

Improving Information Systems Development Agility by Organizational Learning in Large Scale Company- A Case Study

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Abstract—Tenet of information systems development (ISD) agility underlines management of change in which the ability of embracing, creating and learning from change is emphasized. In organizational behavior area, literature shows that characteristics that learning organizations possess share much with agile methodology on dealing with change. While organizational learning ability is regarded as the key to success in the changing business environment, there are few studies exploring the connection between agility in ISD and learning in organizations. This paper designs a case study in a leading large scale telecommunication company to study how organizational learning behaviors interact with ISD agility. We review the literature and interview senior project managers, line managers and software engineers in the company and construct a research model on organizational learning and ISD agility. Development of research propositions is also presented. We applied the research model in the preliminary study and result shows that double loop learning behaviors could be identified in the implementation of most agile practices, such learning behaviors could improve agility by enhancing the change management ability.

Index Terms—Organizational learning, learning organization, agility, change management, double loop learning

I. INTRODUCTION

Today's information systems development (ISD) projects are enacted in increasingly turbulent business environment such as quickly evolving requirements, constantly changing stakeholder preferences, ISD technology as well as time-to-market pressures [16]. Values and practices in traditional ISD methodology such as detailed plan, strict control and non-iterative manner are challenged mainly because the lack of flexibility and ability to adapt to and deal with change under uncertainty [1]. In the last decade, a group of lightweight ISD methodology, namely agile methods, such as eXtreme Programming, Scrum and Crystal etc., were proposed in response to the call for process flexibility. With the wide adoption of Agile methods in the ISD industry, a significant body of empirical evidence could be found that Agile methods have apparent advantage on managing change and uncertainty

[1] [37][38].

As a relatively new research area, there is no unified definition of ISD agility in academia. Highsmith and Cockburn [15] defines agility as the “the ability to create and respond to change”. Conboy [1] systematically reviews the agility literature outside the ISD discipline and constructed the concept of agility in which the necessity of proactively learning from change and customer orientation for agile teams is also highlighted. However, being flexible and being able to manage change and uncertainly is not unique for ISD agility, it has a long history of discussion in the learning organization and organizational learning discipline. For example, Gareth Morgan [7] claims that “learning organizations must develop capacities so that they can scan and anticipate change in the wider environment to detect significant variations, question, challenge, and change operating norms and assumptions when facing uncertainties and allow an appropriate strategic direction and pattern of organization to emerge under uncertainty”.

However, a clear definition of learning organization is absent [2], thus it is not possible to draw on a unified definition to analyze if ISD agility is related to it. We then review the literature and found there is a significant overlap between the ISD agility and the learning organization in terms of the focus of creating, embracing and learning from change and uncertainty though from different angles. We argue that organizational learning behavior in learning organizations have positive influences on improving agility in ISD activities. Some exploratory study could be found in the ISD agility literature to support this argument [34][39][16]. As one of the most important organizational learning behavior, double loop learning is found in these literatures being a possible factor which facilitates the effectiveness of agile teams. However, there are two limitations in these studies; first they didn't draw on the unified concept of agility, so it is hard to determine whether agility is improved. Second, these studies were conducted in small companies, empirical evidence from large scale companies was overlooked.

The rest of the paper arranges as the follows. The second section briefly reviews the extant ISD agility, learning organization and organizational learning literature, provides the support and theoretical background on the connection between ISD agility, learning organization and double loop learning. The third section expounds the research model and the corresponding research hypotheses. The fourth section introduces the research methodology and the research site. The fifth section presents the preliminary study and the conclusion of this paper.

II. LITERATURE REVIEW

Agility is not a unique concept in information systems development, such concept could be found in mainstream literature in reference disciplines such as manufacturing two decades ago [40]. Though considerable body of research appeared in ISD agility area recently, there is still a lack of concept defining literature in the area of ISD agility research [1]. Practice is ahead of research in this area and the fundamental underpinnings of agile methods need to be better conceptualized and theorized [18]. More importantly, clear definitions for concepts is important to theory building [11]. Due to these reasons, Conboy [1] systematically reviews the literatures on management, manufacturing, organizational behavior in which ISD agility research is excluded and defines ISD agility as "the continual readiness of an ISD method to rapidly or inherently create change, proactively or reactively embrace change, and learn from change while contributing to perceived customer value (economy, quality, and simplicity), through its collective components and relationships with its environment." This definition will be used in this paper to build the connection between learning organization and ISD agility.

A. Learning Organization and ISD agility

In the definition of ISD agility, three types of change management approach are indicated, namely create change, embrace change and learn from change. Many authors point out that contemporary companies are experiencing an increasingly changing business environment and therefore organizations' learning ability plays considerable role on managing such turbulent environment. High-tech industries such as telecommunication, software, semi-conductors, etc frequently encounter technological change, so commitment to learning is required [2]. The more a company is involved in global markets, the more its performance depends on the ability to adapt to changes. It is argued that, for large scale companies there is a need for designing organizations that can learn [13]. The ability to learn more rapid than your competitors would be the only sustainable competitive advantage [23]. The quality of learning within a company is crucial in building an organization that is vigilant ready to change to meet the demands of the environment, which itself is often changing [24]. All companies will attempt to learn when environmental changes force change on them. Sinkula, J., Baker, S. and Noordewier, T [17] well summarize this contention as the follows "companies that can adapt when things are going well will be the long-term

winners".

Among these three attitudes toward change, embracing change is considered to be one step further than adapting to change. When change happens, one seeks to cope with change and manage to recover the situation to the original state by adapting to it while one could also take advantage of such change and leaps the situation to a better position by embracing it [1][4]. Such contention is supported by several other conceptual studies [19][20][21]. In organizational learning literature, evidence could be found to address the similar topic. Senge [14][25] argues that change and learning are closely linked, learning organizations enable people and organizations to embrace change. Systemic thinking, one of the most important characteristics of learning organization, is regarded as the ability to consider the whole rather than parts, to see connections between events [2][3][13][26]. Once change occurs such ability allows one to think systematically when trying to intuitively recover the changed state to the original one and if the existence of the better state is confirmed, one would give up the adaptive change management manner and embraces the change by working with it. David A. Garvin [2] distinguishes the productive failure and unproductive success from the past experience. When business change involved in the past experience brings about failure, a productive failure may provide insightful understanding of it if one learns from the change. On the other hand, if past experience is not remembered, though a successful one, it would not be beneficial to the ensuing business activities. Other studies also hold the similar idea, namely a learning organization should learn from change in order to improve the future performance [3][8][13]. For example, Eric Tsang [8] points out that an organization which learns from past mistakes quick to correct its errors and reacts fast to environmental changes outperform better than others.

Proactive attitude and actions are also required in learning organizations when confronting change, this argument could be disclosed in a number of learning organization research [13][26][27]. Three core values of organizational learning orientation were identified by James M. Sinkula et al. [17]. The study contends that proactive actions positively influence commitment to learning, open-mindedness and shared vision, and these three values form the basis of a successful learning organization. Though named differently, adaptive learning and generative learning could be well mapped to reactive and proactive attitude in organizations' learning activities [3][13]. Adaptive learners only react to business environmental change, they usually avoid risk and response to change mainly according to the previous successful experience. While this has merits, such adaptive learning may fail when competitive environment doesn't remain static which in real world happens constantly. Generative learners, on the other hand, evaluate the new situation in a different way. Once change is identified, they will strive to find the solution which addresses the actual reason of the problem, if the reason doesn't align the one in previous

experience, new solution will be proposed.

The idea of creating change extends the notion of embracing and learning from change even further. While such notion is well illustrated in the agility literature [1], learning organizations also share the similar concept. Gareth Morgan [7] argues that a learning organization should not only anticipate change but scanning change as well. As indicated in the book, "We are involved with a much more fluid sense of intelligence that uses, embraces, and at times creates uncertainty as a resource for new patterns of development". The practice of "Experimentation" in learning organizations on the other hand is indicated by Garvin [2] in which involves the systematic searching for and testing of new knowledge. Garvin argues, "They involve holistic, systematic changes ". It is not difficult to discern from the learning organization literature that concept underpinning ISD agility share a significant body of main values. Apparently, it's intuitive to relate learning organizations to the actual learning behaviors inside these organizations. It's the learning activities which take place in organizations form the learning organizations after all. The next section will exam the relationship between learning organization and double loop learning behavior.

B. Double Loop Learning and Learning Organization

In learning organization literature, many studies investigate how to leap the learning to a deeper level. Garvin [2] argues that systematic problem solving is essential to learning in organizations. It urges one to access the underlying causes of the obvious symptoms, though according to conventional wisdom it's unnecessary to do so. The distinction between knowing how things are done and knowing why they occur is considered to be crucial to deep learning. Knowing why is pointed to be more fundamental than knowing how, because the behavior of knowing how is rooted in norms, however, by knowing why would have the ability and potential to challenge norm. In Tsang's study [8], he points out that if only potential behavior and actual behavior is changed without the modification of learner's cognition change, the learner does not understand the rationale behind the changed rules and practices, and this would cause the ineffectiveness of organizational learning. The concept of generative learning [3][13] mentioned in the previous section also implies the necessity of approaching the fundamental reasons of the problems.

Argyris[5][6] indicates that double loop learning addresses the fundamental reasons of the problem. In this article, we only present the very brief introduction on Argyris's double loop learning theory, for more information, please refer to the references [5][6][12][24][28][30].

Argyris defines organizational learning the process of detecting and correcting error [12]. When the process enables the organization to use its current rules to achieve its goals, this is regarded as the single loop learning. When the fundamental

cause of the problem is identified and the norms of the current situation are challenged, double loop learning might occur. The following diagram illustrates single loop and double loop learning.

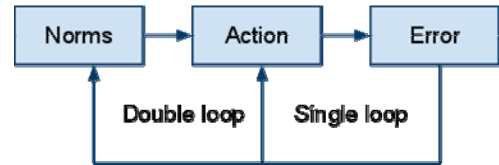


Fig 1 Single loop learning and double loop learning

Once there is a mismatch between the consequences and the current action (an error), a learning behavior to correct the error might happen. It's natural for ones to look for another action strategy to address the problem within the current governing variables and norms. While this is considered single loop learning, double loop learning happens for example, in ISD context, once there is a defect found in the software, not only the way how the defect is fixed is discussed, the actual reason of why such defect was introduced is also scrutinized. The actual reason, for instance, could be the inappropriate system architecture design and therefore a system reconstruction may be needed.

However, double loop learning is likely to be inhibited due to the difference between one's theory in use and espoused theory [30]. It's argued by Argyris that "Valid information", "Free and informed choice" and "Internal commitment" could encourage the double loop learning in organizations and therefore improve the organization's learning ability [12].

III. RESEARCH MODEL AND RESEARCH HYPOTHESES

A. Research model development

We construct our research model by using two approaches. First we review the literature and summarize and abstract the model from the literature. Secondly, we conducted the interview in the organization we study in order to validate and refine our research model. The interviewees include line managers, senior project managers, systems engineers, software engineers and test engineers. The refined research model is illustrated in figure 2. The reasoning of the model is presented in the following.

Based on the definition of ISD agility by [1], the ability of embracing change, creating change and learning from change are three main factors to influence agility, so we add these three factors to our research model. Besides, agility will not be significantly improved if change is only managed adaptively, so we also add proactive attitude to the model. In the latter part of the ISD agility definition, value to the customer is emphasized. While the customer value is the core element of customer orientation [29], we therefore add "customer orientation" into our model as well. According to our literature review in the previous sections, it's clear that learning

organizations share much with ISD agility in core values. We argue that an ISD organization with high learning ability, if agile methods are adopted, will also demonstrate high agility in information systems development.

On the other hand, it's indicated in the previous sections that double loop learning ability, though not completely, reflects the learning ability of learning organizations. Therefore, interplay between double loop learning and learning organization will eventually affect ISD agility since learning organization share much value with ISD agility. In the implementation of agile methodology, agile practices are the main channel to carry out ISD activities in agile manner. Though agility of an ISD team could not be completely measured by the performance agile practices, the effectiveness of agile practices is simply the most direct outlet to reflect the extent of agile. There are much literature studies how agile practices interact with agility [37], but in our model, we take a step further, that is not only pay attention to the relationship between agile practice and agility but to study how organization interplays with agile practices and agility. This would explain the arrow between agile practices block and double loop learning block. If the underpinning concept of agility is similar to learning organization, it's reasonable to surmise that agile practices would influence organizational learning behavior either in the positive or negative way.

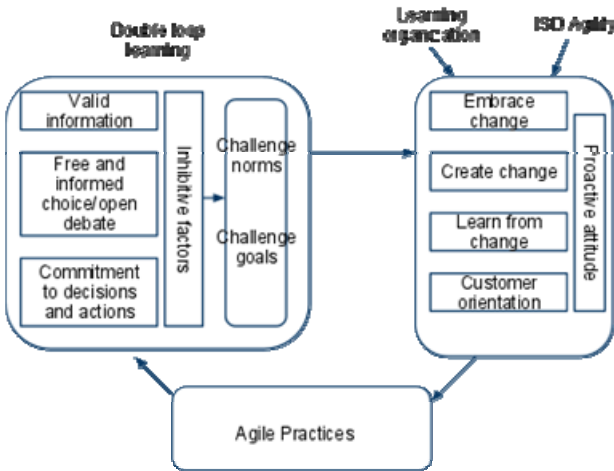


Fig 2 Research model

B. Hypotheses development

According to our literature review and research model, double loop learning behavior would contribute to building learning organizations, values of learning organizations are very similar to the ones underneath of agility. If double loop learning behavior is not completely inhibited by inhibitive factors, agile practices should also be able to benefit from double loop learning behavior. This leads us to our first hypothesis.

Hypothesis 1: Double loop learning behavior could be

identified in agile practices.

If agility could be increased by double loop learning, as the definition of agility [1], the ability of managing change would be increased; this leads us to our second hypothesis.

Hypothesis 2: Double loop learning behavior could enhance agile team's ability of managing change

As a learning organization as well as an agile ISD organization, customer orientation typifies both characters. According to our logic, if double loop learning could facilitate the improvement of ISD agility, behaviors which on behalf of customer orientation could be more identifiable. This constructs our third hypothesis.

Hypothesis 3: Double loop learning behavior could direct agile team's value towards customer orientation

Same as the second and the third hypothesis, as one of the main factors in learning organizations and ISD agility, if ISD agility is improved, proactive attitude should also be enhanced.

Hypothesis 4: Double loop learning behavior could enhance agile team members' proactive attitude

Ideally, if double loop learning takes place, according to previous hypotheses, it would influence agility and therefore influence agile practices. On the other hand, according to our research model, agile practices are likely to contribute to the prerequisite of the occurrence of double loop learning. This could be generalized to the fifth, sixth and the seventh hypothesis.

Hypothesis 5: Agile practices have positive influence on valid information in agile team

Hypothesis 6: Agile practices provide more free and informed choice and encourage open debate

Hypothesis 7: Agile practices have positive influence on internal commitment in team

In the previous sections, we indicated that double loop learning could be blocked by a number of inhibitive factors. If this happens, the loop in the research model would be ineffective. Therefore, we generated the eighth hypothesis.

Hypothesis 8: If double loop learning is inhibited, agile team's change management ability will be negatively influenced

IV. RESEARCH METHODOLOGY

In this section, we will introduce the research methodology adopted in this study and research validity consideration is also

discussed. Then we briefly present the information of the research site. Consider the nature of the research objective, to investigate the interrelationship between organizational learning and ISD agility, a longitudinal, exploratory qualitative research approach is chosen in this study for the following reasons. First of all, individuals are usually not able to discern or explicitly realize their own organizational learning behaviors. [28] points out the difference between espoused theory (the principle you believe) and theory in use (the principle you actually use), and claims that individuals are usually not able to discern such difference even if they contradict each other. Argyris [30] also concludes that double loop learning could be inhibited by defensive reasoning, which in most of the cases, individuals are not only unable to realize the existence of such reasoning but are likely to reinforce it. [31] presents the similar problem and argues team members may not be aware of the influence that is hidden. Secondly, if researchers are not deeply involved in the learning process, it is difficult if not possible for outsiders to monitor and evaluate the organizational learning processes [5]. Bødker K and Pedersen J [32] argue being a "culture insider" allows the researcher to experience the activities in a direct manner. By taking part in the meetings, joining the discussion more hidden evidence is more likely to be observed and discovered. In ISD agility studies, for example, Robinson and Sharp [33], John McAvoy and Tom Butler [34] adopt a case study approach using participant observation in their research respectively and are able to reach deep insights of their research topic, the authors also argue that, such insights are not likely to obtain by using other research methods.

Considering the factors discussed above and by following case study research methodology [35], we adopt the participant observation technique to investigate the phenomenon of our interest. One of the authors of this paper is an experienced ISD practitioner in the research site, therefore he could work with the ISD team we investigate and collect the data directly, for instance during meetings, formal and informal discussions, etc. Other researchers go to the research site regularly to ensure the collected data is correctly interpreted. Ezey [36] points out that such arrangement is vital to participation observation research approach. Other case study research techniques are used in the participation observation to address the internal validity of the study such as prolonged engagement, triangulation, peer debriefing, etc.

We conduct this research in Ericsson China research and development center located in Shanghai. Ericsson is leading telecommunication company in the world. In Ericsson China research and development center various telecommunication information systems such as mobile TV, mobile positioning, instant messaging etc are being developed. In late 2008 Ericsson adopted Agile ISD methodology in its research and development center worldwide, this provides us a good opportunity to investigate this paper's research topic in a large scale ISD firm.

V. PRELIMINARY STUDY AND THE CONCLUSION

We started the research from March 2009, the preliminary research result shows that double loop learning behavior could be observed in most of the agile practices. The following table summarizes this.

Agile Practices	Practices and Adaptations	Double Loop Learning Typical Behaviors Observed	Change Management Benefits
Standup meeting	- Daily meeting at team level, share latest progress and issues. - Daily follow up actions from the meeting by team own. - According to need add missing tasks or remove unnecessary tasks. - Daily reflection on the quality.	- Valid information - Free and informed choice/Open debate - Team internal commitment to the decisions/actions	- Embrace change - Create change
Time-box iterations	- Fixed time (2~3 weeks) for iterative working software delivery. A whole software development life cycle. - Quality assurance is put into each iteration.	- Team internal commitment to the decisions/actions - Questioning norms in the process	- Embrace change - Customer orientation
Demo	- Agree on the demo scope at the beginning of iteration with customer representative. - Show the iteration deliverables to customer representative. - Request customer representative feedback on the deliverables.	- Questioning goals - Valid information - Free and informed choice/Open debate - Team internal commitment to the decisions/actions	- Embrace change - Create change - Customer orientation
Planning game	- Agree on the iteration goal with customer representative based on velocity calculation from previous iterations' experience. - Team makes iteration detail plans together. - Team commits the iteration goal.	- Free and informed choice/Open debate - Team internal commitment to the decisions/actions	- Embrace change - Customer orientation
Cross Functional Team	The role of team members is not fixed and is encouraged to mix, e.g., the engineer could	- Questioning norms in the process - Team internal commitment to the decisions/actions	Embrace change

	- either be developer or tester at different time of iteration. - Encourage help and backup each other within team.		
Retrospective	- Team discussion together to find the success factors or improvement opportunities. - Vote for the most critical problems. - Define actions for the selected most critical problems.	- Questioning norms in the process - Questioning goals - Valid information - Free and informed choice/Open debate - Team internal commitment to the decisions/actions	- Embrace change - Create change - Learn from change - Customer orientation

Table 1 Double loop learning in agile practices

As the ISD agility principles go, we could find double loop learning typical behaviors are embedded in agile practices.

ISD need documentation because the documentation could help easier communication besides the code exchange, help easier competence build up by its clarity and traceability description of the software product. However, these clarity and traceability are a waste, if the corresponding software produced is not what customers want. Also the working software which could be demoed to customer to get feedback could help reduce the cost which is using formal documentation to clarify the expectations and elicit the real requirement. The continuously seeking the feedback and learn from feedback by working software is customer oriented behavior which could enable continuously questioning the ISD project direction and learn from errors. Also the reduced documentation could help reduce the cost of maintain the valid information, and share and communicate within project.

Changes are becoming harder and harder to avoid especially in the ISD projects (the supporting research). For the external changes, which mostly represent customer need, closely link the customer satisfaction. Who could respond quicker to these need, could win more favors of the customer. Top-down plan has less flexibility to give the quick actions on the customer needs. While for the internal changes, which most originates from the project team level, are representing the free decisions better serve for the project team interests, the responding to which could help team internal motivation and thus help boost the team internal commitment.

Double loop learning put high demand on the environments that participants can debate openly and make choices freely. The ISD agility also encourages intensive individual communication with equality and open atmosphere. This effective communication could help individuals learn from each other and clarify the duty of everyone to reach the internal commitment to the self-made choices. It's highlighting the communication goal – valid information rather than the tools and process serving for the communication goal.

The ultimate project goal is to win the customer satisfaction rather than follow the original plan. The double loop learning is giving team the chance to assess their output for this ultimate goal. The behavior of protection of project team and project interest by strict contract negotiation will reduce the possibility to be open to collaboration with the customer thus leads more to win-lose situation.

We could also observe double loop learning is taking effect to help project reach more agile level in two ways --- direct and indirect. Direct way is double loop learning takes effect directly on the existing or classic agile practices to help execute these practices more effectively. While indirect way is double loop learning takes effect to adapt the existing or classic agile practices or influence the environment, e.g., influence the organization structures, etc, to be more agile.

Agile Practices	Ericsson typical behaviors	Double Loop Learning Taking Effect Ways (Direct or Indirect)
Standup meeting	- Record down actions and follow up daily. - Highlight/visualize milestones inside 1 iteration as min-goals. - Record “refactor” and “rework” tasks.	- Direct - Direct - Indirect (by adapting agile practice to highlight task execution quality)
Time-box iterations	- Make iteration roadmap (slogan level iteration goal) as overall project plan. - Define mandatory and optional scope of iteration/project to allow flexibility on scope.	- Direct - Indirect (by changing project commitment model with stakeholders)
Demo	- Invite non-project related people (other project team/management team) into the demo meetings to monitor demo. - Invite members from market/sales to share business cases/experience.	- Indirect (by encouraging open atmosphere in organization) - Direct
Planning game	Add all non-product related requirements (e.g., quality requirement or environment setup requirement) into project scope list to trace from overall point of view.	Indirect (by adapting agile practice to better fit the organization long term goal).
Cross Functional Team	Team setup is fixed with a relatively long period (>6 months)	Indirect (by adapting organization structure to further improve team communication)
Retrospective	Using group discussion (brain storm), mood-curve to warm up.	Direct

Table 2 Double loop learning influence project in two different ways

Table 2 illustrates some concrete double loop learning behavior we identified in the agile practices. We argue that some of the double loop learning behavior will have direct influence to the project, others would have indirect impact to

the project.

In this paper, we review the learning organization and organizational learning literature and build the connection between double loop learning and improving ISD agility. We then build the research model and develop the research hypothesis. The preliminary research result shows that double loop learning behavior could be observed in most of the agile practices, we also find that double loop learning behavior would influence the project, through both direct and indirect ways.

It is widely agreed that learning is critical to company's success, for example, "the rate at which individuals and organizations learn may become the only sustainable competitive advantage, especially in knowledge-intensive industries" [9]; "consensus is emerging that the hallmark of tomorrow's most effective organizations will be their capacity to learn" [10]; "To survive in the turbulent environment, organizations and their workforces must be flexible, far sighted, and able to learn continuously" [22]. This research not only enhances the understanding of improving ISD agility through learning, but has practical implications to ISD practitioners as well.

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