Thinking Strategically About Knowledge Management in Agile Software Development

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Abstract. Agile methodologies gave teams more autonomy regarding planning tasks and executing them. As a result, coordination gets more flexible, but much relevant knowledge remains undocumented and inside teams' borders, due to informal communication and reduced development documentation. Since knowledge plays an essential role in software development, it is important to have effective knowledge management (KM) practices that contribute to a better knowledge resource allocation. Several KM practices have been reported in empirical studies in Agile Software Development (ASD). However, these practices are not evaluated regarding its effectiveness or how do they affect product quality. Besides, the studies do not demonstrate connections between the KM practices in the project level and the strategic level. The lack of connection between these levels can result in deviations from the company's corporate strategy, wasted resources and irrelevant knowledge acquisition. This paper discusses how the strategic management can contribute to an integrated approach to KM in ASD; considering the organizational structure and the corporate strategy. Based on this discussion, we propose research areas that may help with planning KM strategies that can have their effectiveness measured and contribute to product quality.

Keywords: Knowledge Management · Product quality
Agile Software Development

1 Introduction

The knowledge of individuals is a well-known competitive resource, and has been philosophically discussed and validated by several researchers within the strategic management field [6,8,9,17]. Knowledge Management (KM) strategies, which are based on knowledge needs and organizational characteristics [4,13],

M. Kuhrmann et al. (Eds.): PROFES 2018, LNCS 11271, pp. 389–395, 2018.
https://doi.org/10.1007/978-3-030-03673-7_30

help with effective knowledge resources management. Successfully employing the knowledge resource contributes to product and company growth [1].

Software development is significantly dependent on exploiting the knowledge resources [10,13]. However, the Agile Software Development (ASD) empirical literature seems to give more attention to descriptive studies that report the use of tools and practices for knowledge sharing, rather than their effectiveness and impact on the software development [10,20].

We identified in our previous study that the KM practices reported in empirical studies in ASD context have low or no connection with the strategic level of the companies, which has negative implications for traceability between the development practices and the company strategy, and measurement of successful implementation of these strategies [20].

Treating knowledge as a resource implies that it needs to be managed with a logical and structured approach [9,13]. We conjecture that the lack of integration of KM practices with the strategic level, together with the adoption of informal KM practices adds low value to the companies that adopt ASD, and hinders unlocking the full potential that ASD brings.

Based on the recent results of our literature review on empirical studies [20] and on KM theories from the strategic management domain, we discuss future research implications of considering knowledge as a resource in ASD.

2 Knowledge Management in Strategic Management Domain

The rationale behind using theories is the glue that connect the explanatory factors [21]. Therefore, we base our discussion on concepts originated in underlying theories of the strategic management domain.

The theoretical literature in the referred domain states that the knowledge embedded in organizational routines contributes to company's effort to achieve its goals, by creating and delivering value to its customers [5,7]. The value created can be product value as well as organizational competence in solving problems and addressing customer needs.

The value creation process has social and cognitive relationships for enhancing individual's abilities for production. Therefore, organizations arrangements tend to change regarding hierarchical aspects, varying from the factory model to flat organizations. In these different structures, activities are more or less knowledge-intensive, which influence how individuals create value [11].

Several companies perceive the strategic relevance of knowledge as the main competitive resource, especially in knowledge-intensive environments. However, building and maintaining the competitive advantage based on the knowledge resource, requires a strategic plan that integrates the long-term vision with the knowledge resources [12].

Companies are often affected by changes in the external environment, e.g., suppliers, market, laws and customers' requirements. In this changing environment, companies need to adapt themselves in order to be more responsive and monitor current and future knowledge needs.

In previous work, we envisioned a conceptual framework (refer to Fig. 1), that displays a high-level perspective of the integration between the corporate strategy and the project level of ASD. The KM strategy reflects the corporate strategy, and promotes, through practices, one or more knowledge processes (KC - knowledge creation, KA - knowledge application, KT - knowledge transfer, KS - knowledge storage) through the company's levels.

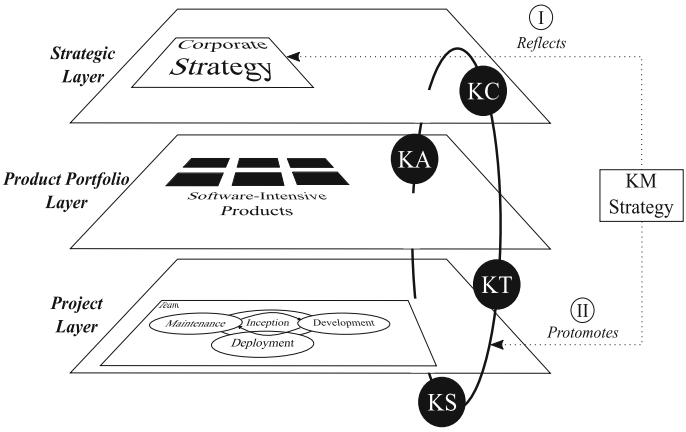

Fig. 1. KMS-ASD [20]

The corporate strategy guides how a company acquires and distributes its resources, e.g., if the company aims for product innovation, which investments in technology and knowledge should be made. In each level, KM strategies might influence different knowledge processes, depending on knowledge needs and their sources [20].

In a study in the manufacturing and services sectors, Ferraresi et al. [14] provided empirical evidence that the business performance is positively impacted by KM strategies only when these strategies are connected to a strategic orientation. Product quality is also affected by KM. Lee et al. [23] investigated in several industry sectors how KM is linked to product quality. They found that product quality is significantly affected by how process management moderates customer knowledge acquisition and the participation of employees in KM activities.

KM effectiveness seems to have a relation to the management encouragement. The rationale behind a KM implementation involves an internal analysis of the company's resources and its needs. Then, the decision regarding which tools and methods to use to achieve the selected goals need to be made [4].

The literature gathers three common approaches for conceiving KM strategies: The rational approach - considers an analysis of the companies resources and need, and external environment of the company, such as market and competitors. The emergent approach - developed based on the employees' daily activities, for example, their methods of problem-solving and their knowledge needs.

The integrated approach, which is the combination of both rational and emergent approaches - it is a dynamic interaction where the strategic level provides guidance with the company's general vision, supported by inputs from the lower level [4].

In any of the three common approaches, we notice that the connection with the corporate strategy of the company is recurrent. Another important aspect that should be considered is the domain where the KM strategies will be executed, by reason of companies size and hierarchy, and knowledge intensiveness of the activities.

3 Knowledge Management Strategies in Agile Software Development

Most of the software development activities are knowledge-intensive [18,19], which evoke the need for the companies to make efforts towards leveraging individuals' competence throughout the organizational layers. However, when it comes to KM practices in ASD, there is a lack of connection between these practices and the corporate strategy [20].

In a previous literature review on empirical studies [20], we mapped the KM practices in software companies adopting ASD (Refer to Fig. 2) and which type of strategy these practices follow. Most of KM practices in ASD are focused on personalization strategies, which focus on human interaction to communicate knowledge, and the majority of them are established in the project layer.

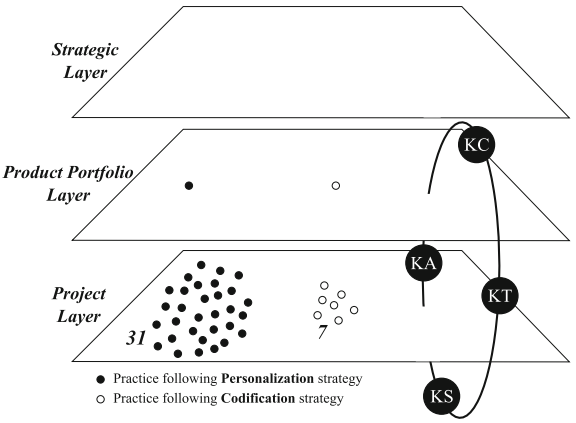

Fig. 2. Distribution of KM practices in organizational layers through KMS-ASD [20]

Moreover, there is a tendency of isolation regarding agile teams when it comes to KM, see Fig. 2. Most of the KM practices might work well inside the teams; however, these practices are informal and occasional. The lack of connection between KM practices and the corporate strategy can result in deviations from

the core vision, wasted resources and irrelevant knowledge acquisition that adds no value to the company [9,13,22].

The corporate strategy guides the resources allocation for achieving organizational aims [4,20]. In the resource-based view of the firm, Barney [9] emphasizes that the means of how a company allocates and uses its resources confers the competitive advantage that differentiates the company from its competitors.

Knowledge is an asset that requires comprehensive and logical management to obtain benefits, since, together with skills, it is the main resource of software development organizations [13,15]. Steen [3] argue that in software development, the product quality phenomenon is heavily dependent on knowledge and skills, however, few research explores this relation.

Santos et al. [16] observed, in an empirical study, that in an ASD context, knowledge sharing effectiveness has relation to purposeful practices, organizational conditions and the stimuli that individuals have to share.

Similarly, goal-modeling may be used in the beginning of software projects to align the system to the organizational goals, which also might indicate that goal-oriented practices are a positive approach to further effectiveness measures for KM; why the practices are needed for; how do them connects to corporate strategy and customer needs.

Both empirical findings and theoretical dialogue connect our discussion, within which the strategic management aspects of having knowledge as a resource, have implications for KM strategy planning.

3.1 Potential Research Opportunities

Since 2010, publication related to KM in ASD gained diversity regarding KM focus, e.g., practices, challenges, and theories. Despite that, the state of the research remains far from the KM mainstream in strategic management studies.

We highlight the following research opportunities for exploring KM in ASD:

- ***Strategic KM.*** Concerns regarding KM effectiveness were raised in previous studies in software engineering [10,20]. Knowing that KM practices produce the desired results might be crucial to a company on deciding to invest in KM. The two essential aspects to consider in planning KM strategies for a company are the connection between the corporate strategy with the organizational arrangement; and the long-term goals of the KM strategy [4]. Illustrating these elements in ASD contexts, we could explore: how KM strategies comply with coordination? what adaptations are necessary? Could goal-oriented KM practices facilitate KM effectiveness measurement in ASD?

- ***Product quality.*** A KM resource remains valuable to the extent that it can deliver value to the customer, and also contributes to achieving enhanced performance [1]. Empirical research has shown that the degree of participation of an employee in activities related to knowledge dissemination impacts the quality of new products significantly [2]. Steen [3] found that software product quality cannot be entirely formalized, but rely on, to a great extent,

the practical knowledge, and experience of individuals. Since knowledge is the main resource for software development, future research should keep attention on how to manage the knowledge resource, in ASD context, in a way that it provides superior customer value. What KM activities result in better product quality? In what context? How these activities affect quality in the software development process, such as requirements, implementation, testing, validation and verification?

4 Conclusion

In this vision paper, we discuss the potential research opportunities of KM perspective in ASD. Our inference is that we have reached a degree where the research demands investigations that go beyond mapping the companies actions against the KM theories, to real planned interventions with companies. Knowledge is socially created and translated into processes and products, representing unique characteristics that every company has. Future research should aim to gather more empirical evidence regarding effectiveness, and substantial impacts of KM strategies in coordination and other aspects, such as software quality.

Acknowledgements. The work is partially supported by a research grant for the ORION project (reference number 20140218) from The Knowledge Foundation in Sweden.

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