Review of Evaluations of Enterprise Architecture

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Abstract: The use of information which is useful for collaborating stakeholders has encouraged and enabled businesses to advance. Enterprise architecture (EA) provides frameworks and methods with information products that aim to satisfy stakeholders' concerns. For positive effects to emerge from using EA, it is necessary, during EA development and evaluation, to examine the work stakeholders do, their practices, how these practices relate to each other, how EA deliverables contribute to stakeholders' work, and how EA information products are (co)-used in stakeholders practices. This paper presents a systematic literature review on evaluations of EA. The review aims to gain insights related to aspects of EA stakeholder practices and relationships that were considered essential to evaluate and how different stakeholders contributed to evaluations of EA. The insights are intended to inform the design of the Work-oriented Approach (WOA), which aims to enrich EA stakeholder analysis and co-use of EA information products. The results of the survey show an uneven contribution by stakeholders and that stakeholder practices and relationships were not clearly defined and evaluated, leaving uncertainties about whether relevant stakeholders evaluated EA benefits. The lack of stakeholder voices and details provides challenges to the validity of results relating to the organisational benefits of using EA.

1 INTRODUCTION

Access to and exchanges of information that is relevant, useful and valuable are essential for organisations and stakeholders in their collaborations. When people have to consider not only their own actions but also other people's views and practices, the design, production and consumption of useful information become more complex.

Enterprise architecture (EA) is a field that works with architectural knowledge and information products (IP), such as models aimed to satisfy stakeholders' concerns. Embedded in EA are stakeholder analysis and management practices. However, several challenges have been identified in EA and its stakeholder analysis practices through literature and empirical studies.

A case study of the use and utility of an information product, the concept of capability, in EA (Tell and Henkel, 2018) identified problems when a single information product does not suit different stakeholder-specific practices when the stakeholders collaborate. For example, some stakeholders did not see the utility of using the EA information product to support their work. Literature studies of EA standards and practised EA frameworks (Tell and Henkel, 2023) (Tell, 2023) reveal that the representation of stakeholders and their concerns is mostly not detailed, which impairs understanding of who is doing what, together with others, for what purpose, and impairs evaluations of an IP's relative advantage (Dearing and Cox, 2018; Venkatesh et al., 2003) compared to other IPs.

EA stakeholder analysis methods can also lack support for representing relationships between stakeholder practices, which limits analysis of stakeholders' work in relation to each other and right-sizing of the use of information products in a multi-stakeholder environment (Tell and Henkel, 2023).

Furthermore, stakeholders can be reluctant to be engaged in EA and participate in evaluations (Kotusev, 2019), leading to misalignment between stakeholders when not all stakeholder voices are heard or when knowledge about stakeholders is mediated by analysts (Tell and Henkel, 2023).

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Research has identified EA success factors (Lange et al., 2016), but EA value-generating mechanisms are often simplified (Ahlemann, Legner, & Lux, 2021), and empirical evidence is based on perceptions from not all stakeholders.

The above challenges led to the design of the *Work-Oriented Approach (WOA)* that aims to improve the representation, design, use, evolution and evaluation of IPs such as EA models (Tell, 2023) (Tell and Henkel, 2023). WOA offers an approach for analysing, explaining and evaluating stakeholders' (possibly diverging) interests and co-use of IPs based on practices and relationships. WOA has the potential to enrich the EA stakeholder analysis (Tell and Henkel, 2023), increase stakeholder participation in EA practices, and ultimately increase the relevance and benefits of EA.

This paper aims to inform the design of the WOA, which contains constructs and methods for representing and evaluating the use of EA and other information products in related practices, through a Systematic Literature Review (SLR), exploring aspects related to stakeholder practices and relationships that were considered essential to include in evaluations of EA and how different stakeholders contributed to evaluations of EA.

The structure of the paper is as follows. The analytical model used for the survey is described in section 2, and the systematic literature review methodology in 3. The research results in 4. Sections 5 and 6 conclude with discussions and a summary.

2 WOA AS ANALYSIS MODEL

In this paper, WOA (Tell, 2023; Tell and Henkel, 2023) is used as an analysis tool to examine how evaluations of EA consider stakeholders, their practices and relationships. While WOA contains concepts and methods to describe practices and relationships in detail, we only use the main concepts here. Figure 1 portrays concepts in WOA relevant to this paper.

In WOA, the work that stakeholders perform in organisational settings is viewed as *practices* where stakeholders participate, and information is needed, offered and used. Stakeholders collaborate in different formations and form relationships where stakeholders produce, exchange, consume, and use IPs, such as EA content, for mutual benefits.

WOA recognise that agents, such as stakeholders, can have their own volition or purpose, points of view, responsibilities, interests (Freeman, 2010), jobs to be done (Ulwick, 2016), use of IPs, needs (INCOSE, 2023), gains and pains (Osterwalder et al., 2015), goals, and access to people and data. *This means they can also disagree, leading to potential conflicts between collaborating agents.*

The main concepts In WOA are described here:

Information Part: A separately identifiable body of information that is produced, stored, and delivered for human and machine use [Source: ISO 42010–- Software, systems and enterprise–- Architecture description, (ISO/IEC/IEEE, 2022)].

Information Product: An information part that is intended to or participates in a practice. An EA model is an example of an information product whose design is governed by a model kind, such as a meta-model.

Agent: An entity that can bring about a change in the world, such as a stakeholder or information system.

Stakeholder: an agent (person or organisation) that can affect, be affected by, or perceive itself to be affected by a decision or activity (ISO/IEC, 2015).

Practice: The customary, habitual, or expected procedure or way of doing something (Bueger and Gadinger, 2014) (Nicolini, 2012) (Clark et al., 2018) (Tell and Henkel, 2018).

Practices typically involve more than activities, such as responsibilities, features, questions that can be answered, access to data, information needs, and pains that may be deemed relevant for a stakeholder's "what is in it for me" and the use of IPs.

Participation: Agents, such as stakeholders, and Entities, such as information products, participate in a practice in (thematic) roles. Participation of an information product in a producer's practice is different from participation in a consumer practice, which means that the utility of an information product in use can be different depending on the practice. Furthermore, two practices may have different views of a single information product that is intended to be exchanged, resulting in two different but related information products being identified and described. For example, when a consumer has information needs that are not matched by a proposed or produced information product. Such diverging views of the information product should preferably be resolved to enable efficient collaboration.

Use: An entity such as an information product participates in one practice where it is used.

Co-Use: An entity such as an information product participates in more than one practice where it is used.

Practice Relationship: The way in which two or more practices with their participating agents and entities are connected, interact or involve each other.

Practice Role: How a practice plays a part or assumes a function in a practice relationship.
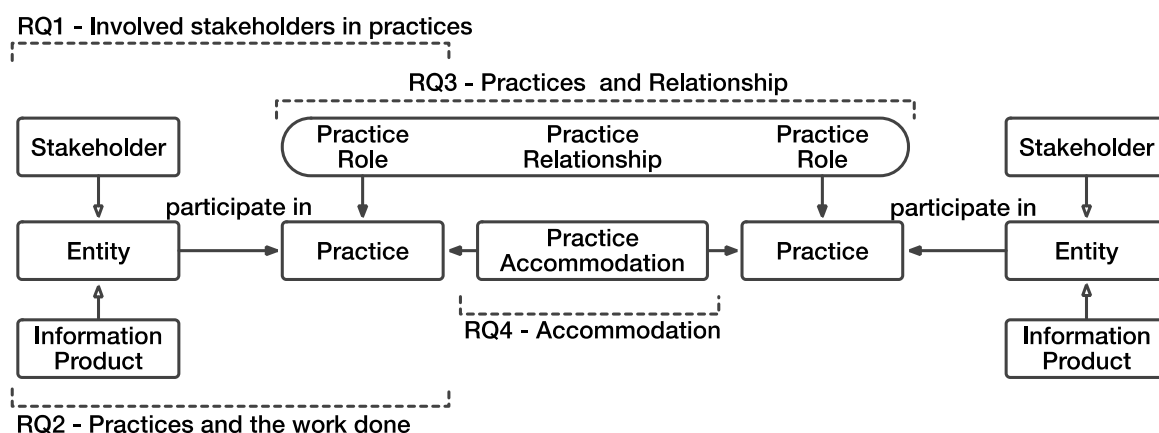
Figure 1: Illustration of main concepts of the WOA analysis model.

Practice Accommodation: How practices and related entities fit or are suitable or congruous, in agreement, or in harmony with each other. The accommodation is a characterisation of a relationship and of what entities in the practices (*what*) structurally *fit* each other, the *mechanism* of how they fit, and the *effectuation* of how the fit is (dynamically) achieved through actions over time.

As an example, in the case of EA, the specific way a produced EA model leads to reduced complexity, where the fit is described as <EA model, (cause or mean), reduced complexity (effect or end)>, the mechanism is described as <description of interconnected entities increase understanding of complexities>, and the effectuation can be described as <users are trained in understanding the EA model before it is used>.

In WOA, practices, relationships, agents and information products can be described at the *desired level of detail* using a set of sentences from controlled (domain-specific) languages (Group, 2019). Each sentence can be associated with the agent that made the sentence, which enables analysis of who said what and whose voices are heard.

Alternative: Something which can be chosen instead of something else.

WOA suggests that *alternative* (ISO/IEC/IEEE, 2019) practices, relationships and information products should be considered during design and evaluation to shift focus from local use of IPs to organisational optimisation of co-uses of IPs and aggregate utility of collaborations.

Relative Advantage: The degree to which using something is perceived as better than something else.

To support design, innovation (Everett, 2003; Dearing and Cox, 2018), and acceptance of the information technology (Venkatesh et al., 2003), WOA suggests considering and evaluating a practice,

a relationship, or an IP *relative advantage* compared to other existing practices, relationships, or IPs.

Moreover, the WOA method enables the *situating and tailoring* of generic IPs to stakeholders' *specific* and *actual* work (Tell, 2023) to increase the value of IPs by improving relevance, intention to use and by providing a better fit between information needs and information products in actual use.

3 RESEARCH METHODOLOGY

This study relies on a systematic literature review (SLR) approach where generated insights are gathered and presented using an explicit and reproducible method based on a four-phased process proposed by Kitchenham (Kitchenham, 2007), followed by the phase of writing the review. The 4+1 phases form a review protocol that is essential to reduce the researcher's bias, increase reliability and improve the study's validity (Kitchenham, 2007).

3.1 Planning the Review

This review is motivated by the identified challenges (Tell and Henkel, 2023; Tell and Henkel, 2018; Tell, 2018) and the intentions to improve WOA.

The SLR was preceded by an exploratory pilot survey of articles with empirical grounded results from evaluations of EA (Kitchenham, 2007). The study indicated a diverse nature of evaluative EA articles, which motivated a more systematic literature review of articles to gain insights and suggest further investigations. To structure the review, a set of review questions was constructed to examine how the EA evaluations addressed the issues of stakeholders, their practices, relationships, and accommodations of IPs.

The review intends to answer the following primary research questions:

- RQ1: Which categories of stakeholders contribute to EA evaluations of EA?
- RQ2: How are practices and the work done in practices part of the EA evaluations?
- RQ3: How are relationships between practices part of the EA evaluations?
- RQ4: How are accommodations between practices part of the EA evaluations?

The research questions aim to improve the understanding of aspects that are considered essential to include in evaluations of EA. RQ1 focuses on the degree to which stakeholders' voices were heard about aspects in their domains of interest, control and responsibility. RQ2 focuses on the work stakeholders do in their practices, and RQ3 on the relationships between stakeholders' practices. RQ4 focuses on how practices and related entities structurally fit and causally relate with each other.

3.2 Data Selection

The principles for the data selection were established before the review protocol was defined to reduce the likelihood of bias (Kitchenham, 2007), and the search terms, inclusion and exclusion criteria are based on the research questions.

The **search process** aimed to identify primary journals that reasonably can answer the research questions (Kitchenham, 2007). The search and indexing engines SCOPUS, Proquest, ACM Digital library and IEEE Xplore were used, which include articles from journals mentioned in the Senior Scholars' List of Premier Journals as specified in 2023 (AIS, 2023).

The **search terms** were formulated liberally to incorporate articles with poorly formulated abstracts and keywords, but where the articles could be relevant to the study (Kitchenham, 2007), and then applied to the article's title, abstract and keywords. The first set of search terms scoped the search for articles in the field of enterprise architecture and the publication period of the latest 10 years of articles since 2013. The second set focused the results on empirically grounded articles. Table 2 presents the applied keywords, and Table 1 presents the inclusion and exclusion criteria that guided the reviews of individual articles to determine the relevance of the articles to the research questions.

The **quality of the search process** and the relevance and quality of articles were assessed using the DARE criteria ((UK), 1995), where the review satisfied the required 4 criteria.

Table 1: Inclusion and Exclusion Criteria.

Inclusion criteria
- Empirically grounded articles
- Peer-reviewed articles
- Journal articles, conference proceedings, books, book chapters, and no conference reviews.
- Full-text articles
- English language articles

Exclusion criteria
- Articles that report evaluations of methods, constructs, and systems designed using EA and not evaluations about EA itself.
- Articles in which the keywords exist but with a different meaning from the study context.
- Duplicate articles.
- Articles that lack research methodology
- Conceptual, formative demonstrations, case studies, explorative, or non-empirical articles.
- Theoretical and conceptual studies that are based on informed reasoning and demonstrations.
- Full articles that cannot be found.

3.3 Data Collection

The data and articles were extracted from each search and indexing engine, added to the Bookends reference database, where duplicates were removed, and then added to the MaxQDA analysis tool, supporting qualitative research methods.

3.4 Data Analysis

The articles were analysed using thematic analysis (Myers, 2009) and the process outlined by Virginia Braun & Victoria Clarke (Braun and Clarke, 2006).

Coding notes: The articles varied greatly in focus, detail and scope, leading to multiple revisions of the codes and themes. The identified *aspects* related to practices, practice relationships and practice accommodations were drawn from evaluative sentences and factors, which serve as indicators for what the evaluators consider essential. For example, many of the examined evaluations used Likert-scale evaluative sentences when collecting data. These sentences were used for analysis.

4 RESULTS

Following the review protocol, 29 articles were collected for review, and 6 articles were snowballed in, which saturated the insights. Table 2 presents the

number of articles organised per search and indexing engine after each step.

Table 2: Applied Search Terms and Reviewed Articles.

Search Criteria	SCOPUS	Proquest	IEEE	ACM
Conference Reviews, English language, June 2023, Search Term "enterprise architecture"				
	3338	2249	783	88
Search Terms: "evaluat*" or "verificat*" or "validat*" or assess*				
	1022	388	247	23
Search Terms: "case study" or "qualitat*" or "empiric*" or "quantitat*" or "survey*"				
	400	151	84	10
Only English, Peer reviewed, No Reviews, Commentaries or Reports, Final papers, Full text				
	314	32	5	7
Restricted to Journals				
	98	32	5	1
Selected Primary Articles	29			
(Qazi et al., 2019; Kaddoumi and Watfa, 2022) (Nikpay et al., 2017a) (Mirsalari and Ranjbarfard, 2020; Anthony Jnr et al., 2023) (M. and B., 2018) (Ahlemann et al., 2021; Foorthuis et al., 2016) (Jonnagaddala et al., 2020) (Nikpay et al., 2017b) (Lange et al., 2016) (Alzoubi and Gill, 2020) (N. and J., 2014) (Perez-Castillo et al., 2021) (Bernaert et al., 2016; Rouhani et al., 2019) (Abraham et al., 2015) (R. et al., 2020) (Al-Kharusi et al., 2021) (Kotusev, 2019) (Fakieh, 2020) (Niemi and Pekkola, 2016) (Doumi, 2019) (Ahmad et al., 2020) (Zhou et al., 2020) (Dang, 2021) (Nakakawa et al., 2013) (Nor et al., 2021) (Rogier, 2021)				
Snowballed Articles	6			
(Shanks et al., 2018) (M. et al., 2015; Pattij et al., 2020; Plessius et al., 2014; Aier, 2014; Alaeddini et al., 2017)				

4.1 Stakeholder Contribution (RQ1)

The **stakeholders'** contributions were coded by individuals' participation in surveys and interviews (respondents) grouped by categories of stakeholders, as presented in Table 3.

The reporting varied in detail among the articles, and it was difficult to categorise respondents due to a lack of precise information. Detailed coding was attempted but determined not to provide reliable and valid results. In many cases, the organisational role was not reported (column Unknown and row Undetermined), and often general terms were used,

such as 'manager' and 'architect', which made it difficult to understand which kind of individual's voice was heard (rows Mixed).

The predominant data collection methods in the articles were surveys and interviews where the population was asked about their perception of evaluative sentences. The contentious use of perceptual and self-reported measures was reported in some articles (Shanks et al., 2018; Jonnagaddala et al., 2020) (Rogier, 2021), although argued not to be a problem for the validity of the results.

Table 3: Contributing respondents per stakeholder group.

Stakeholder groups (sources of data)	Respondents	Unknown Respondents
EA	998	3x articles
IT	626	1x articles
Mixed EA & IT	145	1x articles
Mixed EA, IT & Stakeholder	541	1x articles
Stakeholder / Business	479	3x articles
Student	10	
Undetermined	444	4x articles

The data were *predominately* reported to be provided by EA respondents, followed by IT respondents with prior knowledge of EA. They answered questions about their own practice but also about aspects that lie within other stakeholders' spheres of interest, control and responsibility.

Five (5) papers included discussions (Lange et al., 2016; Dang, 2021; Al-Kharusi et al., 2021) on how stakeholders perceived a particular topic compared to other stakeholders in their evaluative sections, where (Plessius et al., 2014) (Alaeddini et al., 2017) provided short evaluations. Six (6) papers (Abraham et al., 2015; Lange et al., 2016; Jonnagaddala et al., 2020) (M. et al., 2015; Aier, 2014; Pattij et al., 2020) included statements that their samples were not representative as a limitation.

However, no paper included a clear limitation that evaluations should be attributed to relevant stakeholders.

4.2 Practices (RQ2)

The use of **practices** in the evaluation was mostly not well defined. The review of the articles revealed that while the importance of practices was reported (Ahlemann et al., 2021; Nikpay et al., 2017b), practices were not found to be clearly delineated and characterised and thus not directly considered during the evaluations. Even when the term "practice" was defined (Nikpay et al., 2017b), the EA Implementation Methodology (EAIM) practice was

not distinctly defined and evaluated in detail with respect to its parts.

A common theme found in many reviewed articles was that factor-oriented approaches were used in the evaluations, where factors related to entities such as EA, IS/IT or Organisation were identified, linked together and evaluated.

The coding, therefore, focused on identifying clusters of activities that could be reasonably argued to resemble and approximate practices. In many cases, a practice was broadly referred to as 'EA', 'IT', 'management', 'organisation', or 'project' or a 'service' or 'capability'. Table 4 presents approximate generic and more specific practices.

Table 4: Clusters of activities that approximate practices.

Generic practices
Stakeholder, Project, Management, Business, Organisation, Company, Customer, and External
Specific Practices
EA, Agile EA, EA Driven (Dynamic Capability), EA Project, EA Management (Capability), EA Governance (Capability), EA Implementation (Capability), EA Modelling (Capability), EA Planning (Capability), Inter-EA, EAM Infrastructure management, EA Infused Business Project, EA Service (Capability), IT, IS (Capability), Innovation.

To determine how EA **was applied in the practices,** evaluative sentences were coded. The first coding revealed a rich language based on many disparate aspects related to the approximated practices. A precise coding of the aspects and level of details was determined not to provide reliable and valid results because each approximated practice was defined differently, most likely because of the article's varying focus and scope and the reliance on factors.

In a second coding, phrases and statements in the evaluative sentences were coded and categorised, as exemplified in Table 5. The categories provide broad insights into the languages used to represent evaluations of EA.

The *level of details* was coded using the schema: Generic (G) phrases that refer to a broad concept such as 'risk', 'organisation', or 'complexity', Specific (S) phrases that refer to a specific concept such as an 'action' or 'noun', and Characteristic (C) phrases that refer to characteristics of specific concepts such as 'feature of information product', or a verb 'modifier'.

The majority of the phrases were found to be (S), followed by (G), and rarely (C), with an even distribution amongst categories of phrases.

Table 5: Examples of categorised phrases and statements related to how EA is used in practices.

Enable
"EA turns out to be a good instrument to *enable the organization to respond to changes in the outside world in an agile fashion*"(Foorthuis et al., 2016)
Achieve
"…EA Framework has helped the Organization in *achieving all the goals it had intended to fulfill with EA program*" (Qazi et al., 2019)
Relate
"EA turns out to be a good instrument to achieve an *optimal fit between IT and the business processes* it supports."(Foorthuis et al., 2016)
Definitional
"The *roles of EA stakeholders were clearly defined*"(Rouhani et al., 2019)
Have (access to)
"*Appropriate infrastructure was provided* for the enterprise" (Rouhani et al., 2019)
Personal Attitude
"*I am satisfied* with the outcomes/output of the session"(Nakakawa et al., 2013)
Participate
"*The CEO must be involved*" (Bernaert et al., 2016)
Do
"*Project portfolio planning* is effective and informed by EA services" (Shanks et al., 2018)
Use
"*AEA is used* to assess major project investment in GDAD"(Alzoubi and Gill, 2020)
Service
"The *service quality of enterprise architecture* will positively influence IT practitioners and urban stakeholder's intention to use EA for digitalization of cities"(Anthony Jnr et al., 2023)
Result
"use our EA *to adjust our business processes and the technology landscape* in response to competitive strategic moves or market opportunities" (Rogier, 2021)

Noted is that explicit statements about the *participation of agents and IP* in a practice, *who uses an IP* or *who co-uses an IP,* were rarely found but could, in a few cases, be inferred.

4.3 Practice Relationships (RQ3)

The review revealed that relationships between stakeholders and their practices were not explicitly defined and characterised, although relationships could be *derived* from the evaluative sentences covering two or more practices.

The phrase "*improvement of an organizations efficiency resulting from EAM*" (Lange et al., 2016) illustrates the implicit nature of relationships. It is reasonable to infer that at least two practices

(organization and Enterprise Architecture Management (EAM)) are related, and something in EAM leads to improving the efficiency of one or more underdefined parts of the organisations. It is also highly likely that 'organisation' is divided into a multitude of specialised (work) practices. Furthermore, several evaluative statements in the articles covered long causal chains over many relationships, such as EA-Project-Organisation-Customer (Plessius et al., 2014).

Table 6 briefly presents key relationships between generic practices and EA using the "⇔" separator.

Table 6: Key derived practice relationships.

EA modelling] ⇔ [IT], [EA/EAM] ⇔ [IT/IS], [EA/EAM] ⇔ [Project], [EA/EAM]⇔ [Organisation], [EA] ⇔ [IT] & [Organisation], [EA] ⇔ [Innovation], [EA] ⇔ [External], [EA Service] ⇔ [IT], [EA Service] ⇔ [Business project], [EA Governance] ⇔ [IT], [EA] ⇔ [GDAD], [EA Adoption] ⇔ [Management], [EA] ⇔ [Undetermined]. *Note*: GDAD - Geographically Distributed Agile Development

No distinct *aspects of the relationship* were coded due to the same reasons practice aspects were not coded. However, underlying theories such as institutional logic (Dang, 2021) and alignment (Doumi, 2019) (Alaeddini et al., 2017) suggest that there are important dynamics to consider between specific organisational units or practices.

General *roles* such as stakeholder and architect were frequently referenced but not used to characterise agents' participation in relationships. In two (2) articles, roles were defined: (Foorthuis et al., 2016) defined EA creator and EA user, and (Plessius et al., 2014) defined EA Developer, EA Applier, and Stakeholder, which correspond to the archetypical roles of creator, producer, and consumer (Tell and Henkel, 2023), and not with organisational units.

4.4 Practice Accommodation (RQ4)

The fourth RQ concerns how the evaluations examined how practices and related entities fit and causally relate with each other, including how EA was considered to deliver value. The effectuation aspect was not included in this survey.

Regarding how EA delivers value, only three (3) articles were found to be directly focusing on evaluating 'how' EA delivers values, (Foorthuis et al., 2016) (using survey questionnaires and partial least squares (PLS) method to statistically analyse perceptual measures and correlations/causality), (Ahlemann et al., 2021) (using interviews and coding

of open questions and documents), and (Aier, 2014) (survey questionnaires and partial least squares). However, the details about 'how' were primarily defined through informed reasoning and not by formal theories of change.

Even though other articles included evaluations of factors (what) as exemplified by - *EA align business strategies with IT resources to create competitive advantage* (Fakieh, 2020), the details of 'what', ''how' and causality were predominately left to informed reasoning.

No article evaluated time series, and EA constructs such as information flow were not used in the evaluations.

4.5 Additional Observations

EA Frameworks
An interesting observation emerged from the coding, indicating that EA frameworks were not used to formulate the evaluations.

Alternatives and Relative Advantages
The early coding of accommodation suggested that the evaluations did not include alternative sources and mechanisms that deliver the benefits of EA.

Evaluations of alternatives are suggested in the ISO 42030 (ISO/IEC/IEEE, 2019), and relative advantages are suggested in the diffusion of innovation theory Field (Everett, 2003) and acceptance of the information technology (Venkatesh et al., 2003).

Therefore, later codlings included evaluations of alternative methods and relative advantages.

One (1) article (Zhou et al., 2020) included an evaluation of alternative methods for modelling EA models (traditional .vs a method based on ArchiMate), where a controlled experiment shows that the proposed method has better performance than the traditional approaches in terms of efficiency, effectiveness, quality and experience. Furthermore, one (1) article (Abraham et al., 2015) discussed the malleability of boundary objects.

Situated Information Product Artefacts
The early coding of practices suggested that the evaluations did not include the differences between generic information products, such as EA models, and information products that are adapted to specific stakeholders' work and practices.

Therefore, later codlings included evaluations of the situating of EA information products and their adjustment to stakeholder-specific practices.

One (1) article evaluated the malleability of boundary objects to support overcoming pragmatic boundaries where "A jointly transformable object helps different communities to try out solution alternatives and negotiate a common solution" (Abraham et al., 2015). Otherwise, no article evaluated the adaptation of information products to stakeholders' unique perspectives, practices, and relationships.

5 DISCUSSIONS AND KNOWLEDGE GAPS

5.1 Stakeholder Contribution and Uneven Coverage of Voice (RQ1)

The finding that stakeholders' voices were heard unevenly and that predominately EA experts followed by IT individuals with prior knowledge about EA participated in evaluations raises questions about biases and whether there is a knowledge gap in understanding *to whom and how EA delivers organisational benefits*. Interestingly, there were few discussions about covering relevant stakeholders' voices. Furthermore, evaluations of stakeholder perceptions may be problematic when stakeholders express their views of other stakeholders' interests, control, and responsibilities. *Do they have the same beliefs, and do they agree?*

Leaving stakeholders out in the evaluations of the co-use of IP may create un(der)used IP or illusions of success and satisfaction. The identified problems with the co-use of models, as exemplified in "Enterprise Modelling for the Masses – From Elitist Discipline to Common Practice" (Sandkuhl et al., 2016) and stakeholder engagement (Kotusev, 2019), suggest more emphasis on including stakeholders' voices.

A theme was found where EA experts often play multiple roles in evaluations. They build EA theories and define evaluation questions to be answered by either EA experts or individuals with knowledge about EA in surveys and interviews. This further challenges the validity of evaluative results. This also raises questions about the *balance between participatory vs. expert evaluations* and the view that summative participatory evaluations should complement formative expert evaluations (Sager and Mavrot, 2021) to ensure real utility is generated for relevant stakeholders.

5.2 EA and Use in Practices (RQ2)

The findings that stakeholder practices were indirectly, thinly, and variably expressed posed questions about *who is doing what with what to achieve some results* and complicate the analysis and comparison of research models and evaluations.

For example, the evaluative sentence "*EA turns out to be a good instrument to control costs.*" (Foorthuis et al., 2016) raises questions on a servicing relationship where a generic EA is instrumental in controlling organisational costs. Not analysing the underlying practices leads to a number of unanswered questions. *What precisely is the source of control in EA? Who is responsible for the costs? What costs were considered? Who evaluated the control and cost? What does 'good' mean?*

The level of detail in the evaluative sentences suggests there is a knowledge gap in evaluations of *how, in detail, stakeholders' practices and the (co-) use of EA information products contribute to organisational benefits, as valued by relevant stakeholders*.

5.3 Relationship Between EA and Stakeholders Practices (RQ3)

The finding that relationships were not explicitly defined but derived from the evaluative statements and the research models complicates the precise understanding of *who collaborates with whom, co-using information products, and how artefacts and values are exchanged to deliver organisational benefits* (Tell and Henkel, 2023) to someone.

The evaluative hypothesis "*Use of EA Services in IT-Driven Change has a positive impact on Project Benefit.*" Field (Shanks et al., 2018) illustrates the questions raised. Three distinct stakeholder practices can be identified (EA, IT, and Project), but *who and what produces what impact, how, and what is the utility? Were all three stakeholders' voices heard in the evaluations? Did all stakeholders agree on the benefits?*

The findings suggest there remains a knowledge gap in the detailed understanding of *how stakeholders explicitly collaborate, co-use IP, generate benefits for each other, and generate aggregate utility for the organisation in the use of EA*.

5.4 EA and Effects on Stakeholder Practices (RQ4)

The finding that few articles evaluated in detail the what (fit) and how (mechanism) of relationships

supports what is reported in reviewed articles "*...the EA literature is quite fragmented (individual studies focusing on a single EA topic), often implicit (no explicit causal models) and usually not based on empirical data.*" (Foorthuis et al., 2016), and "*To date, the causal relationships and processes behind EAM value generation have not been studied in great detail, nor have they been provided with a solid theoretical foundation.*" (Ahlemann et al., 2021).

Evaluative sentences such as, "*EA turns out to be a good instrument to control the complexity of the organization.*" (Foorthuis et al., 2016) raises questions about *what (cause) in EA is instrumental to the consequences expressed by the general verb 'control' and noun 'complexity' (effect) and the causal how (mechanism).*

The findings suggest a continued knowledge gap in the understanding and evaluation of the *mechanism of change behind the proposition that EA leads to organisational benefits* and *what, in detail, fits, that is, what the real causes/means and effects/ends are.*

5.5 Additional Discussions

Alternatives and Relative Advantages
The lack of evaluations of alternatives and relative advantages raises questions regarding what and how could be contributing to stakeholder benefits, as reported in "*While the presented results focus on the major causal relationships that the empirical data uncovered, we cannot be sure that there are no other, uncovered aspects.*"(Ahlemann et al., 2021).

The finding suggests a knowledge gap in the understanding of whether *other (possibly non-EA) IPs or services can be more acceptable and better suited for co-use and deliver higher aggregated utility for collaborating stakeholders. Maybe, the most effective part of an EA model is not its content but the discussions about what the EA model represents.*

Situated Information Products
Mature companies are found to analyse the information needs of EA stakeholders and to design target group-specific visualisations and reports (Ahlemann et al., 2021). Moreover, "*Second, far from all EA artefacts that proved useful in practice are mentioned in the literature and far from all EA artefacts described in the literature can be found in practice, ...*" (Kotusev, 2019).

In the examined evaluations, there was a lack of discussion on how information products can be adjusted from generic to situated. This finding and aspects of genericity as defined in GERAM (ISO/IEC, 2006) and situational method engineering

(Henderson-Sellers et al., 2014) suggest that there are relevant differences between how *generic* IP found in EA frameworks and *specific* IP products that are adapted to stakeholders' actual jobs to be done and needs, contribute to stakeholder benefits. The findings suggest a knowledge gap with regard to the evaluation of general vs specific EA information products.

5.6 Discussions of WOA

The WOA offer a number of features that promise to address and clarify the knowledge gaps and raised questions outlined in sections 4.2 to 4.5, thereby enriching EA stakeholder analysis, EA evaluations, and the design of the (co-) use of EA information products.

The practice orientation of WOA provides a natural representation of stakeholder interests, such as *who is doing what*" and *what is in it for m*e.

The findings indicate that stakeholders' voices were heard unevenly and that predominately EA experts followed by IT individuals with prior knowledge about EA participated in evaluations.

The voices of stakeholders can be represented by stakeholders' 'Participation' in 'Practices' and through the link between each descriptive sentence and who made this sentence. These two features provide visibility of and encourage due consideration of stakeholders' points of view, which can improve the design of IPs and the validity of evaluations and enable participatory evaluations in addition to expert evaluations. Thus, WOA can separate stakeholder views relating to their own practices and views about other stakeholders' spheres of interests, influence and control.

The explicit representation of 'Practice' enables representations, design, and evaluations of *who does what with whom*, *who said what about what* and *who values what* at the *desired level of detail*, which can increase the understanding by and relevance to stakeholders in their use of IPs and participation in EA activities. The directness of practices makes it clear to stakeholders that they should be engaged in EA-infused activities and consider *what is in it* for them.

The concept of 'Participation' supports the view by Feldman and Orlikowski (Feldman and Orlikowski, 2011)] that there is an essential distinction between the inherent value of technological artefacts such as IPs and the artefact-in-use. It is the ways that artefacts are used by stakeholder in their practices that make them resources, valuable and meaningful for organisations.

This indicates the need to be able to evaluate both the inherent qualities of IPs and the qualities of IPs that participate and are used in a practice.

The richness and diversity of the languages used to express evaluative sentences and factors are supported by using a set of sentences from controlled (domain-specific) languages that cover common aspects of practices, agents, relationships, and information products. The use of controlled languages can simplify comparisons of EA research models and factor evaluations.

The explicit representation of 'Relationships' enables the due consideration and evaluation of stakeholders' different responsibilities and the work they do and the representation and evaluation of alignment and asymmetries (Donaldson and Preston, 1995) between EA and stakeholders in their practices. Relationships provide a structure for representing and evaluating the co-use of information products and the calculation of aggregated utility based on each stakeholder's view of their own use and participation in relationships.

The explicit representation of 'Accommodations' encourages due consideration of visible and formulated causal mechanisms based on theories of change, which provides a vehicle that strengthens the formulation of testable hypotheses and increases rigour and specificity in representations, design and evaluations.

The presence of longer causal (cause leads to effect) and benefit (means leads to ends) chains in reviewed articles and theories, such as the institutional theory, suggests the importance of considering networks of collaborating stakeholders. WOA can explicitly represent networks and information streams through relationships that can capture the fuller dynamics of EA value-creation by considering the interlinked practices of customers, partners, business management, projects, IT management, IT, EA, EA Governance, etcetera.

The explicit consideration of alternative sources of benefits and relative advantages of IPs and EA content can reduce uncertainty about what generates the most benefits and subsequently improve the trust in and qualities of EA services, methods and content.

Furthermore, WOA offers a structure to anchor evaluative factors to stakeholders and the work they do with others in a way that is straightforward for stakeholders to understand and relate to.

While the WOA provides a number of features, as outlined in this section, that address and clarify the knowledge gaps and raised questions, it can enrich and complement traditional factor analysis but not fully replace factor analysis and evaluations of EA.

6 SUMMARY

This paper presents a systematic literature review on empirical evaluations of EA that aims to gain insights into aspects related to stakeholder practices and relationships that were considered essential to evaluate and how different stakeholders contributed to evaluations of EA. The SLR aim to inform the design and improvement of the WOA.

The main knowledge contributions are, firstly, that stakeholders' voices were heard unevenly and that predominately EA experts followed by IT individuals with prior knowledge about EA participated in evaluations, raising challenges about biases and validity in evaluation results. Secondly, stakeholder practices, relationships, and accommodations were not clearly delineated, directly defined and evaluated, suggesting that there are knowledge gaps and questions in the detailed understanding of *who does what and co-using what*, *what impacts what* and *who evaluates what*. Thirdly, few articles evaluated '*how*' something ('what') in EA in detail delivers benefits, suggesting a continued knowledge gap. Fourthly, alternative sources of benefits and relative advantages of IPs and EA content were not evaluated, raising the possibility that new sources of benefit could be created or other existing sources should be identified.

The findings indicate that WOA includes features that can address issues with the participation of stakeholders, knowledge gaps, and raised questions, and enrich EA stakeholder analysis, evaluations of EA, and IP design by including representations of stakeholders' voices, practices, relationships, accommodation and co-use of IP at the desired level of detail.

Based on the findings, it is recommended that summative participatory evaluations complement formative expert evaluations (Sager and Mavrot, 2021) to ensure that real and aggregated utility is generated and evaluated by relevant stakeholders.

Limitations and areas for future work. A grammatical analysis and detailed coding were not performed on evaluative sentences, leaving uncertainties in the identified aspects, which can be addressed as future work to build controlled languages enabling representations of common aspects of practices, such as decisions, activities, needs, access to data, data provenance and uses of IPs, at the desired level of detail.

Another future work involves identifying common practices and relationships related to EA.

The derived relationships can be viewed as forming workflows, streams and causal networks that

could, as future work, be identified and more precisely evaluated considering stakeholders' actual practices, exchanges and co-use of IP. Moreover, archetypical EA benefit networks could be identified based on practice networks, which can be used as comparative baseline(s) for constructing new and comparing EA evaluation studies.

Theories of (social) qualities of 'co-use' and 'aggregated utility' could be developed and added to the toolbox of EA stakeholder analysis and evaluations.

The WOA offers a practice-oriented approach, which differs from factor-oriented evaluations. An analysis of the relative advantages of the practice vs. factor approaches could forward knowledge on how to evaluate the benefits of EA considering the utilities for each stakeholder and aggregated utility in relationships and networks. On this theme, an interesting combination of the factor and practice approaches includes the evaluation of factors that are associated with practices and other parts of WOA.

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