Investigation of the lack of common understanding in the discipline of enterprise architecture

A systematic mapping study

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Abstract—**The number of publications, along with the organization of new conferences are a couple of the relevant elements that usually indicate the progress of an area of study over the years. This is definitely true in the case of the Enterprise Architecture (EA) discipline, which went from having its first journal article published in 1989 to over two hundred published articles by 2015. But in spite of this evolution, EA is still suffering from a considerable lack of common understanding. It has become very important to investigate the current state of affairs concerning the EA discipline through its relevant publications in order to shed some light on this challenge. 171 journal papers published between 1990 and 2015 were systematically selected and examined in order to accomplish this investigation. The quantitative and qualitative findings of this examination show that EA is a young discipline which raises a growing interest in recent years. This examination also confirms the lack of common understanding in EA, which can be observed in the different descriptions of the term "enterprise architecture," and in the diversity of perspective with regards to the whole discipline. Several issues related to this lack has been reported, such as multidisciplinary issue, language issue, structure of research and mode of observation issues. The major issue concerns the absence of enough research to shed some light on this challenge. In addition to this investigation, helpful directions for future research in this area was proposed.**

Keywords— enterprise architecture; common understanding; common terminology; agreed definition; shared meaning; fragmented literature; schools of thought; systematic mapping study; state of the art; literature

I. Introduction

The explosive development of Information Technology (IT) during the last half-century has significantly impacted the daily operations of organizations. In fact, the role of IT in organizations has changed from an automatic one, largely in place to complete routine administrative tasks, to a strategic and competitive weapon [22]. It is now a challenge for contemporary organizations to use IT to manage all aspects of their structure and resources, and to use it for real-time direct and indirect communication with their stakeholders. Trying to meet this need, the new field of research and practice that is Enterprise Architecture (EA) has emerged. EA is a discipline relating to multiple areas of study, including Information Technology (IT), Engineering, and Management. EA intends to prepare practitioners to help organizations manage and improve competitiveness, reduce complexity, and increase changeability through an adequate methodology to address IT integration, business strategy, socio-cultural aspects etcetera.

The purpose of this paper is to present an good overview of the EA literature that can be used by both researcher and practitioner alike. This overview sheds some light on the challenges concerning the different definitions and descriptions of the term "enterprise architecture," as well as the diversity of approaches found in the discipline. More precisely, this paper aims to answer some questions related to the quantitative and qualitative evaluation of the lack of common terminology and common understanding in the discipline of enterprise architecture.

The next section of this paper describes the main research problem and the research questions. The third section describes the research methods used to investigate the research questions. The fourth and the fifth section consecutively present the quantitative and qualitative results of the investigation. The sixth section presents a discussion about the results. And the last section is focused on directions for future research.

II. Background and Related work

The first published use of the term "enterprise architecture" occurred in 1989, in a National Institute of Standards and Technology (NIST) special publication on the challenges of information system integration. Two years earlier, in 1987, John Zachman also published a paper in the IBM Systems Journal, establishing the term "enterprise architecture," even if he did not use it literally, affording him some credit with in the process. However, throughout the twenty years since the term was coined in 1989 to the present day, in which EA has now become an important discipline, considerable research have been conducted. A large part of this increasing academic research in EA is published in journal and conference papers and addresses diverse topics, such as tool conception and evaluation, best practice reports, literature analyses and more [7].

One of the main observations made in these publications is the great variation in the definitions and descriptions of the term "enterprise architecture [16]." These variations are also present in the diversity of approaches to the whole discipline of EA [15]. To address this challenge, researchers have reported a lack of common terminology and understanding, and a problem of fragmented discourse in the literature of EA [31], [34]. Some previous work went deeper in identifying and describing several schools of thought in EA [21]. Some other researchers have followed this lead in continuing to explore the different perceptions in EA [13], [14], [25].

These challenges show that there is no common understanding of the discipline. Without a common structure and a core theory, it will be always complicated to talk about EA as a discipline. It will be difficult for EA team members to work together when their individual understanding about the meaning of EA differs, especially when they are not fully aware of these differences and their extent. Similarly, it will be difficult for EA teams to engage stakeholders. In the academic arena, it will be difficult for researcher to effectively share their ideas and be understood because the reader could make interpretation based on the prism of their own beliefs concerning meaning. It will be difficult to training practitioners in the absence of shared meaning and common foundations. Such challenges contribute to the difficulties experienced by researchers and why they report that the discipline of EA is still relatively immature and incoherent.

Many researchers have mentioned this terminological and perspective issue in their research, even if it is not their main focus. Others try to present it more accurately through an analysis of the EA literature and surveys data from practitioners [24], [29], [7]. In the same way, some previous work on this subject identifies three schools of thought on EA [15]. It explains how this challenge refers to the Indian fable of the six blind men and an elephant, in which each of the blind men perceives the same elephant very differently, according to the part body of its body they touch. These actions contribute to awareness raising about the different approaches to EA, and help us to consider a common structure, and therefore allow for the possibility of EA becoming more mature as a discipline.

But to date, in general, the studies that focus on this terminological challenge have not used a specific and systematic methodology to guide their investigation [14], [15]. Consequently, their data selection processes lack transparency, their data extraction lacks completeness, and their results lack rigor. This study is meant as a contribution to fill this gap. The study has two objectives and was conducted as a Systematic Mapping Study (SMS).

The first objective of this SMS is to provide some quantitative data in order to characterize the research being published. The second is to provide some qualitative data, in the context of the quantitative results, concerning the terminological issue. The data for this study was collected from journal articles published in major computer science, engineering and management journals from 1990 to 2015, in order to answer the research questions presented in Table 1. Table 1 also presents the rationales of each research question corresponding to the objective of this study.

Table.1 Research questions

#	Research Questions	Rationales
1	How many papers were published by the researchers over time?	The progression of EA publications over time
2	What are the sectors in which the researchers are evolving?	The spheres of activity that have interest in EA
3	What are the editors, journals, and publishers of the papers?	The scientific organizations that have interest in EA
4	What are the countries where the papers were written?	The countries and continents where researchers have interest in EA
5	What are the academic disciplines in which the researchers studied?	The branch of knowledge or learning that have interest in EA
6	What are the topics addressed by the researchers?	The focus of the EA publications
7	What are the approach, design and techniques used by the researchers?	The structure of research and modes of observations used to conduct EA research
8	How the different sections of the papers are structured?	The structure of the different parts of the EA papers
9	How the term "enterprise architecture" is used in the papers?	How researchers understand "enterprise architecture"
10	How the papers expressed the challenge about the unshared understanding of EA?	How researchers have addressed the challenge of unshared terminology and perception of EA

III. RESEARCH APPROACH

A. Systematic mapping study

Systematic Mapping Study (SMS) is a methodology that is frequently used in medical research. Nowadays, researchers from many other disciplines, like engineering, use it. It is used to examine the literature of a discipline to provide a systematic classification of it and show the current state of its literature. The categories used to classify the literature are usually based on published information such as authors' names and affiliations, publication sources, publication types, progression of the publications over years… and/or information about the research methods and techniques used [3], usually presented in diagrams, charts and statistics. SMS is designed to provide a wide overview of a research discipline area. It helps to certify if research evidence exists on a specific topic and to provide indicators on the reliability of this evidence [23].

From the scope of the research questions to the search process requirements, the analysis approach, and the limitations of the outcomes, Systematic Mapping Study (SMS) and Systematic Literature Review (SLR) are different. One important difference between SMS and SLR is in the analysis stage. SMS uses the literature to collect data with sufficient detail in order to summarise them and answer a large number of research questions posed, whereas SLR uses the literature to investigate whether the research outcomes extracted from each paper are consistent or contradictory, related to specific research questions [3]. However, the results of a SMS can identify areas suitable for conducting SLR.

B. Motivation

The state of EA, provided by a systematic examination like SMS is really useful to help investigate the challenge concerning the inconsistencies in the description of the term "enterprise architecture" and the different approaches to the whole discipline. Currently, none of the studies that have addressed this challenge has never used a specific and systematic methodology, as "SMS", in order to enhance their

results, despite the importance of such a methodology in qualitative research. SMS is the appropriate method to achieve the objectives of this study.

C. Planning

Identifying a classification scheme to capture the state of the art in EA research was the first priority of this study. In order to have a classification that reflects the reality of EA, any specific classification scheme was not followed. Consequently, a multi-faceted classification system was developed, according to the collected data.

D. Execution of the Planning : Selection process

To achieve this study, five academic digital libraries, such as Compendex, INSPEC, Scopus, IEEE and AIS electronic library were consulted to select the journal papers corresponding to the keywords: "ea," "enterprise architecture," "enterprise architect," or "enterprise architects". Only these keywords were used in order to select only the journal papers that make explicit reference to "enterprise architecture". According to the experience of the authors, and some previous search, the 5 identified libraries correspond to those returning relevant results with the mentioned keywords and paper type. Their results were exported to a BibTex (.bib) files. These files were uploaded to the software StArt, a free software usable for all the stages of the Systematic Literature Review (SLR) process, which follow almost the same process that SMS does at the beginning.

Because this study intends to provide a detailed and rigorous classification of EA literature, no specific exclusion criteria were taken into account. But only journal papers written in English and published from 1990 to 2015 were selected. Also, after revising titles, abstracts, and conclusions, papers without the terms: "ea, enterprise architecture, enterprise architect or enterprise architects, related to the discipline of EA or its practitioners" were removed. And finally, only the papers downloadable online with a licence of the affiliate libraries of the authors were selected. However, the authors of non-downloadable papers were contacted, and approximately 30% of them sent a copy of their papers.

As a result, 388 papers were identified, 159 of them were duplicated and 58 were rejected because they do not refer to the discipline of EA or because their electronic version was not found. Finally, 171 papers were selected for examination. This strategy is consistent with the description of [3] because with SMS, researchers may search only a targeted set of publications, restrict themselves to journal papers, or restrict themselves to one or two digital libraries.

E. Execution of the Planning : Data extraction process

Each paper was entirely read at least once and data was extracted during the reading. The majority of the extracted data was collected directly without any interpretation in a spreadsheet, specifically on MS Excel, in order to regroup them easily after and to create the corresponding graphics. The first author classified each article and the classification was discussed with the second author. And the disagreements occurred were discussed until mutual agreement reached.

IV. QUANTITATIVE FINDINGS

A. Corresponding year of publication

The 171 selected papers had been published throughout 15 years between 1990 and 2015 with an average of 9 published papers for each of these years, including an absence of publication for 2002. The years 1990, 1997 and 2001 count for the minimum occurrences with 1 paper during each. The number of published papers peaked at 30 papers in 2014.

Figure 1 presents the distribution of the selected papers over time and proves the growing interest in EA in recent years. Because only the papers published in the first trimester of 2015 were included, this year was intentionally excluded in the following graph.

Fig.1 Article distribution by publication year
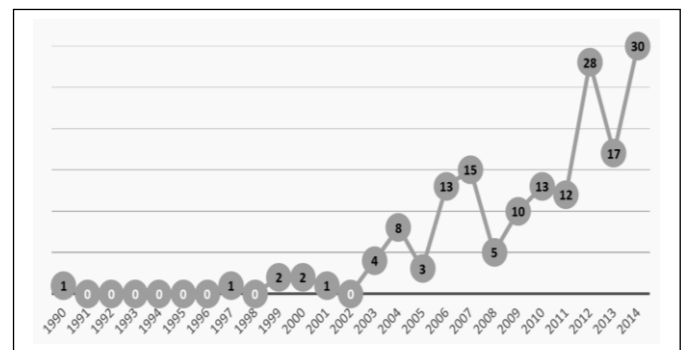
B. Corresponding authors

A total of 364 researchers, including first and corresponding authors wrote the 171 selected papers. 64 of these researchers contributed in the largest number, with a range between 2 to 6 papers. The 300 others contributed to only 1 of the selected papers.

This is an evidence of the evolution of EA because there are many researchers who have published in the EA discipline, with a very good distribution regarding the number of papers published by each.

C. Corresponding sectors of the authors

The first and corresponding authors of the majority of the selected papers – 74% – come from academia, particularly from research centres, institutes, schools, university departments and faculties, as mentioned on their papers. The majority of these authors are student-researchers publishing in collaboration with their teachers-supervisors, and very few of them are only teachers. On the other hand, the authors of 13% of the selected papers are practitioners from public or private organizations, like consulting firms and research or government agencies. 10% come from both academia and professional organizations, and often concerns research with partnerships between academia and industry. 1% of the authors' affiliations is unknown, because of a lack information in their papers.

Table.2 Article distribution by publication country and year

Country	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Australia				1				1	1	2	1		9
Belgium			1	1		1					1		4
Brazil												1	1
Canada				1					2		1		4
China									2	1			3
Colombia											1	1	2
Croatia				1									1
Czech Republic										1			1
Denmark					1	1							2
Finland		1		1									2
France									1		1		2
Germany				1					1	1	1		4
Greece	1		1	1					2		1		6
India			1								1	1	3
Indonesia											1		1
Iran	1					1	2	1	5	3	1	1	15
Ireland											1		1
Japan							1	1					2
Kingdom of Bahrain									1				1
Luxembourg											2		2
Macedonia													1
Malaysia									1		1		2
Mexico										1			1
Morocco									1	1			2
Namibia											1		1
Netherlands	3		1				1	1	4		1		12
New Zealand					1								1
Norway		1											1
Pakistan											1		1
Poland			1										1
Portugal								1	1				2
Qatar						1							1
Russia											1		1
Saudi Arabia										1	1		2
Slovenia								1					1
South Africa	1				1	1					1		4
South Korea			1	1	1		3						6
Spain			1							1			2
Sweden			1	2		1		2	3	1	4		14
Switzerland			1	1						1	2	1	6
Turkey												1	1
United Arab Emirates										1			1
United Kingdom				1				1	1	1			5
United States	2	1	3	4	1	4	6	3	2		5		36
Total	8	3	13	15	5	10	13	12	28	17	30	6	171

E. Corresponding country of the first authors

The affiliation organizations of the first authors (researchers) of the selected papers are located in 44 different countries. Table 2 presents the number of the selected papers published by each of these countries between 2004 to 2015. The empty cells mean that there is no publication for these countries during the corresponding years. This table definitely confirms the growing interest in EA around the World, with a particular focus in United States of America, Iran, Sweden, Netherlands and Australia.

The classification of these countries shows that 41% of the papers come from Europe, 25% from America, 23% from Asia, 6% from Oceania and 5% from Africa. Also, all the selected papers were written in English while this language is the official one in only 39% of these countries.

It is important to mention that the country of the affiliation organizations of the first author was not always the same as the corresponding author's. But only the country of the affiliation organizations of first authors was considered in this study.

F. Corresponding study area of the authors

According to the academic university, department, faculty, school, institute, centre or laboratory corresponding to the first authors, the 5 following categories were identified:

- Social and human science(SS): refers to authors who studied in Management, Administration, Economics, Business, Marketing, Logistics, and Communication;

- Specific area of engineering(ES): refers to authors who studied in a specific area of engineering that does not include IT. For example, Mechanical, Industrial, System, Electrical and Operation Research are some specific areas found on the selected papers. All the names that mix several specific fields of engineering are also included in this category, like Aviation, Supply Chain Management, Industrial Information, Control Systems and Mines-Telecom;

- Information technology(EIT): refers to authors who studied in Information Technology and corresponding areas, like Computer science, Computer engineering, Information and Communication Technology, Information systems, Informatics or Software;

- Engineering(E): refers to authors with papers that mention only a general name of study that might include several other specialized areas related to engineering, like Faculty of Science and Engineering, Faculty of Technology and Engineering, Faculty of Technology Engineering and Environment, Department of Computer Science and Engineering;

- Other: refers to the authors of 2 papers which indicate that the first authors are studying in a School of Medicine and a Center of Forest Studies.

In addition to these categories, another one (ABS) was created for the papers that indicate any interpretative information in relation to the study area of the authors. Also, these categories correspond to the particular academic

D. Corresponding journals

The selected papers come from 103 journals. 28 of these journals represent the largest publications, from 10 to 2 papers for each. The 75 other journals published only one of the 171 selected papers. The length of the selected papers articles in these journals varies from a minimum of 2 pages to a maximum of 39 pages.

This is another proof of the growing interest in EA because there are many relevant journals that have published the EA research. The publishers and editors of these journals include the well known in the academic sector, like IEEE, Frontiers, Springer, Taylor & Francis, Cutter Consortium and Elsevier.

disciplines covered by the 103 journals in which the 171 identified papers were published.

Figure 2 presents the final classification of this section. This classification shows how EA research is much more oriented towards the technological area than the managerial area. 50% of the selected papers were written by researcher who studied in Information Technology and an Engineering discipline, while only 16% were written by researcher who studied in Social Sciences. In addition, it is important to mention that the corresponding study areas of 20% of the researchers were not found because of a lack of information in their paper.

Fig.2 Article distribution by academic study area of the first authors
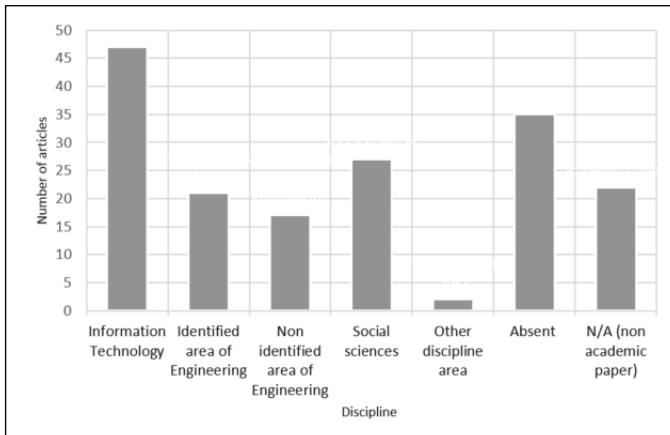
G. Topic addressed by the researchers

The title of a paper is the first factor that gives an idea about the topics addressed. Figure 3 presents a word cloud of the most repeated words in the titles of the selected papers, from "enterprise framework," with 34 repetitions, to "strategy," with 4 repetitions.

Fig.3 Word cloud with the most repeated words in the titles of the articles
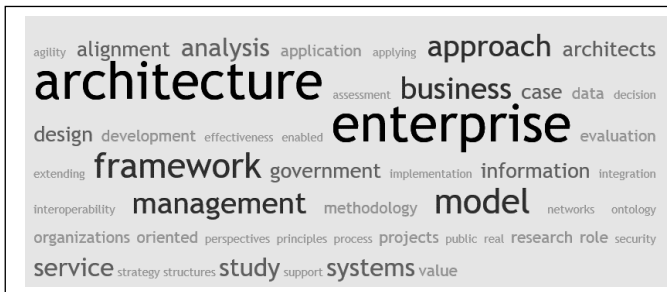

After reading each paper according to the main topic addressed, the following categories where identified:

- EA-Discipline: the main objective here is to present EA and its importance. Some of the specific aspects found in this category addressed the practice of EA, its role, benefits, challenges and differences compared to other fields, and also the steps needed to establish EA as a generally accepted profession;

- EA-Literature: the main objective here is the review of a large number of published papers in order to analyze the EA literature. Some of the specific aspects found in this category addressed the state of the art in EA in general and in China, the bibliometric analysis, and the lack of shared meaning in EA;

- EA-Practitioner: the main objective here is to highlight the role and mission of enterprise architects. Some of the specific aspects found in this category explore how and where EA skills can be developed, the strategies that the architects must used, and how they cannot just generate a plan, but must participate in a holistic, adaptive and team-oriented process;

- EA-Integration: the main objective here is to investigate EA's relationship or association to other specific fields in order to optimize its performance. Some of the specific aspects found in this category address the integration of EA to System of Systems Engineering, Project Management, Cybernetics, Service-Oriented Architecture, Cloud Computer, Public Administration, and Healthcare;

- EA-Design: the main objective here is to study the architecture aspects of EA. Some of the specific aspects found in this category address architecture modelling and descriptions, languages and patterns;

- EA-Measurement: the main objective here is to evaluate the maturity and the performance of EA and their influence in the achievement of the goals of the organizations. Some of the specific aspects found in this category address compliance, long-term financial improvement capabilities, alignment of business and IT, security, and return on investment (ROI);

- EA-Principles: the main objective here is to give a set of steps to follow to build, control and successfully maintain an EA strategy. Some of the specific aspects found in this category address principles to ensure building EA, decision-making, mature practice, structures in different organizational cultures, and getting the most value from EA;

- EA-Strategy: the main objective here is to propose a specific way, approach or method to optimize EA practices, but not only through the description of the steps and principles to follow, like in the previous category. Some of the specific aspects found in this category address automatic generation of EA models, elimination of semantic inconsistency in organizations, and best practices;

- EA-Framework and model: the main objective here is to develop or evaluate EA frameworks or models as a guide on how to build, control and maintain an EA structure. Some of the specific aspects found in this category address adaptation, agility, enterprise competency, planning, decision-making processes, CIO concerns, cooperation, alignment, e-government and also framework evaluation and selection.

Figure 4 presents the number of papers related to each of the previous categories corresponding to major research streams in EA. This information shows how the EA research is much more focussed on the operational side while the structural side of the discipline is neglected. The majority of the selected papers are focussed on building and examination of frameworks, models and design.

Fig.4 Main topic addressed in the articles
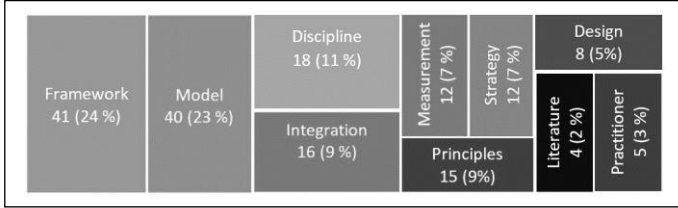
H. Corresponding methodology to conduct the research

A total of 128 of the selected papers (75%), do not mention the research method or techniques used. Figure 6 presents the methods and techniques specified in the 43 other papers.

In addition to the previous information, to better understand the research design or approaches used in selected papers, each phase of these studies was analyzed. For the data collection phase, a large part of the papers used more than one source to collect data, and the main identified sources are academic literature and professional documents (review and study), people (survey), process (observation), existing tools and strategy description (analysis). Also, some papers did not really use specific sources to collect data. The authors of these papers used their own experiences (argumentation) to treat their study.

For the data analysis phase, several methods and techniques were used, such as grouping, comparison, and interpretation (statistics), coding (content analysis), or just discussion and explication (argumentation). And finally, some data evaluation techniques to test and validate the results (survey, case study) are used in a small portion of the papers.

It is also important to mention that not all the papers follow exactly the previous steps. For example, some researchers report one or multiple case studies. That is why, according to [1] and [37], six research structure categories were identified and several modes of observation are associated with each of these structures.

- Descriptive: observe and describe observations to answer what, where, when, and how questions;

- Developmental: develop and describe approaches to support general systems development research;

- Evaluative: generate theory or model resulting from testing and experiments;

- Explanatory: test hypotheses about cause-and-effect relationships to answering why questions;

- Explorative: examine a new interest and gather preliminary information to suggest hypotheses;

- Formulative: develop theories, models, or frameworks that support research and/or scientific progress.

Figure 5 presents the number of the selected papers that corresponds to each of the previous structure of research and mode of observations. This information shows how a large number of the research with focus on building EA frameworks is conducted following the principles of Design Science Research (DSR), even if it is not mentioned in the papers. There are also many studies conducted following the representative techniques of Survey and Case Study. On the other hand, some important research techniques to study the state of EA literature and practice, and to provide direction for future, like Action Research, Literature Review and Simulation/Experiment with human or tools, are rarely used. Informal techniques to draw in the literature, like Literature Analysis, are preferred over formal techniques, like Literature Review, including Systematic Literature Review and Mapping Study and Content Analysis.

Fig.5 Research approach used by the researchers
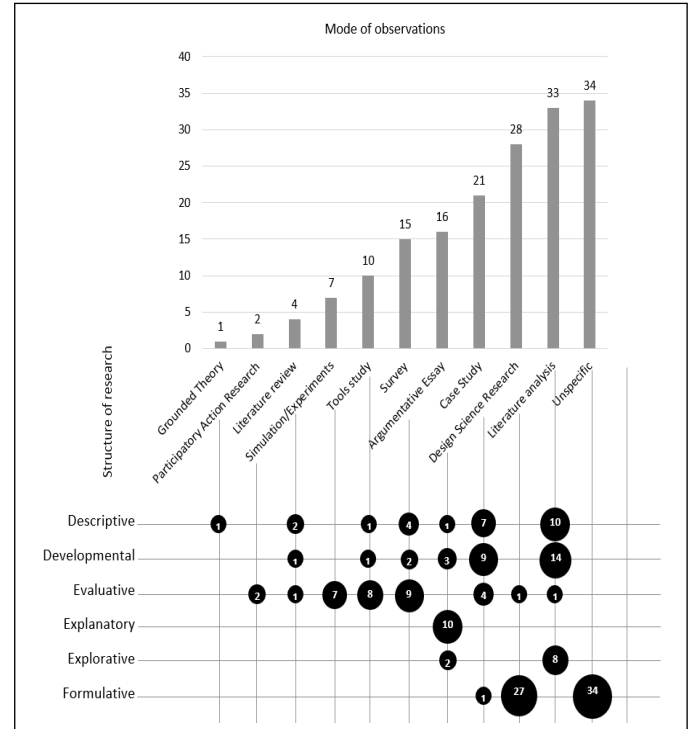
VI. QUALITATIVE FINDINGS

A. Use of the term Enterprise Architecture

The term Enterprise Architecture is different from one paper to the next. The first important observation revealed is that 17% of the papers contain this term only in their title. Other terms like Organizational Modeling, Information Technology, Architectural Approach, Information Systems Research, and others, were explicitly used in these papers to stand in for EA. The second important observation concerns the confusion with regards to the definition of the term. Several researchers used referenced definitions that are not always compatible together.

Actually, approximately 35% of the selected papers do not contain any definition of EA. In these papers, researchers talk about EA as though it is a universal term that people are supposed to know all with the same meaning. 36% define EA only with one or several reference citations. And 29% present EA with a definition composed by the authors and communicate to readers at the very beginning which EA she or he is referring to. However, the important role of definitions in the identity of the thing defined cannot be underestimated. Whenever a researcher or a practitioner engages for the first time with something, the question is invariably "what is this thing I am examining?" [16].

The different approaches to EA observed in the selected papers can be summarized in different concepts such as:

- A tool, including frameworks, models, design developers and others [30], [33], used to describe and organize the relationships and communications between an organization and its various stakeholders;

- A technology roadmap [35] to execute in order to assure relevant alignment between business and technology, to meet technology milestones, or to support the evolution of the system landscape;

- A methodology, including methods, tools, standards, and more [21], to apply and update regularly in order to better realize the daily operations in an organization. To do this, it must also consider the sociocultural aspect of the organization which is supposed to be absent in the two previous categories;

- A long-term strategy [10] to apply and update regularly in order to better assure the daily and future activities of an organization. In addition to the socio-cultural aspect, attention is also given to the organization's environment. A bi-directional relationship between the organization and its environment is identified and taken into account in this approach.

In addition to these observations, the mission, competence and knowledge of Enterprise Architects is not presented in the same way either [2], [8], [11], [18], [26]. The different approaches to the practice of EA observed can be categorized into different roles such as:

- A specialist who understands the known problems of an organization and the best ways to resolve them, without any investigation;

- An investigator who knows the tools, methods and techniques to make good diagnoses for the unknown problems of an organization in order to understand them and apply effective solutions;

- An integrator who is able to unite all the stakeholders in their understanding of the problems and decision-making processes of an organization, in order to find effective solutions;

- A facilitator who can facilitate an understanding of the problems of an organization with detailed explanations, in order to help administrators decide on effective solutions.

If the majority of the selected papers presents EA as a discipline, there are also many – 33% – without one word to demonstrate that the author considered EA as a specific discipline area. The majority of the papers in this category has addressed topic focussed on frameworks, models and designs [32]. These observations are consistent with the differences mentioned in previous studies. According to [15], the three schools of thought in the EA discipline differ with regard to scope, purposes, principles and assumptions.

B. Notification of the divergent understanding of EA

35% of the selected papers mention facing a challenge due to divergent understandings of EA. Many of them present this with neutral arguments. For example, some authors explain that EA is still a challenging concept as there are many conceptions and a variety of definitions that hinder a uniform view [27]. Some others explain that EA lacks semantics, and that humans and systems cannot understand Enterprise Architectures exactly and commonly [6]. But on the other hand, some papers are more to-the-point and declare that EA suffers from vague definitions of what it is supposed to be. They highlight an absence of any consensus of what an EA is supposed to do, and an absence of any general agreement on how an EA is supposed to function [20]. Others explain there are several varieties and differences in the definitions of the EA discipline, and consider it a lack of theoretical foundation, definition, or common understanding among the authors who choose to publish in this context [36]. [5] explains how there are many Enterprise Architects, but there's no commonly accepted baseline of knowledge or standards to ensure consistent service. [4] explains how inconsistency in the definition of EA, prevails in the literature, which further complicates the challenges of defining the role of the Enterprise Architect.

Some propositions are made in the selected papers to explain or solve this challenge. For example, some papers try to create a general approach with several other definitions and concepts of EA or to demonstrate the correspondence of certain approaches to the reality of EA.

Finally, one of the most important considerations that the selected papers address is about the challenge concerning the importance of EA as a whole. One of the most cited papers tries to integrate all of the existing concepts in identifying the schools of thought in EA in order to integrate them [15]. In the absence of clear definitions for the roles that influence architecture success, architects may be viewed as providing no specific value [9]. However, the use of EA depends on how it is understood, defined and scoped [12].

At least 47 of the selected papers reported the lack of shared meaning in EA from 2006 to 2014. These papers come from different countries and journals. They have different focus, and their authors are evolving in different sector and discipline areas. Their number also increases over time. This is a proof

that the lack of shared meaning in EA contributes to the difficulties experienced by both researchers and practitioners, and the scientific community is increasingly aware of this.

VII. DISCUSSION AND IMPLICATION

The distribution of the selected papers over time shows how EA is still young. In fact, the most papers published in a given year between 1990 and 2014 is thirty, in 2014. They are really few comparing the number of published papers in Software Engineering, that is also a young discipline but not as young as EA. This is not to say that EA is not progressing. On the contrary, the increasing number of papers over years, the increasing number of researchers that conduct these studies and the increasing number of journals and publishers that publish these studies are tangible proof that the opposite is true. The diverse topics addressed in the studies and the diverse methods and techniques used to conduct them, are also a good sign for the evolution of EA.

Despite 21% of the selected papers are published by first authors located in United States of America, only 25% of the papers come from America. According to this study, currently the majority of the research on EA, published in journal articles, were conducted by researchers in Europe (41%). European scientists and practitioners seem to have taken over thought leadership in the field [7].

In addition, it is important to mention that 44% of the researchers who studied in Social Sciences are from European academic institutions. Because the majority of the papers for which the study area of the main researcher was not found come from Europe (60%), maybe the difference between the researchers who studied in Information Technology and an Engineering discipline (34%) in not as great as identified currently. Probably a large part of these unknown disciplines corresponds to Social Sciences. In fact, there is a growing interest in EA related to researchers who studied in Social Sciences. Although the technological aspect is dominant in EA, more and more studies begin to take a managerial aspect into account, even their studies are focussed on building and examination of frameworks and models. The word cloud presented in Figure 3 is also a proof of this evolution with some words like strategy, structures and decision which are more and more present, even in the titles of the papers.

The majority of the papers are the result of academic research. One of the constraints of academic research is the obligation to use existing references to derive others. Because of this, if the discipline of EA had relevant shared references to follow, it is obvious that there would not be so many uncommon approaches in its literature as there are.

Also, all the papers were written in English, but only 39% of the selected papers come from countries were this is the first or recognized language. Do the authors always express what they really want, with the right terminology? Do they understand well the citations about the definition of EA before combining several different or contradictory citations?

On the other hand, it is evident that the selected papers address EA with the views of at least three different academic disciplines which are Information Technology Engineering, other specialized Engineering branches, and Social and Human Science. Each of these fields has a different way of conceiving, addressing, and procuring results in cases of real world problem situations. What is its impact on the approach that the authors lend to EA? Perceptions of EA are new ideas [28].

In term of structure of research, there is a lack of significant techniques to conduct research in EA. Only 25% of the selected papers can be considered as explanatory and explorative studies. In term of mode of observation, techniques to study the state of EA literature and practice, and to provide structure and direction to the young discipline, like Action Research, Literature Review and Simulation/Experiment with human or tools, are rarely used. This information proves why there is some gap between theoretical and practical foundation in EA. Research must be more consistent in EA, and the practical aspect must play a more important role in order to be closer to the theory.

Finally, a large percentage of the papers mention the lack of shared meaning in EA, but only a few of them try to review the EA literature to shed more light on this [13],[14], [15], [31], [7]. Also, the majority of the few research focus on this challenge does not mention clearly the sources they use to collect their data and the techniques they use to analyze them. Informal techniques, like Literature Analysis, are preferred to draw in the literature over formal techniques, like Literature Review, including Systematic Literature Review and Mapping Study. It is clear there are not enough relevant publications about this theme even within the increasing publication on EA.

VIII. CONCLUSION AND FUTURE RESEARCH

This study systematically analyzed 171 journal articles according to the well-known and established method of systematic mapping study. Its main limitations concern the selection of only the journal papers. Evidently, other relevant data sources were excluded from this study. Despite these limitations, the contribution of this study is manifold. First, this is one of the really few studies that addresses the review of the EA literature in order to shed some light concerning the lack of common understanding in EA. Second, a well-known method, that is systematic mapping study, was followed to conduct this study, in order to create evidence for the validity of research results. And finally, the categories used to classify the different aspects of the literature within this study emerge without any predefined classification scheme, in order to provide good insights, usable for future studies.

The findings show that EA is a multidisciplinary domain with growing interest. But it is important to take more time to address the challenge of unshared meaning in EA if effectively this discipline aspires to improve enterprise coherence. Future research in this area must investigate the literature more deeply in order to explore the different beliefs in EA. Significant and reliable techniques, like encoding and decoding processes, surveying, and physical observation must be used.

However, all kinds of attempts to create a coherent picture of EA as a concept represent positive contributions to the future body of knowledge on this discipline, which must integrate all relevant existing concepts, and therefore allow itself becoming more mature as a discipline.

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