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The Challenges of Different Roles with Engineering Knowledge Reuse

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Abstract

Organizational knowledge is of important value for the organization and a significant part belongs to the organization through it employees. In order to make knowledge available for future use, different codification strategies can be applied. However, codification doesn't often happen by itself and neither does the dissemination of the knowledge, in fact most of the time individuals are needed in order to make this happen. The paper aims to argue that several roles need to be current for successful knowledge reuse. This paper focuses especially on the role as knowledge disseminator.

This paper is based on literature review and illustrated with a case within a automotive company.

The paper proposes that different knowledge roles need to be concerned and analyzed to identify interruptions in the knowledge flow in order to effectively reuse current knowledge.

Keywords: Knowledge Management, Knowledge Reuse, Knowledge Dissemination, Engineering Knowledge, Perceived Quality.

1. Introduction

Knowledge constitutes one of the major sources for competition in the ongoing knowledge-driven economy (Drucker, 1994). Thus the questions on how to bring value from existing knowledge and ensure future competition is of high interest from both conceptual and practical viewpoint.

However, organizational knowledge (OK) and experience initially comes mainly from individuals and will so be in the near future. In order to maintain a sustainable and competitive advantage over time, individual knowledge needs to be extracted to the organization even if the individual not remain his current position regardless of the reason

(retirement, changed position, resource consultant, displaced etc.). It has been recognized that such intrafirm knowledge flow is a critical source of competitive advantage and a driver of an organizations performance (Argote & Ingram, 2000; Kogut & Zander, 1992; Nonaka, 1994).

Knowledge flow focuses on several different roles from that the knowledge is created until it is reused. Challenges occurs in each of every role, for example when the knowledge holder is not the same as the knowledge applier. In this paper a framework is used describing different roles and focus in this paper are on the role of the knowledge disseminator and related challenges. The presented framework could bring out an efficient and proactive way for consideration of challenges in knowledge reuse among engineers in the product development process.

We illustrate the existing challenges with the perceived quality case from the leading Swedish premium vehicle manufacturer, which addresses the complications regarding integration of knowledge derived from different engineering disciplines. There is to mention that, perceived quality from the engineering perspective is formed by various attributes and the relations between them. Knowledge management (KM) and identification of attributes aligned with perceived quality and craftsmanship are an ongoing challenge for design research and practice (Burnap, Hartley, Pan, Gonzalez, & Papalambros, 2015; Ren, Burnap, & Papalambros, 2013).

In this paper, connected to the illustrative case, we propose the use of Perceived Quality Framework (Stylidis, Wickman, & Söderberg, 2015) for the ontology of the design attributes involved in the product development. We assume that ontology of the design attributes will contribute to the better knowledge dissemination and therefore following potential knowledge reuse.

The paper are structured as follows:
Chapter 2 presents the strategy and methodology used for conducting this research.
Chapter 3 explains and defines OK in this context.
Chapter 3 describes knowledge works and related roles. The role disseminator are deeper investigated and related challenges are mapped.
Chapter 5 exemplifies the how challenges connected to a specific role can be analyzed.
Chapter 6 discusses and presents the results.
Chapter 7 concludes and point out need for further work.

2. Research Approach

This paper is based on a literature review and a qualitative study within industry partner to confirm the proposed framework. The setup of the research study as a partnership with the case company also gave access to detailed evaluation about the topic in a real setting.

Reviews of the existent literature were conducted primarily from the academic fields of KM, knowledge engineering and engineering management. The framework presented to explain challenges connected to the dissemination role is the result of an incremental refinement of our understanding for knowledge reuse, based on the literature reviewed.

The data from the case company were collected through semi-structured interviews and analysis of related documents. The interviews were conducted mainly with the department of craftsmanship. The analyzed result was then mapped into the framework in order to illustrate.

3. Organizational Knowledge

The preserved and accumulated knowledge through time is called OK and is the means by which organizations can learn from their past by avoiding repetition of past mistakes and adopting proven successful practices (Barros, Ramos, & Perez, 2015; Johnson & Paper, 1998). Starbuck (1992) defines OK as stocks of expertise that the organization possesses and capitalizes on. It is comprised of both tacit and explicit knowledge. Routine-based conceptions of learning require that the lessons of experience are maintained and accumulated in routines despite staff turnover and the passage of time. When employees retire from an organization it may be relatively uncomplicated to replace job related knowledge, skills and abilities, however, replacing lost OK gained from experience creates more challenges (Dunham & Burt, 2011).

Spender (1996), based on Nonaka and Takeuchi's work, elaborated further on OK and divided explicit and tacit knowledge into a matrix with individual and social knowledge as columns. Although, all fields are part of OK, he argues that organizations need to stress the importance to balance between individual and social knowledge. Explicit social knowledge is referred to as objectified knowledge, which embodies in patents, designs or information stored on databases. Tacit social knowledge is referred to as collective knowledge that represents all knowledge embedded in social and institutional practices, systems, workflows and culture (Riege, 2005).

4. Knowledge Work of Individuals

An imaginable conflict arises because much of the OK is controlled at the level of individual knowledge workers. However KM argues for the management of knowledge at the level of the organization (Felin & Foss, 2006). It is assumed that, either morally or legally, the organization has the right to identify, refine, store, and disseminate knowledge that individuals have created or acquired.

During the last decade the idea that most of the knowledge and experience in an organization belongs to the employees and not the organization itself has received increasing recognition in the KM community. A long with this, the human natures persist as a serious barrier in KM literature to full and efficient knowledge work in an organization (Cabrera, Collins, & Salgado, 2006; Thomas, Kellogg, & Erickson, 2001). First is the tacit nature of knowledge when it resides in the individual. Second are the motivational and other barriers that exist in the individual, which may inhibit different knowledge work activities (Thomas et al., 2001).

Human behavior literature suggests that individual needs to simultaneously have motivation, opportunity and ability to perform an activity in order to perform it well. These three aspects are usually referred as MOA (Blumberg & Pringle, 1982) and apply to the knowledge work related activities performed by an engineer (Foss, Minbaeva, Pedersen, & Reinholt, 2009; Kelloway & Barling, 2000). This framework is one of many that describe the concept used to describe human behavior, the authors propose that it might be useful for analysis of knowledge work activities, as it incorporates the elements of both individual and organizational level. It allows discussion on the interplay between the engineering level and the organizational level and counteracts on the recent criticism that the KM literature has been overlooking when it comes to micro-level issues and inter-level relationships (Foss, 2007).

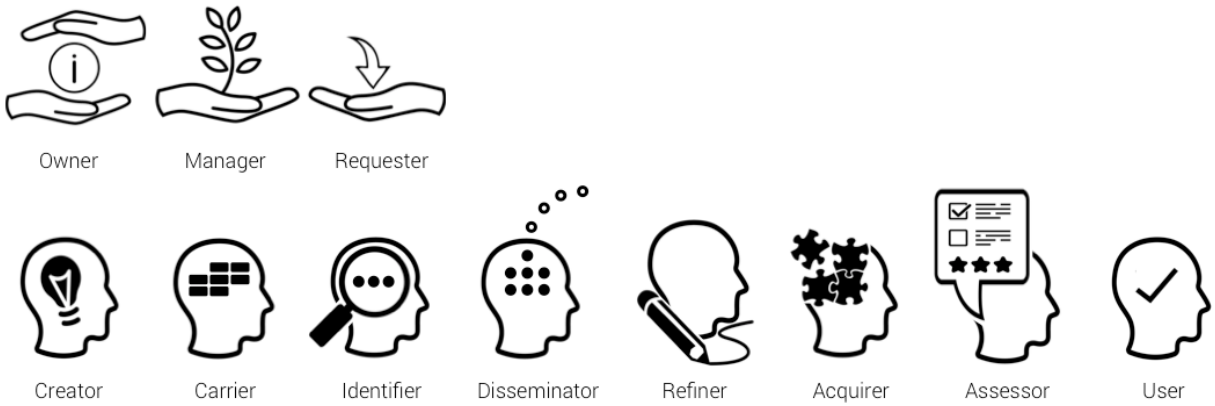

Figure 1 The 11 roles of individuals in knowledge work identified by the authors.

Many authors present barriers concerning individuals when performing different activities to enhance effective knowledge work (Connelly, Ford, Turel, Gallupe, & Zweig, 2014; Gavrilova & Andreeva, 2012; J. Miles & Moore, 1991; Moore & Miles, 1991; Riege, 2005). Just about every book written on KM comments on the dissemination of the right knowledge from the right people to the right people at the right time being one of the biggest challenges in knowledge reuse context.

Knowledge roles can be seen as different activities performed during knowledge work. In this paper we argue that it places more consideration on the individual if they are assigned a role in connection to the knowledge and not only an activity that needs to be performed. The authors base knowledge work on 11 different roles; creator, carrier, identifier, disseminator, refiner, acquirer, assessor, user, owner, manager and requester (**Error! Reference source not found.**). An in this paper the focus is on the disseminator.

a. The Knowledge Role Disseminator and Related Challenges

The knowledge disseminator role includes both transfer & sharing as well as preparing for availability and accessibility - transfer is for a specified receiver and sharing is for an arbitrary receiver (Argote & Ingram, 2000; Bock, Zmud, Kim, & Lee, 2005). This role regards both internal and external dissemination and is an important role, as employees are seldom aware of the knowledge existence, particularly when new knowledge is created and refined. Having an explicit, dynamic, and flexible network of expertise (e.g., community of practice) fosters collaboration and can greatly foster dissemination of knowledge.

The role knowledge disseminator includes preparation of knowledge assets to be stored as an active component in the OK such as knowledge repository. Beyond their intrinsic value, knowledge assets must be stored in a structured way that allows them to be efficiently acquired. Common related activities include metatagging, annotating, classifying, archiving, templating, linking, and optimizing for search and retrieval.

Knowledge dissemination does not come without participant cost, thus personal beliefs that expected benefits will outweigh these costs are likely to be an important factor of the knowledge disseminators behavior.

Challenges for the role as disseminator categorized according to the MOA framework.

Motivation

Motivation to share knowledge (sometimes referred to as knowledge hoarding) has been widely acknowledged (Bock et al., 2005; Cabrera et al., 2006). In connection to motivation Gibbert and Krause (2002) defined knowledge sharing as the willingness of individuals in an organization to share with others the knowledge they have acquired and created. The challenges can have its origin in several different barriers. The classic public good dilemma that includes lack of trust in people because they may misuse knowledge or take unjust credit for it (Riege, 2005). This dilemma is strengthened when expertise (i.e., personal reputation) is highly valued in an organization but mentoring or assisting others is not. Apprehension of fear that dissemination may reduce or jeopardize people's job security and that any knowledge that has been disseminated are given the opportunity to be subsequently judged to be unsound or irrelevant, which can damage the individual reputation (Leonard & Sensiper, 1998; Riege, 2005). Therefore, the lack of sufficient extrinsic and/or intrinsic rewards to counterweigh individuals for these costs of sharing knowledge turn out to be a common barrier to knowledge dissemination (Constant, Kiesler, & Sproull, 1994). Bock et al. (2005) further categorize the motivational benefits into *individual* (self-interest, personal gain, etc.), *group* (reciprocal behaviors, relationships with others, community interest, etc.) and *organizational* (organizational gain, organizational commitment, etc.) benefit.

Opportunity

On an individual level, challenges have been present when providing sufficient opportunities for knowledge sharing (R. E. Miles, Miles, Snow, Blomqvist, & Rocha, 2009). The notion of ‘‘opportunity’’ in an individual setting may refer to a wide range of concerns that include organizational structure, job design, task requirements, communication channels, provision of Information & Communication Technology (ICT), and organizational norms and values; in other words, to organization-level determinants of behavior (Foss et al., 2009; Hendriks, 1999; Jones, Cline, & Ryan, 2006). General lack of time to share knowledge, and time to identify colleagues in need of specific knowledge are common challenges (Riege, 2005).

Capability

The third element of the MOA framework, capability, has received less attention in the KM literature. Nonetheless, there is indication that some individuals are more capable of refining and sharing their knowledge than others (Reinholt, Pedersen, & Foss, 2011). Therefore, it is quite unrealistic to suppose that all engineers having the knowledge expert role also can be able to taking the role as identifier, disseminator and refiner in an organization and consequently be sufficiently motivated, capable and have a chance to invest their efforts into refining their experience into explicit knowledge. Verbal/written communication and interpersonal skills can be challenges related to capability (Riege, 2005).

5. Illustrative Case

The case company is the leading Swedish premium vehicle manufacturer. The product development process is spread across several departments within the company. The overall quality impression, perceived by users, is formed by the influence of various perceived quality attributes. It is non-trivial task to manage knowledge about product design elements that are not well defined, has complex and uncertain structure and a dynamically changing over the time. As an illustration authors describe the “clip case” below (Figure 2).

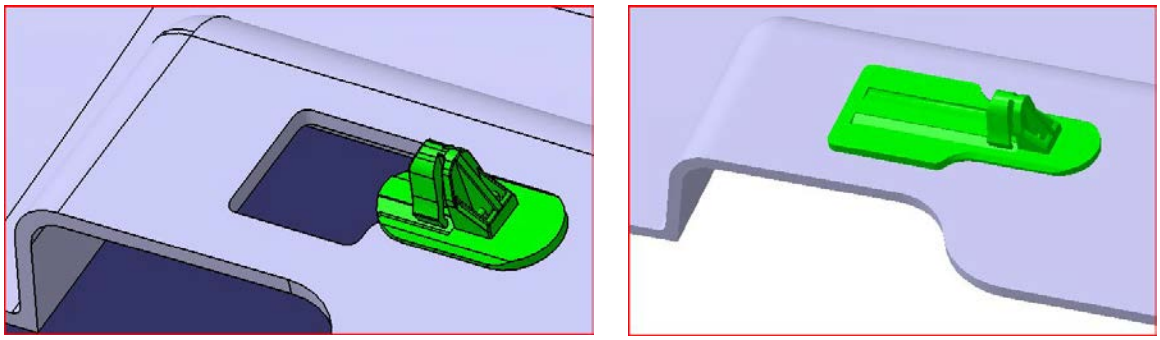

Figure 2 The design of the clip discussed in the illustrative case (left - old & right - new)

Illustrative Case of Perceived Quality in the Automotive Industry

During the first physical test series of a new vehicle program, requirement manager received report about the unwanted noise identified while vehicle is driving on gravel and wet roads. The customers could perceive this noise as an indication that the vehicle's doors are not locked.

The problem was investigated by a team of engineers from the department working on sound quality, solidity and dynamic squeak and rattle in particular. The noise level was measured and as the result, it was clear that the noise level exceeded the requirement limit, due to unforeseen design flaws. The cause of the noise was identified as holes in a lower exterior trim panel of the door that transmitted the noise through the structure, letting the noise propagate into the salon. The hole was designed to give access to clips during assembly, whilst the clip was designed to admit attachment of cable harness to the panel. The issue was corrected by a redesign of the clip, fulfilling the functions of admitting attachment to the panel and at the same time sealed the hole.

The gained knowledge for the engineers designing the clip was never disseminated to the next program in a correct way. Thus, the design flaw was repeated. Analyzing the root cause of reoccurring problem in the illustrative case according to the different knowledge roles pointed out that the main challenges relied within the department responsible for perceived quality and especially sound. Even if the knowledge disseminator had motivation and capability to disseminate the knowledge, the opportunity in form of a common ontology between different disciplines turned out to be the problem. This knowledge sharing was not supported by a standardized structure in the organization.

The organizational structure of automotive manufacturer is quite often driven by the tradition that represents "archaic" or "technocratic" approach to the representation of the product quality. Such a constructs decrease the effectiveness of communication processes and knowledge sharing among different departments and clusters within the company.

For instance, perceived quality traditionally positioned as a subjective, non-assessable dimension of product quality. Therefore, perceived quality paradigm has shifted over the time towards objective assessment methodologies and quantification of the quality perception (Eckert, Bertoluci, & Yannou, 2014; Falk, Quattelbaum, & Schmitt, 2010). Consequently, vehicle manufacturers have a strong demand of gaining the ability to measure and maximize perceived quality. This goal is hard to achieve without effective KM and knowledge reuse.

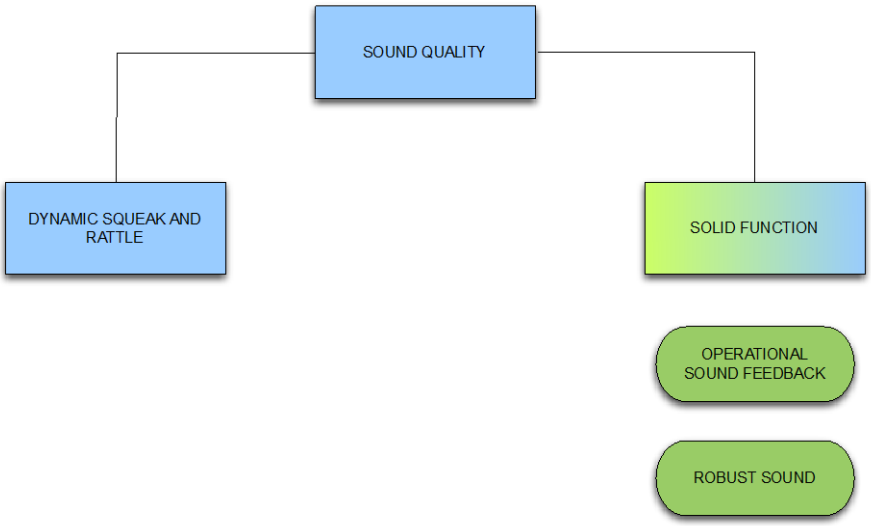

Figure 3 Graphic representation of the Perceived Quality Framework regarding the Sound Quality

At the same time, two major problems are rising: one of them is the deficiency of common terminology regarding perceived quality attributes; consequently, with the absence of taxonomy, there is a poor KM and knowledge reuse regarding perceived quality.

Practically as it is illustrated by the "clip case" critical information about different technical solutions and perceived quality attributes properties often are not saved correctly and never used again. Notably, this problem can be explained by the fact that often designers and engineers rely on their previous experience and intuition. This occurs mainly due to the lack of time, tight deadlines within product development timeline and other factors, even though the decisions they make are critical to the product success on the market (Ranscombe, Hicks, Mullineux, & Singh, 2012) .

Taking Perceived Quality (PQ) Framework (Stylidis et al., 2015) for consideration in the "clip case", the problem that appeared and knowledge associated with the particular design attribute could be linked with Sound Quality and more accurate treated as Dynamic Squeak and Rattle problem (see Figure 3).

PQ framework represents a complete picture of the automotive vehicle manufacturer workflow within the area of perceived quality. The certain characteristics and variables contain various type of information that needs to be stored and reused. From the other side, the framework is reducing the complexity of the perceived quality information management, since the information within is structured and can be assessed in the systematic and objective way. For now, it is highly subjective.

6. Discussion and Results

Analyzing the knowledge flow with the perspective of different knowledge roles has potential to decrease the focus on specific methods to perform the different purposes. One way to overcome challenges and to form effective KM and knowledge reuse is to establish ontology

of the design attributes involved in the process of knowledge creation. This has potential to increase the disseminators' opportunity to succeed with the knowledge flow.

7. Conclusion

The different knowledge roles taken by engineers during knowledge work deserve more attention as the challenges each one of them embraces. Especially for larger companies where the roles are divided between several engineers and when the organization is adapting a strategy for increasing knowledge reuse. This paper has linked potential challenges with the dissemination role according to the MOA (Motivation, Opportunity and Ability) framework.

Analyzing the knowledge flow according to different knowledge roles is proposed by the authors to be a process that makes it easier for the engineers to recognize themselves and in that way identify what type of challenges that are current, however this needs further research to be clarified.

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