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Business Strategy Modelling based on Enterprise Architecture: A State of the Art Review

Abstract

Purpose: Enterprise architecture (EA) is a means of a high level of abstraction of a business' levels which helps organise planning and taking better decisions. Evidence has shown that the scope of EA is not restricted to technology planning, but the lack of business strategy and processes is the most common problem of EA Frameworks. Consequently, a challenge stems from the fact that the formulation of strategy should not be modelled separately but as a holistic approach. This paper aims to evaluate the contemporary problems in existing EA modelling frameworks concerning the optimization of business strategy concepts and to identify areas for improvement.

Design/methodology/approach: Studies were spotted using a three phased literature review methodology which was suggested by Webster and Watson, (2002).

Findings: Although, previous studies have attempted to use tools and models to visualize the technological business planning, limited previous study has focused on modelling strategic planning. Due to issues concerning the lack of guidelines for modelling business strategy, a holistic approach is needed to be made.

Originality/value: The paper contributes to the existing literature by assessing the current EA modelling languages and their skilfulness to modelling strategy. Moreover, it contributes to the determination of difficulties in modelling, as well as to the examination of ease of use of language in the context of strategy. Second, this paper provides an overview to practitioners who would like to develop effective EA modelling projects, as well as to architects who try to solve the problems of business complexity.

Keywords: Business Strategy, Strategic Management, Modelling, Enterprise Architecture, Enterprise Architecture Management, Enterprise Engineering

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Introduction

Despite the increasing complexity in the structure of organizational systems, there have not been adequate studies examining the strategic significance of the above. The research has shown that architecture does not only present the relationship between the aspects in a complex environment. The orientation of Enterprise Architecture (EA) Frameworks to the systems and technology and the lack of integration among strategy, business and processes are the most common problems of EA Frameworks. The main research question is: How to integrate the strategy planning with business processes? Given the strategic significance on using them as a guide of planning, alignment and evaluation of the changing requirements, there has not been a sufficiently strategic approach to get at this question (Heyl, 2014).

EA Modelling is a structured perspective which is used to manage the EA implementation needs and offers a concrete plan for enabling the EA components. EA Modelling involves all phases of the EA lifecycle, including the planning of business understanding projects, the analysis of business requirements, the development of systems as well as the maintenance of all of the above. However, there is inadequate EA methodology that informs about the implementation, because of the complexities which arise in trying to understand processes, models, methods and EA strategy (Rouhani *et al.* 2015).

The implementation of a corporate strategy on the business layer is a major factor for business success. However, the understanding of a holistic approach should facilitate the development of a strategy and the optimization of related processes. But until now, the implementation of the corporate strategy in EA is not well understood and researchers have seen it as a challenge (Lederer *et al.* 2014).

Nevertheless, the recent studies using techniques to model strategy supporting it with EA, suffer from making available guidelines about how to model it. Researchers argue that this is required in order to represent how aspects in the architecture of an enterprise contribute to the strategy, or how changes to architecture may ensure to implement

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strategy. Furthermore, researchers can identify how to model strategy and how it impacts on the EA. This helps businesses analyse and determine which function is best integrated with the strategic intent (scale, money, time) (Aldea *et al.* 2015).

In this regard, many studies were conducted in terms of eliminating the lack of business objectives and business process models. Textual and graphical approaches have been proposed to fulfill strategy in process and workflow models. Providing a successful formulation of the alignment of business strategy with EA, available approaches can not be too general. However, there is still no standard method to show how this integration can be adapted in different cases and different domains (Lederer *et al.* 2014).

This paper aims to evaluate the contemporary problems in existing EA modelling frameworks concerning the optimization of business strategy concepts, to determine the techniques that are supported by EA Modelling and to identify areas for improvement.

The remainder of the paper has been structured as follows: The next section describes work related to EA and business strategy. Section 3 presents the literature review methodology which was followed in order to search and analyze the relative articles. Then, the findings of this review are discussed in next sections. Finally, conclusion and suggestions for future research conclude the paper.

Previous Literature Reviews

Systematic reviews were undertaken to place the current paper to the existing knowledge about EA and business strategy modelling as well as to examine the previous knowledge of this field and discuss the identified research questions based on the results of previous studies.

A comprehensive review of the published literature was reported by Salgado *et al.* (2014). It presents a state of the art on the alignment between business and Information Systems (IS) and its relevant issues, such as frameworks for enterprise, requirements and strategy alignment. The difficulty to establish and maintain a clear and vital

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overview of the concepts involved, as the number of papers on business modelling is too high was indicated.

Heyl (2014) reviewed the existing literature on EA and business process management as well as strategic alignment. Results show that there are many models focused on the process management and structural frameworks which systematically describe a business as a set of models. However, there are no standards that provide orientation to the industry. The main question is: How can strategy planning be integrated with business processes?.

Rouhani *et al.* (2015) presented a review of 46 papers and analyzed the problems of the existing EA models. EA is developed by businesses to provide an integrated environment in order to maintain the alignment of business and IT. These approaches maintain EA development by providing planning for EA project, modelling the EA artefacts, implementing well-structured artefacts, assessing the EA implementation, strengthening the EA governance and supporting the EA implementation.

Methodology

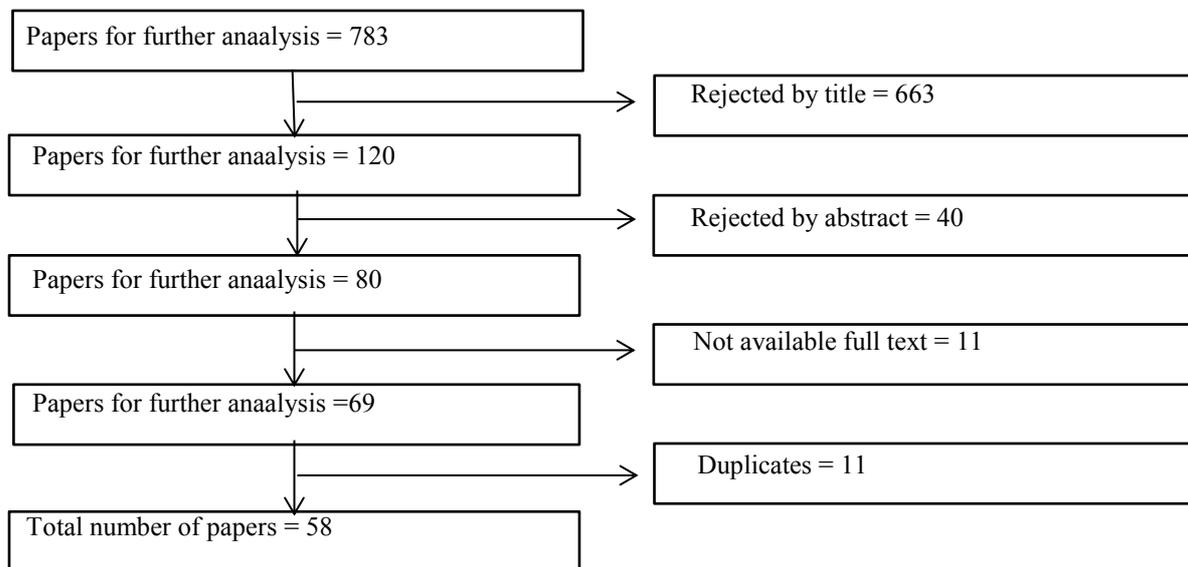
As it has already been supported, this paper aims to evaluate the contemporary problems in existing EA modelling frameworks concerning the optimization of business strategy concepts, to determine the techniques that are supported by EA Modelling and to identify areas for improvement. To achieve the aim of the paper, studies were searched and synthesized using a three phased literature review methodology which was suggested by Webster and Watson (2002). This methodology was used by many researchers in the field of IS, business strategy and enterprise modelling (Berkovich *et al.* 2011; Chen *et al.* 2010; Jourdan *et al.* 2008; Kamariotou and Kitsios, 2017; Kitsios and Kamariotou, 2017; 2016). First, a search of the extant literature reviews was done to select the databases and keywords of the basic search. Then, the backward search was implemented to examine the references of the selected papers and finally the forward search to examine the citations of the selected papers in order to increase their amount. After the selection of papers, they were classified according to their content.

Stage 1: Initial search

The search was done in Scopus, Science Direct, Web of Science and ABI/INFORM using the following keywords “strategy and modelling” and “strategy and enterprise architecture”. Papers published in academic journals and proceedings of conferences. Furthermore, there were no limitations concerning the publication years. The searched papers belonged to fields of Strategy, Management and Computer Science. Finally, the published papers were only in English.

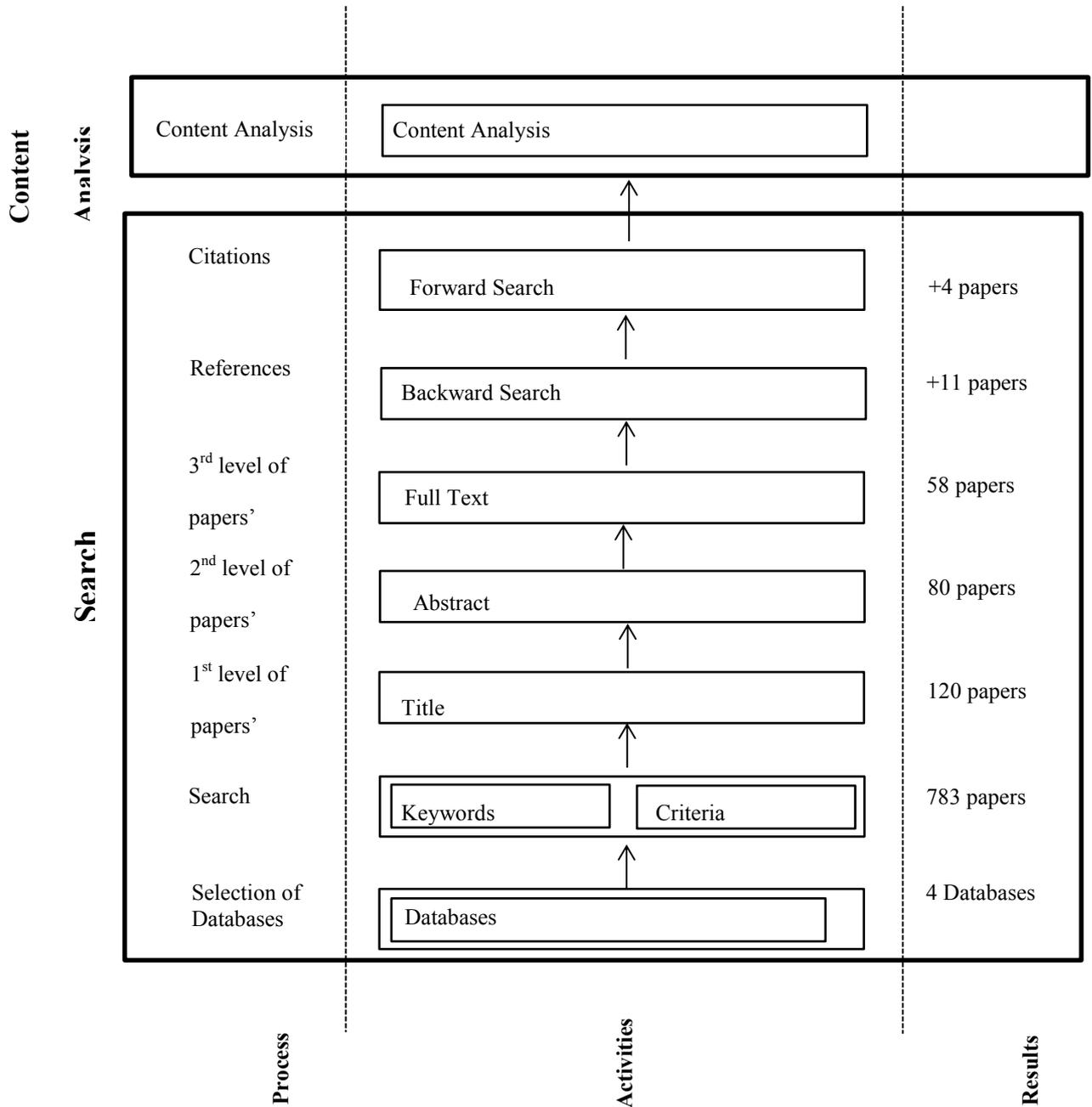
The total number of articles which were gathered using keywords in all databases was 783. Then, examining their titles, 120 articles were found relevant with the purpose of this paper. Next, scanning their abstract, 80 were accepted. A number of studies were rejected because their full text was not accessible. Consequently, 69 articles were selected according to their full text. Duplicate articles were removed and 58 articles were addressed (Figure 1. Article selection process I).

Figure 1: Article selection process I.



In the current amount of papers, more 11 papers were added from the backward search. Additionally, 3 more articles contributed from the "forward search" and thus revealed a total of 50 articles (Figure 2. Article selection process II).

Figure 2: Article selection process II.



Search was finished when it came to common articles from all databases and using different combinations of keywords. It was then that it was decided that the critical mass of related publications was collected (Webster and Watson, 2002).

Stage 2: Classification of articles

The categorization of articles was addressed according to their content and the concepts

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which were discussed in papers are related to architecture, culture, vision, mission, goal, objective, strategy, tactic, stakeholder, resources and capabilities, business environment, SWOT, value chain, assessment, Balanced Scorecard (BSC), strategy map, value, alignment, business model and business process model.

Many researchers have used different EA Modelling techniques, such as Goal Structuring Notation, Object Management Architecture, S-BPM, EA Anamnesis, UBSMM, S-BEAM, Telos, Archimate, Strategy Modelling Language, GORE, TOGAF, UEMML, OWL, RDF, ARMOR, MAP, B-SCP, Strategic Neuron, Semantic, i* framework, e3-value, IBC approach and UML. Over, the last five years, researchers have tried to optimize business strategy using Archimate, which is an open and independent architecture modelling language. Most researchers focused on modelling vision, mission, goals and strategy. Moreover, researchers concentrated on optimizing strategic alignment between business strategy and IT strategy or between business strategy and Interoperability strategy. Fewer studies have been performed to model analysis of business environment, SWOT analysis, value chain and the assessment of business strategy (e.g. applying of KPIs, BSC, SCOR- model).

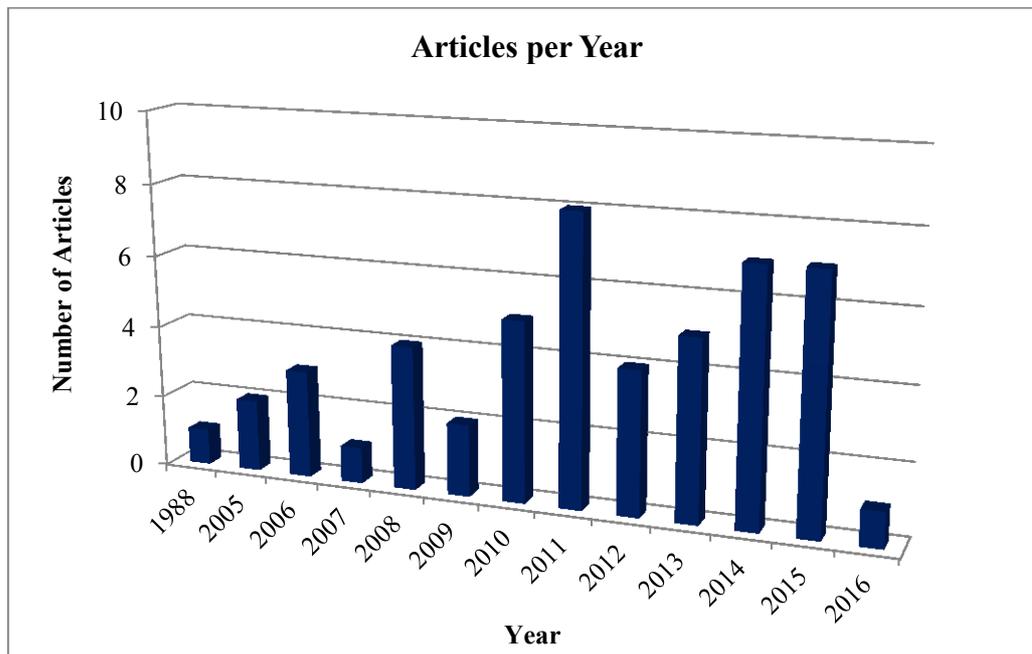
The classification of articles shows that literature review papers are limited so it is necessary to re-examine the current state of this field.

Results

Number of published articles per year

Although researchers in EA and business strategy area conducted studies three decades ago, the majority of papers have been published in the last ten years. This is an interesting finding which highlights both the importance of the field and its continuous development. Figure 3 presents a clear increasing tend in the last ten years.

Figure 3: Articles per year



More specifically, the research area of EA and business strategy has appeared since 1988. The highest number of articles was found in 2011, 2014 and 2015. The number of articles dropped to the lowest level in the period in 1988, 2005-2007, 2009 and 2016.

Due to the expansion of the field to new enterprise modelling techniques, researchers have studied whether the existing modelling languages can provide a holistic approach of the business strategy or not, as well as which are the problems of these languages (Lederer *et al.* 2014; Heyl, 2014; Salgado *et al.* 2013).

Research areas

Figure 4 shows that 94% of papers were categorized as empirical. These papers were mainly focused on the modelling of strategy (15%), goals (12%), mission (8%), vision (7%), objectives (7%), resources and capabilities (7%). These results are presented in Figure 5.

Figure 4: Percentage of articles per method

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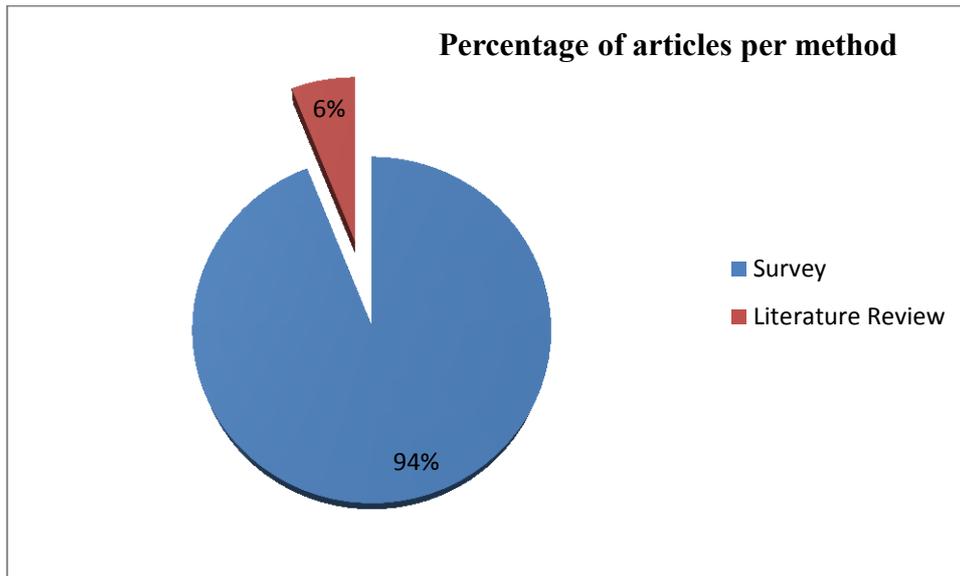
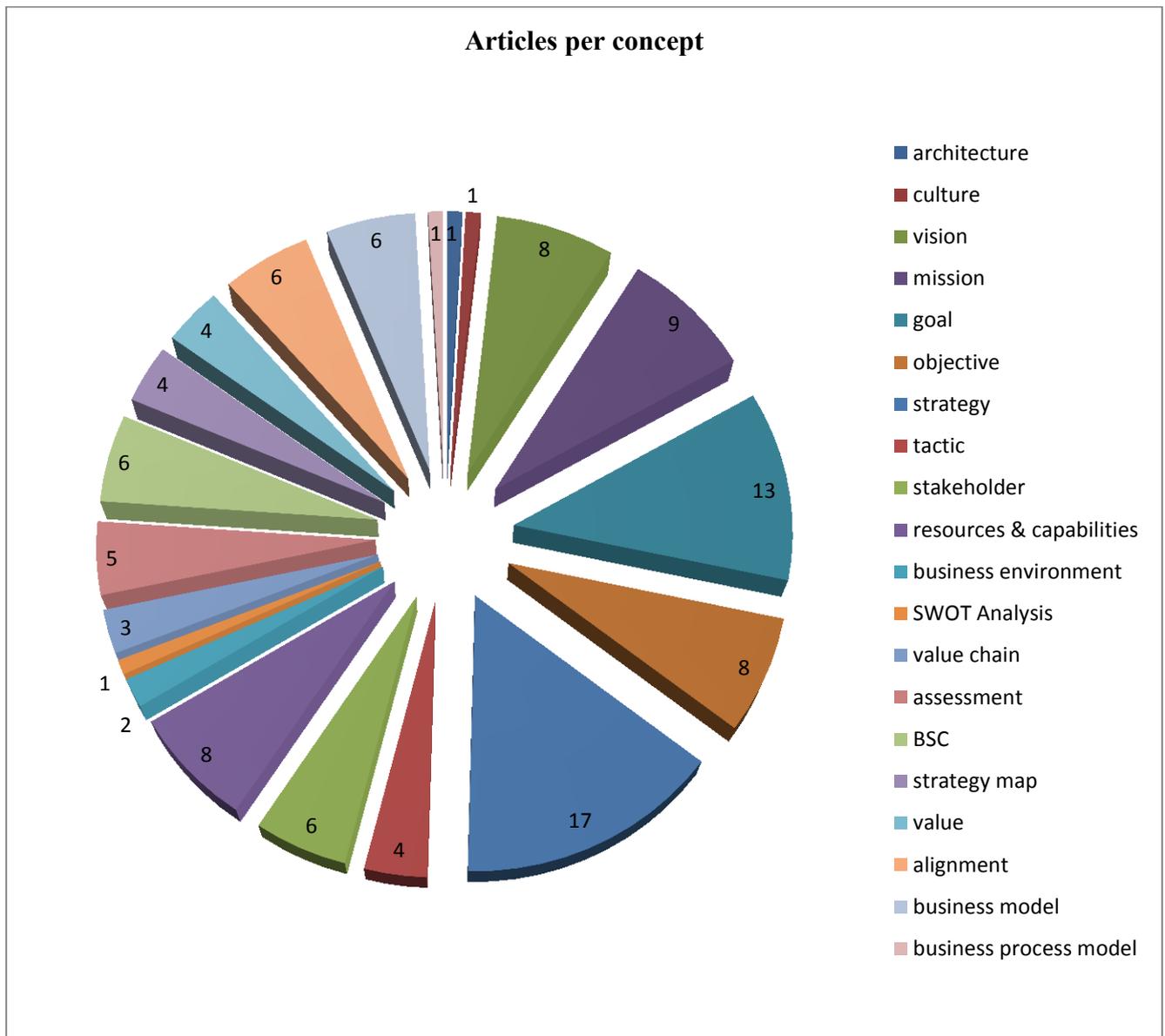


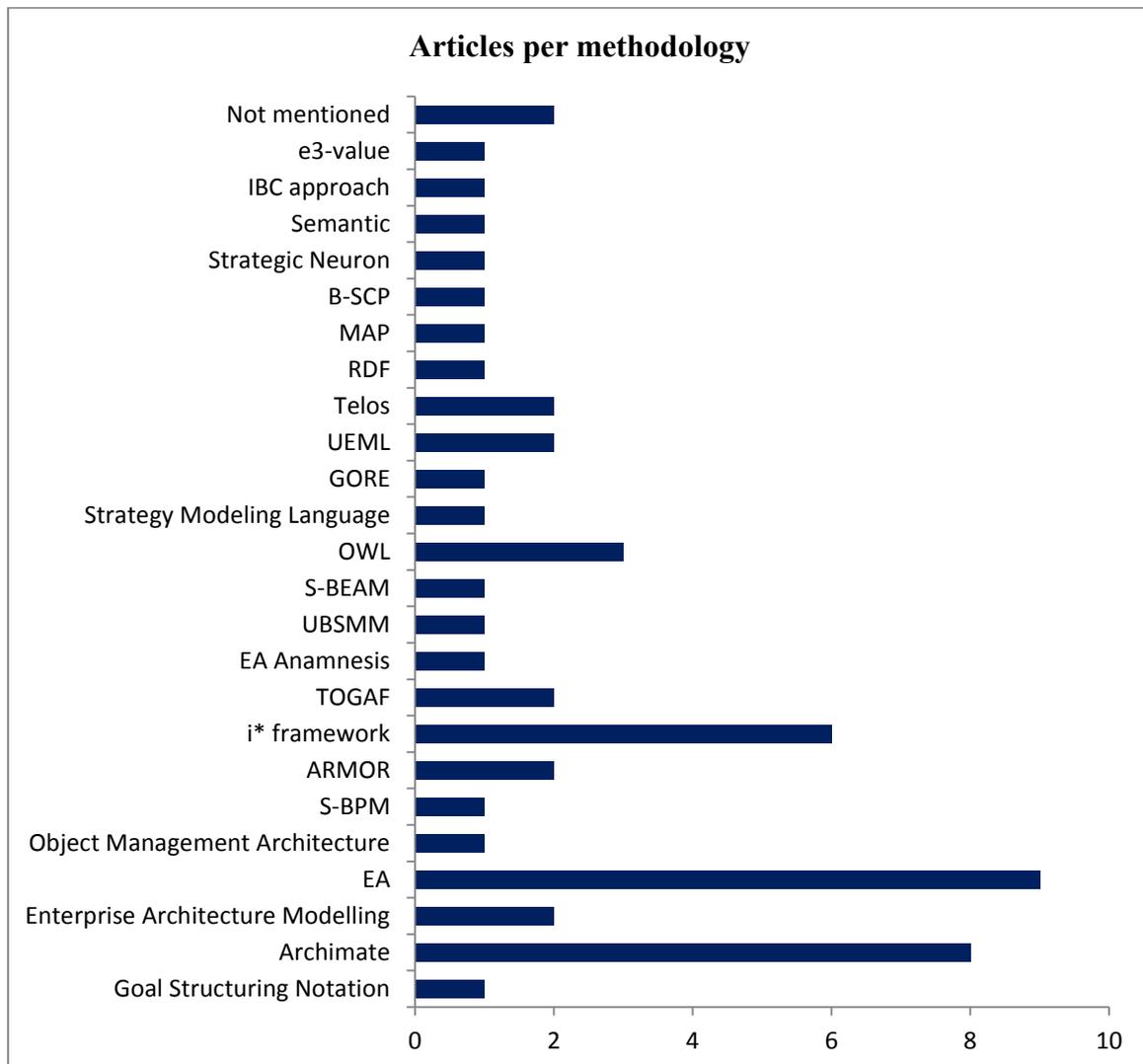
Figure 5: Articles per concept



Research methods

Although researchers have used plenty of Enterprise Modelling techniques to optimize the concepts above, the most frequently used methods are Archimate (14.5%), i* framework (10.9%) and OWL (5.45%). These findings are displayed in Figure 6.

Figure 6: Articles per methodology



Analysis of Concepts

Strategic Planning Process

In this section, the concepts of strategic planning are described as they have been highlighted in papers. These concepts and their meaning are presented in Table 1.

Table 1 Definitions of strategic planning concepts.

Concept	Meaning
Vision	A desired future situation of a business (Aldea et al. 2015).
Mission	The actions of a business and what it does on a daily basis. It includes all the strategies of the business and it makes

	the vision operative (Aldea et al. 2015).
Strategy	<p>A plan for the future or a pattern of behavior. It includes the actions that a business intends to take and what to do in order to integrate its vision in the long run (Aldea et al. 2015).</p> <p>The understanding of an industry structure and dynamics, identifies the business's relative position in that industry and intends either to transform the industry's structure or the business's position to meliorate business results (Bleistein et al. 2006).</p>
Objectives	Statements of concrete outcomes which are to be succeeded in and are usually occurred with performance measures, determinate targets they need to manage, as well as initiatives that can be applied to attain them (Aldea et al. 2015; Iacob et al. 2012).
Tactic	A supported short-term action to achieve an objective (Bleistein et al. 2006).
BSC	It measures the extent of achievement of objectives in four perspectives; the financial, customer, business process and development perspective (Azevedo et al. 2015; Giannoulis et al. 2011; Lederer et al. 2014; Yamamoto and Morisaki 2016).
Capability	A set of differentiated skills, supplementary assets and routines which are enabled and affect positively the competitiveness in a business (Loucopoulos et al. 2015).
Value	The worth of a product or service as perceived by the customer (Aldea et al. 2015).
SWOT Analysis	The combination of strengths, weaknesses, opportunities and threats that supports the formulation of a series of alternative strategies which intend to take advantage of the strengths and opportunities and eliminate their weaknesses

	and threats (Aldea et al. 2015).
Alignment	The dimension to which the IT mission, objectives and plans maintain, and are enhanced by the business mission, objectives and plans (Cuenca et al. 2011).
IT strategy	The choices related to the positioning of the business in the IT marketplace (Hinkelmann and Pasquini 2014).

The vision describes a desired future situation of a business. The mission should determine the actions of a business and what it does on a daily basis. It should include all the strategies of the business and it should make the vision operative. Therefore, a mission should determine the activities of a business which make the vision come true.

Strategy is considered as a plan for the future or a pattern of behavior. Another definition refers to the actions that a business intends to take and how to act in order to integrate its vision in the long run (Aldea *et al.* 2015). Another definition of business strategy indicates that this is the understanding of an industry structure and dynamics, identifying the business's relative position in that industry and intends either to alter the industry's structure or the business's position to meliorate business results (Bleistein *et al.* 2006). The business strategy identifies, in terms of strategic goals, resources, competencies and capabilities, where the business wants to be in the future (Iacob *et al.* 2012).

After defining business strategy, planners translated it into particular measurable objectives. So, they refer to statements of concrete outcomes which are to be succeeded and are usually occurred with performance measures, determinate targets they need to manage, as well as initiatives that can be applied to attain them (Aldea *et al.* 2015; Iacob *et al.* 2012). Balanced Scorecard (BSC) is a method which supports the measurement of objectives. The BSC measures the extent of achievement of objectives in four perspectives; the financial, customer, business process and development perspective (Azevedo *et al.* 2015; Giannoulis *et al.* 2011; Lederer *et al.* 2014; Yamamoto and Morisaki, 2016).

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A strategy map provides with details of the mission, core values, the vision and the business strategy which are integrated and rise business performance. The map starts from a given definition of the mission statement and core values. There is need for a strategic vision, based on mission and core values. Next, the first level involves the financial perspective which started assessing cost structure and the expansion of revenue opportunities. Customer's perspective in which the value proposition is contained, is included in the next level. This view fits with the characteristics of product or service, such as price, brand, quality, availability, partnership, functionality and service. Internal perspective presents operations management processes, customer management processes, innovation processes and social processes concerning the value proposition. Finally, in learning and growth perspective human, organizational and information capital are fulfilled (Giannoulis *et al.* 2013; Svee *et al.* 2011).

Managers make decisions according to the formulation of business strategy based on the analysis of external and internal environment and the identification of factors that influence the business. The most commonly used categorization of factors is strengths, weaknesses, opportunities and threats (SWOT).

An important question about the discipline of strategic management is how businesses gain and sustain competitive advantages. Managers analyze the internal environment using the value chain analysis. The business strategy represents how this value can be created. The extended view of the value chain is the value network. Two perspectives approached a significant difference. The value chain focused on the business itself or the industry, otherwise the value network concentrates on the value-creating system in which different actors coproduce value (Aldea *et al.* 2015).

Businesses continue to feel out their relationship's value as their business and revenue models develop. Important issues such as “How do businesses create value for customers?”, “How can businesses convert the added value into profit?”, “How do businesses organize value delivery and how can they build sustainable cost advantages?” and “How do businesses attract and retain customers?” are addressed. The

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purpose of business model is to provide a different and innovative positioning of the business on the market (Matzler *et al.* 2013).

The value produced from the value chain can be increased through the use of IT (Velitchkov, 2008). However, just developing IS is not enough. IS and business processes should be integrated with business strategy in order to enhance business value, performance and competitiveness (Doumi *et al.* 2011).

EA helps businesses to identify architecture, IS and technology which are responsible for the alignment of business strategy with IT. EA enhances alignment in many ways. First, both business and IS perspective can be modelled together in a common framework. In that case, business and IT aspects are fulfilled and are visible in a common framework. Secondly, the existing and future views of the business and IS are represented and described in detail. The gap analysis between the “AS-IS” and the “TO-BE” architecture is significant for the implementation of strategic, operational and resource planning. The above model, however, does not explain how the alignment could be applied and which elements could be integrated (Cuenca *et al.* 2011). If IT and strategic goals are fulfilled and the related architectures are developed in an appropriate way, then the use of IT boosts the competitive advantage.

As the alignment of business and IT strategy has been an important challenge during the last 20 years, researchers have made many efforts to develop unified notations and languages in order to improve the communication between business and IT perspectives and their relations (Hinkelmann and Pasquini, 2014). However, IT strategy is accurately difficult to be identified and when it is done, it is not compatible with business strategy. Thus, overall improvement of the definition of IT strategy and its alignment with business strategy in EA is needed (Cuenca *et al.* 2010).

Except for IT strategy, the model of alignment involves other components, such as the organizational infrastructure and the IT infrastructure. The first domain contains the design of management structure and work processes. The second includes all the

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perspectives related to the IT infrastructure and applications used in the business (Hinkelmann and Pasquini, 2014).

One of the main issues highlighted by EA reserved for the context of strategic management is how to use modelling languages to visualize the concepts of strategic management. In the following sections the different modelling techniques which have been used to optimize these concepts are represented.

Enterprise Architecture Modelling Techniques

EA is an area where researchers and practitioners have garnered increasing attention since the late 1980s (Simon *et al.* 2014). EA is an architecture which combines business's IT infrastructure and applications with the business processes (Cuenca *et al.* 2010; Plataniotis *et al.* 2013; Van der Raadt *et al.* 2010).

The core of EA consists of three architectures; the business architecture, the application architecture and the IT platform architecture. The first one concerns humans and resources, business processes and rules. It assumes that this architecture is derived from the business vision, goals and strategies. The major components of the application architecture include IS components of business and their interaction. Finally, the last architecture consists of computers, networks, peripherals, operating systems, database management systems, UI frameworks, system service and middleware (Hugoson *et al.* 2008).

EA modelling techniques provide guidelines for what the business should do by visualizing the current (AS-IS) and the future (TO-BE) architectures in terms of informational, behavioural and structural domains of the different architectural layers; business, application and technical infrastructure (Quartel *et al.* 2009). When developing an EA model, a framework will help to manage the complex systems and align business with IT. This would also help to give an overview of the organization and the structure of the EA perspectives (Kurniawan, 2013).

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Researchers have suggested many EA frameworks. The first EA framework is Zackman's Framework which does not provide a strategic planning methodology (Heyl, 2014; Hinkelmann and Pasquini, 2014; Medini and Bourey, 2012; Rouhani *et al.* 2015).

Another important EA framework is TOGAF developed by The Open Group from 1995 to the present. TOGAF Four domain architectures are involved in this framework, called business architecture, the data, the application and the technology. The major component of the first architecture is the integration between business processes with business goals. It assumes that the second architecture gives an overview of how to store, to manage and to access data on the business. The third architecture represents how particular applications are developed and how they communicate with other applications. The last architecture contains the hardware and software infrastructure which support the applications (Kurniawan, 2013; Medini and Bourey, 2012).

Other EA frameworks are CIMOSA, DoDAF, MODAF and NATO.

On the other hand, CIMOSA architecture focuses on process-based enterprise modelling and integrates these models at operational level. It contains a modelling framework and an integrating infrastructure. Three dimensions are the major components of the first dimension; genericity, enterprise models and views. The first dimension starts from generic building blocks and ends up to specific enterprise domains models. The next dimension supports enterprise operations lifecycles and goes from requirements identification to system implementation. Finally, the third dimension represents different aspects to business user, giving guidelines for reducing complexity of the area of concern.

DoDAF was developed in 2010 and it is based on a set of models describing a business pertaining to eight perspectives, namely, All Viewpoint, Capability, Data and Information, Operational, Project, Services, Standards and Systems viewpoints. MODAF is another EA framework which includes six views namely, Strategic, Operational, Service, System, Standards and Acquisition.

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North Atlantic Treaty Organisation (NATO) Architecture Framework (NAF) however is based on both DoDAF and MODAF frameworks and other experiences from different fields (Medini and Bourey, 2012).

However one of the most frequently used modelling language is Archimate. It was developed by the Open Group which is an open and independent architecture modelling language. It integrates business processes, organizational structures, information flows, IS and technical infrastructure in an architectural level, in order to illustrate the concepts and relationships among the architectural domains of a business. The Archimate language consists of three layers named Business, Application and Technology Layer.

The major components of the first layer are the products and services which are offered to external customers. The second one supports the first one with application services which are accomplished by any applications. The last one contains infrastructure services concerning processing, storage, and communication services. They are required to develop applications, accomplished by computer and communication hardware and system software (Lee and Song, 2011; Meertens *et al.* 2012).

The i* framework is another modelling technique which describes the modelling of strategic dependencies among business agents, goals, functions and resource (Doumi *et al.* 2013).

The ARMOR language was developed to optimize the motivation of EA, which involves goals and requirements. Also, it demonstrates its use for analyzing EA, concentrating on strategic alignment issues (Salgado *et al.* 2013).

On the other hand, a strategy driven technique is MAP, which determines objectives as intentions and processes as strategies to achieve them. In contrast, another more technical driven technique is the Role Activity Diagram (RAD) which is more suitable for designing technical level requirements than optimizing strategic requirements (Babar *et al.* 2008).

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Finally, GORE techniques are generic and as a consequence the concept of goal mentions any type of goal in any goal-driven or goal-related domain, involving business strategy (Giannoulis *et al.* 2011). Furthermore, GERAM is a generic EA framework. It provides a set of requirements which includes different tools of enterprise unification (Medini and Bourey, 2012).

Businesses acting in all sectors are dealing with two significant challenges. First, they have to understand better their structures and second they are obligated to align the IT with business strategy. Although researchers have developed enterprise modelling frameworks, they do not provide a structured methodology which includes guidelines of modelling business strategies, as well as process flow analysis and improvements (Medini and Bourey, 2012). Related concepts of business strategy and processes are focused on answering “What do specific innovations matter for the business?” or “What customer groups should business concentrate on?” or “Which emerging technologies may customers accept?” or “Who are the competitors?” or “How may the environmental factors and non-market players affect the competitors’ actions?”. Graphical models have been developed to visualize and provide a better understanding of these issues in recent years.

Consequently, business modelling techniques have been suggested to address these topics. Furthermore, these techniques have been used to answer how the business can increase the value which they offer to customers through their products or services (Samavi and Topaloglou, 2009).

Modelling Strategy with Enterprise Architecture

In large businesses the gap between business and IT is often bridged by developing and supporting EA. EA is a high-level overview of the enterprise, used for managing the integration between business and IT. Furthermore, in recent years EA is employed to enhance the flexibility of the organization and to explain the contribution of IT to business goals. So, EA needs to expand the implementation of IT projects and identify the effect of changes in the business environment on the business goals and the EA, to identify the value of a specific architectural aspect and to evaluate which of the

implemented projects have the most business value. Therefore, an extension of EA Modelling languages with strategic concepts such as business objective and business value and maintenance for tracing business goals to EA components is required (Engelsman and Wieringa, 2014).

A significant challenge for a business designer is to develop business's capabilities interrogating business objectives, classifying functional abilities, identifying related contexts, analyzing data, as well as integrating technology solutions. Business Modelling defines the desirable conceptual framework and methodological guidelines to accomplish these challenges (Loucopoulos *et al.* 2015). Decision making for planners can be intellectually demanding. This is due to stakeholders from different backgrounds and with different interests that should be involved (Plataniotis *et al.* 2013). Also, designers have to realize the meaning of each concept of strategic management in order to visualize it effectively.

The meaning of these concepts as they have been described by EA practitioners are presented in Table 2.

Table 2. Definitions of strategic planning concepts in modelling.

Concept	Modelling Language	Meaning
Goal	AMD	Some desired effects (Quartel <i>et al.</i> 2009).
	Archimate	Goals are the strategic interests of actors who are modelled (Lee and Song 2011).
	KAOS	Desired system properties which have been expressed by some stakeholders (Engelsman and Wieringa 2014).
	i*/ TROPOS	The intentions of stakeholders (Engelsman and Wieringa 2014).

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Stakeholder/Driver	TOGAF Archimate	Stakeholder's interests (Engelsman and Wieringa 2014). Different stakeholders of a business (Quartel, et al. 2009).
Vision		A desired future situation of a business (Aldea et al. 2015).
Mission		The actions of a business and what it does on a daily basis. It includes all the strategies of the business and it makes the vision operative (Aldea et al. 2015).
Strategy		It is a plan for the future or a pattern of behavior. It includes the actions that a business intends to do and how to do in order to integrate its vision in the long run (Aldea et al. 2015).
Objective		Statements of concrete outcomes which are to be succeeded in and are usually occurred with performance measures, determinate targets they need to manage, as well as initiatives that can be applied to attain them (Aldea et al. 2015).
Tactic	i*, KAOS, BMM	Sub-goal (Quartel et al. 2009).
Resource	Archimate	Assets owned or assessed by an individual or business (Iacob et al. 2012).
Capability	Archimate	Abilities which use resources to achieve a goal (Iacob et al. 2012).

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External or Internal Factors	Archimate	Drivers describe internal or external factors that affect the plans and purposes of a business (Iacob et al. 2012).
Strategy map	UEML	It links goals with actors (Giannoulis et al. 2010)
Value	e ³ -value technique	A service, a good, money, or an experience that has economic value for at least one of the actors (Gordijn et al. 2006).

Also, business model has been visualized using Archimate and its aspects have been described in as follows: segments are modelled as business actor, business role, or stakeholder, propositions are modelled as business service value or product goal, channels are modelled as business interface or resource, customer relationships are modelled as business interaction or capability, revenue streams are modelled as value, key resources are modelled as resource and key activities are modelled as capability (Iacob *et al.* 2012).

Although researchers have made efforts to visualize these concepts, they have not provided yet guidelines in order to present a holistic approach which links all of them. In this view, TOGAF does not represent the relation between skills, goals, strategic planning, benchmarking, stakeholders, value chain, vision, mission and how these concepts are modelled (Kurniawan, 2013).

In BPMN diagrams data and object-oriented notations are not aligned with the strategy oriented approach due to their downstream programming orientation. So, they are not able to support organizational processes. Researchers who study BPMN diagrams have introduced flow objectives to achieve a more strategic approach of this modelling technique. They involve performance indicators, targets and actions to construct the link

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between flow objects. Middle managers who strategically manage a process team, take advantage of using this technique, as well as when they need a systematic report to the top management (Lederer *et al.* 2014).

Another modelling technique which presents an approach for optimizing stakeholders' goals is IBC approach. This technique consists of four phases. In the first phase, stakeholders analyze the current business situation. Next, stakeholders identify the goals. In the third phase, the outcomes of the goals on current structures are modelled and in the last phase the results are assessed (Kavakli and Loucopoulos, 2006).

As it is observed from Table 2, the concepts of vision, mission, objective and strategy have the same meaning in Archimate with this in strategic management literature (Aldea *et al.* 2015). Archimate modelling language consists of layers and aspects which support its strategic orientation. The structure aspect represents the actors who participate and how they are related. The behaviour aspect describes the behavior which is performed by the actors as well as the way the actors contact. These aspects are associated with the information one which the problem domain knowledge involves. This is used by and communicated among the actors through their behaviours. Also, Archimate supports the optimization of the value of the services and products which are offered to customers through the value layer.

The Archimate provides an association among the layers, so there is the possibility to align the strategic with the operational. This result increases the possibility to have both a top-down and a bottom-up view of EA. Additionally, a business and an IT perspective maintains the alignment of business strategy and IT infrastructure (Fritscher and Pigneur, 2011).

Other strategic concepts included in Archimate are stakeholder domain which optimizes the stakeholders of the business, as well as their concerns and their evaluation. A concern is identified as an area of interest. The concerns may be assessed using SWOT analysis. The principle domain visualizes the vision, mission, strategies, policies, principles and guidelines of the business, supporting the high-level constraints for the

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design of the EA. The requirements domain optimizes the goals, requirements and expectations that influence the design of the EA (Quartel *et al.* 2009).

Moreover, drivers describe internal or external factors that affect the plans and purposes of a business. Constrain presents limitations in resources. Resources are defined as assets owned or assessed by an individual or business. Archimate links the resources with goals because resources are required for businesses to achieve their goals. Capabilities are defined as abilities which use resources to achieve a goal. Finally, competence should be linked with resources and capabilities because they are used to achieve a goal and thus they support the increase of competitive advantage (Iacob *et al.* 2012).

The Archimate provides an optimization for each level, business, application and infrastructure. This achieves the alignment between the strategic business vision and the strategic IS. In addition, based on the alignment between the three layers, there is also the possibility to integrate the strategic with the operation. This result enhances the possibility to have both a top-down and a bottom-up perspective of EA. Moreover, a business and an IT view supports the alignment of business strategy and IT infrastructure (Fritscher and Pigneur, 2011).

The usage of Archimate has two advantages. Archimate presents the effect of new strategies on the business architecture. So, managers who align strategy and architecture can examine the influence of visualization between strategy with goals, objectives, requirements and projects. The second benefit refers to the effect of the architecture on strategy. When a domain of the architecture is changed it could affect the strategy, as long as it was linked with it (Aldea *et al.* 2015).

In KAOS goals are determined as desired system properties which have been expressed by some stakeholders in contrast with i* framework and Tropos where goal is defined as the intentions of stakeholders (Engelsman and Wieringa, 2014).

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More analytically, the i* framework has been developed to optimize organizational environments and IS. Two types of models are included, namely the Strategic Dependency (SD) model and the Strategic Rationale (SR) model.

The SD model presents the associations among actors in an organizational context, in terms of the alignment of a goal, or the performance of a task or the delivery of a resource. The SR model presents stakeholder interests and concerns, as well as the way they can be addressed. It provides more detail to the SD model by examining the relationships between the previous elements and the external dependencies.

But, in contrast to i*, KAOS aims to present the satisfaction of a goal through the cooperation of the individuals. It does not focus on the modelling of the “intentions” of actors (Quartel *et al.* 2009).

The modelling of the VMOST model includes organizational “means” and organizational “ends”. Means refers to processes, tasks and activities and contains mission, strategy and tactic. Ends are related to states (goals) such as vision, goal and objective and these states have to be achieved by means (Bleistein *et al.* 2006).

The Unified Enterprise Modelling Language (UEML) was used to optimize strategy map meta-model. This meta-model includes six classes. The goal class concerns the goals which have been set throughout the strategy map. The causality-relation class describes the cause-effect relation between goals within a strategy map. The outcome is presented into a tree structure of goals which links goals with all perspectives. The group class concerns any grouping and any classification of goals contained in a strategy map. Sub-groups can be united into groups as a result of making a team of groups inside other groups a tree. The perspective class is mentioned to the highest level of grouping within a strategy map and it is associated with the group class through generalization. Finally the theme class includes the strategic themes selected within a strategy map (Giannoulis *et al.* 2010).

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Business model has been optimized using Archimate. The main elements of business model are defined in Archimate as follows: segments are modelled as business actor, business role, or stakeholder, propositions are modelled as business service value or product goal, channels are modelled as business interface or resource, customer relationships are modelled as business interaction or capability, revenue streams are modelled as value, key resources are modelled as resource and key activities are modelled as capability (Iacob *et al.* 2012).

The e3-value technique is used to model the concepts of business value. The elements of this technique is the actor who is aware of the environment as an economically independent entity, the value object which could be a service, a product, money, or an experience and has economic value for at least one of the actors. An actor exchanges a value object. Also, the value port is used by an actor to provide or request value objects to or from other actors. The value interface includes only those actors who are willing to offer objects to someone else. The value exchange is another aspect which connects two value ports with each other. Finally, the value activity is implemented by an actor (Gordijn *et al.* 2006).

Researchers have made efforts to optimize the concepts of strategic management using different modelling techniques because the modelling of strategic planning is a fundamental area of research. They have tried to visualize the same concepts the fact that each language includes different aspects. However, there is a gap between providing guidelines to model business strategy and its alignment with IT strategy, as a holistic approach. Some languages are technical oriented, than others which are strategic driven focused. Therefore, it is important to study which language is suitable to model each concept as well as which one can be used in order to optimize the holistic strategic process. Additionally, as languages involve specific domains, researchers should effectively understand how to link them with the concepts of strategic management, in order to successfully visualize them.

Conclusions and further research

This paper aims to evaluate the contemporary problems in existing EA modelling

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frameworks concerning the optimization of business strategy concepts, to determine the techniques that are supported by EA Modelling and to identify areas for improvement. In the last decade one of the main issues addressed by researchers in the context of EA and business strategy modelling is to integrate the business strategy to the systems requirements analysis. Many modelling techniques have been implemented to visualize strategy and processes. However, the most frequently reported languages are the Archimate, the i* framework and the OWL, which optimize concepts such as vision, mission, goals and strategy (Aldea *et al.* 2015; Bleistein *et al.* 2006; Cuenca *et al.* 2011).

Business modelling aims to establish and preserve the “best fit” between business needs and system functionalities such as between process models and technology specifications. Modelling languages do not introduce the common views, but they try to model the same concepts. New concepts should not be introduced in languages as an independent concept but it should be examined whether they represent the outcome of any existing concept or not. Most common concepts are modelled using the goal perspective.

At the same time, this study is focused on representing and discussing the current challenges on EA Modelling and business strategy and provides suggestions for further research in this field. Although, previous studies have attempted to use tools and models to visualize the technological business planning, limited previous study has focused on modelling strategic planning. Due to issues concerning the lack of guidelines for modelling business strategy, a holistic approach is needed to be made (Lederer *et al.* 2014). Practices of strategic management and EA could take advantage of this development. The alignment of strategic planning with EA improves the traceability between business planning and EA choices (Azevedo *et al.* 2015).

To this date, however, there is no consideration on requirement analysis in most existing EA techniques. Enterprise architecture (EA) is a means of a high level of abstraction of levels of a business which maintains planning and making better decisions. Evidence

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has shown that the scope of EA is not only restricted to technology planning or its orientation to the systems and technology, but also the lack of business strategy and processes are the most common problems of EA Frameworks (Kurniawan, 2013).

To help address this issue, EA provides general guidelines for business to empower strategic goals by creating opportunity for change. However, EA does not explain how to achieve alignment and which components are to be fulfilled. Several studies have demonstrated the strong link between business strategy and EA which enhances practitioners' understanding of their business strategy (Giannoulis *et al.* 2012).

The paper contributes to the existing literature by assessing the current EA modelling languages and their skilfulness to modelling strategy. Moreover, it contributes to the determination of difficulties in modelling, as well as to the examination of ease of use of language in the context of strategy. First, this study is useful for researchers who would like systematically study the area of EA modelling and concepts of modelling business strategy. This approach of using EA to develop and apply a business architecture framework, combined with strategic management is a way to move more deeply into the research area and offers ideas and advice for academics. Second, this paper provides an overview to practitioners who would like to develop effective EA modelling projects, as well as to architects who try to solve the problems of business complexity. It helps architects to select an appropriate modelling language based on the characteristics and constraints of their business strategy. This study may contribute to a greater understanding among architects and business managers of how EA models can support their work and how EA can be used way beyond the management of the technology landscape.

As reviewed above, this interaction between architects and stakeholders (e.g. senior management, program and project managers, designers, and programmer) is significant but frequently problematic. Although there are many tools for supporting EA, EA implementation suffers from lack of comprehensive tool for maintaining whole perspectives of EA project. EA aspects need appropriate tool to facilitate the progress of EA project. Therefore selecting an effective tool becomes a significant factor for EA

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project in order to facilitate the implementation. The same languages may not necessarily be appropriate in all cases. For example, an organization may not know what its strategy is or may not be able to formulate it. Unfortunately there is lack of consideration on tools and supporting in selected studies.

Future work should be focused on exploring how EA modelling languages could be improved in order to produce a common and holistic approach of optimizing strategy concepts. Academics could extend the current study by focusing on modelling other aspects of strategic management, such as value chain or SWOT Analysis because limited efforts have already been done regarding the modelling of these concepts. Furthermore, in practice, most researchers will be interested in how the complexities due to different aspects and meanings of strategy concepts of different languages could be eliminated. Researchers will be conscious of the lack of consideration given to the identification of conflict situations that could arise during the gap elicitation process. Practitioners should answer the question “What support can EA provide within business strategy, and on what conception of business architecture is this based?” before design a comprehensive business architecture framework.

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