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A reference model-based user requirements elicitation process: Toward operational business-IT alignment in a co-creation value network

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ABSTRACT

Context: To improve operational business-IT alignment (BITA), the development of IT-based systems should be derived from business requirements. However, the requirements elicitation process is challenging and encounters several problems which might lead to acquiring low-quality user requirements and failure of systems development projects. Many of elicitation problems are also identified as being relevant in the BITA literature. We focus on one category of well-known elicitation problems, such as communication flaws.

Until now, the majority of requirements elicitation studies with the aim of addressing operational BITA are based on an asking strategy. This elicitation strategy is suitable for relatively stable situations. To compensate for the limitation of this strategy in a more complex situation, e.g., a co-creation value network (VN) setting, using it in conjunction with other elicitation strategies is more likely to yield satisfactory results.

Objective: To contribute to operational BITA improvement in a VN setting by addressing one category of elicitation problems. For this purpose, we design and evaluate a reference model-based approach to facilitate the user requirements elicitation process.

Method: Two-phase research according to the design science approach is followed. In the design phase, a reference model-based user requirements elicitation process is designed. Also, as a proof of concept, two instances of this artifact are designed. Two reference models, respectively, describing customer knowledge management processes and customer knowledge management challenges in a VN setting are used separately in designing these two instances. In the evaluation phase, the applicability and usefulness of these instances are evaluated in two separate studies.

Results: A reference model supports asking-based user requirements elicitation process via a Delphi method in a complex context of a VN. It improves the user requirements elicitation process by addressing a set of recognized elicitation problems.

Conclusions: The reference model-based approach, by addressing the elicitation problems, contributes to user requirements elicitation process improvement in general and to a better operational BITA in the complex situation of a VN in particular.

1. Introduction

Over the last three decades, despite research efforts in addressing Business-IT alignment (BITA), BITA remains among the key IT management concerns of organizations [1,2]. One of the primary challenges which confront organizations is that BITA is a moving target due to changes in the organization's external and internal environments [1,3]. To have BITA contribute to an organization's performance over time, it is thus necessary to address BITA improvement as a continuous process. However, achieving better BITA is difficult for organizations, and they encounter several problems such as communication flaws and a lack of shared domain knowledge among others [2,4,5].

In general, BITA refers to the degree of fit or harmony between the business and the IT side of organizations [3]. BITA can be defined at different organizational levels, such as the strategic and operational levels [1,6,7]. While the earlier literature on BITA typically concentrated on addressing alignment at the strategic level, addressing it at the operational level has received much more attention in recent studies [5,7,8]. Addressing operational BITA is important because, on the one hand, the actual value of the business strategy is realized through its implementation in business processes at an operational level [6]. On the other hand, nowadays, with advanced information technologies, the execution of business processes heavily relies on supporting IT-based systems [9]. This then implies that the development

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of successful IT-based systems not only relies on an understanding of system requirements but also on different aspects of a business context, such as business processes, which should be taken into account [5,7,8].

The first process of the software requirements engineering is user requirements elicitation process which is used for identifying and acquiring user requirements of the needed IT-based systems [10]. This process is regarded as one of the critical processes in the success of IT-based system development projects [10]. If user requirements are properly identified and met by IT-based systems functionalities, the business and IT will be aligned better [5,7,8]. However, the user requirements elicitation process is a challenging task and encounters several problems which might lead to low-quality requirements, which in turn, result in organizations being misaligned [5,11,12]. Many of the elicitation problems are also identified as being relevant and important problems in the BITA literature [2,4,13]. In this paper, we focus on one category of well-known elicitation problems, i.e., user-related elicitations problems, such as weak domain knowledge and communication flaws.

Until now, the majority of user requirements elicitation studies with the aim of addressing operational BITA are based on a pure asking strategy [5,14]. For eliciting user requirements, Davis [15] introduced four elicitation strategies (i.e., asking, deriving from an existing model, synthesis, and discovering from experimentation) in a hierarchical order. This hierarchy was based on the complexity of a situation. According to Davis, the asking strategy is aimed at relatively stable situations that provide users with a well-defined structure to support requirement identification.

A co-creation value network (VN) setting, where a set of autonomous service providers together with customer,VN actors, collaborate to deliver seamless customer experience by providing integrated solutions that meet customer needs is usually more complex [9,16–18]. In a VN setting, integrated solutions provisioning processes rely on the dynamic collaboration of multiple actors [19]. This dynamic collaboration requires much more tightly synchronized business processes across individual organizations leading to inter-organizational business processes [17]. Thus, a VN has complex inter-organizational business processes that IT-based systems are required to support their design, execution, and management [16,20]. However, heterogeneous working environments, diverse interests, and different organizational backgrounds of actors of a VN may cause conflicting interpretation during the requirements elicitation process [21]. Also, as a VN is an emerging field, there is a lack of well-defined structural models which contain detailed and reliable information, to be used as a common basis to support asking-based user requirements elicitation process. Accordingly, individuals may face difficulties in formulating problems, and identifying and articulating their requirements for the IT-based systems in a systematic way [15,22]. Thus in a complex situation of a VN, a pure asking strategy could not yield to satisfactory results.

To compensate for the limitation of a pure asking strategy in such a complex setting, Davis suggests using it in conjunction with other strategies [15]. A reference model strategy, by providing additional structure and support for asking focused and more-detailed questions, can support dealing with the complexity. It is suggested that systematic asking of focused questions during requirements elicitation process can stimulate users toward deeper thoughts before they give answers and this helps them to identify and articulate their requirements [23]. In this paper we provide a reference model-based elicitation process, following the suggestions by Davis, to deal with the added complexity caused by the VN setting. We show that this contributes to operational BITA improvement by addressing a category of well-known elicitation problems such as communication flaws.

For this purpose, we conduct two-phase research based on the design science research approach [24,25]. In the design phase, a reference model-based user requirements elicitation process is designed in a three-step process. To demonstrate the feasibility of our approach and as a proof of concept, we also design two instances of it. Two reference models, respectively describing customer knowledge management processes and customer knowledge management challenges in a VN setting are used separately in designing these two instances. In the evaluation phase, the applicability and usefulness of each of these instances are evaluated in separate case studies.

Findings show that our designed reference model-based user requirements elicitation process has several benefits such as a clear structure, enhancement of idea generation, and enhancement of situational awareness. Therefore it is capable of coping with a set of recognized elicitation problems leading to the requirements elicitation process improvement. Based on the research findings, suggestions for further refinement and redesign of the artifact are provided.

This study contributes to the software requirements engineering literature. Firstly, we use a combination of a reference model strategy and an asking strategy for the design of a user requirements elicitation process as a way to deal with the added complexity caused by the VN setting. Secondly, we address a set of recognized elicitation problems by designing a reference model-based user requirements elicitation process and consequently to contribute to improving the outcome of this process.

This study also contributes to operational business-IT alignment improvement in a VN setting by improving requirements elicitation process by addressing one category of elicitation problems.

The outline of the paper is as follows. Section 2 provides an overview of the research background. The research methodology is discussed in Section 3. Results and Discussion are presented in Sections 4 and 5. Finally, the Conclusion and future works are presented in Section 6.

2. Related work

In this section, we give an overview of state of the art related to this paper. We first discuss the research field of BITA within a VN setting. Then, we move our attention to the research field of BITA in software requirements engineering. As a third main topic, we address the use of a reference model strategy for facilitating a user requirement elicitation process.

In recent years, addressing BITA has gained attention in the VN literature. In a VN setting, the BITA discourse goes beyond the boundaries of a single organization and is discussed at a networked level. This network-level discussion on BITA is essential because it contributes to creating and sustaining a profitable collaboration [7] and it entails a more efficient use of IT-based systems across a VN [26]. In addition, in a VN setting, achieving BITA is considered to be even more challenging than in an intra-organizational setting, due to the complexity of a VN [7,20,26,27].

From this review, we realized that even though the VN literature acknowledges the relevance and importance of addressing operational BITA, it mainly focuses on conceptual frameworks. For instance, Pijpers, et al. [7] with the aid of different conceptual modeling methods designed an inter-organizational BITA framework. Although in their framework four perspectives (i.e., strategic goals, value proposition, business process, and information systems) are included, they did not research the relationship between business process and information systems perspectives. They focus on a value perspective which connects the other perspectives [7]. In the other study, Santana Tapia, et al. [26] designed a maturity model for BITA within four areas of, respectively, partnering structure, IS architecture, process architecture and coordination in a VN setting. To conclude, there is a lack of finer-grained detailed explanation on how to address BITA at an operational level of a VN which helps improve alignment in IT development projects, i.e., to improve alignment between collaborative business processes and their supporting IT-based systems.

The research area of BITA in software requirements engineering has been trying to deal with this limitation. For instance, Ullah and Lai [28] expressed that operational BITA can be achieved when the business requirements are properly derived from a business context and met by information system functionalities. Operational BITA is addressed

by several papers [5,8,14,28]. However, so far, the majority of user requirements elicitation studies with the aim of addressing operational BITA typically aimed at addressing BITA within a single organization setting [14,28]. In addition, the majority of these studies are based on the pure asking strategy. In these studies the asking strategy is realized by using different elicitation methods such as using a goal-based method [28], context diagrams and role activity diagrams [14], and modeling notation based on UML to represent business processes [8].

However, according to Davis, an asking strategy is suitable for a stable situation that provides users with a well-defined structure [15]. Thus, in a more complex situation, such as a VN, a pure asking strategy could not yield satisfactory results. Because in a VN setting due to the complexity of inter-organizational business processes [16] and a lack of existing structural models, that encompass qualified information, to serve as a guideline during asking about user requirements [15], users often face difficulties in identifying and articulating their needs systematically [22]. To compensate for this limitation of a pure asking strategy in a complex situation of a value network setting, a combination of this elicitation strategy with the next level strategy (i.e., a reference model strategy) is suggested by Davis [15]. Davis [15] classifies requirements elicitation methods into four groups of elicitation strategies. These strategies are in a hierarchical order according to the complexity of a situation. Apart from his classification of requirements elicitation methods, some other classifications, such as [29,30], exist. However in those classifications, not enough attention is paid to considering the situational complexity as a means of selection. This consideration is important because the characteristic of the environment determines the selection of the appropriate elicitation strategy [15,31].

In general, a reference model is a generic abstract conceptual framework which describes essential elements of a particular domain that helps to establish a common understanding about that domain, and it can be used as a reference for the development of particular models [32–34]. A reference model has advantages such as:

(1) It can be used as a template to facilitate communication [33–35].
(2) It assists in creating a shared understanding [33].
(3) By capturing domain knowledge, it can be used as a means for structuring discussions around requirements in software engineering [35].

It was suggested by Osterwalder, et al. [36] that a reference model could improve the requirements elicitation process and could contribute to the creation of a common understanding between business and IT, leading to better alignment. This needs to be investigated.

To the best of our knowledge, the applicability and usefulness of a reference model strategy in combination with the asking-based strategy, as suggested by Davis, to improve user requirements elicitation process in a complex VN setting has not yet been investigated.

3. Methodology

The objective of this study is to design and evaluate a reference model-based user requirements elicitation process with the aim of contributing to operational BITA improvement in a VN setting by addressing elicitations problems. As this study was triggered by elicitation problems, a set of elicitation problems that might be handled by a designed elicitation process needed to be identified first. The research team assumed that the literature could provide a sufficient basis for identifying the elicitation problems because the investigation of elicitation problems has been the focus of a number of research studies, such as [11,12,37]. For instance, recently Fernandez, et al. [12] identified a list of 21 problems from the literature and tested their occurrence in practice by conducting a large-scale survey. This list of 21 elicitation problems can be classified into four groups:

(1) Governance-related elicitation problems such as unclear responsibilities.
(2) Evolutionary-related elicitation problems such as moving targets and changing circumstances.
(3) Project team-related elicitation problems such as communication flaws within the team.
(4) User-related elicitation problems which are listed in Table 1.

This study focused on this fourth group of the elicitation problems which encompasses seven problems.

From a theoretical perspective, we argued that based on the advantages of a reference model which were derived from literature [33–35] in Section 2, these user-related elicitation problems could be addressed. This was done based on logical reasoning in a group discussion in which the research team identified the possible relationships between the advantages of a reference model and addressing these elicitation problems. This discussion led to the proposed supports (Table 1). An example of this discussion is given here. Based on the "template for communication" advantage of a reference model, we argued that a reference model by providing a structure and systematic approach for communication could be used as a means of communication and thus it can support dealing with the problem of "communication flows between the project team and users." (A full description of the argumentations is available by the authors.

Table 1 gives an initial indication of the possibility of using a reference model to support dealing with these elicitation problems. We would like to test this in practice. However, as in practice, a reference model is not used in isolation, we could not judge purely the use of a reference model in addressing these elicitation problems. We can only look at the combination of a reference model and a user requirements elicitation process in which such a reference model is applied. Therefore we can only test the combination.

In this study, to address these user-related elicitation problems by using a reference model-based approach, a design science research ap-

Table 1
A potential of using a reference model to support dealing with user-related elicitation problems.

Advantages of a reference model	User-related elicitation problems ([12])						
	Weak knowledge of an application domain	Communication flaws between a project team and users	Terminological problems	users with difficulties in separating requirements from previously known solutions	Missing traceability	Incomplete and/or hidden requirements	Inconsistent requirements
A template for communication	√	√	√	√	√	√	√
Creating a shared understanding	√	√	√	–	–	–	–
Structuring discussion	–	√	–	√	–	√	–

√ (support); – (No support).

proach was followed. Design science research is an iterative approach for the design of an artifact, where steps in the iteration take both relevance (i.e., the importance for the application field) and rigor (i.e., alignment with the academic state of the art) into account [24,25].

In the design phase, the design of a reference model–based user requirements elicitation process was triggered by addressing the seven user-related elicitation problems (Table 1) which ensure research relevance. Drawing from existing knowledge, a combination of the asking strategy and reference model strategy suggested by Davis [15] was used to design the elicitation process. We opted to use the classification of elicitation strategies by Davis because in his classification the complexity of a situation is considered as a means of selecting a proper elicitation strategy. These strategies were realized by selection of particular reference models and elicitation method. These selections were based on the theoretical justification which ensures the scientific rigor of the research (detailed information in Section 3.1). In this phase, to demonstrate the feasibility of our approach and as a proof of concept, the two reference models were used separately in the design of the two instances of a reference model–based user requirements elicitation process (Section 3.1).

In the evaluation phase, the applicability and usefulness of these two instances were rigorously evaluated in two separate studies (Section 3.2).

To ensure research rigor, both the design and evaluation phases were guided by the existing body of knowledge and a well-defined methodology. Full information on the rigor of the research process is provided in Section 3.3. In this study, the first iteration of design-and-evaluation cycle was done. Based on the results of the first iteration, suggestions for refinement and redesign were provided (Section 6).

In summary, based on a design-and-evaluation cycle, in this study, these steps were followed:

(1) Problem identification and motivation (explained above)
(2) Design (Section 3.1)
    - Select /design a reference model
    - Select an elicitation method
    - Design a reference model-based elicitation process
(3) Evaluation (Sections 3.2 and 4)
    - Execute designed artifact in a case situation and evaluate its applicability and usefulness
(4) Suggestions for the redesign process model if required (Section 6)

For the design phase, the results are presented in Section 3.1 for the sake of readability. For the evaluation phase, the results are provided separately in Section 4.

3.1. Design phase

In this phase, a reference model–based elicitation process within a VN setting was designed. A combination of a reference model strategy and an asking strategy suggested by Davis [15] was used. While the former strategy was realized by means of particular reference models, the latter was realized by means of a particular elicitation method. This phase consisted of three steps:

Design step 1): Select/design a reference model.

Design step 2): Select an elicitation method.

Design step 3): Design a reference model-based elicitation process based on the selected reference model and the selected elicitation method.

Design step 1)

In this step to realize a reference model strategy, particular reference models were designed. As a VN is an emerging research field, there are no off-the-shelf reference models for a VN setting to choose from. Therefore, we designed reference models.

To design the reference models and to be able to deliver a proof of concept, we focused on the domain of customer knowledge management of value network (VN-CKM). We opted to focus on that for two reasons. First, in literature an in-depth understanding of customer needs and customer context is regarded as a first step towards delivering a seamless customer experience through co-creating integrated solutions [38]. For such an understanding, customer knowledge is required and to effectively use customer knowledge it requires to be managed across a VN. Second, VN-CKM is one of the key capabilities areas of a VN which are strategically important for the success of value co-creation and thus a locus of BITA [39]. This focus is important because the central premise of the BITA literature is to effectively prioritize and target IT initiatives for key capabilities [40,41].

Within the VN-CKM application domain, two reference models of VN-CKM process and VN-CKM challenge were designed and validated in our previous works [39,42]. The reason for designing these two types of reference models was that when talking to people about their tasks and roles, talking about abstract objectives and goals would have been too difficult. But talking about the things people do and the challenges and problems that affect their work would be much easier. Consequently, developing a reference model which describes the business processes and challenges associated with their processes will be aligned with topics that people can easily talk about. Thus, we expected that the VN-CKM process and the VN-CKM challenge reference models can be understood by people and are likely to be used by them.

To ensure the quality of these two reference models, they need to meet two types of requirements (i.e., a generic and specific). The generic requirements result from the nature of a reference model and include design adequacy, language adequacy, clarity, systematic design, and comparability as suggested by Otto, et al. [43]. In addition, the VN-CKM process and challenge reference models need to meet this specific requirement which was derived from the literature on value networks [19]: The proposed reference model should take a customer-centric and networked view. The customer-centric nature of co-creation value by providing integrated solutions requires the VN-CKM reference models to explicitly accommodate a customer-centric and networked view.

Here, a brief introduction of these reference models is given (more information can be found in the original paper [39,42].

- Customer knowledge management processes are required in order to get the right customer knowledge to the right people at the right time, to handle it systematically, and to leverage it across a VN. Achieving a shared understanding among actors about the VN-CKM processes, as a basis for joint actions, is thus required. A systematic and comprehensive view of the VN-CKM processes (in the form of a reference model) might support this by providing additional structure and process contents. In the VN-CKM process reference model, the four main processes of customer knowledge creation, storage/retrieval, transfer, and application within a VN setting are identified and characterized systematically and comprehensively. These processes are characterized regarding their sub-processes and the dedicated characteristics, respectively, activity, control, and outcome. To show the structure of this reference model, an example part of it is illustrated in Table 2.
- As customer knowledge disperses across a VN, its management is a challenging task. Value networks have to deal with the wide range of challenges which might hinder effective customer knowledge management. In a complex situation of a VN setting, achieving a shared understanding among actors about such challenges might even be more difficult. A systematic and comprehensive overview of the challenges (in the form of a reference model) might support this by providing additional structure. In the VN-CKM challenge reference model, these challenges are identified and classified systematically and comprehensively into five challenge areas and 28 challenge types. To show the structure of this reference model, an example part of it is illustrated in Table 3.

In this paper, we used these two reference models to design two instances of our proposed reference model-based requirement elicitation process as explained in the third step of design phase. These two

Table 2
Example part of VN-CKM process reference model to show its structure.

Process	Subprocess	Characteristics			
		Activity	Control		Outcome
			Formal	Informal	
Knowledge Creation	Tacit-tacit (Socialization)	Contextual understanding of customer experience and problems, socializing in relaxed environments		Briefing sessions; reciprocal interactions; dialogues	Mutual understanding of customer problems in the context of usage, Increasing social cohesion in a network

Table 3
Example part of VN-CKM challenge reference model to show its structure.

Challenge area	Challenge types
Network Structure	Transactive memory
	Relationship
	Complex network
	General distance
	Cultural distance
	Lack of communication facilities

reference models by providing a structure and detailed and reliable information can be used as a basis for asking focused questions and guiding communication during user requirements elicitation process.

Design step 2)

In this step to realize an asking strategy, a particular elicitation method was selected in order to carry out the user requirements elicitation process. To select a proper elicitation method, it has been recommended that selection must be based on situational characteristics and not on personal preferences [31,44]. Based on this contextual characteristic of a value network "autonomous actors with different interests should communicate and collaborate to provide integrated solutions" [17–19], two requirements for a selection of a suitable elicitation method were defined as:

R1: A selected elicitation method should facilitate disclosure of multiple perspectives among VN actors. The reason for this is that in a VN setting different actors with diverse perspectives collaborate in providing integrated solutions.

R2: A selected elicitation method should allow for group communication, questioning, comparing and reflecting among actors of a VN. In a VN setting, requirements elicitation process is a collaborative effort of VN actors. Thus, communication among actors as a basis for joint actions is required.

In our study, participants were from different value networks located in different geographical zones. It was not feasible for us to organize face-to-face group meetings. Therefore, the last requirement for our purpose can be defined as follows:

R3: A selected elicitation method should facilitate a distributed requirements elicitation process.

In order to select the appropriate requirements elicitation method, we opted to use a list of requirements elicitation methods suggested by Carrizo, et al. [31] as they systematically classified elicitation methods according to the situational characteristics. From this list, we identified that a Delphi method is the only option that adhered to *R1, R2,* and *R3.* Therefore we use a Delphi elicitation method for the purpose of this study.

A Delphi method is a structured process with iteration rounds and with controlled feedbacks aimed at obtaining reliable judgments and opinions of a group of experts anonymously [45,46]. The anonymity feature of a Delphi method allows participants to express their ideas unbiased by peer-group pressure and eliminates undesirable group effects, such as the destructive dominance of a more powerful participant [45].

Based on the results of this comparison, a Delphi method was selected. The advantages of applying a Delphi method are [45–47]:

(1) By using a group of experts, a Delphi allows obtaining multiple ideas and perspectives.
(2) A Delphi method supports asynchronous communication and distributed requirement elicitation. Regardless of geographical and time constraints, each expert can participate in the Delphi sessions.
(3) The structured process of iteration and controlled feedback of a Delphi contribute to more objectivity, group communication, refinement, and group consensus.

However, there are three main concerns about the Delphi method [45,47]. These concerns and the tactics used in this study to mitigate them are explained in the results section.

Design step 3)

In this step, based on the combination of results of design steps 1 and 2, a reference model-based user requirements elicitation process was designed. This artifact is a typical Delphi process but now supported by the selected/designed reference model. The structure of the reference model is used for design of Delphi protocols and data analysis. As we were looking for both user requirements and rationales for requirements, we opted to select an interview-type Delphi rather than a questionnaire-type Delphi. Each interview-type Delphi round consists of semi-structured interviews, one with each expert individually. The semi-structured interview allows experts to give enriched answers by providing details and examples and to provide clarifications when asked for [48]. This artifact consists of these steps:

i. Expert selection,
ii. Design of a protocol of the 1st Delphi round based on the structure of the selected/designed reference model,
iii. Execution of the 1st Delphi round,
iv. Data analysis based on the structure of the selected/designed reference model and feedback to the participants,
v. Design of a protocol of the 2nd Delphi round based on the results of a 1st round and the structure of the selected/designed reference model,
vi. Execution of the 2nd Delphi round,
vii. Data analysis based on the structure of the selected/designed reference model and feedbacks to the participants.

In the following, these steps are explained by using information from our study. In our study, to demonstrate the feasibility of this artifact and as a proof of concept, the two reference models (i.e., the VN-CKM challenge and the VN-CKM process reference model) were used separately in the design of two instances of this artifact.

It should be noted that in this explanation we consider steps *ii.* and *v.*, steps *iii.* and *vi.*, steps *iv.* and vii. As comparable pairs so, a single description is provided for each.

Step i.

As the efficient application of the Delphi method relies on the selection of eligible experts to participate in the Delphi rounds, this selection should be done carefully [45,46].

In this study, to select the eligible experts a set of four requirements as suggested by Skulmoski, et al. [46] is used. Accordingly, the Delphi participants should meet these four requirements: 1) knowledge and experience with the issues under investigation; 2) capacity and willingness to participate; 3) sufficient time to participate in the Delphi; and, 4) effective communication skills.

Step ii. and ***v.***

In each Delphi round, information was gathered by a researcher through semi-structured interviews with each expert individually, and the anonymity of responses was thus maintained. This conversation should be structured around user requirements and their rationales for requirements. For this, in each Delphi round, interviews were guided by a set of open-ended focused questions. These questions were defined based on the structure of the selected/designed reference model and placed in a Delphi protocol (for each round). It is recommended that systematic asking of focused questions during such a conversation, stimulate participants toward deeper thoughts before they give answers and this helps them to identify and articulate their requirements [23]. In addition, to ensure that the questions were formulated appropriately, the protocol of each Delphi round was examined in a pilot interview.

As an example, consider the protocol of the first Delphi round which was based on the VN-CKM challenge reference model. The open-ended questions were associated with each of the challenges of this reference model. Hence, in the protocol, for each of the challenges it was separately asked whether an IT-based system can play a role in mitigating that challenge. If so, then it was asked what you want to be able in dealing with that challenge. Whenever an expert proposed the requirement, the rationale for the proposal was also asked by asking 'why' question. Asking 'why' questions encouraged participants to think before answering and to give their opinions more precisely.

Regarding the protocol of the second Delphi round, it was designed based on the results of a first round and the selected/designed reference model. As an example, consider the second Delphi round based on the VN-CKM challenge reference model. For each challenge of this reference model, the suggested user requirements with the given rationales of all of the experts from the first Delphi round were combined and used in the protocol of the second round. By using this protocol, the experts were asked whether they recognized their own inputs, in order to check the quality of our interpretation. It was then asked which of the requirements suggested by other experts were useful in the context of their VN. Subsequently, they were asked for additional requirements, as they saw the feedback of others and could be triggered by the suggestions and rationales of the other experts.

Step iii. and ***vi.***

The first Delphi round is for individual brainstorming where each expert gives his requirements independently from the others. To determine the accuracy of our interpretation of the participants' requirements and their associated rationales and to give them an opportunity for comments, the results of the first Delphi round were returned to them. The second round is for verification of the results of the first round, and justification/adding the expert's suggestions based on controlled feedback from the others [45]. During each Delphi rounds, data are collected through semi-structured interviews guided by one of the designed Delphi protocols.

Step iv. and ***vii.***

Conducting each Delphi round resulted in data on user requirements and the rationales. To analyze these data, a structured data analysis process was followed. Here, a summary of this process is given (see for further details [49]). First, regarding the qualitative nature of the user requirements, data analysis was done based on the content analysis approach [50]. Second, for each Delphi round, to structure the data analysis process, a data extraction form was designed which was based on the structure of the selected/designed reference model. Third, the form was completed for each interview using relevant quotes from his or her transcript. For instance, regarding data from the first Delphi round that was based on the VN-CKM challenge reference model, a quote was relevant if it contained user requirements and the accompanying rationales corresponded to each challenge of the reference model. Fourth, after each Delphi round, to ensure that interpretation and positioning of the participant quotes were done correctly, a summary of user requirements and the rationales were mailed to each expert. After that, the summary of requirements and the rationales of all experts were combined to be used for design the protocol of the subsequent round.

3.2. Evaluation phase

In the design phase, by using our two reference models, two instances of a reference model-based user requirements elicitation process via a Delphi method were designed. In this phase, the applicability and usefulness of each of these instances were evaluated as suggested by Hevner, et al. [24] . Applicability means that the design artifact works in real-life situations and results in an expected outcome which demonstrates the utility of the artifact[51]. Usefulness means that a user believes that using the design artefact provides gains to its user [52].

This phase consists of four main parts:

1. Evaluation strategy and evaluation method selection,
2. Case selection,
3. Data collection,
4. Data analysis.

3.2.1. Evaluation strategy and evaluation method selection

To evaluate a designed artifact, different evaluation strategies have been proposed in the design science research literature [24,25,51]. For instance, Venable, et al. [51] classified these evaluation strategies as artificial evaluation and naturalistic evaluation strategies.

In this study, the naturalistic evaluation strategy was chosen as the more appropriate one. The reason for this choice is that the designed user requirements elicitation process (i.e., a Delphi process supported by the reference model) is a communication-rich process in which human actors in a real-life VN setting should be involved to be able to evaluate the applicability and usefulness of this designed artifact. An artificial evaluation is not able to embrace all the complexities of human interactions in a real situation. The naturalistic evaluation is a human-focused approach, and it explores the performance of a proposed artifact in a real environment [51]. So it is was selected for this study.

Among the evaluation methods under naturalistic strategy, action research, a survey, and a case study were considered as the alternative methods to be used in this study. Each of them had its strengths and weaknesses. In action research, the focus is on defining the actual problem-by-problem owner and carrying out iterative reflections until a practical solution for the specific problem is achieved; consequently, it requires long-term collaboration [53]. Regarding the setting of this study, i.e., a VN context, the way the research problem is defined (beforehand by the research team), and also the time frame of this study, the action research approach would not fit properly.

Among the two other alternative evaluation methods, the survey's ability to consider the context of a designed artifact is limited, as it uses closed questions in collecting data [48]. This limitation can severely restrict an in-depth evaluation of the usefulness of the designed elicitation process in the context of a VN. Consequently, a case study approach, which enables both considerations of the research context and an in-depth investigation of the phenomenon in its actual context [48,54] is considered as the most appropriate evaluation method for this study.

3.2.2. Case selection

Based on selecting a case study as an evaluation method, one study for evaluating each instance of the reference model-based user requirements elicitation process was conducted. The first study was based on the VN-CKM challenge reference model and the second study was based on the VN-CKM process reference model.

In both studies, a purposive sampling strategy was followed to select information-rich cases [55]. Purposive sampling in the context of this research means that we need a representative of a typical value network which can be characterized as a customer-centric, multi-actor collaboration, and delivery of a concrete integrated solutions [19]. Based on these characteristics of a typical VN, the selection criteria were defined as follows:

Table 4
Case description.

Case study	Value network	Customized solution offering
Case 1	A	Object detection solutions
	B	Communication management software solutions.
	C	ICT solutions for education
	D	ICT management solutions for stable IT infrastructure
	E	Examination services for industries
	F	Financial document management solutions
	G	Business intelligence consultancy services
	H	Testing systems for industries
Case 2	F	Financial document management solutions

(1) Regarding a customer-centric view of networked collaboration in a VN setting. In a selected case, a customer has to be actively involved in the integrated solutions provisioning process;
(2) Regarding the triad as a building block of a network [56], at least three actors have to be involved in each case;
(3) In a selected case, a networked collaboration of actors has to lead to at least one concrete integrated solution.

Based on these criteria, we were pleased to find as many as eight value networks for the first study. For the second study, only one of the VNs from the first study was willing to cooperate. We refer back to this in Section 4 and 5.

A summary of the studied VNs is presented in Table 4. For confidentiality reasons, they are anonymized.

3.2.3. Data collection

An actual full user requirements elicitation project was not executed. This research is limited to establishing a proof of concept. So, in each study, the specific parts of one of our reference models were used for the evaluation of the applicability and of the usefulness of the designed artifact. We reflect on this limitation in Section 5.

In the first study, the top ten most important and relevant challenges from the VN-CKM challenge reference model and in the second study the tacit-related processes from the VN-CKM process reference model were used in two-round Delphi sessions.

3.2.3.1. Data collection for evaluating the applicability. As mentioned above, in each study, based on the specific part of one of the reference models, the instance of reference model-based user requirements elicitation process was executed in a case study to see whether it works in a real-life VN setting and is able to identify and extract user requirements with their underlying rationales. For this purpose, for each question of the first Delphi session, each participant should give at least one suggestion with the reasoning for it.

In each study, data were collected through a two-round interview-based Delphi process guided by the Delphi protocols which were designed in Section 3.1.

3.2.3.2. Data collection for evaluating the usefulness. In each study, the usefulness of one instance of the designed user requirements elicitation processes in dealing with the seven user-related elicitation problems (Table 1) was evaluated. This was done by asking open questions at the end of the second Delphi round. Directly asking closed questions about the user-related elicitation problems might bias experts toward confirmation. To avoid this bias, the participants independent of each other and without being primed by the closed questions were asked open questions about the usefulness, followed by the 'why' question. By asking 'why,' we were looking for the arguments of the experts. These questions were asked:

Do you think you get a grip on the VN-CKM processes/ challenges? Why?
Do you think the proposed approach is a good way to identify user requirements? Why?
What is the most valuable part of this study for your value network? Why?

To give an impression on the answers given by the participants, three example quotes of their answers are presented here. Service delivery manager from VN (C) of noted: "*because it enables me to formulate a couple of things that implicitly run through my head.*" An account manager from VN (I) stated: *"I have even used the results of this user requirements elicitation process in an important presentation for customers and suppliers."* IT architect from Case 2 stated: "*as the context is made very clear and this requirements elicitation process provides multiple perspectives on user requirements.*"

3.2.4. Data analysis

In line with the data collection, in each study, the data analysis encompassed two parts: one for evaluating the applicability of the designed artifact, and one for evaluating the usefulness of the designed artifact. The entire research team was involved in data analysis.

3.2.4.1. Data analysis for evaluating the applicability. According to the definition of applicability, at the beginning of Section 3.2, to demonstrate the applicability of the designed reference model–based user requirements elicitation process in practice, it should be executable in the real situation of a VN. In the context of this research, this means that each instance of the research artifact should be executable in a case study and be able to identify and extract user requirements with their underlying rationales. In this regard, the participant answers to the questions as defined in Delphi protocols were analyzed (see steps ***iv.*** and ***vii.*** in Section 3.1).

The execution of the designed elicitation process may result in an extensive set of initial user requirements which may contain similarities. To provide a more coherent, well-structured, and smaller set of user requirements types at a higher level of abstraction, in each study, the initial list was then classified in a structured way by the research team, based on the structured classification approach in Metaplan sessions [57]. The Metaplan is a card sorting technique based on group discussions. It facilitates a structured classification process. The group discussions aspect of this technique prevents individual bias in classification [57]. See for further details in [49].

The well-structured set of user requirements types of the two studies, i.e., the results of the two classifications, were then cross-compared. The focus of this comparison was on identifying the complementarities of these two sets. Although, as mentioned before, the two reference models of VN-CKM processes and VN-CKM challenges were used partially in the evaluation phase, these two well-structured sets of user requirements types should be complementary, because these two reference models are complementary. The research team made this comparison in the research group meeting in which the user requirement types of the two sets were compared against each other.

3.2.4.2. Data analysis for evaluating the usefulness. To evaluate the usefulness of the designed elicitation process, the experts' answers to the dedicated questions were analyzed. The objective of this analysis was

to link their answers to the seven user-related elicitation problems presented in Table 1. Given this objective and due to the descriptive nature of these data, the participants' answers were analyzed by using a content analysis approach [50]. This was done by the research team by conducting the processes of open coding and closed coding. Open coding was done to establish meaningful categories of labels from the content analysis of these answers. Closed coding was done to link these emerging categories of labels to the user-related elicitation problems.

In the open coding process, the participants' answers in both studies were pulled together into a single document. These data were pulled because using one instance of the same elicitation process in each study and following the same approach for evaluating the usefulness of the designed artifact leads to comparable data. Subsequently, each answer was read carefully to identify the expert's arguments (i.e., a number of words or phrases) regarding the benefits of the designed elicitation process. To identify the arguments, keywords such as 'so,' 'because,' and 'I think' were used. Then, the identified arguments were labeled by the research team to summarize their meaning. The same label was given to similar arguments. This process resulted in the categories of labels which showed the participants' perceived usefulness of the designed artifacts.

In the closed coding process, to see whether the perceived usefulness can support addressing any of the seven user-related elicitation problems, the categories of labels which emerged from the open coding were discussed against the seven elicitation problems. This discussion was based on logical reasoning given by the research team members. To facilitate this group discussion, three criteria were defined by the research team:

- Strong support (++): the label shows strong support for the elicitation problem if, based on the logical reasoning in a group discussion, a clear link between label and problem can be identified.
- Weak support (+): the label shows weak support for the elicitation problem if, based on the logical reasoning in a group discussion, an indirect link between label and problem can be identified.
- No support (−): the label shows no support for the elicitation problem if no logical reasoning can be given.

Following this process, the labels of perceived usefulness were mapped to the user-related elicitation problems. To give an impression on how the research team conducted this open and closed coding process, one example of our discussion is presented here. Consider this expert answer "*it is useful as you show the list of VN-CKM challenges and provide a consistent and structured way of looking at them during the two Delphi sessions, by going through the list I do see things which I can plot on what we do*". In open coding process this answer was read carefully by the research team and the two arguments were highlighted and labeled, respectively, "the elicitation process has a clear structure" and "idea generation". In the closed coding process, we argued that as the designed elicitation process has a clear structure, it provides a common basis for communication, so it strongly supports addressing the elicitation problem of "communication flow between project team and users."

3.3. Research validity and reliability

In qualitative research addressing the rigor and trustfulness of a research process and its findings, both quantitative terms (i.e., internal and external validity and reliability) and equivalent qualitative terms (i.e., credibility, transferability/generalizability, and dependability/consistency) have been wieldy used [48,58,59]. The rigor and trustfulness concerns are about establishing confidence in a research process and its results [58]. To address the reliability, internal and external validity of this study employ different tactics, as suggested by Yin [48], Merriam and Tisdell [58].

Tactics used to deal with the *reliability* concern:

- The precise description of a research objective and theoretical foundation of the study were explained and documented.
- Sets of requirements for the reference models, elicitation methods, case, and experts were identified from literature.
- Detailed descriptions on a well-structured research process were provided and followed.
- Delphi sessions were directed by a set of focused questions as defined in Delphi protocols.
- Consistent and transparent data collection and data analysis were conducted and documented by following the well-defined processes.
- A brief introduction of our reference models were presented at the beginning of the Delphi sessions. The familiarity with the reference model increased the likelihood that all participants had comparable information about the VN-CKM processes and challenges.
- The researcher who collected the data carried out the data analysis in relation to the applicability evaluation of the designed artifact. To avoid researcher bias and to facilitate cross-checking, a random set of transcript data was analyzed independently by another researcher, and the results were compared. Consistency in the data analysis results of the two researchers signals the reliability of the research. In case of disagreements research group meetings were organized to discuss issues and to reach an agreement.
- Regarding the usefulness evaluation of the research artifact, all research team members through several meetings carried out data analysis through well-structured open coding and closed coding processes. In the case of disagreements, discussions were continued until an agreement was reached.

Tactics used to deal with the *internal validity* concern:

- In the evaluation phase, data triangulation was used. Within each study, a heterogeneous group of experts with multiple perspectives was selected. This was done on the basis of selection criteria defined by the research team.
- Data analysis was done on the basis of a structured process of content analysis.
- Logical reasoning of the research team provided substantial discussions on the link between the perceived benefits of the proposed elicitation process and the seven user-related elicitation problems.

We are aware of researcher bias in data interpretation during data analysis. To overcome this issue and to enhance objectivity, the reference models were used as a guideline.

Generally, using a model made people think within a particular framework, so the world beyond the model became less visible [44]. By following a well-structured research process in developing the reference models we believed that they covered the key elements of VN-CKM application domain significantly.

Tactics used to deal with the *external validity* concern:

Based on the purposive sampling strategy used in both studies and the replication logic [48], we are confident that the results can be generalized into similar VN settings. However, the generalizability of the research results in other complex inter and intra organizational contexts should be evaluated in future research.

4. Results

The results of the design phase, for the sake of readability, are presented in Section 3.1. In this section, the results of the evaluation phase are given.

All of the studied networks adhere to the selection criteria (Section 3.2.2). We were pleased to find as many as eight value networks for the first study. This gave an opportunity to provide a broader view on the applicability and usefulness of the first instance of the designed artifact (based on the VN-CKM challenge reference model) across different networks. For each of those value networks, one actor participated in our research. For the second study, only one of the VNs from the first study was willing to cooperate. Fortunately for the second study, three

actors of the participating VN could be involved. This gave an opportunity to provide a more in-depth view on the applicability and usefulness of the second instance of the designed artifact (based on the VN-CKM process reference model) among different actors of the same network.

Based on the expert selection criteria in Section 3.1, a total of 17 eligible experts participated in this research study. In the first study, one expert from each VN participated. In the second study, three experts from each actor of the participating VN were selected. However, one of the nine experts withdrew from the participation because of personal time restrictions. Regarding the required number of experts to be included anonymously in Delphi sessions, in both studies, the number of eight was in line with the recommendations of Hallowell and Gambatese [60].

In each case study, two-round Delphi sessions were conducted successfully. Two members of the research team, one for each of the studies, collected data independently. Each served as a neutral facilitator who guided the group of experts, who were anonymous to each of the other participants. All interviews were recorded, transcribed, and preserved in the research database. The data collection process of both studies covered a period of over four months and resulted in 31 in-depth interviews. This encompassed 16 interviews in the first study and 15 interviews in the second study (one of the participants could not take part in the second round of Delphi because of personal time constraints). The average duration of these interviews was one hour.

Three main concerns about a Delphi elicitation method [45,47] and the tactics used in this study to mitigate them are as follows:

(1) Questions, if poorly formulated, could lead to poor quality results. To deal with this, our reference models were used as a basis for defining a set of well-structured and focused questions. Additionally, the unambiguity of the designed questions was checked by conducting pilot studies, which resulted in further clarifications.
(2) Inefficient application of this method, such as inaccurate expert selection or lack of explanation to the experts. To mitigate the first issue, eligible experts were selected according to selection criteria. To address the second issue, at the beginning of Delphi sessions, a brief introduction of the Delphi method was given to the participants. Moreover, a brief theoretical description of our reference models were presented, to keep the focus of the conversation on the subject of this study.
(3) Insufficient analysis of results. To address this issue, data analysis was done in a structured way following the process explained in Section 3.2.4.

A summary of the results of data analysis process of evaluating the applicability and usefulness of the proposed reference model-based user requirements elicitation process is given here:

- Regarding the applicability: The results are quite satisfactory which means that the designed artifact works in a VN setting and results in an outcome which is a set of user requirements.
- Regarding the usefulness: The results show that the designed artifact is useful in addressing the user-related elicitation problems in a complex situation of a VN.

These results are explained in details in the subsequent sections.

4.1. Results of evaluating the applicability

The results of evaluating the applicability of the designed artifact are given here. In each study, one instance of the reference model-based user requirements elicitation process via two-round Delphi process was successfully applied. Overall, both instances judged quite satisfactory by the experts.

In the first study, only one expert (from Case E) had unsatisfactory responses to the designed elicitation process. For instance, he mentioned, "*We have already a solution for these VN-CKM challenges, so not much changes for me*". This quote indicates that he might have felt overconfident regarding the current situation. As a result, he was likely to overlook suggestions given by other participants. In the second study one expert, despite his willingness to participate and rescheduling several sessions, could not take part in the second Delphi round.

The data analysis process of the first Delphi round of the two studies resulted in 16 completed forms. Almost all participants agreed with interpreting and positioning their answers (two gave minor comments on presenting their requirements). In the first study, each participant offered one or two requirements for each of the top ten challenges of the VN-CKM challenge reference model. A similar number of suggestions were also observed in the second study about tacit-related processes of the VN-CKM process reference model.

In total the initial sets of 111 and 120 user requirements with their accompanying rationales were obtained, respectively, from the first and the second study. These results indicate that in both studies the first Delphi round was executed successfully and it enabled identification and capture of multiple perspectives on the user requirements.

In addition, in the first Delphi round, participant arguments (i.e., answers to why questions) indicated that their proposed requirements are meaningful and plausible.

The data analysis process of the second Delphi round of the two studies showed that all 15 experts recognized their own suggestions (i.e., results of the first Delphi session), which means that the content analysis was done properly. In addition, they often found the suggestions of others useful. Furthermore, triggers from the others' input resulted in 11 and ten additional requirements, respectively, in the first study and the second study.

Then, in each study, through three Metaplan sessions, the sets of user requirements (i.e., the outcome of second Delphi) were classified systematically into two well-structured sets of user requirement types. While in the first study the classification process resulted in 21 user requirements types, in the second study, this process resulted in 13 users requirement types [49]. These two well-structured sets of user requirements types of these studies were then compared against each other. This comparison showed they complemented each other. It also showed that each study extensively pointed to the several user requirements in accordance with the specific reference model used in that study. Also, significant overlaps between these two sets, mainly in the area of communication and data storage, were observed. These overlaps indicated that both instances of our reference model-based elicitation process enabled a focused discussion.

4.2. Results of evaluating the usefulness

In this section, the results of data analysis process for evaluating the usefulness of both instances of the designed reference model-based user requirements elicitation process in dealing with user-related elicitation problems is presented.

First, the open coding process of content analysis by the research team (Section 3.2.4.2) resulted in generating seven categories of labels which show the perceived usefulness of the designed artifact by the experts (Table 5). Second, based on the criteria defined in Section 3.2.4.2, the closed coding process was conducted by the research teams to map between the seven categories of the labels and the user-related elicitation problems. The results of this closed coding process are summarized in Table 5.

According to Table 5, some conclusions can be drawn:

- The findings show that for each of these seven elicitation problems there is at least one strong support from the labels and quite often more. This indicates the usefulness of the designed reference-based user requirements elicitation process via a Delphi method in addressing the user-related elicitation problems in principle.
- As mentioned by 12 experts, the designed user requirements elicitation process has a clear structure. This clear structure strongly

Table 5
Usefulness of the designed artifact in addressing the user-related elicitation problems.

		User-related elicitation problems (Fernandez, et al. [12])						
Labels of perceived usefulness of the designed elicitation process by the experts	Repetition by people out of 15 experts of the two studies	Weak knowledge of an application domain	Communication flaws between a project team and users	Terminological problems	Users with difficulties in separating their requirements from previously known solution	Missing traceability	Incomplete and/or hidden requirements	Inconsistent requirements
The elicitation process has a clear structure	12	++	++	–	++	++	++	++
Enhances idea generation	11	++	+	–	–	–	++	–
Creates situational awareness	6	++	++	++	++	–	++	–
Provides multiple views on user requirements	4	++	+	–	++	–	++	–
Allows in-depth insights on own requirements	3	++	++	++	++	–	++	–
Enables prioritizing user requirements	2	–	+	–	+	–	–	–
Enables asking better questions	2	++	++	++	++	–	++	–
Total strong and weak support		6	7	3	6	1	6	1

++ (Strong support); + (Weak support); – (No support).

supports addressing six out of the seven user-related elicitation problems.
- The label of "enables asking better questions" implies to the fact that a pure asking is too complex to be followed by the experts in a VN setting. Thus, the combination of the reference model and asking strategies for eliciting user requirements is suitable. This means that, in a complex situation of a VN, our designed artifact could help users to identify and articulate their requirements systematically.
- Although the results of the two studies were combined in Table 5, each study leads to the same conclusion. This means that both instances of the designed elicitation process produce comparable results.

Further discussions on the results are presented in Section 5.

5. Discussion

This discussion consists of three main parts. First, a brief overview of the research objective and research process is given. Second, some discussion of the results and limitations of both phases of this study is given. In the end, some findings of this study are compared with prior studies.

The importance and relevance of operational BITA are acknowledged in both literatures on VN and a software requirements engineering. Despite the contributions of studies on BITA within the software requirements engineering literature, the focus of previous studies is mainly on a single organization and a pure asking strategy [14,28,61,62]. In a complex situation of a VN setting (Section 2), using a pure asking strategy in the user requirements elicitation process might not yield a satisfactory result. An alternative would be applying an asking strategy in conjugating with a reference model strategy [15].

In this study, we focused on the set of seven user-related elicitation problems identified above (Table 1). To deal with these problems within a VN setting, based on the design science research approach and the combination of the two elicitation strategies of Davis [15], a reference model-based user requirements elicitation process was designed successfully. To demonstrate the feasibility of this artifact and as a proof of concept, we designed two instances of it. The applicability and the usefulness of each of these instances were evaluated successfully by applying the evaluation method of the case study.

In this study, the reference model strategy was realized through selection of the two reference models of VN-CKM process and VN-CKM challenge. These two reference models are from the key capability of the VN-CKM. Our focus on addressing BITA for this strategically relevant key capability area is based on a fact that the primary locus of alignment (i.e., where alignment is tightest) should be for the key capabilities areas of a VN [40,41]. If a degree of BITA in these areas is low, a VN might encounter difficulties to achieve its goals.

Also, the asking strategy was realized through election of a Delphi requirement elicitation method. The reference model strategy was realized through using specific reference models. All of these selections were based on theoretical justifications which ensure the theoretical vigor of this study. Then, two instances of the reference model-based user requirements elicitation process were designed. Each of them consisted of two-round Delphi sessions facilitated by one of our reference models. The reference models provided a common basis to define focused questions. These questions were asked and guided the conversation during Delphi sessions.

Some discussion on the results and limitations of the evaluation phase is given below.

- In the evaluation phase, as a proof of concept and for a practical reason, in each study specific parts of our reference models were used. In the first study top ten important and relevant challenges from the VN-CKM challenge reference model and in the second study the tacit-related processes from VN-CKM process reference were used. As the significant and the most relevant parts of these models were used in one of the studies, they were sufficient for the purpose of this study. Therefore, including the rest of the parts would be more of the same and seems unlikely to affect the results.
- An actual full user requirements elicitation project was not executed. This research is limited to establishing a proof of concept. However, we believe that the results of the evaluation phase are valid because the evaluation was based on the rigorous research methodology, the experts were committed in their collaboration to this research, they participated seriously and actively in both Delphi sessions, and they recognized the quality of the results. To support our argument three example quotes from the experts are presented. Customer communication manager from VN (B) stated: *"for sure I will have a look at this together with a consultant."* Service delivery manager from VN (I) said: *"the translation of these user requirements to concrete IT solution steps would be very useful for us."* An account manager from VN (I) noted: *"I have even used the results of this user requirements elicitation process in an important presentation for customers and suppliers."* Therefore, we expected that in a real software requirements engineering project the similar results would be obtained.
- The two reference models used in this study together provide rich views on a number of different aspects of application domain of VN-CKM that might not be considered explicitly in a pure asking strategy in a complex situation of VN. However, we realize that the process-based and challenge-based reference models are not the only options available. Given that information systems can be described from different aspects includes process, data, application, platform, and organization [63], other types of reference models might be useful as well. This should be investigated in future research.

Regarding the evaluation of the applicability of the designed artifact:

- Empirical findings showed both instances of the designed user requirements elicitation process were executable in practice, and they were widely accepted by the participants. These findings demonstrated that the artifact works, which in essence indicates the applicability of the combination of the asking strategy with the reference model strategy for eliciting user requirements in a VN setting. This study, by conducting two separate studies for each of the reference models, provided a sufficient basis for establishing a proof of concept.
- During the elicitation process usually a large number of user requirements are collected. Thus, it is necessary to structure them in a proper way [44]. Dealing with a large size of user requirements is a general concern of all elicitation methods [31]. To deal with this, in this study, the structure of Delphi method enabled us to combine and narrow down the results of the first round to be used as an input for the second round. In addition, the structure of our reference models further enabled us to classify the two lists of user requirements (results of the two studies) through Metaplan sessions into two well-structured and smaller lists of user requirement types.
- Cross-comparison of these two lists of user requirement types indicated they were complementary and overlapping. The overlaps indicated that our reference model-based elicitation processes via a Delphi method enabled a focused discussion. But it also implies duplication. In the actual elicitation process, to avoid such duplication, the overlaps need to be handled by integrating the two reference models.

Regarding the evaluation the usefulness of the designed artifacts:

- In the first study, the designed elicitation process was implemented in eight value networks. In the second study, the designed artifact was implemented in a single VN. This difference is a matter of breadth versus depth. Of course for each of our studies, we would like to have both of them to get better quality research. That is a limitation of the current study. But we see that in both studies, the results of evaluating the usefulness of the designed artifact were similar and comparable.

- In evaluating usefulness, the focus was on what the experts thought about the designed elicitation process and their arguments for such thoughts. Therefore, open questions were asked to avoid to a large degree risk of participants' bias. But we could not guarantee that we fully control this bias. We believe that the results, although indirect, are more reliable.
- A well-structured content analysis (open coding and closed coding) of these answers enabled mapping of the perceived benefits of the designed elicitation process into the seven user-related elicitation problems. Accordingly, each of these elicitation problems was strongly supported by at least one of the labels (Table 5). This result indicated that the design artifact helped to address these problems. The improved elicitation process can thus result in more complete, unhidden, consistent, and traceable set of user requirements. As a logical consequence, if the user requirements in the scope of VN-CKM application domain are properly met by supportive IT-based systems functionalities, then the business and IT will be aligned better in this particular area. This needs further investigation in a future study of the IT-based systems development project.

The following discussion reports on the two widely perceived benefits of our designed artifact: the clear structure and idea generation. In each discussion, the empirical findings of this study are compared with prior studies from the software requirement engineering literature.

Clear structure of elicitation process: 12 out of 15 participants perceived that the designed user requirements elicitation process has a clear structure. According to table 5, this clear structure strongly supported six out of seven elicitation problems. This finding is in line with the prior studies that have demonstrated that providing a structure for user requirements elicitation process was beneficial. For instance, it enhanced communication [44,64,65] and shared understanding [10,44,66], enabling a focus on the requirements and the needs of the user [15], supporting traceability and consistency [21,64,65], and uncovering hidden/incomplete requirements [15,23,44,64].

In prior studies, such a structure was quite often provided by asking-based elicitation methods [10,64,65]. Given the complexity of a VN setting, a structure offered by pure asking-based elicitation methods may not be sufficient for this setting. Different from past research, in the current study, a specific way of providing a clear structure for user requirements elicitation process was developed. It was rooted in both the structure of the reference model and the structure of the Delphi method. Also, this way of providing a clear structure for the elicitation process was more in tune with the circumstances of VN and the user-related elicitation problems. Furthermore, the structure of the designed reference model-based elicitation process is simple, without any technical details, and easily understandable by nontechnical business people.

Idea generation: 11 out of 15 participants perceived that the designed elicitation process facilitated idea generation, triggered people to start thinking explicitly about their needs, and provided a source of inspiration. It, therefore, aided actors in VN to articulate their requirements, to recognize the missing requirements, and to identify further requirements.

Proving a source of inspiration and idea generation was similar to those of previous studies [15,23,67,68]. For this provision, different approaches such as using an existing model/system as an anchor point [15] and using directed questions as checklists [23,67,68] have been suggested. These approaches primarily aid recognition and stimulate and activate people's memories. Such an approach is usually used in combination with one of the elicitation methods. For example, in prior research, a set of context-independent focused questions (such as who, how, and why questions) were used in the user requirements elicitation process via interview [23,68]. Empirical findings of these studies indicated that focused questions stimulate information in user memory and cause the user to reason and generate arguments; hence, they can improve idea generation and reduce the risk of incomplete/hidden user requirements [23,68]. In the present study, we have extended these findings:

- In contrast to individual idea generation via an interview in previous studies [23,68], in this study, collaborative idea generation via iterative Delphi sessions was conducted. In a network setting, collaborative idea generation by transcending from an individual focus promoted a more thorough understanding of the user needs [30,65].
- In contrast with previous studies in which context-independent focused questions have been used, by using our reference models a set of context-dependent focused questions were used in this study. It has been recommended that context-dependent focused questions are more effective than context-independent questions [23,68,69].
- While previous studies have evaluated the usefulness of their approach in a single organization setting [23,68], we evaluate the applicability and usefulness of our approach in the complex network situation of a VN.

6. Conclusion and future works

The objective of this study is to design and evaluate a reference model-based user requirements elicitation process to address the user-related requirements elicitation problems with the aim of contributing to better achievement of operational BITA in a VN setting. The design of the user requirements elicitation process is triggered by the seven user-related elicitations problems identified from the literature which ensures research relevance. These problems are communication flaws between the project team and the customer, terminological problems, weak knowledge of application domain, stakeholders with difficulties in separating requirements from previously known solution designs, incomplete and hidden requirements, missing traceability, and inconsistent requirements.

To deal with these user-related elicitation problems, based on design science research approach, a reference model-based user requirements elicitation process was successfully designed and evaluated in practice. We do not claim that this approach is the best but demonstrate its applicability and usefulness in practice.

This study contributes to software requirement engineering literature. Firstly, based on 31 interviews with practitioners from eight value networks in the Netherlands in two-round interview-based Delphi process, the empirical findings indicated the viability of using a reference model-based user requirements elicitation process in dealing with these seven elicitation problems within the complex situation of a VN. Secondly, the results of this study demonstrate the capability of using a reference model strategy to compensate for the limitation of asking strategy in a more complex situation such as a VN setting.

In addition, our designed artifact by addressing these seven elicitation problems improves the requirements elicitation process. It thus contributes to operational BITA improvement within a VN setting, specifically in the area of customer knowledge management of a VN. Hence, this study also contributes to the operational BITA research in VN literature.

The results of our study confirmed the suggestion of Osterwalder, et al. [36] that a reference model could improve the requirements elicitation process and thus could contribute to the creation of a shared understanding between business and IT, leading to better alignment.

This research provides practitioners with a reference model-based approach for conducting user requirements elicitation process in a VN setting. It can be applied in real-world projects to support asking-based elicitation methods, handle the user-related elicitation problems, and thus substantially improve user requirements elicitation efforts. Moreover, the designed artifact can be used as a basis for developing a guideline to be used by software engineering team in designing and developing supporting IT-based systems in a VN setting.

Five suggestions for future research are presented below.

First, as demonstrated in Table 5, the two elicitation problems of communication flow and weak domain knowledge are supported well by the designed artifact. Within the literature on BITA, these problems are acknowledged as the two main barriers to achieving better BITA [2,4,13]. We believe that our reference-based elicitation process can contribute to dealing with these BITA barriers. This needs further investigation in future work.

Second, the two Delphi sessions as used in this study are a creative space that can naturally lead to a large number of user requirements. The two initial lists of user requirements are then classified systematically into the smaller sets of user requirements types at a higher abstraction level. For the purpose of this research study two-round, Delphi is sufficient. For a future study on the actual user requirements elicitation process with the aim of developing software systems, we recommend that based on the results of such a classification, a third Delphi session will be conducted. Third Delphi round aims to determine the convergences among experts. The resulting list can be then used as a basis in the software development project.

Third, in this study, the seven user-related elicitation problems are addressed by the designed user requirements elicitation process. In order to fully capture and mitigate other elicitation problems (Section 3), those problems and their associated mitigation approaches should be investigated in future studies.

Fourth, in this study, the two reference models which describe VN-CKM processes and VN-CKM challenges were used separately in designing the two instances of the reference model-based elicitation process. These two instances were applied in real-life value networks to evaluate the applicability and usefulness of the research artifact. According to design science principle, the design-and-evaluation cycle is typically iterated through justification and refinement until it reaches the final design artifact [24,25]. The first iteration is done in this study. The empirical findings of the two studies demonstrate overlap between the two sets of user requirements. Therefore, to improve and to refine the designed artifact, it is recommended that in future research the VN-CKM process and VN-CKM challenge reference models be integrated into a single reference model. Then, by using this integrative reference model, the second iteration of design and evaluation of the reference model-based user requirements elicitation process can be started.

Fifth, in this study, we investigated the applicability and usefulness of using a reference model-based elicitation approach to facilitate dealing with the elicitation problems and thus to improve the requirements elicitation process in a complex value network setting. To enhance the generalizability of the research results, we suggest that the applicability and usefulness of this approach in other complex inter and intra organizational contexts will be evaluated in future research.

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