Communication Artifacts for Requirements Engineering

Miloslava Plachkinova[1(✉)], Ken Peffers[2], and Greg Moody[2]

[1] Claremont Graduate University, Claremont, CA, USA
`miloslava.plachkinova@cgu.edu`
[2] University of Nevada Las Vegas, Las Vegas, NV, USA
`{ken.peffers,greg.moody}@unlv.edu`

Abstract. The current study aims to improve the requirements engineering (RE) communication, as often times projects fail due to poorly specified or misunderstood requirements. We use design science methods to build and evaluate a conceptual model which can add value to managers by offering them a set of guidelines and best practices for facilitating the RE communication. We did a qualitative study to investigate what the criteria are for selecting communication artifacts and we discovered that organizational culture plays a key role in this process. We demonstrate that the used artifacts need to adequately reflect the dynamic and intensity of the communication. Finally, we extend the RE process by adding two transitional phases to avoid requirements slipping through the gaps. Our findings indicate that such transitions are more distinct in traditional waterfall organizations and less salient in agile companies. The current study approaches the RE communication process from a design science perspective which adds more knowledge on the topic and addresses some existing issues leading to project failure.

Keywords: Communication artifacts · Requirements engineering · Design science · Qualitative research

1   Introduction

Requirements engineering (RE) is the process of eliciting individual stakeholder requirements and needs and transforming them into detailed, agreed upon requirements documented and specified so that they can serve as the basis for all future systems development [1]. This process is important because it provides team members an opportunity to discover the needs and requirements of the end-users at an early stage, so the final product or service can meet those predefined specifications.

Successful communication among the individuals involved in the RE process is of key significance to the overall development of information systems (IS) [2]. Thus, engagement and active participation of the team members are essential to effective transfer of knowledge and information across the various activities performed during RE.

The successful integration of RE and communication is problematic. Poorly specified requirements are considered to be a major factor for project delays and failures [3]. Differing motivations and expertise are additional factors contributing to poor

communication during the RE process [4]. This problem is often caused by the varying backgrounds of the participants in the RE process. Prior studies have established that end-users, systems analysts, developers, and managers frequently face challenges when working together [5]. Such miscommunication can lead to significant challenges in adequately translating user context and needs into user requirements [6].

The goal of this study is to investigate how communication is occurring throughout the RE process and to establish some good practices and guidelines for successful requirements elicitation. We focus on communication artifacts and metaphors [7], as prior research has established a connection between the success of the IS and the value of tools for communication [8]. The research question guiding this study is: "What are the factors leading to the selection of communication artifacts for information systems requirements engineering?"

We follow design science research methods proposed by Hevner and Chatterjee [9] and Hevner et al. [10] because they consider IS from a more practical perspective. We use qualitative methods and more specifically, we apply a case study approach. We conducted semi-structured interviews with nine participants to investigate the RE process in seven projects across four different organizations. One of the respondents was an independent consultant who performs requirements elicitation on a regular basis and has a much broader perspective of the process. This qualitative method provided us with deeper and more meaningful information regarding the selection of communication artifacts for the RE process and allowed us to compare and contrast practices across a number of organizations.

The current study extends knowledge on requirements engineering in several aspects. First, we address the existing gap in the RE communication process, as we offer some input on the rationale of selecting certain artifacts and their use. Second, we explore how the project methodologies adopted in various environments reflect the selection of communication artifacts for the RE process. Third, we explore the communication metaphors suggested by Putnam and Boys [7] and we provide more insight on their application for RE. And fourth, we employ a design science methodology and propose a theoretical solution to a common problem in the practice of IS development, thus bridging the gap between theory and practice. These findings are significant, as they shed more light on the problem of RE communication and provide practical recommendations for improving the process by matching each stage of the RE process with specific communication artifacts which would add more value to the individuals involved.

2   Background

2.1   Requirements Engineering

Requirements engineering occurs at the start of software development and involves the analysis and negotiation of what capabilities and features a new IS should possess [11]. The RE process has been extensively investigated by researchers in the past. Sommerville and Kotonya [11] suggest that it consists of a number of stages - from elicitation, validation, and management to non-functional specification, classical

techniques, viewpoint-oriented techniques, and interactive specifications. Wieringa et al. [12] propose the following sequence of activities involved in the engineering cycle: problem investigation, solution design, solution validation, solution selection, solution implementation, and implementation evaluation. Browne [13] discusses information gathering, representation, and verification as the three main steps performed to gather requirements. Nuseibeh and Easterbrook [14] identify elicitation, modeling and analysis, communication, agreement, evolution and integration as the six main phases of the RE process. A model for differentiating the RE activities proposed by Scacchi [15] involves: inception, initial development, productive operation, upkeep, and retirement. For the purposes of this study, we are adopting the RE activity differentiation proposed by Browne [13], as it is more general and we expect to find it in the case studies we are conducting. Further, its has much wider application which demonstrates its universality. The remaining studies are of no lesser value but they are too specific and may not be as widely used by practitioners.

2.2   Communication Metaphors

Communication can be conceptualized in terms of communication metaphors. A metaphor is a way to link abstract concepts to concrete things or to tie the familiar to the unknown [16]. One method to categorize metaphors for communication processes is within and across organizations on the basis of selected sentences from academic articles [7]. De-contextualizing the use of particular metaphors (at the linguistic level) within individual academic articles can be done to bring them together in coherent categories of conceptual or cognitive meaning [16]. The eight metaphors proposed by Putnam and Boys [7] include:

1. Linkage – organizations as networks of relationships in which information connects individuals, groups and institutions;
2. Performance – communication as social interaction;
3. Symbol – sensemaking through rituals and narratives;
4. Voice – expression or supression of the voices of the organizational members;
5. Discourse – language in use, words and signifiers that constitute an organization as inter-relationships among text;
6. Conduit – channel that transmits messages;
7. Lens – information processing by focusing on the nature and flow of information;
8. Contradiction – opposing forces or binary relationships between contradictory messages.

For the purposes of the current study, we are considering only the first five, as the other methaphors are more generic and do not directly relate to the RE process.

2.3   Communication Artifacts

The design of IS involves many communication activities occurring through different channels. Each of these channels utilizes certain artifacts which are more or less applicable based on the context. For example, interviews and conversations provide

very detailed information and personal interaction with the participants but they are time and resource consuming [18]. Surveys and questionnaires, on the other hand, are cheap and easy to conduct because participants are familiar with the format but at the same time researchers have no control over the participants and there may also be issues related to the quality of the data [19]. Conceptual models are used to represent non-functional aspects of the new IS but they are time and resource consuming and there is no guarantee they will provide the necessary specifications requested by the end-users [20]. Ideation workshops are used to generate ideas from a large talent pool but it is often times very difficult to coordinate the schedules of multiple participants [17]. Prototypes are appropriate because they increase user confidence and involvement but they can also be very expensive and time consuming [21]. Narratives or stories are useful for keeping track of activities and participants are familiar with the format. However, they require constant updates and sometimes employees can feel overwhelmed with information and can experience cognitive overload [22]. Spreadsheets are familiar to many but in some cases users need specific skills to understand and interpret the presented data. Diagrams and animations are easier to visualize and comprehend but they are typically used as supplemental materials and not as a main form of communication. Meetings provide instant feedback and they are relatively inexpensive which makes them very widely used in the corporate world. The disadvantage is that they require an agenda and a moderator to keep everyone on track [17]. Finally, observations provide detailed information on user behavior but they require time in the field which makes them expensive, as often the researchers would need specific training and skills to remain objective [23].

2.4   Levels of Interaction

Based on the characteristics of these communication artifacts, we can attribute a certain level of interaction to each of them. To classify the levels of interaction, we re-fer to a differentiation proposed by Leonard-Barton and Sinha [24]. They organize the interaction in terms of low, medium or high depending on its intensity and frequency. The following is a differentiation of the communication artifacts we developed based on the levels of interaction:

- Low – narrative/story, spreadsheet, diagram/animation, observation;
- Medium –prototype, survey/questionnaire, conceptual model;
- High – interview/conversation, ideation workshop, meeting.

3   Conceptual Model

Based on the summarized information from prior literature on the RE process, communication metaphors, and artifacts we expect to observe a certain pattern or rationale for the selection of some communication artifacts over others. The current study investigates what factors are leading to the selection of communication artifacts for information systems requirements engineering.

We hypothesize that the level or amount of interaction among participants during each phase of the RE process is a key factor for determining the communication artifacts used for that phase. Matching the level of interaction is a factor when selecting artifacts because it can provide the most effective and efficient communication among the participants [25]. Thus, we expect to observe a connection between the levels of interaction and communication artifact selection as they are related to improving user satisfaction with new IS. To classify the levels of interaction, we refer to a differentiation proposed by Leonard-Barton and Sinha [24].

We use design science principles [9, 10] to develop our conceptual model. More specifically, we follow the iterative approach consisting of design, rigor, and evaluation cycles. The current study addresses a practical problem many individuals and organizations are facing. The proposed conceptual model emerged from a thorough understanding of prior studies and it was then tested in a number of real projects to evaluate its applicability and utility. As a result, we refined the model to better correspond to the environment and meet the needs of practitioners.

We propose a conceptual model of categorizing communication artifacts, metaphors, and levels of interaction that would be likely to correspond to the different phases of the RE process. The model represents the three phases of the RE process: discovery (D), analysis and verification (A&V), and decision making (DM) [13]. We extend the RE process by adding two transitional phases (T1 and T2), as often times requirements are slipping through the gaps and our goal is to encompass RE as a more comprehensive process and improve the existing communication. Based on these five phases, we hypothesize what would be the expected level of interaction among participants and we provide a list of artifacts which would allow a corresponding amount of intensity and frequency of the communication. We also provide a short rationale for our expectations.

In addition to the assumptions we have made, we also expect to observe that the organizational culture or existing project methodology plays a role for the selection of communication artifacts. For example, agile companies would prefer more flexible methods for communication which provide more dynamic and are easy to perform more frequently. On the contrary, the traditional waterfall method would suggest communication artifacts which are more structured and support more robust interactions. Further, we expect to observe more distinct transitional phases in waterfall projects, as in agile methodology there are typically more iterations and overalapping between RE phases.

Based on the conceptual model presented below (Table 1), we develop the following hypotheses to answer our research question:

H1: The organizational culture and established methodology influence the selection of communication artifacts for RE.
H2: Communication artifacts should be corresponding to the level or amount of interaction among participants.
H3: There is gradual transition between the different phases of the RE process.

Table 1. Conceptual Model

Phase	Artifacts	Metaphors	Interact.	Rationale
D	Interview, Conversation, Survey, Questionnaire, Meeting	Linkage, Discourse	High	Intensive communication, multiple participants and viewpoints, defining and asking the right questions
T1	Conceptual model, Meeting	Performance, Discourse	Medium	Additional feedback before designing the prototypes, verification that requirements are understood correctly
A&V	Workshop, Prototype, Meeting	Performance, Discourse	High	Highly interactive communication, gathering additional requirements, remodeling the initially elicited requirements if needed
T2	Narrative, Spreadsheet, Diagram, Animation, Meeting	Symbol, Discourse	Low	Structured and organized information, easy to measure and compare objectives
DM	Meeting, Observation	Voice, Discourse	Medium	More structured and static communication, supporting graphical and text tools

4   Methodology

To test our conceptual model and find support for our three hypotheses, we follow the design science methodology proposed by Hevner and Chatterjee [9] and Hevner et al. [10]. Since this is an exploratory study on such a broad topic, we used a qualitative approach to gather deeper and more meaningful information from the participants. We conducted a total of nine semi-structured interviews with participants across five different organizations within the US. We discussed seven projects to better understand how the RE communication process was occurring and to evaluate our model. We used a case study approach to be able to more adequately compare and contrast RE communication practices across the organizations and increase the generalizability of the findings.

Participants in the interviews represent a large public university, a local government, an international gaming corporation, and a private company for supplying geographic information systems (GIS) software. In addition, we conducted an interview with an expert working for a private consulting company specialized in requirements definition and management.

Interviews were conducted in person and via phone in cases when the individuals were geographically dispersed. Each interview took about 30-45 minutes and it was recorded for data analysis purposes. We strived to contact multiple participants from each organization to increase the validity and reliability of the collected data but due to high turnover and the fact that some projects were completed several years ago, this was

not possible in all cases. We contacted key informants and using the snowball technique we were able to identify other members who took part in the projects. We chose a convenient sampling method in order to find participants who were familiar with the RE communication process and were actively engaged with the projects in their respective organizations. Using the information provided by the respondents regarding the RE communication, we assigned metaphors to each RE phase based on the definitions provided by Putnam and Boys [7]. Finally, we compared the results of the case studies with the proposed conceptual model to evaluate it and to demonstrate its utility.

5   Data Analysis and Results

5.1   Public University

We conducted three interviews with members of a large public university in the Western US. We discussed two projects – one on copyright violations related to peer-to-peer downloads using the campus network, and the other on email notifications to students. Participants in the interviews were the Vice Provost of Information Technology (IT), a Network Operations Center Manager, and an Administrator at the Student Housing Complex. The university did not have a specific project methodology and the IT team used best practices from both agile and waterfall based on the needs and complexity of the projects.

Copyright Project
The purpose of the copyright project (Table 2) was to create a notification system for responding to violations of copyrights by students, to store information about the violators in a database, and to provide input to university representatives about these violations on a regular basis. The project was initiated by changes in legislation and the team members involved in the RE process were concerned mostly with eliciting requirements from the official documention and transforming them into functional specifications.

Table 2. Copyright Project

Phase	Artifacts	Metaphors	Interact.	Rationale
D	Interview, Narrative, Meeting	Linkage, Symbol, Discourse	High	Very intense interaction, employees from various departments working together
T1	Narrative, Meeting	Symbol, Discourse	High	Additional features of the system kept emerging along the way
A&V	Narrative, Diagram, Meeting	Symbol, Discourse	High	Team members were pressed by time
T2	Narrative, Meetings	Symbol, Discourse	Medium	Requirements continued to emerge and changes were constantly made
DM	Narrative, Meeting	Symbol, Voice	Medium	Creating a consensus about the technology used for developing the system

Email Announcements Project

The purpose of the email announcements project (Table 3) was to consolidate all important announcements to students (i.e. dealines, workshops, events, etc.) in a weekly newsletter format. For a long time students felt overwhelmed by the constant daily notifications sent to them and they were the ones who initiated a new announcement system. Students also took part in shaping the features and specifications of the system, as well as in the development of the business processes – how to collect the announcements, which ones to be sent, who should send them, when is the best time for the bulletin to be distributed, etc.

Table 3. Email Announcements Project

Phase	Artifacts	Metaphors	Interact.	Rationale
D	Narrative, Meeting	Symbol, Discourse	High	Provide justification for the project and discuss possible solutions
T1	Narrative, Diagram, Meeting	Symbol, Discourse	High	Clarifying the initially gathered requirements
A&V	Narrative, Meeting, Prototype, Observation	Symbol, Performance, Discourse	High	Develop detailed procedures and guidelines, students testing the prototype, OIT observing and improving the system
T2	Narrative, Meeting, Prototype	Symbol, Discourse, Performance	High	Debug the prototype before implementation, make sure all features are implemented
DM	Narrative, Meeting	Symbol, Voice	High	Make a decision which requirements are out of scope and eventually implement them in separate systems

5.2   Local Government

We conducted two interviews with members of a local government in the Western US. We discussed two projects – one on online business licensing, and the other on online submission of plans for licensing and building permits. The goal of both projects was to save citizens time and money by providing them a number of online services. Participants in the interviews were the IT Portfolio and Applications Manager and the Systems Manager. The local government relied on established project management guidelines, had a handbook of approved procedures, and waterfall was the typical project methodology used.

Licensing Project

The purpose of the licensing project (Table 4) was to allow customers to submit their business licensing applications online which would save them time and resources. The city would also be able to track each application easier and faster, so the system would prevent document loss and accidental destruction.

Table 4. Licensing Project

Phase	Artifacts	Metaphors	Interact.	Rationale
D	Interview, Conversation, Meeting	Linkage, Discourse	High	Users were most familiar with the features of the system and they explained it to the team
T1	Meeting	Discourse	Medium	Initial requirements were refined based on existing paper form
A&V	Narrative, Meetings	Symbol, Discourse	Medium	Routine procedure, official approval required
T2	Prototype, Observation, Meeting	Performance, Discourse	High	Users and analysts were working together
DM	E-mail, Phone call	Voice	Medium	Customers' agreement was required before implementation

E-Plans Project

The purpose of the E-Plans project (Table 5) was to provide customers with the ability to upload plans for building permits online. In the past, they were required to print 15 sets of plans, one for each department which was costly and inefficient because for every single change all 15 sets had to be replaced. Developers from the local community were actively participating and providing their requirements for the new system.

Table 5. E-Plans Project

Phase	Artifacts	Metaphors	Interact.	Rationale
D	Interview, Conversation, Meeting, Diagram	Linkage, Discourse, Symbol	High	Gather ideas from as many users as possible
T1	Meeting, Diagram, Narrative	Discourse, Symbol	Medium	Refine initial requirements and gather more information
A&V	Meeting, Diagram, Narrative	Discourse, Symbol	Medium	Routine procedure, user feedback was collected before submitting the requirements to the vendor
T2	Prototype, Observation, Meeting	Performance, Discourse	High	Users and analysts were working together, the vendor was also involved
DM	Meeting, E-mail, Phone call	Voice	Medium	User feedback was used to decide which features to be included

5.3   Gaming Corporation

We conducted one interview with a systems analyst at a large international gaming corporation. We discussed two projects – one on reward cards system, and the other on a loyalty program for customers. The purpose of these projects was to increase

satisfaction and provide better and more customized services to customers. Waterfall was the typicall methodology used for developing new systems in the organization. Due to the high turnover in the gaming industry we were not able to obtain another person to participate in the data collection.

Reward Cards Project
The purpose of the reward cards project (Table 6) was to improve customer service and add more value to the guests. This was the first project to allow employees to sign-up customers for its loyalty program via a mobile device. This project was phase two of a larger project aiming to increase customer satisfaction across over 40 casinos and resorts.

Table 6. Reward Cards Project

Phase	Artifacts	Metaphors	Interact.	Rationale
D	Interview, Narrative, Spreadsheet, Meeting, Diagram	Linkage, Symbol, Discourse	High	Intense interaction, many team members involved, strict deadlines
T1	Phone call, E-mail	Discourse	Low	Translate initial requirements into functional and feature specifications
A&V	Meeting, Narrative	Discourse, Symbol	Low	Single session to approve the requirements document
T2	Meeting, Narrative	Discourse, Symbol	Low	Official approval from the business owner
DM	Meeting, Narrative	Voice, Symbol	Low	Decision had to be made in the beginning of the project, either to meet a deadline or to implement more requirements

Loyalty Project
The purpose of this project was to integrate the customer loyalty program with an online ticketing website (Table 7). The customers using the program would receive tier credits every time they purchase a ticket from that website and would be able to spend their money at the casino or resort. This system was part of a larger project and it had to be integrated with the online ticketing system as well as with the company's existing systems.

Table 7. Loyalty Project

Phase	Artifacts	Metaphors	Interact.	Rationale
D	Interview, Narrative, Spreadsheet, Meeting, Use Case Diagram	Linkage, Symbol, Discourse	High	Intense interaction, people from different organizations involved

Table 7. (*Continued*)

T1	Meeting, Narrative	Discourse, Symbol	Low	Refine requirements and develop an interactive prototype based on them
A&V	Meeting, Narrative, Interactive Prototype	Discourse, Symbol, Performance	High	Test prototype, confirm specifications and business logic
T2	Meeting, Narrative	Discourse, Symbol	Low	Confirm end-user workflow processes
DM	Meeting, Narrative	Voice, Symbol	Medium	Official approval of the requirements documentation

5.4   GIS Supplier

We conducted two interviews with members of the Spatial Analysis team at an international supplier of GIS software products. We discussed one project which was representative of the RE process for that organization – development of online analysis tools. The company relied on agile methods for IS development and it had embraced scrum as its main approach. Due to the methodology used, the participants did not have official titles within the company.

Online GIS Analysis Project
The purpose of the online GIS analysis project (Table 8) was to add customer value and provide a web-based solution for spatial analysis. This project would allow multiple users to collaborate on the same project and would extend the current product offerings.

Table 8. GIS Analysis Project

Phase	Artifacts	Metaphors	Interact.	Rationale
D	User conference, Workshop, User request	Linkage, Symbol, Discourse	Low	Routine activities, user feedback is gathered on a regular basis
T1	Design meeting, Mock design	Discourse, Performance	Medium	User requests are transformed into possible specifications
A&V	Meeting, Observation	Discourse, Symbol	Medium	Unofficial release of the software update
T2	Meeting, Online training	Discourse, Symbol	High	Gathering input from the user community
DM	Meeting	Voice	Low	Software updates are quite frequent and decisions are informal

5.5   RE Consultanting Company

In addition to the case studies, we also conducted an interview with an expert working at a private company which provided consulting expertise, methodologies, standards and resources to the IT and business community in medium to large corporations and

governments worldwide. This was a different approach compared to the case studies, as an external organization was used to facilitate the RE process. Employees may not always have the necessary experience and knowledge on requirements gathering, thus using a consulting service could increase the success of the project. Such a perspective can also be useful to avoid office politics. The consulting company used predominantly agile methods and recommended this approach to their clients. During the interview, the participant outlined a common scenario for outsourcing the RE process (Table 9).

Table 9. Common RE Process

Phase	Artifacts	Metaphors	Interact.	Rationale
D	Checklist, Meeting	Linkage, Symbol, Discourse	High	Heavy interaction, engaging the customers in the RE process
T1	Test script, Scorecard, Wiki, Repository/ Track system	Discourse, Symbol, Performance	Medium	Iterative process with constant client feedback and vendor input
A&V	Meeting, Observation	Discourse, Symbol	Medium	Reviewing gathered content and getting multiple perspectives
T2	Meeting, Report, Wiki	Discourse, Symbol	Low	Most of the work has been done already, traceability purposes
DM	Balanced scorecard, Meeting	Symbol, Discourse, Voice	Low	Information is gathered already, customer is making an informed decision

6 Discussion and Future Work

Based ont the data from these case studies, we were able to find support for our hypotheses and to answer the research question driving this study. H1 was supported, as the studied organizations demonstrated significant influence of the organizational culture on the selection of communication artifacts. The agile companies had a preference for faster turnover and results, more frequent meetings, and design iterations on a regular basis. On the other hand, the more traditional businesses were looking for more structured artifacts which could support long term projects with heavy reliance on documentation and reports. These findings correspond to previous studies. More specifically, they confirm the notion that agile methodologies focus on individuals and interactions rather than processes, working software rather than comprehensive documentation, customer collaboration rather than contract negotiation, and responding to change rather than following a plan [26]. The current study extends these concepts by identifying artifacts which are more commonly used in the requirements communication process and focuses on differences and similarities between agile and waterfall project methodologies.

H2 was partially supported. During the interviews, the participants confirmed the importance of a relationship between the levels of interaction in the RE process and the

communication artifacts but admitted that the selection was made mostly based on already established principles and methodologies within the organization. Further, employees are familiar with the most common artifacts such as meetings, documentation or prototypes and there is no need for additional training or resources.

H3 was also partially supported. We found that transitional phases were more distinctive in organizations using traditional waterfall methodologies while in more agile companies the transitions from one RE phase to another were more seamless due to constant iterations and frequent software releases. In addition, participants in more agile organizations reported to have less communication issues during the RE process. This can be also related to the relatively small teams working on each project and the geographic proximity of the team members.

In addition, we can draw several inferences from the evidence in the case studies. First, some metaphors are more common in certain RE phases. The linkage metaphor is more frequently used in the discovery phase which supports the notion that there is a need for a network to recruit end-users for collecting initial requirements. The voice metaphor is also observed predominantly towards the end of the RE process which suggests that there is a relationship between making a decision on which requirements need to be implemented and the demonstration of power and superiority within the team.

Second, there are two metaphors (discourse and symbol) which are more universally adopted and are not tied to a particular RE phase. These metaphors represent meetings, conversations, and document exchange which are occurring across all RE phases. One explanation for the widespread utilization of these communication artifacts and metaphors, respectively, is their ease of use and general acceptance in all organizations regardless of the implemented project methodology.

And third, the fact that participants identified a number of important activities which took place during the transitional phases implies that RE is a much more complex process with many underlying layers of communication. Thus, it is important to further investigate how the RE activities gradually change and how knowledge and information can be more successfully transferred from one phase to another. Such insights can be used to improve the RE communication and avoid the problem of requirements slipping through the gaps [6].

Overall, the conceptual model we proposed has an application in organizational strucures and can add value to the RE communication process. Following the best practices in design science research [9, 10], we demonstrated the utility and usability of our artifact. We were able to establish a pattern for selecting RE communication artifacts and tie these artifacts to certain metaphors and levels of interaction. Such a relationship can be beneficial for both researchers and practitioners, as it provides a solution to the existing communication gap in requirements gathering and addresses the problem of misinterpretation of user needs and input in the initial stages of the IS development process.

This is an exploratory study on such a broad topic and more research needs to be done in this area. We recommend that others extend our study by considering all communication metaphors proposed by Putnam and Boys [7]. Using a much larger sample size would increase the generalizability of the findings. We suggest looking at small and mid-sized organizations, since they may have a different approach to the

RE communication process. And finally, while the current study considers only the communication between individuals, it may be beneficial to examine the RE process from a technological perspective as well.

7   Conclusion

The current study presents a design science method for solving the existing problem of misinterpreting and misunderstanding end-user requirements. By taking a more rigorous scientific approach, practitioners can improve the communication during the requirements gathering process. Such practices can lead to higher user satisfaction with the final products or services and can provide much richer and more meaningful communication among the participants.

We developed a theoretical model to answer the research question driving this study. We found that there are several factors leading to the selection of communication artifacts for RE. First, the organizational culture plays an important role and determines to a great extent the communication artifacts used by the team members. Second, we discovered that it is important for the artifacts to match the intensity and frequency of the communication, but this is not a primary concern for most participants. Instead, they follow established practices and project management guidelines, as the employees are already familiar with them and there is no need for training or additional costs associated with the adoption of new methodologies. Finally, the preferred organizational approach (agile or waterfall) determines the need for more distinctive transitional phases during the RE process. In agile organizations, processes typically overlap and there are no clear boundaries between the phases, while in traditional companies transitions are more clearly differentiated and a significant number of activities are performed in those in-between phases. These differences helped us to outline the need of a conceptual model which can be used to facilitate the RE communication and to offer practitioners a more scientific perspective to perform the requirements elicitation process.

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