Revisiting the Requirements Communication Problem from a Knowledge Management Perspective

Hermann Kaindl and Lukas Pilat
Institute of Computer Technology
Vienna University of Technology
Vienna, Austria
kaindl@ict.tuwien.ac.at, lukas.pilat@student.tuwien.ac.at

Abstract—**The communication problem between stakeholders in requirements engineering is well known. It is typically attributed to stakeholders having different background and domain knowledge and, therefore, using different "languages". However, even when this is not the case, there is an inherent problem in such communication. In order to explain it, we revisit the requirements communication problem from a *knowledge management* perspective.**

Keywords-requirements engineering; communication problem; knowledge management.

I. INTRODUCTION AND BACKGROUND

Gathering requirements from stakeholders involves communication, which may be modeled via *communicative acts* as in [3]. However, what is communicated cannot be the requirements per se, but some *representations* of them [4]. So, it is important to understand the consequences of the *transfer* and *transformations* involved.

Knowledge transfer and transformation are central concepts of *knowledge management* (KM) in the context of knowledge sharing in organizations [1]. They are based on the distinction between *tacit* knowledge and *explicit* knowledge, which leads to the spiral of knowledge [5]. In our own previous work [6], we have adopted this concept in form of a spiral of *requirements* knowledge. We have not yet elaborated there, however, on the specific facet of the communication problem related to knowledge transformation.

Since the stakeholders (or their representatives) as well as the requirements engineers are humans, the *transfer* of knowledge can take place either directly through face-to-face exchange using human communication, or through the intermediary of an artifact representing the knowledge to be transferred (e.g., a document). Neither the human communication nor the representation in form of an artifact can transmit the knowledge without communication error and unambiguously.

This results from the fact that every transfer of knowledge is inherently bound to a knowledge *transformation*. The knowledge that a stakeholder has in his mind is typically transformed into an explicit representation in natural language and non-verbal channels of human communication during direct interaction. The knowledge of a knowledge holder is also transformed when he codifies it into an artifact, possibly using a formal language with a certain expressiveness. Additionally, the receiver of the transferred knowledge transforms codified knowledge through his interpretation of the given representation, which is again error-prone when using natural language due to its inherent ambiguity.

So, in the course of requirements knowledge transfer between stakeholders and requirements engineers, transformation of knowledge occurs and thus errors are creeping in. When the stakeholders speak a different "language," then the communication problem is certainly reinforced. Our point is, however, that the problem is inherent and exists also if this was not the case.

II. THE REQUIREMENTS COMMUNICATION PROBLEM FROM A KNOWLEDGE MANAGEMENT PERSPECTIVE

In order to explain this inherent requirements communication problem from a KM perspective, let us assume that the stakeholders share the essential domain knowledge and "language". Still, they have to use some language to express and represent requirements in the course of the corresponding knowledge transfer. We make the following strict distinction here, being aware that various combinations in semi-formal languages exist as well:

- *Natural language:* This is the most widespread kind of language in practical use for communicating about requirements. It is well known that any natural language is inherently *ambiguous*. It is equally important to know that also the *expressiveness* of any natural language is inherently limited. Wittgenstein coined an excellent example: the sound of a clarinet can be easily recognized from having heard it before, but a description of that very sound in natural language is very hard to give.
- *Formal language:* A truly formal language based on mathematical axioms is *not ambiguous*, but it may still be wrongly interpreted by humans for various reasons. Such a language is much more restricted in terms of *expressiveness* than a natural language. So, even more can be "lost" when a requirement is represented in a formal language.

Based on that, let us explain this inherent requirements communication problem from a KM perspective in more detail

 ISBN: 978-1-61208-165-6

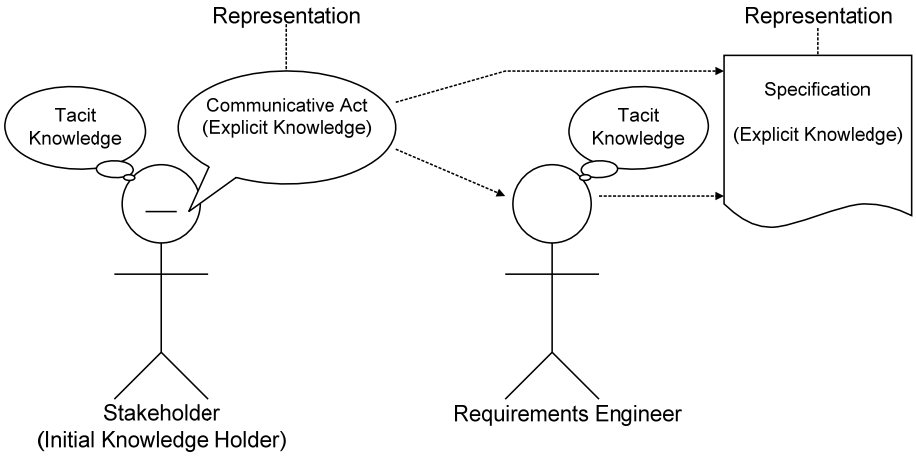

Figure 1. Transfer, Transformation and Representation of Requirements Knowledge

using Figure 1. A stakeholder is the initial holder of some requirements knowledge. It has been recognized that the knowledge of stakeholders is mostly tacit [2] (for the notion of *tacit knowledge* in KM see Nonaka [5], e.g.: "Tacit knowledge is highly personal. It is hard to formalize and, therefore, difficult to communicate to others."). So, there is tacit knowledge about requirements in the stakeholder's mind. In the course of requirements elicitation, he tries to communicate his requirements knowledge to the requirements engineer. As indicated above, this can be viewed as a knowledge *transfer* via *communicative acts* as in [3].

In this course, tacit requirements knowledge needs to be made explicit, i.e., a knowledge *transformation* occurs. Usually, the stakeholder will use some natural language. So, what is actually communicated is both restricted through the expressiveness of the particular natural language used and inherently ambiguous. When the requirements engineer attempts to understand the requirement, he has to internalize what is communicated to him explicitly and combine it with his own tacit knowledge. Since the representation in natural language is inherently ambiguous, an error may be induced. If, instead, a formal language is used for this communication, its expressiveness may cause a major difference between the requirements knowledge held by the stakeholder and the one internalized by the requirements engineer.

Based on already changed requirements knowledge as received and internalized from several stakeholders, the requirements engineer will have to prepare a requirements specification, i.e., an explicit representation of the knowledge that he acquired about the requirements. (Of course, he may intentionally change something, in order to figure out the *needs* from mere wishes of the stakeholders, but this is yet another issue beyond the scope of this paper.) Again, depending on the ("mix" of) languages used, the same problems arise as explained above, so that even more errors creep in.

This is an inherent difficulty when doing requirements, addressed by proceeding in an iterative manner. The initial knowledge holder can check his knowledge against the knowledge resulting in the specification. This necessitates that he internalizes the knowledge codified within the specification, and this is, again, error-prone.

Alternatively, a stakeholder may directly represent his requirements knowledge in the specification. This approach avoids the problems through the internalization by the requirements engineer, but it still involves the problems of making tacit requirements knowledge explicit. Of course, this approach entails other problems as well, especially when several stakeholders would simply put a requirements specification together, leading to inconsistencies and even conflicts in the specification.

Finally, it should be noted that tacit knowledge about requirements can also be transferred between the stakeholder and the requirements engineer through *socialization* [6]. As this does not explicitly involve communicative acts, it is beyond the scope of this paper.

III. CONCLUSION

In this paper, we revisit the requirements communication problem from a KM perspective. In this way, we explain a facet of this problem that appears to have attracted less attention. Still, it poses an inherent issue when doing requirements. With an improved understanding of this issue, it may be possible to reduce the resulting errors in requirements specifications.

REFERENCES

[1] T. H. Davenport, and L. Prusak, *Working knowledge: how organizations manage what they know*. Harvard Business School Press, 2000.

[2] R. Gacitua, L. Ma, B. Nuseibeh, P. Piwek, A. N. de Roeck, M. Rouncefield, P. Sawyer, A. Willis, and H. Yang, "Making Tacit Requirements Explicit", in *Proceedings of the Second Int Managing Requirements Knowledge (MARK) Workshop*, 40–44, 2009.

[3] I. J. Jureta, J. Mylopoulos, and S. Faulkner, "Revisiting the Core Ontology and Problem in Requirements Engineering", in *Proceedings of the 16th IEEE International Requirements Engineering Conference (RE'08)*, 71–80, Sept. 2008.

[4] H. Kaindl, and D. Svetinovic, "On confusion between requirements and their representations", *Requirements Engineering*, Springer London, vol. 15, 307–311, 2010.

[5] I. Nonaka, *The knowledge-creating company*. Harvard Business Review, 1991.

[6] L. Pilat, and H. Kaindl, "A Knowledge Management Perspective of Requirements Engineering", in *Proceedings of the Fifth IEEE International Conference on Research Challenges in Information Science (RCIS'11)*, 48–59, May 2011.

 ISBN: 978-1-61208-165-6