

# Knowledge Transfer Support Tool for R&D Project Management

## - Linking Awareness-on-Project and Awareness-in-Project -

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In recent years, importance of project management in research and development (R&D) in companies is well recognized. Since it is difficult to establish codified project management knowledge in R&D projects, knowledge transfer among project managers becomes important. The most important knowledge is awareness ability for future chances and risks. The authors have proposed a knowledge transfer method utilizing a project case database. This paper proposes wiki-based tool for supporting this method. Using this tool, project managers can be aware of future chances and risks by studying similar project cases. The characteristic features of this tool include linking awareness-on-project and awareness-in-project based on project review checkpoints and project phases.

Key Words & Phrases: Project Manager, R&D Project Management, Knowledge Transfer, Project Case Database, Wiki

### 1. Introduction

In era of global competition, the ineffectiveness of research and development is recognized as a critical issue in Japanese manufacturing companies. There are several reasons for the ineffectiveness, including inability to meet the structural change of innovation and to gain exclusive profit from innovative technology. Quality of project management also affects the effectiveness of R&D. Several management tools, such as stage gate [1] and phase review [2], have been introduced in R&D project management. However, they tend to become a dead letter if managers lack sufficient skills and knowledge to utilize these tools. In fact, it is not easy to gain sufficient skills and knowledge because each manager participates in a limited number of projects. We focus on project management knowledge of R&D managers and have been developing a method of project management knowledge transfer in order to share skills and knowledge in the same organization [3][4][5][6]. In the proposed method, a project case database is utilized. We also implemented a wiki-based project case database, which deals with only past project cases and no relation with the ongoing project [7]. This paper proposes a new wiki-based tool featuring linking past projects and a target ongoing project by using a new concept (“awareness on project” and “awareness in project”).

### 2. Literature Review

Since knowledge of new technology and product development is recognized as a core competence in manufacturing companies, there is much research on knowledge transfer [8][9][10]. However, most of this research focuses on knowledge transfer of technology and there are few reports on project management knowledge transfer. Project management knowledge is structured and standardized as PMBOK (Project Management Body of Knowledge). But PMBOK does not mention the knowledge transfer procedure, especially in regard to knowledge internalization.

Niwa and his colleagues proposed a knowledge transfer support system for large plant construction project management where useful project management knowledge is codified in an expert system [11]. Since the expert system can generate only knowledge which was stored, they developed a human-computer cooperative systems that support human awareness ability. Aoshima and Nobeoka introduced “project knowledge” and considered knowledge transfer in automobile manufacturers [12]. Hitachi Ltd. has implemented the organizational learning process for project management knowledge of software development and plant construction project. This process consists of three steps: knowledge externalization by failure analysis, knowledge crystallization by a project management office, and knowledge internalization in organizations [13][14]. Compared with project management in plant construction, software development, and automotive development in which the target product requirements are clear, R&D projects involve many uncertainties

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and risks, and therefore additional considerations are required. The New Energy and Industrial Technology Development Organization (NEDO) has investigated its past projects through post-project review and developed “NEDO R&D Management Guidelines” in which the reviewed past project cases are linked to a project management checklist [15]. These activities are a step in the right direction but they do not amount to the concrete procedure of a knowledge transfer process of R&D projects.

In our previous papers, we proposed a method of project management knowledge transfer and introduced a project case database which is used as boundary objects of knowledge transfer [3][4][5][6]. We also developed a wiki-based project case database for supporting browsing project cases [7]. In these researches, we mentioned a support mechanism for linking past projects in the project case database to the target ongoing project is one of remaining future works. This paper is intended to address this remaining agenda.

### 3. Knowledge Transfer Model

Figure 1 represents the proposed knowledge transfer model consisting of knowledge externalization and knowledge internalization. Here, we suppose knowledge transfer among different generations in the same organization, which provides a contextual environment “Ba.” The senders of knowledge externalize their knowledge as boundary objects. The receivers internalize the knowledge through boundary objects. A boundary object is a codified medium of knowledge transfer [16] and boundary objects are structured using the structure of organizational knowledge.

Figure 2 shows the knowledge transfer process in R&D project management based on the model. This process consists of knowledge externalization in post-project review (PPR) and knowledge internalization in project phase review (PHR). Table 1 shows purpose and function, timing, participants, and method of PPR and PHR. Awareness in PPR and PHR is mentioned later, which is a key point of this paper.

“Structured project analysis” is a method of knowledge externalization that reviews a finished project and produces a structured project case in the post-project review. The structured project analysis clarifies success and failure factors of the project. This

structured project case is utilized as a boundary object in the context of knowledge transfer.

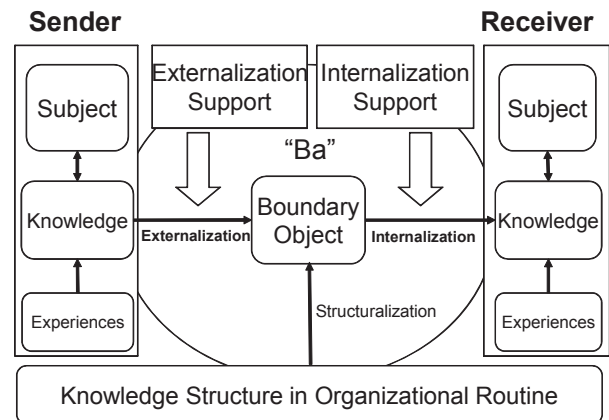


Figure 1 Knowledge Transfer Model with Boundary Object

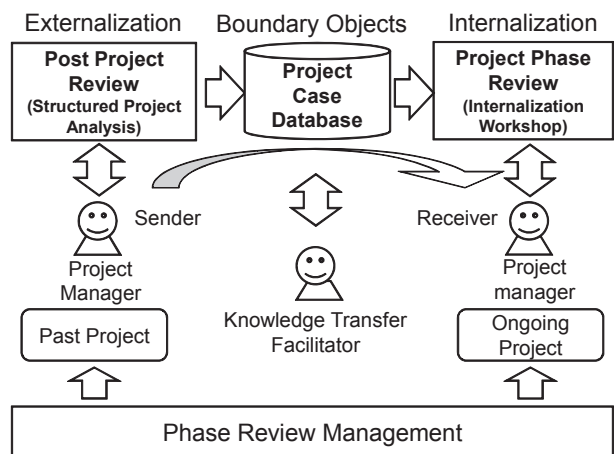


Figure 2 Knowledge Transfer Process in R&D Project Management

Table 1 Post-Project Review and Project Phase Review

	Post Project Review (PPR)	Project Phase Review (PHR)
<b>Target</b>	Finished past project	Ongoing project
<b>Purpose and Function</b>	Externalization of knowledge which should be learned from the past project.	(F1) Recognition and sharing of future chance and risk items and action items to improve the project. (F2) Decision-making in project management using results of (F1).
<b>Timing</b>	When the project has finished.	When the project is reviewed in phase transition.
<b>Participants</b>	Project manager, project members, facilitator.	Project manager, project members, stakeholders, facilitator.
<b>Awareness</b>	Awareness-on-action	Awareness-in-action
<b>Method</b>	Structured project analysis	Internalization workshop

Figure 3 shows a structured project case in which we introduce three types of structures to the traditional text-based cases:

- (1) Phase review framework:  
Phase structure (e.g. idea discovery, concept generation, feasibility study, development, testing and validation, product production and launch, and product support).
- (2) Review checkpoint areas:  
4 areas (technology, market, business structure, human resources and organization) of the review checklist. Table 2 shows an example of checklist consisting of 22 items classified into 4 areas. This checklist has been used in project phase reviews in the R&D organization.
- (3) Causal relations of success and failure factors:  
The structured project analysis clarifies success and failure factors of the project with these structures as a manager’s aware items. Each aware item explains a causal relation of failure and success from the manager’s view.

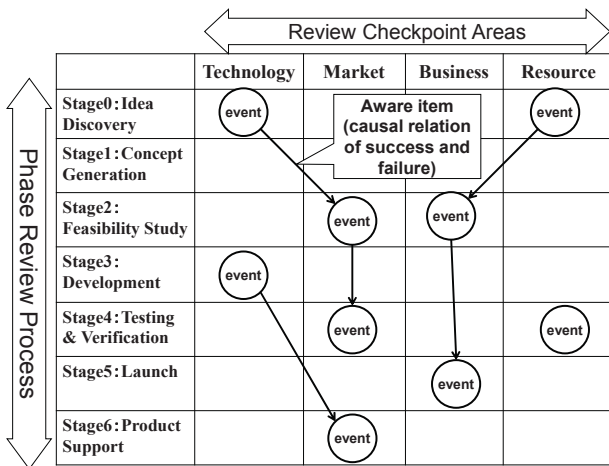


Figure 3 Structured Project Case

The extracted project management knowledge is stored in a project case database. However, it is not trivial for project managers to internalize the knowledge using the case database. A case method using cases in the database is an effective way to internalization of the knowledge. However, the case method forms a scheduled class room education, and cannot timely meet demands from managers of the ongoing projects. Therefore, we also propose the "internalization workshop" method in a project phase review for managers to internalize the project management knowledge based on the analogical transfer approach. The method selects success and failure scenarios from the case database that have

some similarities to the ongoing target project and shows them to the managers. Then, the method prompts the managers to imagine and analyze future scenarios (future chance and risk items) of their target ongoing project by analogy and take action concerning them. The internalization workshop is held in the first half of the project phase review ((F1) in Table 1).

Well-structured project cases can improve quality and motivation of project phase reviews. Good project phase reviews leave qualified records of projects, which improve post-project reviews. The combination of post-project review and project phase review utilizing the knowledge transfer method can create a virtuous cycle of organizational learning. It can improve R&D project management quality, and then improve the success probability of R&D projects.

Table 2 Example of Checklist

	Area	Check Point
1	Technology	Strong core technologies
2	Technology	Robustness of core technologies
3	Technology	Sufficient system technologies
4	Technology	Sufficient process technologies
5	Technology	Standardization & Regulation
6	Technology	Killer application
7	Technology	Unbiased consideration
8	Marketing	Future big market
9	Marketing	Changing point
10	Marketing	Real needs
11	Marketing	Competitor
12	Marketing	Alternative technologies
13	Marketing	Contextual consideration
14	Business	Responsible business unit
15	Business	Strategically fitness
16	Business	Utilization of business unit
17	Business	Sharing chance and risk with business unit
18	Resources	Communication among stakeholders
19	Resources	Strong leadership
20	Resources	Key person's support
21	Resources	Utilization of outside resource
22	Resources	Resource & risk management

#### 4. Awareness and Organizational Learning

In project management, awareness ability of a project manager is a key for success. If a manager can be aware of future chances and risks earlier, the manager takes actions earlier in order to reduce the risks and make a good use of the chances. Usually, awareness ability can be learnt through experience and depends on personal career. However, as mentioned, it is not easy to learn it in R&D projects, then organizational learning is required. We think knowledge transfer is a good method to foster awareness ability as an organizational learning.

We classify awareness into two types: “awareness on project” and “awareness in project”.

**Awareness-on-project (Backcasting)**

A manager’s insight of cause-and-effect relations clarifying success and failure factors of the finished project which are aware in a post-project review (PPR). The manager can learn knowledge from his project.

**Awareness-in-project (Forecasting)**

A manager’s insight of cause-and-effect relations forecasting future chances and risks of the ongoing project which are aware in a project phase review (PHR). The manager can learn knowledge from other finished project.

Figure 4 shows relation of two types of awareness. From organizational learning, both types of awareness should be treated in the same way

Classification of awareness (awareness on project and awareness in project) is conceived from Schön’s concept of reflection [17]. However, to avoid confusion, I define two types of awareness independently of Schön’s concept of reflection.

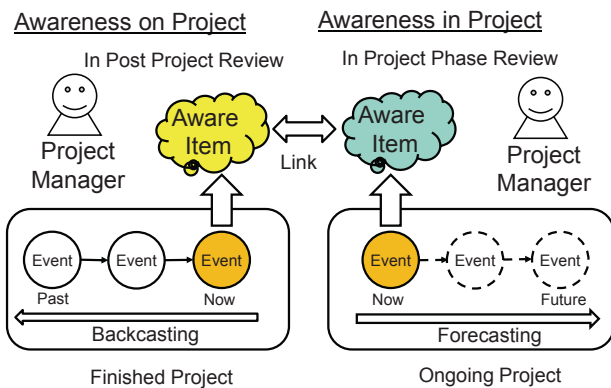


Figure 4 Awareness on Project and Awareness in Project

5. Knowledge Transfer Support Tool

We have been developing a knowledge transfer support tool which fosters a project manager’s awareness ability in both post project review and project phase review. Aware items are linked to projects based on project management viewpoints (technology, marketing, business structure, and resources) and project phases. This tool is implemented by the wiki software (pukiwiki) considering flexibility and extensibility. The wiki’s hyperlink function is utilized for linking aware items and projects.

Figure 5 shows the linking structure of events of project, project management viewpoints, project phases, and project attributes, that corresponds to phase review framework and review checkpoint areas in Figure 3.

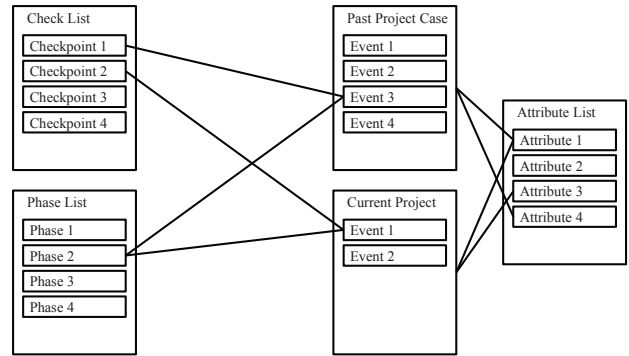


Figure 5 Linking Project Events and Checkpoints and Phases

Figure 6 shows the linking structure of aware items, events of project, project management viewpoints, project phases, and project managers in the organization. Each aware item corresponds to a cause-and-effect relation of Figure 3. Figure 7, 8 and 9 show interface screen shots of the wiki tool. While the linking structure of events, checkpoints and phases in Figure 5 is stable, awareness of Figure 6 depends on person and may be changing over times. In some cases there exist opposing aware items which are registered by different persons and timing. Therefore, the linking structure of events, checkpoints and phases (Figure 5) and the linking structure of awareness (Figure 6) should be implemented by different ways. While awareness on project is registered in the post-project review, awareness in project is registered in the post phase review by referring awareness on the related finished project.

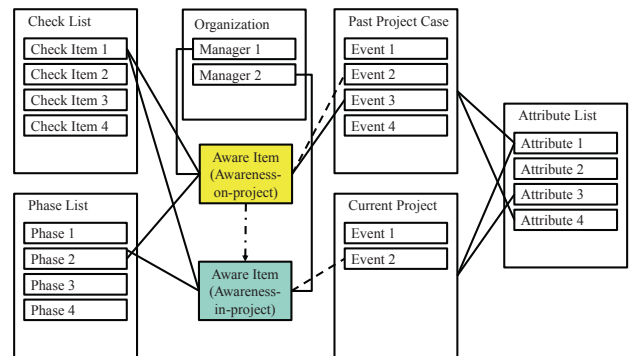


Figure 6 Linking Awareness-on-Project and Awareness-in-Project

When the ongoing project will be finished, awareness in the ongoing project will be used as source of awareness on project in a post-project review.

We explain a typical use case of the wiki-based tool for a manager to create a new aware item in a project phase review:

- (1) A project manager selects a similar project to his ongoing project using project attributes (target business, business model, technology type, etc.) in the top menu. Then he understands a summary of the project. If the ongoing project is relating to healthcare, the manager browses and selects one of healthcare-related projects (e.g., healthcare chip project) in Figure 7.
- (2) The manager selects an aware item of the similar project which he feels some anxiety about relating to his project in the aware item list. In Figure 8, there are several aware items that explain success and failure factors of the selected project (healthcare chip project).
- (3) The manager read events linked to the aware item and understand what happened in the similar project.
- (4) The manager browses other aware items of other project with the same check item and selects one of them.
- (5) The manager read events linked to the aware item and understand what happened in the selected project.
- (6) The manager becomes aware that his ongoing project has a similar chance or risk.
- (7) The manager creates his new aware item (future chances and risks) in analogical thinking and registers it in the ongoing project case database with link (Figure 9).
- (8) The manager does the same process repeatedly.
- (9) Finally, the manager collects all his aware items of his ongoing project and makes action items in order to reduce risks and make a good use of the chances.



Figure 7 Screen Shot of the Tool (top menu)



Figure 8 Screen Shot of the Tool (aware item of the similar past project)



Figure 9 Screen Shot of the Tool (aware item of the ongoing project)

## 6. Conclusions

Zedtwitz mentioned that the post-project review in R&D projects is effective for organizational learning but there are several barriers for organizations to use it [18]. Software tools are one of approaches to reduce the barriers. We have developed a knowledge transfer support tool for R&D project management which can deal with both awareness on project and awareness in project. Awareness ability is a key for success in project management. Future works include establishment of awareness based organizational learning and development of a navigation function to support the organizational learning.

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