtz & Snowden, 2003). This model proposes five basic situations including "Known, Knowable, Complex, Chaos and Disorder." "Known" corresponds to a system where "*cause and effect relationships are linear*" and knowable by everybody. "Knowable" corresponds to a system where "*cause and effect relationships may not be fully known, or they may be known only by a limited group of participants.*" "Complex" corresponds to a system where cause and effect relationships may not be known because the number of components of the system and the number of relationships between them "*defy categorization or analytic techniques.*" "Chaos" corresponds to a system where "*there are no such perceivable relationships between cause and effect.*" "Disorder" is

placed in the centre of the previous four situations and corresponds to "*conflict among decision makers who perceive the same situation from different points of view.*"

In summary, this model provides one of the "concepts" of the worldviews surveyed in this study, which is "cause-and-effect", as presented in Figure 5.3.

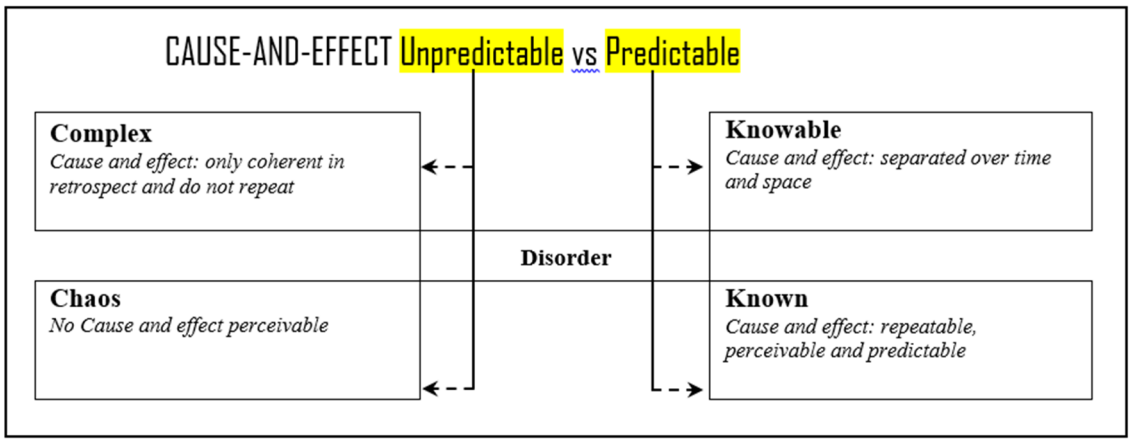

Figure 5.3 Concepts derived from the Cynefin Framework

In conclusion, Table 5.1 presents the context of the "concepts" derived from the previous models and included as the components of the worldviews surveyed in this study, their "characteristics", and their "sources".

Table 5.1 Context of the concepts selected and their characteristics

References	Context	Concepts and their Characteristics
(Pepper, 1942)	*-Does EA prioritize enhancing organizational capacity for adaptation (**Unpredictable** future), OR developing plans and targets (**Predictable** future), in order to predicting the future of the organization?*	Future – Predictable or Unpredictable
	*-Does the functioning of an organization operate similarly to other organizations (**Universal** operations) OR should they be adapted to the context of the organization (**Contextual** operations)?*	Operations – Universal or Contextual
	-Does EA work organizationally "function by function" *(**Reductionist** vision) OR consider the organization in its entirety, even if work concerns mainly a specific function of the organization (**Holistic** vision)?*	Vision – Reductionist or Holistic
(Jackson & Keys, 1984)	*-Do the culture, habits, beliefs and previous experiences of individual EA practitioners influence OR not the decision-making process of their group within the organization (**Irrational** versus **Rational** decision-making)?*	Decision-making – Rational or Irrational
	*-Do the individual opinion, beliefs and concerns of the members of an organization concerning its functioning correspond naturally (**Similar** concerns), not correspond but are compatible (Different concerns but **Not In opposition**), OR not correspond and are incompatible (Different concerns and **In opposition**)?*	People's Concerns – Similar, or Different but Not in opposition, or Different and In opposition
	*-Does the organization represent a system which is influenced only by its internal environment (**Closed** system) OR a system which also influenced and can be influenced by its external environment (**Open** system)?*	System – Closed or Open
(Kurtz & Snowden, 2003)	*-Can the causes of the events that may affect an organization be identified and understood (**Perceptible** cause-and-effect relationships) OR not (**Imperceptible** cause-and-effect relationships) by the EA function which expends the necessary efforts?*	Cause-and-effect – Perceptible or Imperceptible

5.3.2 Data collection

To identify and characterize the EA practitioners' worldviews according to the "concepts" presented in Table 1, an opinion survey was conducted with EA practitioners around the world. In this regard, the guidelines of (Kline, 1986) and (Dillman, Smyth, & Christian, 2016) were followed to create a self-administered questionnaire.

The first part of the questionnaire collected information concerning the EA practitioners' worldviews regarding organizations and the people within them (actives variables). Three (for two characteristics) or four (for three characteristics) questions were asked for each "concept" in order to test the coherence of the responses. The "characteristics" with the largest occurrence for each "concept" (2/1 or 3/0, and 2/1/1 or 3/1/0 or 4/0/0) were considered the final responses for each respondent. The second part of the questionnaire collected information concerning the background of the respondents and their sociodemographic context (supplementary variables), for example their current role and their number of years of experience in EA. All of the questions were phrased in a closed ended format using a Likert scale and predefined answers (Kline, 1986). However, the questionnaire included a comment section to let the respondents add additional information.

Three pilot tests of the survey were conducted with twenty-six collaborators from academia and industry. These pilot tests helped us refine the questionnaire and ensure its content validity (Kline, 1986). The final anonymous questionnaire — in accordance with required ethical conditions — was distributed via the online survey tool Checkmarket from January to February 2018. The hyperlink was posted in the LinkedIn pages of the second author, the Association of EA, and the EA Network because these professional social media pages are frequently followed by many EA practitioners. No specific sample was expected given the exploratory nature of the study; sampling is a concern doing inferential statistics.

5.3.3 Data Analysis

Using various models about the nature of reality to analyze the lack of common understanding and terminology in EA posed various methodological challenges that had to be addressed.

Firstly, converting the "concepts" described in the models used to formal questions was challenging. Rather than asking respondents to answer questions composed literally with the descriptions found in these models — which often used technical words — the questionnaire included hypothetical scenarios which tried to put the models in a real-life context. For example, rather than asking, "*Do you consider an organization as an open or a closed?*" they had to answer the following question: "*How useful is it for an EA function to seek information about the evolution of the external environment of its organization for consideration in decision-making?*" This strategy helps reduce bias because the respondents cannot easily link the questions to the contexts of the models used, even if they know these models.

Secondly, finding a way to let the respondents answer questions without putting them in a situation where they feel they are taking a test was another challenge. Using "closed ended questions" was one of the strategies applied to address this challenge because it provides the same possible answers to all the respondents. Using "Likert scales" was another strategy applied because they invite respondents to only indicate their level of agreement/disagreement (i.e.: strongly agree, agree, disagree) rather than taking radical positions which could make them feel too committed. Another strategy was the variation of the structure and formulation of questions because this motivates the respondents to finish the questionnaire. Finally, several other best practices for online questionnaires were applied in order to address this challenge, such as the limited used of technical words, the inclusion of short questions, the avoidance of double-barrelled questions, etc. (Kline, 1986).

Third, it was important to ensure the reliability of the responses collected. The strategy used was asking more than one question for each "concept," located in different places in the questionnaires. To implement this strategy three questions were sufficient for most of the

variables (“concepts”) which are binary and include two categories (“characteristics”), because this way one of the categories always scores the largest occurrence (ie: 2 for the first category and 1 for the second category; or 3 for the first category and 0 for the second category), and that is considered as the final response. But one of the variables includes three categories (“people’ concerns”) and in this situation there is no way to avoid having any category score the largest occurrence (ie: 1 for the first category, 1 for the second category and 1 for the third category for 3 questions; 2 for the first category, 2 for the second category and 0 for the third category for 4 questions, etc.), which constitutes an unusable response. Four questions were asked for this variable, and one of the questionnaires has been rejected for this reason. Furthermore, it is a good strategy to ask more than one question for each concept of a survey, but each question must also be organized in a way not to allow more than two possible responses to completely reduce the risk of having unusable responses.

Because this study is an exploratory study and the data collected from the survey are categorical, exploratory data analysis techniques are the appropriate statistical techniques to use. Accordingly, Multiple Correspondence Analysis (MCA) and a Hierarchical Cluster Analysis (HCA) were used to analyze the data.

MCA is a factorial data analysis technique which studies categorical or nominal qualitative variables, or quantitative or numerical variables converted in ordinal variables (Benzécri, 1980). Relationships between the rows (observations) and the columns (variables and categories) are synthesized in a matrix and graphically represented “*as points in a low-dimensional Euclidean space, usually of dimensionality two or three*” (Greenacre, 2013). On the other hand, HCA is a clustering data analysis technique which allows us to characterize observations according to a defined similarity/dissimilarity criterion presented in a matrix indicating the distance between observations taken pairwise. Observations are thus clustered iteratively in order to create a tree diagram, usually called dendogram. The truncation of the dendogram provides the number of clusters (Kaufman & Rousseeuw, 2009). Researchers usually use MCA to reduce the number of dimensions with categorical data in large datasets (Arimond & Elfesi, 2001) ; (Panagiotakos & Pitsavos, 2004) ; (Padilla-meléndez & Águila-

obra, 2013) before applying HCA to identify the final number of the clusters included in the data and their characteristics (Bidan et al., 2012) ; (Fink, 2011) ; (Hussin et al., 2017) ; (Eszergár & Caesar, 2017).

The statistical software tool Xlstat, for MS Excel, was used to apply the data analysis techniques. The results were compared to those of other software tools, including Tanagra and Stat Graphics to ensure reliability.

5.4 Findings

5.4.1 Sample profile

Seventy-five respondents fully completed the survey questionnaires and thirty partially completed it. Two of the fully completed questionnaires were rejected because one of them was answered by a student and the other one did not provide a category that scored the largest occurrence when comparing the responses of the four questions related to one of the "concepts." Finally, the data of seventy-three respondents were analyzed to provide the findings.

Most of the respondents are professionals practicing EA within an organization as an employee or consultant. A few of these professionals (16%) also work in academia as a teacher or a researcher. Most of the respondents have intermediate professional experience: they have 6 to 15 years of experience (64.38%), and only a few of them (4.11%) have been working in EA for more than 25 years. A few of the respondents studied in only one discipline area related to Information Technology (17.81%), to a specific area of engineering (5.48%) or to social sciences (12.33%). Most of the respondents have studied in more than one academic discipline. Most of the respondents (78.08%) have been working for the longest time in EA in Australia, Canada, Czech Republic, South Africa, Sweden, United Kingdom and United States.

5.4.2 Identification of the worldviews

The data collected in the first part of the questionnaire (active variables) were structured in a two-dimensional table which includes in the rows the "identification number of the respondents" called observations (i.e. "*id1", "id2", "id3"*) and in the column the "concepts" called variables (i.e. "*system"*). The body of this table includes the corresponding "characteristics" called categories (i.e. "*open"* or "*closed"*). Table 5.2 presents the frequency of each category according to the answers of the respondents.

Table 5.2 The frequency of responses for each concept

Variables	Categories	Counts	Frequencies	%
SYSTEM	closed	3	3	4.110
	open	70	70	95.890
PEOPLE's CONCERNS	in opposition	9	9	12.329
	not in opposition	64	64	87.671
DECISION MAKING	irrational	59	59	80.822
	rational	14	14	19.178
FUTURE	predictable	5	5	6.849
	unpredictable	68	68	93.151
VISION	holistic	65	65	89.041
	reductionist	8	8	10.959
CAUSE-AND-EFFECT	imperceptible	13	13	17.808
	perceptible	60	60	82.192
OPERATIONS	contextual	61	61	83.562
	universal	12	12	16.438

5.4.2.1 Multiple Correspondences Analysis

The first step is the application of a Chi-squared test which confirms a dependency between the rows and the columns of the dataset because the critical value of the test is lower than the

observed value, and the computed p-value is lower than the significance level alpha, as shown in Table 5.3.

Table 5.3 Test of independence between the rows and the columns (Chi-square)

Tests	Results
Chi-square (Observed value)	556.065
Chi-square (Critical value)	200.334
Degree of Freedom	169
p-value	< 0.0001
Alpha	0.05

The second step is the decomposition of the total inertia (eigenvalues) which provides information concerning which axes account for most of the variability in the data, as shown in Table 5.4.

Table 5.4 Eigenvalues and proportion of variance

	Axis1	Axis2	Axis3	Axis4	Axis5	Axis6	Axis7
Eigenvalue	0.219	0.184	0.151	0.132	0.122	0.102	0.090
Variability (%)	21.890	18.423	15.123	13.156	12.229	10.197	8.983
Cumulative %	21.890	40.313	55.436	68.592	80.820	91.017	100.000

Only the first two axes (Axis1 and Axis2) were considered because they provide a cumulative inertia higher than the maximal value of the eigenvalue in terms of the row and column (Bendixen, 1995). This selection also considers that the eigenvalue of an axis most be higher than the inverse of the number of variables ($\mu > \frac{1}{p}$) to be considered significant (Saporta, 2011).

The third step is the computation of the Burt table, which provides the row and column profiles used to summarize the results of the MCA. The data concerning the row and column profiles were analyzed to understand which observations and categories can be interpreted. The higher the contribution is for a selected axis, the more the corresponding category or observation contributes to variability along that axis, and is significant to the interpretation (Greenacre, 2013). As indicated in (Saporta, 2011), only the categories that present contribution higher to their mass if the data were random ($\mathrm{CTR} > \frac{1}{\mathrm{p}}$ X 100) must be considered.

Figure 5.4 presents an asymmetric observation biplot which enables us to interpret the distance between the observations, the categories, and both simultaneously. The categories corresponding to the same variable are in the same colour (i.e. open and closed are in blue). Taking into account the analysis of the row and column profiles, the interpretation of this biplot, which is the last step, is based on the consideration of the following additional key features:

- The distance between the observation points is related to the similarity/dissimilarity of the response-patterns of the survey's participants. A unique point for several participants means their final responses are completely similar (i.e. id30-51-69).
- The distance between the observation points and the category points indicates what category is discriminant/insignificant to these observations.
- The points which are close to the centroid do not sufficiently contribute to the information included within a specific axis. They must be interpreted with caution.

Axis 1 is influenced by the categories "*cause and effect*-imperceptible, *decision making*-rational, *vision*-reductionist, and *future*-predictable". While Axis 2 is influenced by the categories "*system*-closed, *people's concerns*-in opposition and *future*-predictable". This means that these categories significantly contribute along the corresponding axis.

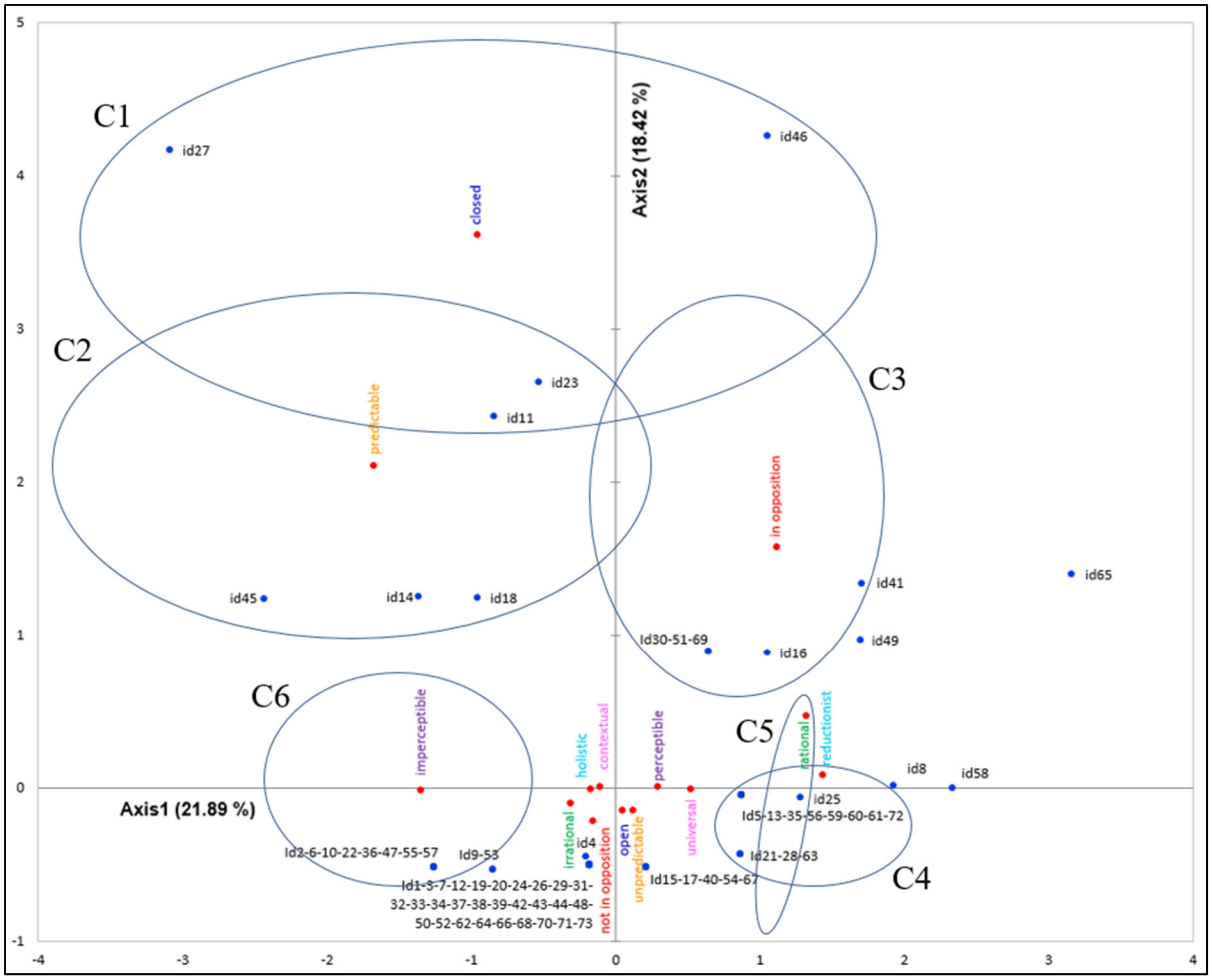

Figure 5.4 Asymmetric observation plot

Finally, Figure 8 indicates the presence of 6 clusters which provide enough distinguishing properties because they are respectively influenced by one of the categories, as indicated in Table 5.5.

Table 5.5 Clusters provided by the MCA

Worldviews	Discriminant variables and categories
C1	SYSTEM Closed
C2	FUTURE Predictable
C3	PEOPLE's CONCERNS Different and In opposition
C4	VISION Reductionist
C5	DECISION MAKING Rational
C6	CAUSE-AND-EFFECT Imperceptible

The categories which are absent from Table 5.4 (i.e. vision-holistic; operations-contextual, etc.) are not sufficiently discriminant to be well positioned in the first two dimensions in order to know if they have influenced a specific cluster. Consequently, these categories could help reduce the dimension of the dataset in order to realize the HCA with only the data which provide enough distinguishing properties. But because this study does not include a large dataset, and only 40.31% of the total variation contained in the data are represented in the biplot, the whole dataset was used to conduct the HCA, which is more precise regarding the other categories.

5.4.2.2 Hierarchical Cluster Analysis (HCA)

The first step is the selection of the algorithm to compute the measure of proximity between each pair of observations from those available in the literature, including the Euclidean distance, the city-block or Manhattan distance, and the Gower distance (Saporta, 2011). Because the observations of this study are described with nominal variables defined with categories, the appropriate algorithm is the Chi-Square distance. The Chi-Square distance is also the distance used in the MCA applied previously. In addition, the Chi-Square distance is commonly used to analyze surveys because with this algorithm the distance between each pair

of observations depends on the global distribution of each category to all the observations. Computing the Chi-Square distance provides a proximity matrix in which the more the distance between each two observations approaches 0, the more these observations are susceptible to creating a new cluster. The distances of this new cluster now have "*to be redefined towards all other clusters*" (Eszergár-Kiss & Caesar, 2017).

The second step is determining how to compute the agglomerative distances, which are the distances between clusters, from amongst those available in the literature, for example the single or complete linkage, or the weighted or unweighted pair-group average. These different agglomerative clustering algorithms can be differentiated by "*the way they define the distance from a newly formed cluster to a certain object, or to other clusters in the solution*" (Mooi & Sarstedt, 2011). Given the objective to have smaller unshared categories among the observations within a cluster and smaller shared categories among the observations within two distinct clusters, and given the previous use of the Chi-Square algorithm to compute the measure of proximity between the observations, the appropriate algorithm to compute the agglomeration proximity distance is Ward's method. Ward's method allows us to form hierarchical groups of objects "*which are maximally similar with respect to the specified characteristics*" (Ward Jr, 1963). Among the agglomerative clustering algorithms, Ward's is the only one that provides clusters which "*minimize within-group dispersion at each binary fusion*" (Murtagh & Legendre, 2014).

In summary, "*each observation starts in its own cluster, and pairs of clusters are merged as one moves up the hierarchy*" (Rokach & Maimon, 2005). This aggregation of the observations provides the dendogram presented in Figure 5.2. The truncation was placed on this dendogram where "*it provides the best partitioning and representation of intra-cluster relevance and inter-cluster distance*" (Bidan et al., 2012) ; (Chan & Lai, 2011), specifically where at least one characteristic differentiates each cluster from the others, and where at least one characteristic is common to the observations of the same cluster. As a result, this provides 9 clusters — including the 6 clusters ("C1 to C6") found from the MCA — as presented in Table 5.5 which

shows the distance (dissimilarity), the components (observations) and the structure of these clusters.

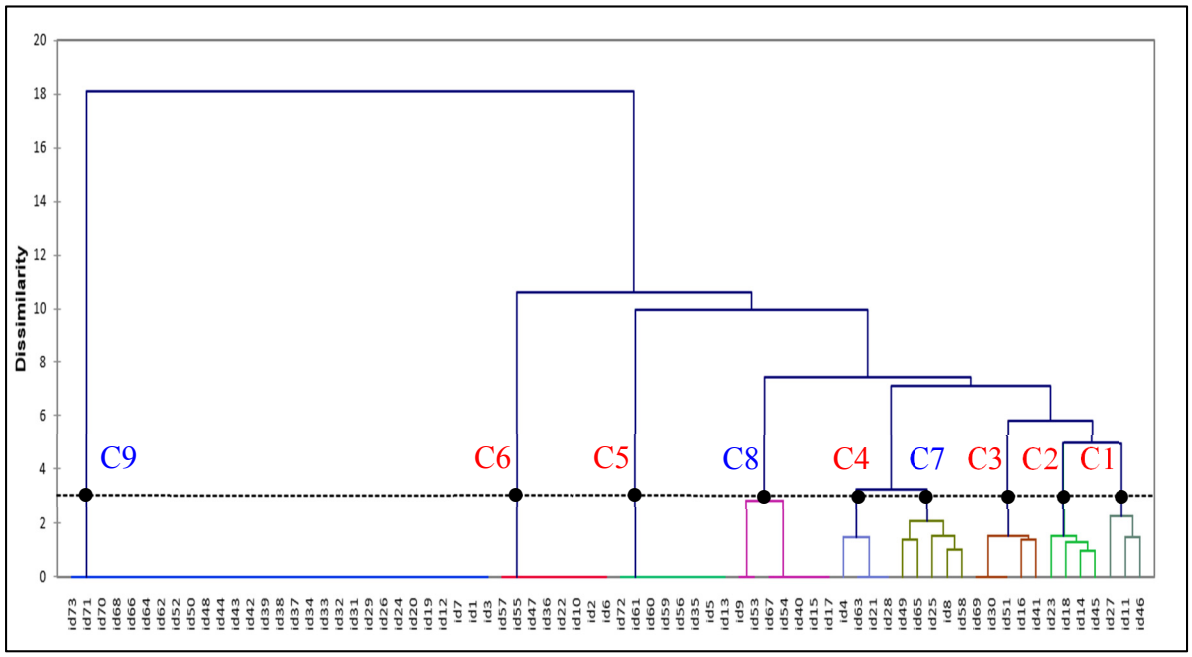

Figure 5.5 Dendogram of the observations

Table 5.6 presents the properties of the clusters. The cluster centroid is the observation which presents the minimal distance to all the other observations within the same cluster. Consequently, when all the observations of a cluster are identical (i.e. “C9, C6 and C5”) the centroid does not exist in reality. The minimum, average, and maximum distances to the centroid indicate how the observations within a cluster are close or distant from each other, to detail the within-cluster variance. Observing Table 5.6 indicates that there is more homogeneity within “C8, C4, and C3” than in “C7, C2, and C1”.

Table 5.6 Intra-cluster characteristics

	Clusters								
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**
Number of observations (n)	3	4	5	4	8	8	5	7	29
Percent of observations	4%	5%	6%	5%	11%	11%	6%	9%	39%
Within-cluster variance	2.66	1.50	0.80	0.50	0.00	0.00	2.00	0.47	0.00
Minimum distance to centroid	0.94	0.61	0.40	0.35	0.00	0.00	0.89	0.40	0.00
Average distance to centroid	1.30	1.03	0.70	0.53	0.00	0.00	1.23	0.57	0.00
Maximum distance to centroid	1.49	1.17	1.16	1.06	0.00	0.00	1.67	1.01	0.00

The last step concerns the identification of the categories which influence each of the clusters as presented in Table 5.7. Observing this table shows that at least one category influences each cluster, except clusters C7 and C9. In fact, when the value of a category equals 1, all observations of the corresponding cluster include this category. The more this category is present in fewer clusters, the more it represents a discriminant category which differentiates the cluster where it presents the value 1 to the other clusters. The values of the categories that are in such a situation, and then influence a cluster, have been highlighted in Table 5.7.

Table 5.7 Cluster centroid

	Clusters / % of observations								
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**
closed	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
open	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
in opposition	0.33	0.25	1.00	0.00	0.00	0.00	0.40	0.00	0.00
not in opposition	0.67	0.75	0.00	1.00	1.00	1.00	0.60	1.00	1.00
irrational	0.67	1.00	0.80	1.00	0.00	1.00	0.20	1.00	1.00
rational	0.33	0.00	0.20	0.00	1.00	0.00	0.80	0.00	0.00
predictable	0.33	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
unpredictable	0.67	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
holistic	1.00	1.00	1.00	0.00	1.00	1.00	0.20	1.00	1.00
reductionist	0.00	0.00	0.00	1.00	0.00	0.00	0.80	0.00	0.00
imperceptible	0.33	0.25	0.00	0.25	0.00	1.00	0.00	0.29	0.00
perceptible	0.67	0.75	1.00	0.75	1.00	0.00	1.00	0.71	1.00
contextual	1.00	0.75	0.80	1.00	1.00	1.00	0.40	0.00	1.00
universal	0.00	0.25	0.20	0.00	0.00	0.00	0.60	1.00	0.00

Finally, Table 5.8 presents the 9 clusters found from the HCA, including 7 among them (C1 to C6 and C8) which provide enough properties to distinguish them from each other because one of the categories influenced them more than any other cluster.

On the other hand, C7 and C9 did not provide enough properties to distinguish them from the others.

Table 5.8 Clusters provided by the MCA

Worldviews	Discriminant variables and categories
C1	SYSTEM Closed
C2	FUTURE Predictable
C3	PEOPLE's CONCERNS Different and In opposition
C4	VISION Reductionist
C5	DECISION MAKING Rational
C6	CAUSE-AND-EFFECT Imperceptible
C7	- - -
C8	OPERATIONS Universal
C9	- - -

5.4.3 Interpretation of the worldviews

According to the results of the MCA and the AHC, the major worldviews in EA can be summarized as presented in Figure 5.6. The cases which include two characteristics (i.e.: Imperceptible or Perceptible) indicate that they can both be present in the corresponding worldview.

World views	SYSTEM	PEOPLE's CONCERNS	DECISION MAKING	FUTURE	VISION	CAUSE-AND-EFFECT	OPERATIONS
C1	**Closed**	In opposition **or** Not in opposition	Irrational **or** Rational	Predictable **or** Unpredictable	Holistic	Imperceptible **or** Perceptible	Contextual
C2	Open	In opposition **or** Not in opposition	Irrational	**Predictable**	Holistic	Imperceptible **or** Perceptible	Contextual **or** Universal
C3	Open	**In opposition**	Irrational **or** Rational	Unpredictable	Holistic	Perceptible	Contextual **or** Universal
C4	Open	Not in opposition	Irrational	Unpredictable	**Reductionist**	Imperceptible **or** Perceptible	Contextual
C5	Open	Not in opposition	**Rational**	Unpredictable	Holistic	Perceptible	Contextual
C6	Open	Not in opposition	Irrational	Unpredictable	Holistic	**Imperceptible**	Contextual
C7	Open	In opposition **or** Not in opposition	Irrational **or** Rational	Unpredictable	Holistic **or** Reductionist	Perceptible	Contextual **or** Universal
C8	Open	Not in opposition	Irrational	Unpredictable	Holistic	Imperceptible **or** Perceptible	**Universal**
C9	Open	Not in opposition	Irrational	Unpredictable	Holistic	Perceptible	Contextual

Figure 5.6 Identified EA practitioners' worldviews

A summary description of the EA practitioners' worldviews identified is presented in Figure 5.7.

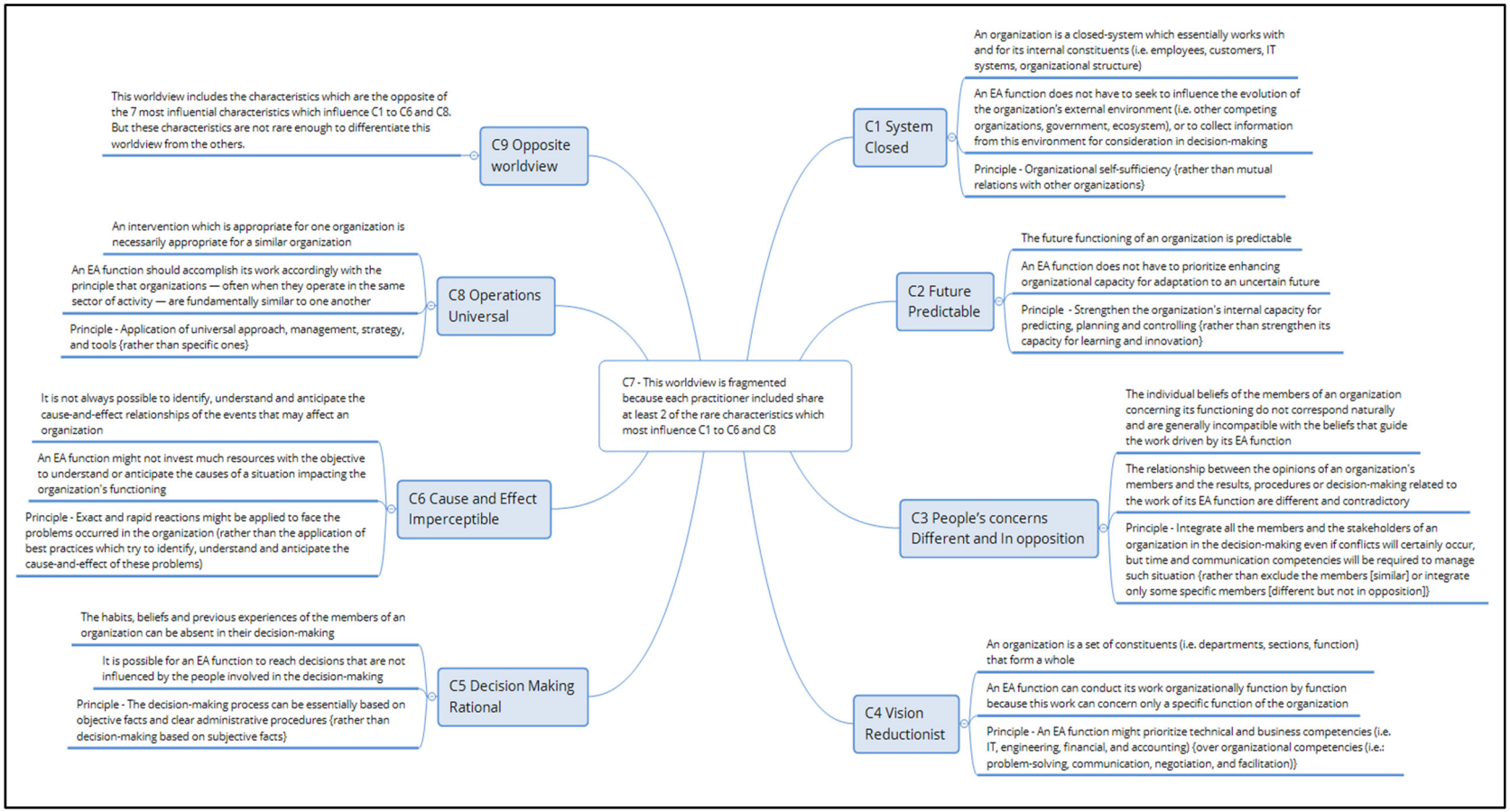

Figure 5.7 Characteristics of the worldviews

5.5 Relationships between the worldviews and the existing schools of thought

As mentioned previously, many EA belief typologies have already been proposed, including the three schools of thought on EA (Lapalme, 2012), the tripartite approach to EA (Korhonen & Poutanen, 2013), and the additional four schools of thought (Preez et al., 2014). Moreover, applying the concepts used to characterize the worldviews found in this study to these typologies — without the concepts "decision-making" and "operations"— provides the corresponding worldviews shown in Table 5.8.

Sources	Worldviews	SYSTEM	PEOPLE's CONCERNS	FUTURE	VISION	CAUSE-AND-EFFECT
3 schools of thought Tripartite approach	**EITA** **Technical**	**Closed**	Similar	**Predictable**	**Reductionist**	Perceptible
3 schools of thought Tripartite approach	**EI** **Socio-Technical**	Open	Not in opposition	Predictable **or** Unpredictable	Holistic	Perceptible
3 schools of thought Tripartite approach	**EEA** **Ecosystemic**	Open	**In opposition**	Unpredictable	Holistic	**Imperceptible**
Additional 4 schools of thought	**EPA**	Open	Not in opposition	Unpredictable	Holistic	Perceptible
	EC	Open	**In opposition**	Predictable **or** Unpredictable	Holistic	**Imperceptible**
	EITP	**Closed**	Not in opposition	**Predictable**	**Reductionist**	Perceptible
	EITD	**Closed**	**In opposition**	?	**Reductionist**	Perceptible

Figure 5.8 EA practitioners' worldviews derived from the existing EA belief typologies

5.6 Discussions

5.6.1 Discussion on data analysis challenges

In addition to data collection challenges, a number of data analysis challenges had to be addressed.

MCA is usually the data analysis technique used to identify and describe underlying relationships between the rows and columns of a categorical dataset. But the results of a MCA cannot be interpreted without caution. There are certainly some essential rules to follow — related to the distance between the points and between the points and the centroid — but there are no rigorous rules to ensure that the interpretation of an analyst will be as rigorous as the interpretation of another one. Consequently, MCA is not a confirmatory or decisional technique, because there is no one solution, but an exploratory technique. In fact, if the structure of the observations to be analyzed includes only a few variations, it is important to deeply analyze the underlying data and more than two axes in order to make a complete interpretation of the results.

For example, observing the biplot presented in Figure 4 does not show that the observations "id9 and id15" belong to the same cluster, nor does not show that the category "universal" is the one which has presented the most variations for these observations. In effect, as presented in the results, only 3/7 categories and 21/73 observations are significant in the creation of axis 1 and/or axis 2, while these axes allow us to observe only 40.31% of the total variations included in the data. Because of this, all the points are not well represented in the biplot, which consequently cannot show the relationships between all the categories and observations. This is why MCA is often used when there is a large set of data: because it is often appropriate to help identify the data which present important variations. Furthermore (Benzécri, 1979) and (Greenacre, 1993) have suggested adjusted versions to compute the inertia of the axes to allow higher and more meaningful percentages of inertia in the Euclidean space.

On the other hand, it was possible to directly apply HCA because the data was not too large to require reduction through MCA. Moreover, Formann (1984) has suggested including a minimal size of observations equivalent to 2^m to perform HCA, with m as the number of variables (Dolnicar, 2002). Consequently, this study would include a minimum number of 128 observations to be valid if this recommendation was a formal rule. No rules-of-thumb exist concerning the minimal sample size for cluster analysis. However, the formal scenario (MCA

and HCA) could be used for future extended study which will include a larger number of observations.

The challenge with HCA is the existence of various algorithms to measure the proximity and the agglomerative distances, and they do not necessarily provide the same result. Because this study concerns the categorization of beliefs it aims to bring together observations that share a rare category (outliers) in order to identify worldviews which can be clearly differentiated each other. Ward's method is the best to achieve this objective because this algorithm does not only aggregate the two most similar objects (observations or category) consecutively, but it also takes into account that the overall within-cluster variance must increase to the smallest possible level when aggregating objects. Moreover, the fact that the Ward's method tends to produce the same size clusters constitutes an important limit when working with clusters of unequal diameters.

For example, the automatic application of Ward's method on the dataset of this study found 3 clusters. This result keeps the existing "C1 and C2" and considers the existing "C3 to C9" to be a unique third cluster with "system-open" as the most influential category. Because of this, using Ward's method requires carefully observing the composition of the clusters in order to properly place the truncation of the dendogram. In effect, the results of HCA must be meaningful and interpretable. But there is no one solution to address the problem concerning the number of clusters to retain, and a recommended approach is the "*repetition of calculations with varying numbers of clusters and evaluation of the results with regard to relevant criteria*" (Dolnicar, 2002). However, it is also important to note that the literature and software used two different algorithms to apply the Wards' method which can produce different results (Murtagh & Legendre, 2014). Nevertheless, the number of observations that have been examined in this study is low, and this has made it easier to visually observe the coherence of the classification provided by the HCA and its concordance with the previous MCA.

5.6.2 Discussions Concerning the Findings

The first impression concerning the characterization of the EA practitioners' worldviews provided regards to the large variation found in the data and the large number of worldviews found. In fact, the literature often presents three worldviews in EA (Doucet et al., 2008) ; (Lapalme, 2012) ; (Korhonen & Poutanen, 2013) ; (Saint-Louis & Lapalme, 2016). Moreover, (Preez et al., 2014) has already opened the way to provide deeper investigation into this issue in identifying four additional schools of thought.

But the limitation of Preez's "seven schools of thought" model is that the survey used asked respondents to answer in a manner following existing EA frameworks, models, and maturity stages, without taking into account the underlying assumptions behind these tools. Consequently, it is not surprising that our study identified nine worldviews after improving on the methodological limitation with a survey that asked respondents to answer directly according to some epistemological assumptions and systems thinking, in order to minimize the interpretation phase and increase the reliability of the results. In fact, the large number of worldviews in EA simply underlies the critical state of the lack of common understanding and terminology in this discipline (Saint-Louis et al., 2017).

5.6.3 Implication for Practice and Research

The findings of this study are beneficial for the EA practice community because they provide more structured knowledge that helps to identify and categorize many potential concepts that distinguishes EA practitioners' worldviews. Practitioners will know more about what distinguishes each practitioner's worldview. With this information, an EA team can collaborate better and be more tolerant of and open to every practitioner, even if their worldviews are different. The administrative team and stakeholders can become better able to work and develop relationships with EA practitioners.

These findings will also help the EA practice community answer whether or not the tools available on the market correspond to the worldviews of every EA practitioner. For example, to predict the future of the organization it is clear that an EA practitioner team who prioritizes enhancing organizational capacity for adaptation does not necessarily need the same tools as one who prioritizes developing plans and targets. The administrative and human resources teams can become better able to hire appropriate EA practitioners according to the worldview of their organization and the work to achieve. For example, an organization which is not open to frequent collaborations with other organizations does not need an EA practitioner team which considers the organization as a system that influences, and can be influenced by, its external environment.

Finally, these findings provide structured knowledge that will help the EA research community to conduct forward investigations. It is also important to mention that this study provides a relevant demonstration of categorizing worldviews that could be used to achieve any other related study. The strategy used to create the questionnaire based on well-known epistemological models, the strategy used to analyze the responses and the exploratory data analysis techniques used, are some of the aspects of this study that demonstrate a novel analysis approach of categorizing worldviews.

5.7 Conclusion

This study conducted a survey to identify and characterize EA practitioners' major worldviews regarding the organizations and the people within them. To achieve this, data were collected according to models from epistemological assumptions and systems thinking, and they were analyzed according to techniques from exploratory data analysis. The findings show nine different worldviews. Seven of these worldviews include properties can be clearly differentiated each other, including EA practitioners who consider their organization as a closed "system", its "operations" as universal, the "cause and effect" relationships of the problems occurred as imperceptible, the "future" as predictable or the "people's concerns" as

different and in opposition, and those who believe that an EA function can achieve its works according to a reductionist "vision" of the organization, or can set up a rational "decision-making" process.

The findings of this study represent a relevant source of information concerning the existing worldviews of EA practitioners (see Figure 6) and constitute for the EA practice community an "*invitation to encourage dialogue about EA and belief systems*" (Lapalme, 2012). In fact, this study makes four major contributions: first, it identifies the major EA worldviews with primary sources of data, while many previous studies on this topic used secondary data. Second, this study used many methodological strategies (i.e.: closed ended questions, Likert scale, many questions for each concept, data analysis techniques, etc.) to ensure its reliability contrary to many previous studies. Consequently, this study offers some guidelines for conducting future surveys concerning the EA belief systems. Third, many scientific questions have been raised, and thus have opened methodological perspectives for future studies. Finally, the findings of this study could help the EA practice community to be more tolerant and open to all EA practitioners, even if their worldviews are different than others.

CHAPTER 6

GENERAL DISCUSSION

The implications of this thesis for research and practice have already been presented at the end of Chapter 3, 4 and 5. Consequently, this chapter will discuss concerning the underlying challenges of this thesis.

The lack of common understanding in the discipline of EA is a problem that mainly concerns distinctions based on qualities and characteristics, rather than quantifiable quantities and values. This fact is an element that makes investigating the issue difficult. Given the nature of the problem, qualitative research is a necessity. Moreover, given that little is known about the issue, conducting exploratory research is also a necessity. But one of the obvious limits of exploratory qualitative research lies in its exploratory aspect. Such study can, for example, helps develop hypotheses about opinions, beliefs, perceptions, motivations and attitudes, but cannot provide generalizations or solutions that can be directly applied in real life. As a results, it is often very difficult to demonstrate the quality of such studies and consequently its scientific evidence is often called into question by the community, especially when the community has a bias towards quantitative explicative studies.

The first study conducted in this thesis analyzed journal articles published in EA in order to develop hypotheses concerning information related to their publication (i.e. title, year of publication, author, journal, publisher, etc.), their authors (i.e. number of publications, sectors of activity, discipline of study, country, language, etc.), and their content (i.e. presence/absence of the word — words, term, concept, etc. enterprise architecture, presence/absence of definitions of enterprise architecture, presence/absence of other denominations of enterprise architecture, focus of the description of enterprise architecture, etc.). The results of this investigation has allowed these three elements (publication, authors and content of the articles) to be grouped into distinct categories that clearly highlight some key aspects of the uniformity that exists in the literature of EA, but the generalizability of the categories created will not

always be possible to be fully demonstrated in order to convince the scientific community to unanimously accept them. However, some elements which can be useful to demonstrate the generalizability of the categories created are, for example, the importance of the sample of data considered, the methods and techniques used to analyze this sample, and the transparency of the interpretation of the results.

In fact, the first study conducted in this thesis analyzed only journal articles which represent less than 20% of the publications in EA, based on the results returned by the electronic libraries Inspec, Compendex and Scopus in mid-2018. The search strings also include only explicit references to EA, mentioned only in the titles of the articles. Consequently, this study should be extended to include other types of publications — conferences, proceedings, books, etc. — and search strings — enterprise IT architecture, enterprise system architecture, enterprise computing, organizational modelling, architectural approach, etc. — in order to "*get a more complete picture of the phenomenon in question*" (Leedy & Ormrod, 2013), and then improve the generalizability of the categories created. Another technique could be the coding of the articles by many people in order to calculate their level of agreement (inter-coder reliability).

All the strategies listed previously to improve the generalizability of the first study conducted in this thesis are applicable to the second one. In addition, the analysis of implicit definitions of EA should be considered the second study, instead of analyzing only explicit definitions.

Concerning the third study conducted in this thesis, beyond all the tests and modification conducted on the survey questionnaire, as well as the strategy of asking questions corresponding to each concept several times, it should be useful to be sure that the survey participants understood the questions in the same way. Some methodological techniques propose for example to have the questionnaire answered several times by the same participants in order to calculate the validity of their responses. And a critical factor should be to survey the most possible participants in order to improve the generalizability of the findings of this study.

However, generalizability is not the unique criterion to judge the quality of qualitative research. Numerous terms have been proposed in the literature as "*more suitable criteria to judge the quality of qualitative research*" (Whittemore, Chase, & Mandle, 2001). Table 6.1 presents some influent frequently criteria proposed.

Table 6.1 Criteria to judge the quality of qualitative research

Author	Criteria
(Thorne, 1997)	Methodological integrity, representative credibility, analytic logic, interpretive authority
(Maxwell, 1996) (Maxwell, 1992)	Descriptive validity, interpretive validity, theoretical validity, evaluative validity, generalizability
(Lincoln, 1995)	Positionality, community as arbiter, voice, critical subjectivity, reciprocity, sacredness, sharing perquisites of privilege
(Altheide & Johnson, 1994)	Plausibility, relevance, credibility, importance of topic
(Leininger, 1994)	Credibility, confirmability, meaning in context, recurrent patterning, saturation, transferability
(Sandelowski, 1993) (Sandelowski, 1986)	Credibility, fittingness, auditability, confirmability, creativity, artfulness
(Eisenhart & Howe, 1992)	Completeness, appropriateness, comprehensiveness, credibility, significance
(Marshall, 1990)	Goodness, canons of evidence
(J. K. Smith, 1990)	Moral and ethical component
(Guba & Lincoln, 1989) (Lincoln & Guba, 1985)	Truth value, applicability, consistency, neutrality

Table 6.1 shows the existence of more than one single set of scientific criteria and techniques which "*contribute to valid knowledge*" (Morgan, 1983), as well as a "*lack of common validity criteria*" in qualitative research (Whittemore et al., 2001) ; (B. Kitchenham & Charters, 2007). However, judgment is indispensable to define the optimum level of each criterion in accordance with the study in question (Eisenhart & Howe, 1992) ; (Lincoln, 1995), particularly its "*research question, study design, and philosophical stance*" of the researchers (Koch, 1994). Nevertheless, quality in research depends first on "*honest and forthright investigations*" (Marshall, 1990) and every investigation has "*biases and particular threats to validity*", as well as every method and technique have "limitations" (J. K. Smith, 1990). Consequently, the

priority of this thesis lies in the determination of the appropriate validity criteria (Altheide & Johnson, 1994).

In fact, each of the complementary studies conducted in this thesis used appropriate validity criteria and techniques to improve its general quality. (B. Kitchenham & Charters, 2007) indicates three quality concepts to take into account when conducting a systematic literature review (SLR), which are: bias, internal validity (validity) and external validity (generalizability and applicability). Based on Cochrane Reviewers' Handbook (Cochrane Collaboration, 2003) ; (B. Kitchenham & Charters, 2007) have suggested that quality refers to the extent to which the research reduces bias and increases internal and external validity. (K. Petersen & Gencel, 2013) have suggested descriptive validity, theoretical validity, generalizability, and interpretive validity as quality criteria to take into account when conducting a systematic mapping study (SMS). In effect, the application of these quality criteria was discussed in Chapter 2 which presents the research design applied to the first and the second part of this study that respectively conducted an SMS and an SLR. This chapter also presented the strategy applied in order to ensure the content validity and avoid complexity in the questionnaire (Kline, 1986) (Dillman et al., 2016) of the opinion survey conducted in the third study conducted in this thesis. The priority of this study also lies in the application of the optimum methods and techniques, and the critical presentation of the research process and analysis in detail (Altheide & Johnson, 1994).

As demonstrated in the previous sections, appropriate validity criteria and optimal methods and techniques were considered in order to improve the quality of each of the three complementary studies included in this thesis. However, a more representative sample of EA publications and survey respondents should be considered to provide more generalizable results. The achievement of such objective would also require much more time and organization, or even more financial resources to access some publications for example, and pay coders. In fact, a Ph.D. student, as a single researcher, must ensure its study "*does not continue beyond the time available*" (Woodall & Brereton, 2006) and consequently this limit

can affect the quality of its study which could, however, *provide significant baselines to support new research* (Woodall & Brereton, 2006).

On the other hand, this thesis focused on a problem that worries both researchers and practitioners of the discipline of EA since as demonstrated throughout this report which shows how the lack of common understanding in the discipline of EA is mentioned in a considerable number of publications (Schöenherr, 2009) ; (Lapalme, 2012) ; (Korhonen & Poutanen, 2013) ; (Preez, Merwe, & Matthee, 2014) ; (Rahimi, Gøtze, & Møller, 2017) even when this is not their main research topic (Mentz et al., 2012) ; (Bidan, Rowe, & Truex, 2012) ; (Lange, Mendling, Recker, Lange, & Mendling, 2017). However, the lack of common understanding in the discipline of EA seems to be also a sensitive subject because even if many authors/researchers mention it in their publications, it seems that some others do not want to hear about it. Talking about the different schools of thought which have existed in EA and conducting further investigation on them give certain notoriety to some of these schools which are maybe unknown or unaccepted in some communities. This also gives the impression that EA is fragmented while some EA researchers and practitioners do not really accept this evidence. This fact is probably a reason why only a few studies have been focused on a further examination of this issue in order to have more consistent results that allow to better understand this problem and to address it adequately.

Another delicate aspect why only a few studies have been focused on a further examination of the lack of common understanding in the discipline of EA concerns maybe the crucial obligation to go forward what is already known concerning this issue. In fact, to achieve this objective, new results or interpretations are often presented in the form of criticisms.

For example, some may affirm that the first study included in this thesis criticized the fact that:

- the authors of the journal articles analyzed do not appear to be permanent researchers in EA because a large majority of them only participated in the publication of one article;

- there is not a set of publications that appear to be accepted within the discipline, which could be used as a reference by academic EA researchers;
- there is a lack of journal and publisher mainly dedicated to the publications on EA;
- the majority of the EA studies focuses on the development of new tools (i.e. frameworks, models ...) while the evaluation and improvement of EA and existing tools are neglected.

In the same line of ideas, some may affirm that the second study included in this thesis criticized the fact that some of the explicit definitions of EA are:

- implicit, because they include technical words or appear in figurative forms, and can therefore give rise to several different interpretations;
- incomplete, because they do not provide a complete description of what EA is;
- complex, because their composition and structure do not guarantee easy reading and comprehension;
- inconsistent, because the different parts of these definitions — as classified in this study — are not compatible.

Finally, some may affirm that the third study included in this thesis criticized the existence of several fragmented worldviews conceptions in EA.

Such comments may not always be viewed favorably. Especially when they are viewed as criticisms which concerns a whole community, as in the case of this study which addresses a general problematic within the discipline of EA. However, even these comments may be viewed as criticisms, they represent after all constructive criticism that carefully avoids insults but aims to provide information concerning the lack of common understanding in the discipline of EA and guidance for future research.

CONCLUSION AND RECOMENDATIONS

Despite growing interest in the discipline of Enterprise Architecture (EA) around the world in recent years, EA suffers from a lack of common understanding because researchers and practitioners do not use a shared approach and terminology when describing EA, its application, methodology, process or outcomes. Such a situation negatively impacts the evolution of EA. Several studies have highlighted the lack of common understanding in the discipline of EA and its negative impacts, even if it is not their primary focus. But only a few studies have conducted a deep analysis on the extent of the situation by identifying and describing the characteristics of the major EA schools of thought. Those studies offer relevant insights but they all have methodological limitations. Consequently, there is still a need for deeper investigation of the lack of common understanding in the discipline of EA. And the objective of this thesis was to fill this gap.

To achieve this objective, this thesis conducted an exploratory study which applied well-known methodological design and techniques, and provided more details concerning characteristics that can play a role in the lack of common understanding in the discipline of EA. In fact, the first study included in this thesis conducted a Systematic Mapping Study using articles published from 1990 to mid-2018 in major engineering, computer science, and management journals, and identified sources of variety in the literature which could be on the basis of the lack of common understanding. The second study conducted a Systematic Literature Review using concepts from the academic field of terminology and thematic analysis techniques with 170 explicit EA definitions, and identified sources of implicitness, incompleteness, complexity and incoherence in the definitions which could be on the basis of the lack of common understanding. The third study conducted an opinion survey with 73 EA practitioners analyzed with the help of exploratory data analysis techniques, and identified different EA practitioners' major worldviews regarding organizations and the people within them.

This thesis provides a novel analysis approach of applying the mapping study (study 1), analyzing EA definitions (study 2) and categorizing worldviews (study 3). Its findings provide more structured knowledge that helps to identify and categorize potential factors contributing to the differences in the EA literature (study 1) and in the EA definitions (study 2), and to categorize many potential concepts that distinguishes EA practitioners' worldviews (study 3). This contributes to a better knowledge of the lack of common understanding in the discipline of EA and provide a better possibility to deal with this lack, as implication for practitioners. These findings also provide relevant directions to researchers for future studies concerning this topic or using the methodological design and techniques applied. For example, these findings may help practitioners identify EA worldviews with which they may find it appropriate to work.

The administration staff and the human resources can use these findings to better know and choose the kinds of EA professionals they need, depending on what their organization want to achieve. These findings may also help the EA practice community to be more tolerant and collaborative to all EA practitioners, even if their worldviews are different than others. In the same line of thinking, this study could motivate the integration of all the existing perspectives in the EA academic programs, in order to provide universal training to future practitioners. And these findings may help researchers find appropriate publications or methodological strategies for future research. Concretely, this study should help practitioners to be conscious of the factors contributing to the lack of common understanding in EA. This should help them to find appropriate EA practitioners, to pay more attention when providing a new EA definition, and to design adapted EA tools/training. As well as this study proposes relevant insights and directions for future research that should focus on confirming the influence of the potential factors identified.

To continue identifying and clarifying the characteristics of the lack of common understanding of EA, first, this thesis recommends both researcher and practitioner to support more descriptive and experimental research which prioritize the practice of EA, including for example the evolution of EA, the role of EA practitioners, their worldviews, and their needs to

concretely measure an EA methodology, process, or outcome. Second, this thesis also recommends both researcher and practitioner to pay more attention to the definition of EA they provide when they produce a new article in the EA literature. Third, this thesis recommends prioritizing the importance of each of the ways of approaching EA and its practitioners, without any superiority of one over another, even if they seem to be divergent and conflictual sometimes, in order to integrate them all into a shared reference. Finally, this thesis encourages dialogue concerning EA and belief systems.

A limitation to note is that the first and second study of this thesis often reviewed journal articles in order to keep the data source to a manageable size. Due to this limitation, future studies on this topic must include other relevant data sources, such as conference articles, book chapters, and more, and must use other reliable methodological design and techniques, such as content analyses, interviews, participant observation, case studies, etc. On the other hand, the opinion survey conducted in the third study was answered by only 73 respondents.

Due to the limitation mentioned previously, future studies should include other relevant data sources, such as conference paper, implicit EA definitions, and a largest number of respondents, in order to make it better possible to generalize the findings of this study. Another improvement that future studies should include concerns a formal conduction of the data selection, extraction and analysis by more than one person in order to calculate the inter-coder agreement coefficient, such as Krippendorf alpha. The application of the inter-coder agreement should increase validity and reliability. Future study should also apply other reliable methods/techniques, such as content analysis, participative action research, in order to perform future investigations concerning the lack of common understanding in the discipline of EA.

The first study of this thesis analyzed the EA literature, while the second one analyzed the EA definitions and the third one analyzed the worldviews of EA practitioners. As future research, the model used to conduct each of these studies can be applied to complement each other. For example, future study should also consider the framework used to identify the worldviews of EA practitioners in the third study to analyze the papers reviewed in the first study. In addition,

this future research should compare the worldviews found from the survey with EA practitioners to those found in the EA literature in order to report their similarities and dissimilarities. In the same line of idea, the framework used to identify the worldviews of EA practitioners in the third study should be used to analyze the EA definitions investigated in the second study. Future study should also try to characterize the EA definitions analyzed in the second study according to the factors found in the first study in order to investigate whether each definition correspond to a particular EA school of thought.

ANNEX I

QUESTIONNAIRE OF THE OPINION SURVEY

Survey on beliefs in Enterprise Architecture

Note - Your answers may not necessarily correspond to how Enterprise Architecture (EA) is applied within an organization. Rather, they should correspond to 'how you personally believe it is reasonable to practice EA' within an organization. 'EA' is used throughout the questionnaire to indicate Enterprise Architecture 'EA Function' refers to the people who are responsible or involved in EA concerns and tasks within an organization, regardless of if these people are grouped together or not in a specific organizational structure. 'Organization' refers to any institution created for the purpose of producing goods and services, where the EA function is responsible for EA concerns and EA tasks.

1st PART OF THE QUESTIONNAIRE - - - - - - - - - -

Perception of Enterprise Architecture (EA)

Q1A - How useful is it for an EA function to seek information about the evolution of the external environment of its organization for consideration in decision-making?

1. Extremely useful
2. Useful
3. Not very useful
4. Not at all useful

Q2A - How do the beliefs of an organization's members correspond with the beliefs that influence decision-making by the EA function?

1. They correspond naturally, regardless of the situation
2. They do not correspond naturally, but are generally compatible
3. They do not correspond naturally and are generally incompatible

Q3A - To what extent do you agree with the following statement: 'Unavoidably the habits, beliefs and previous experiences an EA function's members influence the work of the function.'?

1. Strongly agree
2. Agree
3. Disagree
4. Strongly disagree

Q4A - When considering the future (3-5 years) functioning of an organization, how do you evaluate an EA function that prioritizes enhancing organizational capacity for adaptation, RATHER than developing plans and targets for the future functioning of the organization?

1. Excellent
2. Good
3. Bad
4. Very bad

Q5A - How satisfied are you with an EA function that focuses on doing its work organizationally 'function by function'?

1. Strongly satisfied
2. Satisfied
3. Dissatisfied
4. Strongly dissatisfied

Q6A - To what extent do you agree with the following statement: 'An EA function that expends the necessary efforts will always be able to identify and understand the causes of events that may affect its organization.'?

1. Strongly agree
2. Agree
3. Disagree
4. Strongly disagree

Q7A - To what extent do you agree with the following statement: 'An EA function should accomplish it work accordingly with the principle that organizations are fundamentally different from one another.'

1. Strongly agree
2. Agree
3. Disagree
4. Strongly disagree

Q8A - Which of these behaviors should the EA function encourage its organization to PRIORITIZE?

1. Organizational self-sufficiency
2. Mutually beneficial relations with other organizations

Q9A - How do you rate the level of similarity between the professional concerns of members of an organization?

1. Extremely similar
2. Different but not in opposition
3. Different and in opposition

Q10A - To what extent do you agree with the following statement: 'It is possible for an EA function to apply a decision-making process that can eliminate personal influences (feelings, opinions, interests, etc.).'?

1. Strongly agree
2. Agree
3. Disagree
4. Strongly disagree

Q11A - Which of the following activities does the EA function have to PRIORITIZE to prepare for the future of its organization?

1. Activities that predict the necessary functioning of the organization to a certain future
2. Activities that make it possible to adapt the functioning of the organization to an uncertain future

Q12A - To what extent do you agree with the following statement: 'An EA function must PRIORITIZE technical and business competencies over organizational competencies (problem-solving, communication, negotiation, facilitation, etc.) when hiring.'

1. Strongly agree
2. Agree
3. Disagree
4. Strongly disagree

Q13A - To what extent do you agree with the following statement: 'An EA function should accomplish it work accordingly with the principle that organizations operating in the same sector of activity while be fundamentally identical. '

1. Strongly agree
2. Agree
3. Disagree
4. Strongly disagree

Q14A - To what extent is it important for an organization to invest the necessary resources to identify and understand the causes of a situation impacting the organization's functioning?

1. Extremely important
2. Important
3. Not very important
4. Not at all important

Q15A - How important is it for an organization's EA function to seek to influence the evolution of the organization’s external environment?

1. Extremely important
2. Important
3. Not very important
4. Not at all important

Q16A - How do you describe the relationship BETWEEN the opinions of an organization's members AND the results, procedures or decision-making related to the work of its EA function?

1. Different and contradictory
2. Different but not contradictory
3. Extremely similar

Q17A - Generally, is it possible for an EA function to reach decisions that are not influenced by the people involved in the decision-making?

1. Always
2. Often
3. Rarely
4. Never

Q18A - Which one of the following activities does an EA function need to invest more time in order to prepare the organization for the future?

1. Strengthen the organization's internal capacity for learning and innovating
2. Strengthen the organization's internal capacity for predicting, planning and controlling

Q19A - To what extent is it necessary for the EA function of an organization to always consider the organization in its entirety, EVEN IF the work to realize concerns mainly a specific function of the organization?

1. Extremely necessary
2. Necessary
3. Not necessary
4. Not at all necessary

Q20A - Considering an event that may impact the organization, how often do you think, if the EA function deploys the required level of effort, will it be able to anticipate the consequences of this event on the organization?

1. Always
2. Often
3. Rarely
4. Never

Q21A - How do you evaluate the level of similarity BETWEEN the individual beliefs of members of an organization about its functioning AND the beliefs that guide the work driven by its EA function?

1. Extremely similar
2. Not very similar
3. Not similar at all

Q22A - To what extent do you agree with the following statement: 'A solution that is appropriate for one organization is necessarily appropriate for a similar organization.'?

1. Strongly agree
2. Agree
3. Disagree
4. Strongly disagree

Q23A - Which of the following concerns is CLOSEST to the main concern of EA?

1. Design a technological information system to meet the needs of the organization
2. Design all facets of the organization and their integration, including its technological information system
3. Design all facets of the business as well as their integration, including its technology information system, and develop the organization's ability to influence and be influenced by its environment

2nd PART OF THE QUESTIONNAIRE - - - - - - - - - - -

Background and sociodemographic questions

Q1B - What is your current role in EA?

- □ Private Sector Consultant
- □ Private Sector Employee
- □ Professor-Researcher / Research Director
- □ Public Sector Consultant
- □ Public Sector Employee
- □ Self-employed
- □ Teacher / Lecturer
- □ Other, please specify

Q2B - How many years have you been working in EA?

- □ 1-5 years
- □ 6-10 years
- □ 11-15 years
- □ 16-20 years
- □ 21-25 years
- □ More than 25 years

Q3B - What is the primary industry sector in which you have been working for the last 15 years?

□ Aerospace	□ Agriculture	□ Chemical
□ Computer	□ Construction	□ Defense
□ Education	□ Energy	□ Entertainment
□ Financial services	□ Food	□ Health care
□ Hospitality	□ Manufacturing	□ Mass media
□ Telecommunications	□ Transport	□ Water
□ Other, please specify		

Q4B - What was the primary focus of your studies?

- □ Computer and Information Sciences
- □ Economics
- □ Electrical and Electronics Engineering
- □ Industrial Engineering
- □ Management and Business Administration
- □ Management Information Systems
- □ Mechanical Engineering
- □ Project Management
- □ Public Administration
- □ Systems Engineering
- □ Other, please specify

Q5B - In which country have you been working for more time in EA or related disciplines?

□ Australia	□ China
□ Belgium	□ Colombia
□ Brazil	□ Czech republic
□ Canada	□ Denmark

□	Finland	□	Norway
□	France	□	Pakistan
□	Germany	□	Poland
□	Greece	□	Portugal
□	India	□	Qatar
□	Indonesia	□	Russia
□	Iran	□	Saudi Arabia
□	Ireland	□	Slovenia
□	Japan	□	South Africa
□	Kingdom of Bahrain	□	South Korea
□	Luxembourg	□	Spain
□	Macedonia	□	Sweden
□	Malaysia	□	Swiss
□	Mexico	□	Turkey
□	Morocco	□	United Arab Emirates
□	Namibia	□	United Kingdom
□	Netherlands	□	United States
□	New Zealand	□	Other, please specify

.....

Comments - Please add any additional comments that you feel are important to this questionnaire.

ANNEX II

MAPPING STUDY PROTOCOL

Indications concerning the information to extract in the articles

Information already available in the Excel sheet -----

1-Title
The title of the article.

2-Authors
The authors of the article.

3-Publication Year
The year of publication of the article.

4-Journal
The journal which has published the article.

5-Author affiliation
The author's affiliation institution.

6-Publishers
The publisher of the article.

Information to add in the Excel sheet -----

7-Author sector
The sector of activities where the authors evolved.

Consider the "Author Affiliation" category to determine this information.

4 Possible categories
A -> for Academia (when authors are a student or professor);

P -> for Professional (when authors are from professional institutions);

B -> for Both (when some authors are from academia and some other are from professional institutions);

DKN -> for Do not know (when the affiliation institution of the 1st author is absent and there is no possibility of finding it on the Internet).

8-Academic disciplines

The study area in which the 1st author has studied [when author sector is Academia].

Analyze the "Author Affiliation" category to determine this information.

7 Possible categories

IT -> for Information Technology (when article indicates that the 1st author is studying in Information and Communication Technology, including author who is studying in corresponding fields, like Informatics, Information Systems, Software, Computer Science, or Computer Engineering);

SS -> for Social and Human science (when article indicates that the 1st author is studying in social fields like Administration, Management, Business, Economics, Communication Logistics or Marketing);

ES -> for Specific areas of engineering (when article indicates that the 1st author is studying in a precise field of engineering different than Information Technology and its corresponding fields, for example Mechanical, Electrical, System and Industrial. This category also includes the names of study that mixed several specific fields of engineering, like, Industrial Information, Supply Chain Management, Mines-Telecom and Control Systems);

E-> for Non-identified areas of engineering (when article indicates that the 1st author is studying in a general name of study that might refer to several other specialized engineering fields, for examples: the Faculty of Technology Engineering and Environment, the Faculty of Science and Engineering, the Department of Computer Science and Engineering and the Faculty of Technology and Engineering);

O-> for Other (when article indicates that the 1st author is studying in a field different than IT, engineering and social sciences, as presented in the previous categories, for example School of Medicine, Center of Forest Studies);

ABS-> for Absent (when article does not indicate enough interpretative information concerning the study area of the 1st authors and it is possible to find this information on the Internet);

N/A-> for Non-Applicable (when "author sector" is "P" for professional or "Do not know").

9-Subject area

The subject areas of the journal which have published the article.

Consider the "Publisher" category to search this information on the Internet.

Ex: Computer Science, Business, Management and Accounting, Mathematics.

10-Country
The country where the 1st author's affiliation institution is located.

Extract this information in the paper or consider the "Author affiliation" category to search this information on the Internet.

Ex: Canada, Sweden, USA

11-Continent
The continent where the 1st author's affiliation institution is located.

Consider the "Country" category to determine this information.

Ex: Africa, America, Asia

12-Language
The first language of the country where the 1st author's affiliation institution is located.

Analyze the "Country" category to determine this information.

2 Possible categories
E -> for English (when 1st language is English);

Ex: Australia, Canada, Ireland, Malaysia, Namibia, New Zealand, Pakistan, South Africa, Turkey, United Kingdom, United States of America

O -> for Other (when 1st language is other than English)

13-Topic
The main topic addressed in the article.

Read and analyze the abstract, introduction, and conclusion of the article to determine this information. Read the whole article when this information cannot be found in the previous parts of the articles indicated.

5 Possible categories
EA-Discipline (when the central aim of the article is to describe EA as a discipline and a practice in order to make its importance clear);

Ex: articles that are focused on EA practice, challenges, roles, benefits, and comparison to other fields; or articles that addressed the steps required to help EA become a recognized profession.

EA-Practitioner (when the central aim of the article is to highlight the mission and role of EA-practitioners);

Ex: articles that are focused on exploring the development and improvement of EA skills, and the strategies apply to achieve the mission of EA practitioners.

EA-Tools (when the central aim of the article is to study the tools developed for EA-professional to achieve EA objectives and the tools developed for an organization according to an EA approach);

Ex: articles that are focused on the description, development and evaluation of EA languages, patterns, architecture modelling, and frameworks.

EA-Application (when the central aim of the article is to describe a specific use of EA which accomplishes a beneficial activity for the progress of an organization, or to provide a set of specific steps to implement when an EA strategy must be built, controlled and maintained;

Ex: articles that are focused on the principles that guarantee a successful application of EA or the maturity of EA practice, finds of how to get the most value from EA, and successful decision-making.

EA-Measurement (when the central aim of the article is to evaluate and demonstrated the performance and maturity of EA.

Ex: articles that are focused on aligning business and IT, compliance, return on investment, and long-term financial improvement capabilities.

14-EA Presence

Presence of Enterprise Architecture in the article.

Make search with the keywords “Enterprise Architecture” and “EA” in the article to determine this information.

2 Possible categories
Y -> for Yes (Enterprise Architecture is not present only in the title of the article, but also in the content of the article);

N -> for No (Enterprise Architecture is present only in the title of the article)

15-EA Definition

Presence of explicit or implicit definitions of Enterprise Architecture in the article.

Make search with the keywords "Enterprise Architecture" and "EA" in the article to determine this information.
Possible categories
Y -> for Yes (the article includes a minimum of 1 definition of Enterprise Architecture);

N -> for No (the article include any definition of Enterprise Architecture).

Ex: An Enterprise Architecture is a blueprint to guide the manager and fill the gap between business and IT (Bijarchian & Ali, 2014); EA aims to bridge the gap between organizational and technology aspects (Janssen et al., 2012).

16-Lack Notification

Presence of notification concerning the lack of common understanding and terminology in EA in the article.

Read and analyze the introduction, literature review and conclusion of the article to determine this information. And/Or make search in the article with corresponding keywords like "common", "shared", "meaning", "definition", "lack", "understanding", "terminology", "agreement"… in the article to determine this information.

2 Possible categories:
Y -> for Yes (the article includes notification concerning the lack of common understanding and terminology in EA);

N -> for No (the article does not include notification concerning the lack of common understanding and terminology in EA).

Ex: […] It should be noted that albeit the increased popularity, no common definition of the term EA analysis has yet emerged. This may be caused by the plurality of techniques and methods that are subsumed under the term (Razavi et al., 2011) ; […] Is it a mature discipline? It's challenging to answer such questions, given the plethora of terminology and lack of shared meaning in this domain (Lapalme, 2012).

17-Other EA

Other terms used to designate EA in the article

Read the abstract, introduction, and conclusion of the article to determine this information. Read the whole article when it is necessary.

Ex: Information Technology, Information Systems Research, Organizational Modelling, Enterprise System Architecture, Architectural Approach, and Enterprise Computing.

18-EA Focus

The focus of EA as presented in the article.

Read and analyze the abstract, introduction, and conclusion of the article to determine this information. Read the whole article when this information cannot be found in the previous parts of the articles indicated.

3 Possible categories:
Technological -> (when the analysis, design, planning, implementation, and other activities related to practicing EA are only focused on the 'technological context' of the organization, such as the conception of technological components, their evaluation, and their alignment with the business);

Ex: (Goudos et al., 2007)
This article presents a conceptual component to address the common public administrative 'problematic of matching a citizen's needs with accessible public services'. This IT component follows a "Governance Enterprise Architecture model" and consists of a citizen's needs received as input, and a group of public administrative services provided as output. This set of services satisfy the need by employing semantic technologies and by using a public administrative service model. The proposed system architecture includes different elements, which are an application server (Apache Tomcat), a reasoner (Pellet) and a Web Ontology Language file that represents a knowledge base. The end users use a common Internet browser to access the application.

The use of EA in this article contributed to building a component that is often the focus in the technological context. This study does not treat questions related to the socio-cultural aspect of the people who are developing and will use this component.

Socio-technological -> (when the analysis, design, planning, implementation and other activities for conducting EA are not focused only on the 'technological context' of the organization, but also on its 'socio-cultural context, such as people who are developing and using the technological components of the organization and their integration and participation in the decision-making process);

Ex: (Gregor et al., 2007)
This article presents a case study realized in a public-sector organization. This study shows how the decision-making process of EA development allows people to participate. In fact, the staff at all echelons and departments of this organization are involved and are free to express varied points of view concerning the business and technical concerns. Executives (senior management) take into consideration proposals from the staff, stakeholders, managers and program components. Many communication ways to share business documents, as well as to share understanding and knowledge across this public-sector organization, were used.

As part the technological aspect of EA presented in this study, it also underlines how stakeholder and staff involvement at all echelons and departments enables the improvement and agreement of the strategic orientations, work plans and other.

Eco-technological -> (when the analysis, design, planning, implementation and other activities for conducting EA are not only focused on the 'technological and social context' of the organization, but also on the 'ecosystem context, such as other organizations, the community, the government, the environment, the ecosystem, the standards (requirements, specifications, guidelines...)).

Ex: (Marques et al., 2011)
This paper describes a strategy to focus on business and process information that are necessary in order to achieve wood supply and forest management. This strategy is developed in an organization that operates in wood pulp production. A lot of people who do not share a direct relationship with the organization were actively involved during the development of this strategy, such as business experts, Information Technology managers, forest and plant supply planners, operation planners, forest certification experts, and other. The objective of this strategy is also to achieve intercompany collaboration with the adoption of similar business process architectures and concepts.

This strategy and the participants involved in its development show how EA is not only limited to the direct beneficiary of the organization, but also considers its environment, like compliance with standards (i.e. certification experts), the ecosystem (i.e. forest planners), society (i.e. other organizations) and more.

18-EA Practitioner
The way to approach the practice of EA.
Consider the "EA Focus" category to determine this information. Read and analyze the abstract, introduction, and conclusion of the article to determine this information. Read the whole article when this information cannot be found in the previous parts of the articles indicated.

3 Possible categories:
Specialist -> (when EA practitioner is presented as a professional who can imagine and understand the needs of an organization, the problems it is facing, and the perspectives it is following in order to find and implement the best manners to satisfy or resolve them with IT. These enterprise architects think they can help organizations choose the best solutions to meet their needs);

Integrator -> (when EA practitioner is presented as a professional who has the ability to join all the stakeholders together with their understandings of the needs, perspectives and problems of their organization. These enterprise architects believe that IT alone cannot be an effective solution, but the participation and the motivation of the stakeholders in the decision-making process is crucial, and that effective solutions can be achieved through communication, negotiation, and collaboration, for example);

Facilitator -> (when EA practitioner is presented as a professional who is capable of facilitating a good understanding of the needs of an organization, the problems it is facing, and the perspectives it is following through the adaptation of these elements with the environment. These enterprise architects do not only focus on the internal environment of the organization, as the previous category does. In fact, these enterprise architects think that IT and the social implication of the stakeholders of the organization must also be accompanied by organizational adaptation to the outside world in order to take the lead in innovation and sustainability)

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