

Pro-active dissemination of Knowledge with Learning Histories

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Abstract. Because they routinely work with intangible goods, software organizations need to be aware of the importance of knowledge. Different knowledge management approaches exist in the literature to help them manage this fundamental asset. However, the current approaches suffer from different problems, like dealing only with explicit knowledge (e.g. in the form of best practices), or focusing on “on demand” knowledge access. In this paper we present a richer, pro-active, knowledge management approach suitable for small or medium organizations. We report on an experiment we conducted with our model.

Keywords: Learning Histories, Knowledge Management, Software Project

1 Introduction

The software business deals essentially with intangible goods, the main one being the knowledge of the members of an organization: the technology evolves on a day to day basis, each new software project requires to learn a new application domain and new business rules, etc. Acknowledging this situation, research proposed techniques to help capture and disseminate knowledge in software organizations (e.g. project review [4,5], the experience factory [2]).

We identified some problems with these techniques: They require a sizeable investment (in time, people, or process) more suitable to larger organizations; they focus on explicit knowledge (e.g. in the form of guidelines or best practices); and they require the users to “pull” (look for) the knowledge from a repository.

In this paper, we propose an approach adapted to small and medium organizations. It is based on a model by Dixon [6] for pro-active knowledge dissemination and a technique called Learning History [8] that allows richer knowledge transfer: In Section 2, we review some models for knowledge management, including Dixon’s model. In Section (3) we present the Learning History technique. We describe our

approach in Section 4, and present a case study in Section 5. We finish with a discussion of related work 6, and our conclusions 7.

2 Knowledge Management

Individuals in organization create and communicate knowledge naturally as part of their work. For example, when one applies a known technique to a new situation, a broader understanding of the technique is created, and when people discuss their problems, exchanging ideas and possible solutions they are sharing or transferring knowledge. One of the purpose of knowledge management is to promote these activities on a larger scale and more efficiently.

Kleiner and Roth [9] explain that if people act collectively in organizations, they learn individually. Given an event, each one will have its own interpretation of what happened, why and how. That is why formal techniques are proposed to help people learn in group and from each other. One such model is that of Dixon [6]. In this model (Figure 1), a team performs a task, reaching a given result (satisfactory or not). From this the team must pause and reflect on what happened and its actions contributed to the result obtained. After this activity, the team has captured and expressed new knowledge (how the action “created” the result) and is in a better position to perform a new, similar, task.

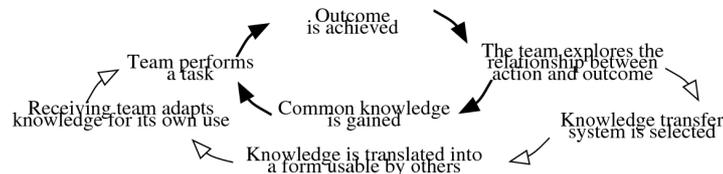


Fig. 1. Creation and transfer of common knowledge (from [6, p.20])

But the knowledge also need to be transferred to other members of the organization. For this, a knowledge transfer system must be selected, the knowledge must be expressed in a form that will allow its transfer (e.g. in a list of “lessons learned”) and, finally, it must be transferred to another team that will integrate it and will be able to use it to perform its tasks. Dixon proposes five knowledge transfer systems according to three dimensions: Who will receive the knowledge? (Do they perform a similar task? What is their learning capacity?) What is the nature of the task? (Repetitive? Frequent?) What kind of knowledge is transferred? (Tacit or explicit?) We will focus on the *far transfer* system that targets transfer of tacit knowledge between two teams performing similar non-routine tasks in differing contexts.

3 Learning History

Learning History is a technique that aims at capturing not only the results of a project of interest, but the mental processes, feelings or opinions of the project's members [11, p.531]. It is a technique for capturing and disseminating knowledge from the various perspectives of the participants of the project. A learning history is the story of the events as told by the people who participated in it. It should present the points of view of all the participants including contradictions and conflicting views. Its goal is not to reach a final verdict or lesson from the event but to present the facts as they were perceived by the participants, allowing the reader to build his-her own understanding and learn from it [8].

Basically a learning history is a two-column document where the right column presents the story as told by the participants and the left column presents comments and analyses made by the historian (see example in Figure 4). The story is organized in sections¹ presenting the various notable results of the project covered.

Kleiner and Roth [8] propose a process for the construction and use of learning history (Figure 2): *Planning*, where the scope of the project is defined and its “notable results” —that justify the need for knowledge transfer— identified. *Reflective research*, where the stories are collected interviewing the relevant persons. *Distillation*, where the relevant topics are selected by the historian to be, later, refined in a form suitable for reading. *Writing*, where the document is created. *Validation*, where the document is validated by the people who told the stories. *Dissemination*, where a receiving team reads the story, discusses it and tries to relate it to its experience to build its own knowledge. Finally, there is a possible *publication* of the story for a larger public.

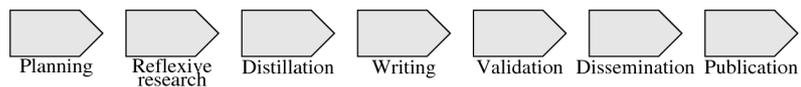


Fig. 2. A process for the construction and use of learning history (from [8])

Some interesting characteristics of learning history are: (i) it includes much more than the mere facts of the project, by telling their stories, people include their opinions, sentiments, belief in the tale; (ii) contradictory opinions may (and should) appear, presenting all the points of view and giving room for the interpretation of the events and results in their broader context; (iii) the “knowledge” embodied in the story is not explicit (e.g. as in best practices or lessons learned), but the participants in the dissemination must construct it from the story and from their own experience and discussion; (iv) although learning histories are mainly presented as large projects resulting in entire books [3,8], it is our experience that they may be done on a smaller scale.

¹ or chapters for larger stories.

4 Knowledge Dissemination with Learning History

This paper details a knowledge management proposition attending to the following requirements: Lightweight approach suitable for small or medium organizations; Richer approach allowing to transfer not only the lessons learned, but their context; Proactive approach where the knowledge is “pushed” to the members of the organization instead of being “pulled” by them when need arises².

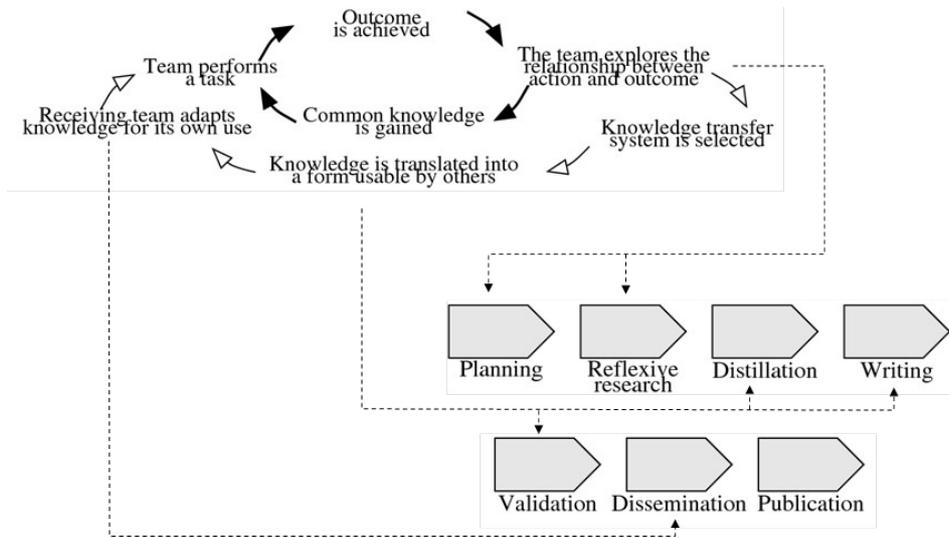


Fig. 3. Mapping of the learning history process to Dixon’s knowledge cycle

We are interested in the kind of knowledge gained during software projects. This kind of knowledge falls in what Dixon [6] calls “common knowledge” and we will therefore follow her knowledge cycle proposal (already presented in Figure 1). One of the steps of this cycle is the selection of a transfer system. Given the characteristics of software projects and their executing team (each project is unique, transfer is from one team to another team doing a similar, non-routine, task in differing contexts), we chose the “far transfer” system. This system is also well suited because it emphasizes a pro-active (push) dissemination.

It should be noted that two additional characteristics of the far transfer system are the independence on technology and the possibility of transferring tacit knowledge. Given the requirements we set for our proposal (particularly the rich context) and the additional characteristics of the far transfer system, we chose the learning history technique to implement Dixon’s knowledge cycle. Figure 3 illustrates how we

² Note that the push model does not exclude the possibility of pulling knowledge when needed.

mapped the learning history process to Dixon's model. Concretely, our proposal is the following: (i) A team realizes a software project (e.g. development of a new system); (ii) some significant result is obtained that justifies preserving the knowledge gained; (iii) interviews of the relevant project members are planned and conducted, this corresponds to Dixon's activity where the team reflects on the relation between its action and the results, it is also the 1st and 2nd steps in the learning history process (planning and reflexive research); (iv) knowledge is converted in a form suitable for dissemination in the next 3 steps of the learning history process (distillation, writing and validation); (v) later, at the beginning of a new project by another team, the story is recovered (we will see how soon) and the receiving team adapts the knowledge to its own necessities during a dissemination meeting (see below); (vi) the history may eventually be published so that it is available to other teams on a "pull" basis.

To complete the description of our proposal, we need to explain how the dissemination occurs: Before starting a new project, a learning history of interest is selected from a repository and presented and discussed within the receiving team. For this, one must first, find a story of interest for a given team and project, and second, concretely use it for knowledge dissemination.

We propose to add to the learning history a tagging system where the various topics treated in the story would be marked according to some categories coming from a taxonomy such as the one proposed in [7]. For example, a particular topic would be tagged "concept=process; instance=USDP" for a topic dealing with how the USDP was used in a project. At the beginning of a new project, the project leader selects, from the taxonomy, some concepts s-he would like to improve in the team. This could be done based on past mistakes on other projects, or on an evaluation of the critical risks for the new project. Given these concepts of interest, s-he would look in the base of story for some stories dealing with these concepts.

The dissemination is done in a workshop (meeting) structured as follows. First, a week in advance, all members of the receiving team receive a copy of the learning history and some instruction on how to prepare for the dissemination meeting: the story will be discussed during the meeting and, as such, they should read it beforehand and analyze the historian's comments; they should write down questions, reactions, comments in the story; they must compare the setting of the project described with their experience; and, finally, they may not discuss the story between them before the meeting as such discussion should happen with all members present. The meeting in itself includes two parts. First, the story is discussed, to check whether there are comments or questions about it and what each one understood of it. Second, the receiving team adapts the knowledge (contained in the story) to its own necessities by discussing what is similar between the project described in the story and the project about to start? What good result could be replicated or what mistake should be avoided? How the story may impact the future project?

³ If the knowledge management initiative is just beginning, it is important to clearly state what is knowledge management, what the meeting aims at, etc.

5 Case Study

As a case study, we created one learning history from a project and realized a dissemination workshop to another team about to start a similar project. The particular project of the case study was selected because: It was an innovative project (it used a new process and the team was mostly freshly hired); it was expected to be the first of a series of others occurring in similar conditions; it was rich in notable results (both positive and negative); we had easy access to its participants; and we knew well the project in itself (although none of us participated in it). This project lasted 7 months and involved 2 business analysts, the head of the department, one project manager, 2 (internal) clients, and some users consulted when more details were needed on some particular area.

We conducted five interviews (1 manager, 2 clients, 2 business analysts) for a total of 3 hours of interview. The cost of the total case study is summarized in Table 1 and was judged acceptable given the size of the project. A small part of the resulting story (which has 20 pages) is presented in Figure 4. The dissemination was conducted in a 3 hours meeting with a team of 5 persons, about to start a project in similar conditions. One of the authors is the project manager (of the new project) and acted as moderator during the dissemination meeting. The overhead of the initiative is very small, about 1 week (39 man/hour) to build the history for a 7 months project with five interviewed of the first team (the actual team was larger than that), and 18 man/hours for the dissemination for the new project (the dissemination is not dependent on the length of the new project, but on the size of the new team).

Table 1. Cost of a knowledge cycle using learning history

Activities	Duration	Participants	Total man/hour
Planning	1 h	Historian	1 h
Interviews	3 h	historian & team members	6 h
Story transcription	12 h	secretary	12 h
Document conception	20 h	historian	20 h
Story reading	?	new team	?
Dissemination workshop	3 h	knowledge manager & new team	18 h

Beginning of all: Information	
The [organization] produces information on agribusiness and supply chain. Produced indicators were treated by different departments, historically with communication problems. As a result, each department created its own reports with redundant information and differing formats (from the other). The SIA project aims at correcting this problem.	
<i>System's goals: Organize and make accessible</i>	SUPER-INTENDANT: Based on the [organization]'s strategic planning, some goals were defined, which were exactly that the [organization] would become a reference in terms of providing information and knowledge in the agricultural supply chain sector. So, to actually fulfill this goal, an internal

<i>information in order to fulfill the strategic goals of the organization</i>	<p>reorganization was needed. This is where the SIA fits, and also the reason why it was set as a priority.</p> <p>MANAGER: In the 90's, we developed a system for pricing, that is now called "agripricing". Later new tools appeared on the market, the [organization] went from mainframe to client/server, and we would always talk about the necessity to have a project where we could map all the information on the agribusiness, not only prices.</p>
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Fig. 4. Excerpt from a learning history (translated from Portuguese).

The meeting was evaluated very positively by the participants, one of them actually proposing that the organization should generalize this kind of proactive knowledge dissemination action (he did not know the details of the research and that this was our goal from the very beginning). Another evaluation showed that some conditions necessary to learning were actually fulfilled⁴. These conditions are [13]: mutual trust, positive empathy, assistance access, kind judgment, and courage. We found that three of these conditions were fulfilled, and that we lacked data to reach any conclusion in two. We evaluate that this lack of data was due to the first part of the meeting (understanding of the story) having taken too much time. During this part, little knowledge is actually created. The second part (adaptation of the story to the team's reality) had to be interrupted before it was actually completed. This is something that we plan to correct in the next dissemination meeting.

The tagging of the story and retrieval from a repository has not been tested.

6 Related Work

We found some propositions in the literature related to our work. All failed to meet the requirements we listed in section 4.

Project review [4,5] (also known as postmortem analysis or project retrospective) is a knowledge capture technique. It can be used for example to capture knowledge in the Experience Factory (see next item). A project review does not consider dissemination explicitly but some dissemination may occur inside a team performing jointly a project review. It also tends to insist on the lesson learned to the detriment of more contextual and richer knowledge.

The *Experience Factory* [1] is a heavy structure. It is not meant to be proactive, neither does it normally consider the kind of rich contextual information that we are looking for. A new proposition (dust-to-pearl) [2] introduces a shorter feedback loop and a lighter structure, however it still does not support proactive dissemination of knowledge or contextual information. A related approach [10] proposes to mix Case Based Reasoning (CBR) and the Experience Factory. The work still focuses explicit knowledge, contextual information being "provided" by the author of the knowledge whose name is recorded.

⁴ Instead of evaluating whether learning actually occurs, which is difficult, one may evaluate whether the conditions, or the organizational environment, are favorable to learning.

Tautz [12] proposes a experience lifecycle model for creation and improvement of knowledge stored in an experience base. The focus is on explicit knowledge with tools to support dissemination.

7 Conclusion

In this paper, we proposed a new knowledge management approach for software projects having the following characteristics: pro-active dissemination of the knowledge, suitable for small to medium organizations, rich contextual information about the knowledge. Our approach is based on a knowledge cycle by Dixon [6] and the Learning History technique.

Although we still lack one small part of the model (indexation of the stories and retrieval from a repository), we conducted a first experiment that showed that the capture and dissemination of the knowledge actually happen at a relatively low cost.

References

1. Victor Basili, Patricia Costa, Mikael Lindval, Manoel Mendona, Carolyn Seaman, Tesoriero Roseanne, and Marvin Zelkowitz. An experience management system for a software engineering research organization. In *Proceedings of the 26th Annual NASA Goddard Software Engineering Workshop*. NASA Goddard Space Flight Center, 2001.
2. Victor R. Basili, Gianluigi Caldiera, and H. Dieter Rombach. *Encyclopedia of Software Engineering*, volume 1, chapter The Experience Factory, pages 469–76. John Wiley & Sons, 1994.
3. H. Bradbury and C. Mainemelis. Learning history and organizational praxis. *Journal of Management Inquiry*, 10(4):340–357, 2001.
4. Kleiber D. de Sousa, Nicolas Anquetil, and Káthia M. de Oliveira. Learning software maintenance organizations. In Grigori Melnik and Harald Holz, editors, *Advances in Learning Software Organizations – 6th International Workshop, LSO 2004*, number 3096 in Lecture Notes in Computer Science, pages 67–77. Verlag, June 2004. ISBN 3-540-22192-1.
5. Torgeir Dingsøy, Nils Brede Moe, and Nytrø Øystein. Augmenting experience reports with lightweight postmortem reviews. *Lecture Notes in Computer Science*, 2188:167–181, 2001. PROFES 2001, Berlin, Germany.
6. Nancy M. Dixon. *Common Knowledge: How Companies Thrive by Sharing What They Know*. Harvard Business School Press, 2000.
7. R.A. Falbo, C.S. Menezes, and A.R.C. Rocha. “Using ontologies to improve knowledge integration in software engineering environments”. In *Proceedings of the World Multiconference on Systemic, Cybernetics and Informatics / 4th International Conference on Information Systems Analysis and Synthesis*, jul. 1998.
8. Art Kleiner and George L. Roth. *Learning about Organizationl Learning – Creating a Learning History*. MIT Center for Organizational Learning, 1995. Accessible at: <http://www.solonline.org/static/research/workingpapers/18001.html> Last access: 06/18/2005
9. Art Kleiner and George L. Roth. Learning histories: A new tool for turning organizational experience into action. *Harvard Business Review*, sept./oct. 1997.

10. Markus Nick, Klaus-Dieter Althoff, Thomas Avieny, and Bjorn Decker. How experience management can benefit from relationships among different types of knowledge. In *Proceedings of German Workshop on Experience Management*, page 10. Lectures Notes in Informatics, 2002.
11. Peter Senge, Art Kleiner, Charlotte Roberts, Richard Ross, George L. Roth, and Bryan Smith. *The dance of change: the challenges of sustaining momentum in learning organizations*. Nicholas Brealey Publishing, London, 1999. ISBN 1857882431.
12. Carsten Tautz, Klaus-Dieter Althoff, and Markus Nick. Learning from project experience—a case study on experience factory. In *Proceedings GI-Fachgruppentre en Maschinelles Lernen, FGML'00*. Sankt Augustin, GMD, 2000.
13. Georg von Krogh, Kazuo Ichijo, and Ikujiro Nonaka. *Enabling knowledge creation*. Oxford University Press, New York, 2000.