

A view towards Organizational Learning: An empirical study on Scrum implementation

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Abstract—Scrum is one of the agile methods gaining more relevance among academics and practitioners. It is mainly applied in the context of software development, which is a knowledge-intensive activity and depends on learning to evolve. Therefore, it becomes crucial to understand the question: *Does Scrum implementation trigger a process of Organizational Learning? If 'Yes', how does the OL occur?* This relation has never been established in previous studies. The answer to these questions was based on a qualitative research, involving key members from UOL - the most important Brazilian company regarding content and services on the Internet, key members from an academic project and an expert in agile methods implementation. Among the main findings, we highlight that the process of Organizational Learning could be verified through the individual members' learning and through the changes within the organization in management, people, process and technology. Beyond the relation established between Organizational Learning and Scrum implementation, this study contributes to academic and practical fields by the identification of changes occurred in type of knowledge valued, physical structure, promotion criteria, and individual dependence decrease when implementing Scrum. It is perceived that knowledge management, as a way of perpetuating the learning in the organization is still a challenge for agile software organizations.

Keywords- *Organizational Learning; Agile Software Development; Scrum implementation.*

I. INTRODUCTION

Agile methods have been in evidence lately. Among these, one of the most popular agile methods is Scrum [1], which is focused on project management and holds ceremonies and roles that follow the agile values and principles formalized by the Agile Manifesto [2]. Its reputation is due to the increasing chances of project success, when applied properly [3].

Software development is a knowledge-intensive activity [4]. Given that, learning is crucial for organizations in this area. As more software development organizations are adopting Scrum, it becomes relevant to understand whether it contributes or not to the process of Organizational Learning (OL).

Every organization learns, as it is a basic requirement for its sustainable existence; and its learning is acquired through their individual members. Yet, OL is a more complex phenomenon than the simple sum of individual's learning [5, 6, 7, 8].

The definition of OL is not consensual and it involves multiple aspects. In this study, we take Nicolini and Meznar's definition that relates learning to change: OL corresponds to investigating why and how the organization changes [9]. Fiol and Lyles [7] associate change with behavior development and learning with cognitive development. Based on that, they add that not all changes imply on learning and that might be learning without any accompanying change in the behavior. Therefore, in this study we will consider cognitive developments and changes in behavior accompanied by cognitive development as learning.

Through a wide search on the topic, including several electronic databases pointed hereafter, the relation between Scrum implementation and the OL process has never been fully established in literature. However, it is quite relevant to study this relation since learning is decisive for software development organizations. For this reason, this research aims to perform an empirical study to understand whether the Scrum implementation triggers OL and, if positive, how it occurs. This study represents an innovative focus on Agile Software Development (ASD) field.

Cognitive and behavioral changes were verified through the analysis of whether the perceived individual learning of the organizational members increased with the Scrum implementation (as it is the first step for OL to happen). And also through the modifications in four aspects: management, people, process and technology. These aspects were pointed out by Nerur, Mahapatra and Mangalaraj [10] as the key issues in migrating to agile. Since they clearly relate them to organizational change, we used these key issues to guide our study. We complement their findings, as contributions for academy and practice, providing other identified changes, such as in types of knowledge valued, physical structure, promotion criteria and in individual dependence decrease.

This research consists of a qualitative analysis involving three lectures on the theme of Scrum implementation and six interviews with actively involved people on its implementation.

The structure of the paper is as follows. In Section II, we review the literature related to OL and ASD implementation. In Section III, the research methodology is described. In Section IV, we present the data analysis. In Section V, we discuss the findings. Finally, in Section VI, the conclusions are presented.

II. LITERATURE REVIEW

After searching within several electronic databases, such as ACM Digital Library, Compendex, EBSCO, Elsevier ScienceDirect, Google Scholar, IEEEExplore, ISI Web of Science, JSTOR, SpringerLink, and Wiley Online Library, no specific study was identified exploring the relation between the Scrum implementation and the OL process.

However, there are few relevant previous studies relating ASD to OL concepts, such as Argyris double-loop learning [11, 12], maintenance of corporate experience repositories as a way to guarantee continuous learning [13], and March's exploitation-exploration balance [14] [15]. We also found studies outlining the importance of OL in Scrum/Agile adoption, but they stress the need to support the process itself to improve long-term learning [16, 17, 18, 19, 20, 21, 22]. Likewise, one study relates Scrum adoption as organizational becoming [23]. Also, two studies relating software process improvement to organizational change were identified [24, 25]. Besides, studies point out the need for future research on OL in ASD [21, 26, 27].

Despite the wide acceptance of OL and its importance to strategic performance, there is no theory or model largely accepted [7], and the concept is still evolving [8].

We use the definition of Nicolini and Mezner [9] that relates learning to change. They state that OL rely on exploring why and how the organization changes. Other authors support this view. Antonello [8], in a literature review about OL, stated that the literature promotes a strong relation between learning and change, and some authors contend they are synonyms. As stated by Fiol and Lyles [7], OL is the process of improving actions through better knowledge and understanding. The authors differentiate organizational learning (cognitive development) and change (behavior development). Therefore, changes in the organization can be considered learning as long as they are accompanied by cognitive development.

There is a consensus that OL is first acquired by the organization individual members, but OL is not the simple sum of each member's learning [5, 6, 7, 8]. It means that the first step onto OL comprehension is the understanding of its individual's learning. As the synergy of the shared understandings and consensus increase within groups through knowledge propagation and socialization, the organization starts to adjust its behavior as a response to performance problems [5].

Past studies in ASD acknowledge that there is learning at individual and group levels [1, 21, 28, 29], however none has actually described the OL process in ASD.

For a deep comprehension of OL, there are other aspects to be analyzed such as changes in management, people, processes and technology. Specifically in the software development area, it is important to take into account Nerur, Mahapatra and Mangalaraj [10] study where they detail key issues (Table I) that an organization may have to face when migrating to agile.

TABLE I. KEY ISSUES IN MIGRATING TO AGILE

Management and Organizational: Organizational Culture, Management
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Style, Organizational Form, Management of Software Development Knowledge and Reward System.
People: Working effectively on a team, High level of competence and Customer relationships (commitment, knowledge, proximity, trust, respect)
Process: Change from process-centric to a feature-driven/people centric approach, Short iterative, test-driven development that emphasizes adaptability, Managing large/scalable projects and Selecting an appropriate agile method
Technology (tools and technique): Appropriateness of existing technology and tools and New skill sets (refactoring, configuration management, J-units)

These issues can be seen as causes and consequences of migrating to agile because at the same time that they represent assumptions or enablers for the implementation to happen, they are also affected when the implementation takes place.

Chang and Thong [30] have provided a critical review of the literature on the acceptance of agile methods. They found only eight case studies discussing the acceptance of agile methods. Only two of them were specifically about Scrum implementation [31, 32]. Table II depicts those main factors.

TABLE II. AGILE METHODOLOGIES ACCEPTANCE ADAPTED FROM [30]

Factors for agile methodologies acceptance	Method studied
Negotiation skills	Scrum
External support, Career consequences, Micromanagement, Resistance due to past experience	Scrum, XP
Compatibility with agile methods	Scrum, Agile
Individual ability / competence/ motivation / Experience in software development	Scrum, Agile, XP
Teamwork, Management support, Communication, Project type, Team size, Organizational culture and form, Management style, Management of software development knowledge, Reward system, Customer relationship, Existing technology and tools, Training	Agile

After the Scrum implementation, several challenges related to Knowledge Management (KM) need to be faced to perpetuate and leverage the learning in the organizations. Levy and Hazzan [4] highlight how the agile approach initiates a culture change that is in line with the one needed for a KM initiative. They describe KM enablers that are embedded in the agile approaches. For Chang and Thong [30], KM is critical for ASD, but it has to be conducted in a different way, since agile methods are more people-oriented and deal mostly with tacit knowledge.

An important aspect related to OL observed in previous studies is the lack of KM practices integrated to the Scrum management process [4], even though the practices encourage the knowledge exchange among individuals in a team. In summary, the process of OL that started with Scrum implementation must be supported by KM practices in order to perpetuate the learning in the organization.

III. RESEARCH METHODOLOGY

This empirical study is a qualitative research [33], since it aims to discover and understand the complexity and interaction

of factors related to the phenomenon in study. As Seaman [34] state, the main advantage of using qualitative methods is that they force researchers to deepen the complexity of the problem, rather than generalize it. Thus, the results are richer and more informative. On the other hand, they are more difficult and stressful than a quantitative analysis.

A. Research Question

This research can be classified as exploratory [35], since the goal is to examine a topic or research problem scarcely studied, for which we have many questions not addressed before [36]. We aim to answer the following research question:

- *Does the Scrum implementation trigger a process of OL? If 'Yes', how does the OL occur?*

B. Data Collection

Semi-structured questionnaires with open questions were held to allow improvisation and to invite a broad range of answers and issues from the phenomenon in study.

The questionnaires were constructed from the literature, in order to answer the research question, considering the necessary assumptions for Scrum implementation to happen and their perceived changes after the implementation (in areas related to Management, People, Process and Technology). There were also questions regarding the challenges related to KM (what is being applied to perpetuate the learning initiated with Scrum implementation). The questions were adapted to each interview. All interviews were recorded and transcribed.

C. Data Analysis Method

The analysis of the collected data was made inspired by open coding in grounded theory [37]. Interesting expressions were categorized to describe the phenomenon in study.

D. Data Sources

The empirical study considers the qualitative analysis of three lectures on the theme and six interviews involving three different data sources to provide data triangulation:

- Two key members from Universo Online (UOL), the most important Brazilian company regarding content and services on the Internet (http://sobreuol.noticias.uol.com.br/index_en.jhtm). The expansion of services offered to the web market has demanded changes in company's process, which has led to the Scrum implementation in some of the software development areas. We attended lectures of both professionals, which are actively involved on Scrum implementation, and we conducted two group interviews with them to investigate the OL process at the organizational level.
- Three members from the Workbench Project (WP), an academic project that applies Scrum method (<http://www.groupwareworkbench.org.br/gt>). This project is an initiative of the Institute of Mathematics and Statistics from University of São Paulo to develop components aimed at social interaction and collective

intelligence for building collaborative applications on Web 2.0. We interviewed individually the Scrum Master, the technical leader and one of the developers to analyze the learning at individual and group level.

- Specialist in implementing agile methods, including Scrum, Heitor Roriz, from Massimus Consulting (<http://massimus.com/>) conducted a lecture and was also interviewed by the authors to deepen the understanding of the relationship between Scrum implementation and OL. Given his experience in several software development organizations, his point of view was important to triangulate data and to perceive if the results verified at WP and UOL could be found in other organizations or if they were restricted to their context.

IV. DATA ANALYSIS

Data analysis was performed by coding interesting expressions detected by the authors, considering their expertise on the research topic. This section presents them in detail.

The qualitative analysis highlighted the importance of what we have called "assumptions", factors that contribute to the acceptance of the Scrum implementation. They are endorsed by the literature. Also, it raised the changes identified in the study, representing evidences of learning that have occurred.

A. Assumptions for the Implementation

It is important to understand the assumptions adopted for the Scrum implementation as they allow the organization to benefit from the subsequent organizational learning generated. The assumptions identified are detailed as follows.

1) *Understanding of the Scrum method*: An understanding of the Scrum method is important once many organizations have lack of knowledge of the practices required to use Scrum effectively. As well, many organizations confuse some of their practices with other methods. The specialist interviewed supported this point by stating that "*It happens that some companies say that they are using Scrum, when they are not actually doing so. An example is when they use Kanban – which belongs to Lean – thinking it is Scrum*". This way, it is important to achieve a broad understanding and a full implementation of the Scrum method to perceive its benefits.

2) *Make sense in the context*: It is crucial that the implementation makes sense for the organization. In the case studied, some factors contributed to this aspect: team dissatisfaction and overload with the previous method, the need to have a fast method to keep up with the organization's startups, competitors already using Scrum as well as some of the team members getting in contact with Scrum by external conferences, academic influence and books. One of the interviewees from UOL argued that "*if everybody were comfortable with the process... 'oh, it is ok, it works'... or 'leave it like this', it wouldn't have changed*";

3) *Top management support*: To change the work method, it is necessary to convince the top management that it is worth.

An interviewee reported the need to also line up the Scrum implementation with the business expectations and adapt the technical to management vision to support top management convincement: *“the development area had to ‘speak the language’ of the top management to be able to convince them. It was of no use to talk about the method. We needed to focus on the benefits it might bring: reductions in time, cost...”*;

4) *Shared vision establishment*: In a change process, it is important to establish a shared vision of the future. It implies expectations alignment and also changes understanding. Metaphors may help in this task as it was used at UOL, as reported in the lectures: *“We were changing the airplane’s wing during the flight... so it would not be an overnight change as it is difficult to do such thing”*. Another statement related to the expectation alignment was: *“we made clear for the development team as well as for the top management that Scrum was not the solution for all the problems”*;

5) *Team’s competency and commitment*: It was also pointed out to have a competent and committed team. As an interviewee from UOL stated: *“You need competent people, with a strong knowledge base, committed to the job... this is the base... without it... it is an assumption”*;

6) *Non hierarchical culture*: Not all organizations can implement Scrum. It was reinforced by the specialist interviewed as well as at WP and UOL. A WP member summed up this need by saying that *“the culture cannot be the ‘I impose and you obey’”*.

B. Changes and Learning

According to Nicolini and Mezner [1], in order to understand the phenomenon of OL, it is important to analyze the changes that occurred in the organization. Fiol and Lyles [7] add that change can be considered learning since it is accompanied by cognitive development. Given the basis provided by these authors, cognitive developments of the members and changes in behavior accompanied by cognitive development were considered learning.

Through the data analysis and consensus among the researchers, subcategories were created below within the categories proposed by Nerur, Mahapatra and Mangalaraj [10].

1) Management and Organizational

a) *Types of knowledge*: The organization undergoes significant changes in the types of knowledge. Individual tacit knowledge increases due to a higher communication and teamwork. Many interviewees state that the individuals end up increasing their knowledge because of the higher interaction with other team members. A Workbench project member endorsed it by saying: *“I saw that other people’s level was above mine and it forced me to learn (...) not because somebody told me to, but for self motivation. The organizational tacit knowledge also increases by the reinforcement of shared culture and process. However, we identified a more unexpected change in the explicit knowledge. Despite the decrease in the documentation related in all the interviews, it was possible to conclude that the explicit knowledge increases with Scrum implementation. It*

happens because the documentation that used to be generated rapidly became outdated and, therefore, people did not access them: *“in the past, people used to write a lot, but anybody read that”*. Knowledge is related to action [38], so a document that is not accessed and does not lead to any action, cannot be considered knowledge, but information instead. As the documents generated when working with Scrum contain only the essential knowledge, it is therefore accessed and turned into action: *“today, everything that is critical is documented”* as well as *“what is updated is what you have the obligation to update in order to make it work”*.

b) *Hierarchical structure*: This indirect change happened because as the development teams must work together and sit near each other, these individuals tend to become part of the same functional area. This is confirmed by an interviewee from UOL: *“the hierarchical structure changed [...] some departments disappeared, some remained but changed their way of working”*. The change in the way of working refers to the team members that respond to a different area becoming really part of the team, even working in the same space/room.

c) *Physical structure*: As the team members sit close to each other when working with Scrum, the physical structure in the development area has changed. It was seen as a very important change, as now the cross-functional team work for the same product: *“it used to be resource competition among the areas”*.

d) *Promotion criteria*: The change in the type of knowledge already presented, alongside with the transparency increase by Scrum implementation may improve the promotion criteria: *“the promotion criteria became more legitimate, more the essence of the person’s value and not the circumstance”*.

2) People

a) *Values and behavior*: As Scrum is usually implemented along with agile principles, there are joint reflexes in changes of team values and behaviors. This is one of the main changes pointed out by all the interviewees. One of the interviewees from UOL commented about the changes he observes in the team: *“just the fact that everybody is in a smaller team [...], the daily exposition by the daily Scrum, the task visibility on the board, everybody talking about what they are doing, the deadline commitment... and even when a new member comes to the team, somebody just go there to help him... it is very good for the team”*. Some of the several aspects related to this topic and indicated during the research were: increase of communication and transparency in the relationships, less imposition by managers, bigger sense of commitment, responsibility, organization and freedom of expression (questionings, opinions etc), better understanding of the work processes, commitment to the final product and objectivity during the meetings. The specialist in Scrum implementation supported these changes as he observes in several organizations: *“the characteristic of every team when you implement Scrum: feeling of responsibility.... Everybody say that. The feeling of organization [...] you know what you are doing. Then you compromise”*.

b) *Individual dependence*: An interesting impact of Scrum can be the reduction of the individual dependence for the organization. It happens because the knowledge is largely widespread through several members, reducing the need for one specific individual: “*knowledge is spread [...]there were component owners previously[...] today it doesn't exist anymore. Now the team takes everything. When we started with Scrum, we had to make an effort to stop that. So I would say that the dependence has decreased*”. However, the human dependence as a whole remains strong, only the individual one decreases: “*[the dependence is] less from the individual. People dependence still exists because software is a human activity*”. It was pointed out by the interviewees from UOL that “dependence” must not be misunderstood: it does not mean that the organization has started to diminish the importance of each person, but quite the opposite. It was only the negative part of the dependence that has decreased (for example: a person who is not delivering a good job but cannot be fired because he/she is the only one who has a specific knowledge in the organization).

c) *Roles*: Scrum proposes different roles in the organization: Scrum Master and Product Owner as well as a different role for the team, demanding an active participation in the decision taking. The team becomes self-organized and the leadership operates as a coach more than a manager. One of the interviewees from UOL commented about his team active participation in the process: “*there isn't that attitude anymore of 'I have finished so I move the task ahead'*”.

d) *Particular language development*: Another change was the development of a particular language by the team. It is partly because of the shared work and values. It was commented that the team starts to say things such as “*that is a sprint thing*”, that has no meaning for a person of the organization outside the development team.

3) *Process*

a) *Delivery model*: The delivery model proposed by Scrum – iterative and incremental – differs from the traditional long term ones. It changes the way of thinking the job by the team members. An interviewee from UOL stated that “*We didn't have a culture of delivering in pieces [...] and the thought of maximizing value at each delivery*”.

b) *Tests*: In order to cope with the new way of working, developers build the software and test it at the same time. It may represent an overlap with the tester role. However this is faced as a positive aspect: “*there is an overlap with the tester role, because the developer ends up implementing tests alongside with the development, but this is seen as a positive thing because it improves the test estimates*”.

4) *Technology*

a) *Tools*: While Scrum does not strictly recommend the use of tools, developers use them for purposes of facilitating project management and improving their source-code. A WP member said: “*Virtual tools help us seeing the progress of the project [...] also, they force us to improve our work [...] you realize that people are afraid of generating bad code*”.

V. DISCUSSION OF THE FINDINGS

Our research question was: *Does Scrum implementation trigger a process of OL? If 'Yes', how does the OL occur?* We verified that the answer to the first question is positive as an increase in individual's learning was identified – the starting point for OL – and several changes involving intellectual growth and improved actions could be seen in the organization that took place with the Scrum implementation. As our definition of OL involves the understanding of how organizations change, these changes are the basis to verify if a process of learning has occurred.

The study innovates by focusing on the relation between Scrum implementation and OL, never explored in previous studies. Besides, it contributes to the understanding of the issues in migrating to Scrum. It could be added in the study of Nerur, Mahapatra and Mangalaraj [10] the possible change with the physical structure of the organization, not only in the organizational form in the sense of hierarchy. Moreover, the promotion criteria is another point that may undergo change as Scrum increases transparency and disseminates knowledge within the team, making a contribution to a more fair criteria for promotions.

A very interesting finding is related to the change in types of knowledge in the organization. Nerur, Mahapatra and Mangalaraj [10] pointed out the shift in the balance of power from management to development teams that may occur as the majority of knowledge in agile development is tacit and resides in the heads of team members. However, we have concluded that explicit knowledge also increases with Scrum implementation (but not as much as tacit knowledge). This is based on the fact that the documentation developed in traditional methods could not be considered knowledge as it was hardly used because it rapidly became outdated.

Another interesting finding in the study is related to the organization's decrease in individual dependence. As the knowledge becomes more diffuse among team members, the organization becomes less dependent on individuals. Although it was noticed that people become more valued, the harmful dependence of a single individual is reduced.

Then, when Scrum implementation is overcome, a further challenge raises: how to manage the organizational knowledge in this context? In this study, some initiatives being established were identified, but the interviewees confirmed that this is a very important aspect to be dealt with in the near future.

VI. CONCLUSIONS AND FURTHER WORK

The findings of the present study may be useful in several ways. First, it shows that Scrum implementation triggers a process of OL, a crucial process for software development organizations. Besides, it clarifies some of the changes that an organization may undergo when implementing Scrum.

This qualitative study presents some limitations that reflect in threats to validity of the results. It is not yet possible to generalize the findings, since the sample is not extensive, but adequate to the research goals. Only one organization was studied and yet few people were interviewed. Moreover, although the people interviewed are considered key, we cannot

guarantee that their views are consistent with other team members and the organization respectively.

Future studies may complement the identified factors in different organizations to increase the power of generalizing the results. Moreover, there is an opportunity for further research on how to manage knowledge in organizations that have already implemented Scrum [29].

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