

A Training Method Proposal for R&D Project Managers

Mamoru Kiyota, Hiroshi Kubo

Chiba Institute of Technology, Department of Management and System Engineering, Narashino, Chiba, Japan

Abstract--When a research and development (R&D) technology leads to the development of a product, obstacles occur such as the so-called "Valley of Death" and the "Devil's River."

Our earlier study reported on conquering obstacles in applying new project management processes in R&D, depending on the level classification of R&D technology themes.

However, in many cases, there is no project manager (PM) in the R&D section and it is necessary to train PMs to handle these processes.

A new method is proposed for short-term training of PMs in the R&D section, as per the level of the R&D technology theme, using progressive tool utilization and applying the meeting administration technique. Also the risk management method that is particular to the R&D section is applied for training of PMs. Further, it was demonstrated that a PM in the R&D section—after acquiring project management skills—can be a part of the project team of the product in development, and contribute in the formulation of a smooth and effective process from R&D to product development. The result of training method and the effectiveness in several R&D technology themes were exhibited.

I. BACKGROUND OF THIS STUDY

The project management measures systematized in Project Management Body of Knowledge (PMBOK) ®[1] is utilized in projects such as the construction of buildings and bridges, IT systems, and event management. In the PMBOK, a project is defined as "A project is to create a unique product, service, or result. A project is that it has a defined beginning and end in time, and therefore defined scope and resources."

Project management is utilized in product development. The RICOH company Ltd. (RICOH), which mainly produces and sells photocopiers and printers, successfully applied integrated product development process (IPD) [2] into product development, a project management process of the IBM Corporation. In contrast, in case of R&D, project management has not been utilized positively. For example, Cooper states that project management is required in the latter half of the R&D stage when a business design becomes clear [3]. The purpose of R&D is to provide clarity to complex techniques, however even with clear goals there might not be a fixed objective. Therefore, clarifying an objective through project management methods is considered difficult in R&D.

However, obstacles such as "Devil's River" and "Valley of Death" are known to occur during the R&D process that leads to success in the product market [4][5]. Therefore, RICOH applied an unconventional project management method that was arranged for R&D process to R&D section to conquest the "Devil's River" and the "Valley of Death" and reported success in some cases [6] [7]. However, project management

administration is not common in the R&D section, and there are few, if any, experienced PMs in many cases. Therefore, it is necessary to train PMs in the R&D section before developing project management processes suitable for R&D.

II. SUMMARY OF EARLIER STUDIES

A new project management method was applied to the R&D technology theme in the earlier study of the R&D section of RICOH, and reported a few successful instances in conquering the "Devil's River" and the "Valley of Death" [6] [7]. The following steps constitute the process of setting up a new business that is, achieving Commercialization and Industrialization from elemental R&D technologies.

(R)Research→(D)Development→(C)Commercialization
→(I)Industrialization.

The process between (R) and (D) is referred to as the "Devil's River," between (D) and (C) as the "Valley of Death," and between (C) and (I) as the "Sea of Darwin," and they are said difficult to conquer [4] [5].

The initial investigation was conducted with the cooperation of a consultant, which is one reason why project management was not utilized in the R&D section of companies. Consequently, it was discovered that initially project management was not suitable for an R&D theme due to unclear objectives and high uncertainty. In addition, the preconception that the effects will be minor acted as a disincentive.

Therefore, RICOH developed and studied a project management method appropriate for R&D, enabling it to conquest the "Devil's River" and the "Valley of Death." First in Study 1 [6], RICOH overcame the "Valley of Death" using limited highly completed technology themes located between R&D and product division; subsequently in Study 2 [6], RICOH used the whole R&D technology themes to conquest the "Devil's River." The detailed methodology is as follows.

(Study 1) Conquest of the Valley of Death [6].

(Target themes): Highly completed R&D technology themes when commercialization is relatively near

(Problems): There was disassociation between the R&D section and product divisions without development activity, information, and cooperation of the personnel between the R&D section and the product division.

(Method): A cross-functional project team was attempted and put together between the R&D section and the product division.

(Result): There was robust development in both R&D and in

the product development process. One theme in on two themes developed a new business and conquered the Valley of Death.

Reasons for the obtained effective results are as follows:

- The result images was able to communalize for the future between the R&D section and the product division,
- Intention and technical terminology were able to communalize between the R&D section and the product division,
- A output delivery level and a decision degree of the result was able to share,
- The common developmental assets of both sections was able to utilize.

(Study 2) Conquest of the Devil’s River [7].

(Target theme): All R&D technology themes

(Problems): The theme’s commercialization target, its stage-gate to commercialization, and its relation with product division are uncertain

(Method):

- A premise of flexible objective was adopted.
- A theme matrix was prepared based on people participation and an technology completed level with a three-level classification.
- A tool inflection standard was prepared for project management at each level.
- A stage-gate and method was established in R&D
- The level of correspondence was specified with product division according to the technology completeness.

(Result): From eight, the technologies of four themes was successfully adopted for a product and conquered the Devil’s River.

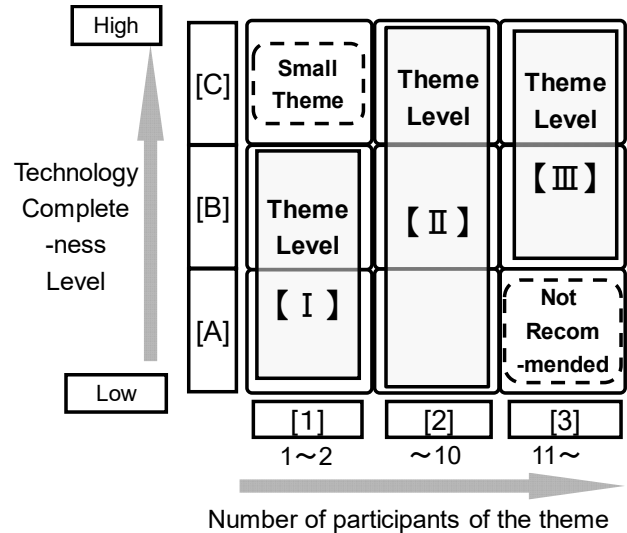
Reasons for the obtained effective results are as follows:

- The utilization of the project management tool was useful at each level,
- The relationship between the R&D section and product division regarding the product development process was clearly defined,
- Intention and technical terminology were able to communalize between the R&D section and product division,
- A delivery level and a decision degree were able to share for the R&D result.

The details of the study are as follows. First, the conception diagram was discussed, which is shown in Study2 [7]. Here, R&D technology themes were classified in nine boxes, with people participation (horizontal axis) [1][2][3], and a technology completeness level (vertical axis) [A][B][C], and named it an “R&D-theme 3x3 matrix” (3x3 matrix). Figure 1 is the conception diagram of the 3x3 matrix. Generally, the R&D technology themes progress from the lower left to the top right corner. Further, the technology is

shifted to product division by switching from the upper line of the matrix.

The recommendation tool list was shown for project management, which was suitable for every theme classification of each [I][II][III] and promoted project management based on tool utilization. (Details in Section 5) Actions of R&D section undertook with the product division, as this depends on a technology completeness level with product division on the vertical axis. In addition, a stage-gate management was conducted as the theme progressed and crossed the border of each box into the next.



[Figure 1] R&D theme classification of “R&D-theme 3x3 matrix”

Regarding the [3] [C] box theme, which was in high technology completeness level and relatively near product, the organization cross-functional project was developed with product division in Study1 [6].

A conquest of the “Valley of Death” as the cross-functional project was confirmed with an intermediary role in product business.

III. PURPOSE OF THIS STUDY

Generally, PMs did not exist in R&D section because there were no project management process ever. Several PMs exist in the product division; however, there is a limitation on transfer of PM human resources from the product division to the R&D section. Therefore, it is necessary to train theme leader as PM to develop suitable project management skills in the R&D section mentioned in section 2.

The purpose of this study is to confirm the importance of solving the following items (1) (2) to train PM candidates in R&D section accordingly:

- (1) Suggest hypothesis methods for the PM candidates training necessary to develop suitable project management skills for R&D and show the performance evaluation of training.

- (2) Evaluate the effectiveness of trained PM skill toward the development to conquer the Valley of Death and the Devil’s River.

IV. HYPOTHESIS OF PM’S SKILL IN THE R&D SECTION

First, the duration was considered of project management experience necessary for training a PM.

To have a PMP® certification [8] which is a project management qualification of PMI®, leading and directing projects experience is needed of 7500 hours for a person of secondary degree (high school diploma, associate’s degree or the global equivalent), and 4500 hours for a person of four-year bachelor degree. Gladwell states that 10000 hours are necessary to become an expert in any field [9]. Briefly, it is clear that several thousand hours of project management experience is necessary for a project manager to acquire competency. In the case of RICOH, the problem was that a majority of PM candidates were young engineers who were inexperienced in project management. According to the investigation conducted by NIKKEI SYSTEMS [10] in system development, the following three characteristics are required for the development of project managers.

- a: Project management ability (ability in the main volume of PMBOK®[1])
- b: Technology (technical development capability in the applicable field)
- c: People skills in project management

In addition, the findings showed that projects fail due to lack of a (44%), b (12%), and c (45%).

People skill includes the following elements mentioned in PMBOK® [1] “appendix”, Idiot’s Guide to Project Management [11] “Essential People Skill for Project Managers”.

- leadership • team formation • incentive • communication • influence • decision making
- recognition of the political culture • negotiation • listening • empathy • fairness etc.

In addition, the Idiot’s Guide to Project Management states the following evaluations regarding experience levels and skill. Real R&D technology themes in RICOH was confined to 20 people. The skills required for a PM in the

R&D technology theme is of an entry-level equivalent to that represented by A: Project Manager in Table 1.

Some technology theme leaders had enough results of technology development in RICOH R&D section, it is estimated they had sufficient technical knowledge and some social skills. However, they had not have experience of developing the project management method; therefore, they are considered suitable as PM candidates for theme development of R&D if they have education and training of project management.

In summary the skill-set and hypnosis of eight themes leaders of the RICOH R&D section were as follows:

- (1) They had the basic ability, experience, and social relationship skills required to propel an R&D technology theme.
- (2) However, they had no experience of project management methods
- (3) Therefore, training of project management suitable for R&D is effective for them in short time

It is estimated that this is the general situation in an R&D section.

V. METHOD TO TRAIN PMS IN R&D SECTION IN A SHORT TERM

In this section, a method of training for PMs are discussed in project management suitable for R&D.

At first contents are summarized of the tool utilization that was reported in earlier studies [6] [7].

When discussing the RICOH R&D case, it is simplified an R&D process based on PMBOK®[1], stated the requirements of each process and decided to establish the project management tools applied to each process. The following nine tools were recommended in the earlier study.

- (1) Theme proposal, (2) Responsibility assignment matrix (RAM), (3) Communication plan, (4) List of demand works information, (5) Unification schedule management, (6) Action item management tracking list. (7) Responsibility management plan, (8) Work breakdown structure (WBS), (9) Risk plan management.

In the earlier study, the table 2 was shown as the recommended tools list, Tool (1) to Tool (9), that should be used for R&D technology theme level [I], [II], [III] in a 3x3 matrix.

[TABLE 1] PROJECT MANAGEMENT SKILL LEVEL
(Modified quotes from the Idiot’s Guide to Project Management, p. 346, 2014 [11])

	A: Project Manager	B: Senior Project Manager	C: Program Manager
Typical Nature of Project/Program	Low Risk (small project)	Middle Risk (big project)	High Risk (program)
Project Manager Skill	Entry-level project Manager	More experienced in project management	Strong customer Relationship and management skill
Project tools and Techniques	Fundamental	Advanced	Expert
Project skills	Fundamental	Advanced	Expert

[TABLE 2] RECOMMENDED PROJECT MANAGEMENT TOOL SET TO THE LEVEL OF THE R&D TECHNOLOGY THEME [6][7].
Depends on technology theme level of [I], [II], [III] on the 3x3 matrix

Tool recommendation level		⊙ : Essential	○ : Desirable	△ : Use it if effective
Theme Level	【 III 】	All nine tools	—	—
	【 II 】	(1)(5)(8)(9)	(3)(6)(7)	(2)(4)
	【 I 】	(1)	(5)(8)(9)	(2)(3)(4) (6)(7)

The following three new R&D PM training methods are suggested in this study.

[Method a]: In each nine-tool, set the graded utilization degree at level of difficulty level and practice it in R&D project administration.

[Method b]: A meeting administration process was systematize in which we apply those management items exclusive to R&D.

[Method c]: The reasons for delays were analyze in R&D projects, predict them, and formulate solutions through a risk management process.

[Method a]: Details

First, a degree of difficulty was set for each 9 tool. Depending on the application skill of PMs, we set five-phased degree of difficulty of 0–4. For setting, the original utilization process was adopted for R&D.

The original R&D utilization process characteristics was explained, compared to project management of the product division, is mainly an uncertainty of themes. Project management serves as a method to achieve a product development target such as building architecture, we call this conventional project management as compare with the R&D type project management. However, in the case of R&D, the mission of the theme itself is to provide clarity on an uncertain objective. Therefore, we classify a clear part and an uncertain part for each technology theme. It is important that a process removes uncertainty while being conscious of it. A process was demonstrated for establishing an objective in the 3x3 matrix in Figure 2 considering a progressive alignment with stakeholders and push forward development.

removing the uncertainty progressively that was part of the original theme. In the part of the process a discussion and agreement with the stakeholder is necessary at each time.

In nine tools, a tool usage method was adopted, which is exclusive to such an R&D process, depending on the degree of difficulty. Among the nine-tool set we first examine Section 5, with an example of WBS (Tool 5). With WBS, the five phases of difficulty were described as follows, with level 0 being when the PM cannot utilize this tool at all, and level 4 which is the highest utilization level. Level marked with symbol * are particular characteristics of R&D administration of WBS.

Level 0 : The breakdown of activities (work package) is not clear

Level 1 : Activity items are grasped and come in appropriate breakdowns

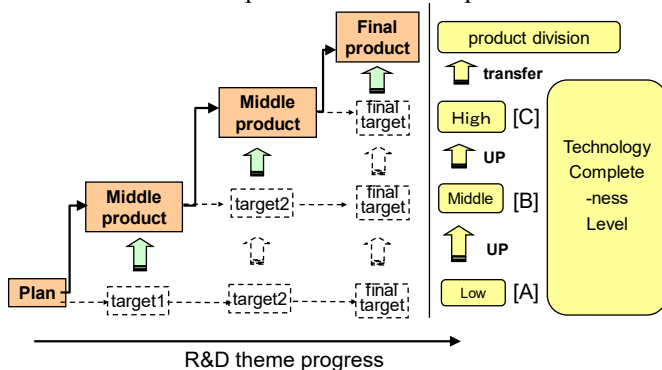
Level 2 : The individual in charge of all activity items is known

Level 3 : *Certain items and uncertain items are all clearly assorted

Level 4 : All connections and before/after relationship of all activity items is clear

In the product division, there must not be an uncertain item in WBS. In contrast, in the item evaluating level 3:* is a peculiar characteristic of R&D. This item is also shown as level 3:* in the schedule plan management table (Tool 7) of the tool set like “Schedule of certain items and uncertain items are all clearly assorted.”

Therefore, a utilization method is defined for each tool and added the application usage exclusive to the R&D theme. Stuffs of PMO (project management office) conducted tool utilization training for PMs. In the training, the tool application level and choice of the recommended tool were considered, which should be suitable at a level of [I],[II],[III], respectively. Further, the skill of each PM’s tools utilization degree in an index were judged and evaluated. The level was standardized with a score range of 0–10, with 10 being the highest. Score seven was set as the standard pass mark. Along theme administration, it was followed how a tool application level of each PM of eight people improved at the start of training and 1 years passed. The results are shown in Section 6.



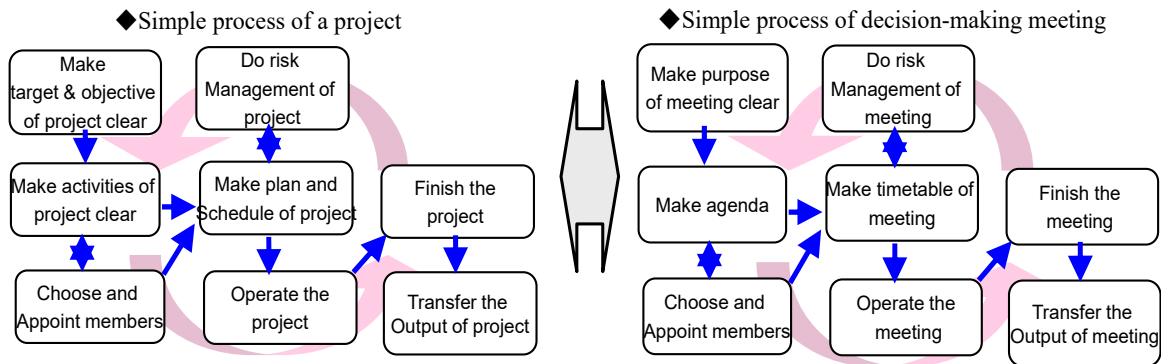
[Figure 2] Aim clarification process of the R&D theme corresponding to the 3x3 matrix vertical axis

In other words, it is assumed that in the progress of an R&D technology theme, an objective is defined by

[Method b]: Details

In Figure 3, the simple process is shown of project promotion (left) and the process of decision-making meeting administration (right). Both processes are understood similar and have common points.

2016 Proceedings of PICMET '16: Technology Management for Social Innovation



[Figure 3] Simple process of "project and decision-making meeting"

Some meeting administration of several prominent PMs of the product division was observed, and it was found that excellent PMs who could run a big project theme were able to operate an excellent meeting administration technique.

Therefore, a hypothesis was shown as follows: PM candidates may be able to get the skill to run a project after they learn to run a meeting with the right administration process.

Below are examples of administration items involved in the decision-making meeting. Items marked with symbol * are particular characteristics of R&D theme administration.

[Administration items in the whole meeting]

- 1) * Is the administration situation of certain and uncertain parts assorted?
- 2) * Is the risk situation based on assorted matters?
- 3) * Is there a viable reason for change in the situation and legitimacy of the aim.

[Administration items at the beginning of a meeting]

- 1) Is the chairperson declared and appointed at the beginning of a meeting?
- 2) * Is the positioning, content, purpose, and topic of deliberation understood?
- 3) Is an agenda and meeting schedule shown?

And more.

[Administration items in the middle of a meeting]

- 1) Do you push forward the meeting administration while confirming and adjusting time, based on an agenda?
- 2) *Based on a meeting format, is an item reported incorrectly?

And more.

[Administration items at the end of the meeting]

- 1) Are comments received through an attendant?
- 2) *Is the content of the deliberation appropriate and based on the purpose of the meeting?

And more.

The meeting administration performance was followed of

eight themes PMs based on method b at the start of training and 1 years passed. A score index was made of how well the PMs could run a meeting.

The level was standardized with a score range of 0–10, with 10 being the highest. Score seven was set as the standard pass mark. The results are shown in Section 6.

[Method c]: Details

There are several reasons for delays in R&D technology themes such as, technical problems, administration problems, internal and external theme problems. It is necessary to recognize a corresponding risk and to cope. In the product division, product development plans are devised and fixed in the beginning. In contrast, the mission of an R&D section is to create a technology to create an unknown value. In other words, R&D technology themes have unidentified risks. As mentioned in Section 4, the following three capacities are needed for PMs to complete a project. (A) Project management skill (B) Technology skill and (C) People skill; however, this study focuses on skill (A). Initially PM candidates were appointed who have basic level of (B) and (C) skills, and these skills were trained in other studies. The problem is in delay of a theme because an inner reason of themes has no relation with the technology itself. Prior to this study, the reason why R&D technology themes schedule delay was investigated. 30 technology themes were investigated and analyzed with more than three months delay in one year. Consequently, the following reasons for the delays were obtained. Here, frequency rates a, b, c, and d denote the number of delays that occurred in 30 themes.

[Frequency a] more than 8 themes, [frequency b] 5–7 themes, [frequency c] 3–4 themes, [frequency d] 1–2 themes.

[Frequency a] reasons for the delays

A: A technical problem that should have been anticipated went unnoticed initially; however, it became known during development.

B: The initial plan faced basic problems as it lacked details. There was an uncertain relationship between activities and delivery conditions of the output etc.

C: A shortage in workforce occurred, such as transfers of

important members, unexpected conference presentations, long business trips, and so on.

[Frequency b] reasons for the delays

D: External causes such as trial manufacture and external software development were delayed.

E: The QCD change included the theme delay of external organizations such as the production division.

[Frequency c] reasons for the delays

F: It has taken more labor than expected for preparing the document and for the data count.

G: A difficult technical problem that was not expected occurred in the middle of development.

[Frequency d] reasons for the delays

H: Higher goal is set and will give it priority over delivery date during development.

I: Organizing the briefing session or report meeting took longer than expected as the schedule of the top management required adjustment because of a long business trip.

J: During development, the competitor filed a solid patent for a new product or its technology of superior specifications.

K: Technical problem was unable to conquer and aborted the development process.

Further, the reasons for delay A-K were classified such as technical problems, theme management problems, internal factor, and external factor, and had a matrix in [I, II, III, IV]. The matrix is included in Figure 4 and it was named the “R&D Technology Theme Risk Matrix”.

	Internal Factor	External Factor
Technology Problem	Risk Area I (G,K)	Risk Area II (D,J)
Theme Management Problem	Risk Area III (A,B,C,F)	Risk Area IV (E,H,I)

[Figure 4] A classification of the reasons for R&D theme delay: “R&D Technology Theme Risk Matrix”

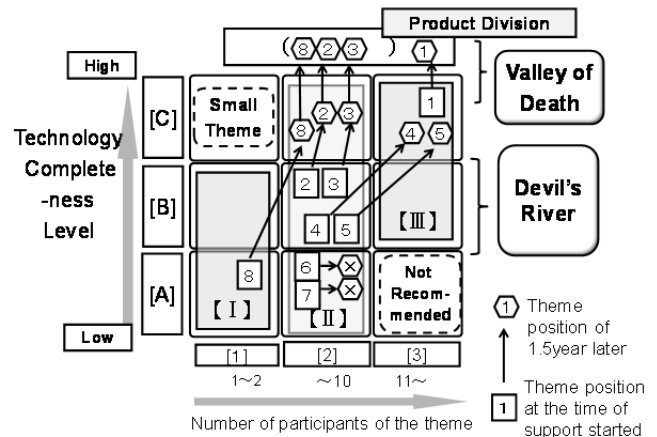
Methods of risk management in each matrix area are different. If PMs recognize a state of risk, it is recommended the risk management with the help of this matrix. Thereby, PMs can prevent theme delay. Risk management training was conducted and planned improvements with the help of the risk matrix when a delay risk was discovered. From the viewpoint of PM training, development of the project management method can reduce an outbreak risk of area III

in the internal and management factor of the technology theme; therefore, the risk area III was focused on. Regarding technology risk area I, II and IV, that reinforcement technology skill and the technology evaluation of the associated section were separated from this study.

VI. RESULT OF PM TRAINING IN R&D SECTION

In this section 6, the result of the eight themes PM training are shown. Figure 5 is the summarized output and progress of eight themes in 1.5 years. This output and Figure 5 are from our earlier study [7].

The numbers surrounded by the quadrangle mark denotes when the support and training started, and those surrounded by the hexagon mark denotes the position 1.5 years later. Figure 5 shows six themes made progress, while two canceled. Four themes 1, 2, 3, and 8 were moved to the product division to develop a commercial product. Theme numbers 2, 3, 4, 5, and 8 that crossed the “Devil’s River” area [B] were developed in area [C], which was the joint development level with the product division.



[Figure5] Eight technology themes progress in a 3x3 matrix (quoted from our earlier study [7])

The following shows the result of this study. In table 3, we show the levels of trained PMs. We show the theme progress and level of training of PMs both initially and after 1 year. Theme progress level are shown in the 3x3 matrix in Figure 1 and 5, the technology completeness level [A] [B] [C] on the vertical axis, and theme level [I],[II],[III]. Of the eight themes, six themes had progress, four themes moved to product division. Two were canceled due to technical difficulties. In addition, it is estimated that each PM had been in charge for 2000 hours around in administration of project management in this study.

[Method a] Results of the tool utilization level improvement

In nine recommended tools, five phases of administration level were established and the requirements of R&D for administration items were considered. PMs of the eight themes were trained in tool administration depending on their

level. Tool development level of each PM were digitized initially and one year later. The digitizing considered the level reached by PMs in tool administration through PM's interview and observing the meeting administration. Points of 1-4 point levels of the tool utilization improved on all PMs of themes to show it in table 3. Six PMs achieved the 7-points required to pass standard mark.

[TABLE3] TABLE OF TECHNOLOGY THEMES AND PMS TRAINED LEVEL PROGRESS
x: Delay means a delay of more than 3 month

Theme No	Theme Progress		[Method:a] Tool Utilization Level		[Method:b] Meeting Administration Level		[Method:c] RISK Management Level	
	Begining	1.5year later	Beginni ng	1year later	Beginn ing	1year later	Risk Area III	Risk Area I
1	III [C]	Product	5	7 *	5	8 *	○	○
2	II [B]	Product	5	6	5	6	○	○
3	II [B]	Product	6	7 *	4	6	○	○
4	II [B]	III [C]	4	7 *	3	6	○	○
5	II [B]	III [C]	5	8 *	5	8 *	○	○
6	II [A]	x canceled	4	7 *	4	7 *	○	x
7	II [A]	x canceled	2	6	5	6	○	x
8	I [A]	Product	3	7 *	5	8 *	○	○
							*:pass standard mark 7~ ○:No Delay, x :Delay	

[Method b] Result of the meeting administration level improvement

The meeting administration level improved three points from one for all eight PMs initially and one year later, and four PMs achieved the 7-points required to pass standard mark. Initially the process of meeting and theme administration was similar. Therefore, the hypothesis was confirmed that the success of both administrations are interdependent. In addition, similar feedback was received from all eight PMs on interview, and it confirmed that PMs recognized themselves that improving meeting administration ability is necessary for effective administration of the project.

[Method c] Results of risk management in R&D project management

Presence of delays examined of eight themes for over three months as an internal factor of the themes in risk matrix area I and III. First, a theme delay occurred in theme six and seven due to the inside technology factor of risk matrix area I. Technology development did not seem possible to recover and these two themes were canceled. One of the primary purposes of this study was to train PMs in risk management methods to prevent theme delays resulting from inside factor of administration of risk area III. The delays of over three months due to risk matrix III were good results of 0. This indicates that PM training for the prevention of delays is effective.

Therefore, the effectiveness of PM training methods a, b, and c was confirmed for eight PMs.

In addition, interviews of each PM and their bosses were not digitized; however, improvement was confirmed in people skills mentioned in Section 4. Two themes were canceled; however, this was not due to problems in project administration but purely due to a technical problem, and administration ability was evaluated good for two themes.

VII. DISCUSSION AND PROPOSAL

[Method a] Discussion on the results of tool utilization level improvement

Tool utilization capability improved for all eight PMs, as shown in table 3 in Section 6, particularly for four PMs in this study, whose initial level was as low as 4 or less out of 8 points at the beginning of the project. By taking into account these four PMs, it became clear that little or no experience was utilized in most of these nine tools. Furthermore, the non-utilization of tools was checked for each PM individually, making it clear that they had not learned nor used the tools until the beginning of the project training phase. A hypothesis implies that PMs did not use the tools because they had no experience or expertise in project management, even though it is clear that using these tools makes R&D theme management more effective. It is considered important to train project tool management to all PMs and theme leaders in the R&D section, even though project management is thought to not be related to R&D.

[Method b] Discussion on the results of meeting administration level improvement

The meeting administration level improved for all eight PMs, as shown in table 3 in Section 6. PMO members examined the training of meetings to PMs in the case of all eight people. As a result, a common opinion was provided, that even for both a long-term project or short meetings, it was helpful to acquire the concept of the process shown in figure 3 by experience. Further, in meeting administration, PMs recognized the importance of making uncertain items clear, which is peculiar to the R&D section. This survey shows that PMs acquire the concept of the basic process and basic project management ability by experience in short-term meeting administration in the same way that they acquire the concept and ability in the experience of long-term project management. In the R&D section, in particular, where it is difficult to develop many systematic project management skills for all themes, project management meeting training and administration is considered to help the spread of project management to the R&D section.

[Method c] Discussion on the results of risk management in R&D project management

As shown in table 3 in Section 6, theme delays in Risk Area III did not occur after risk management measures were taken, with at least five cases of delay occurring even before

the measures were taken. This might have improved because project management tool utilization was thoroughly implemented. Management issues in Risk Area III were basic, such as technical problem extraction at the time of the theme start, certain plan development, and certain schedule management of project members. Particularly in the R&D section, it is important to steadily predict risks due to uncertainty and carry out basic project measures.

[Further discussion and recommended measure]

Here, the effectiveness was considered of the results mentioned in Section 6. First, the merits of performing a training process was discussed that leads to commercialization, through PM training and smooth R&D. In earlier studies [6] [7], the problem of technology transfer was analyzed between the R&D section and the product division. Consequently, it was realized that though both sections are neighbors in the same company, a technique transfer is not successful due to factors such as cultural differences, technical terminology etc. The reason for process failure was considered in the “Valley of Death,” and it was suggested a solution through cross-functional project on the R&D theme. The solution included an example of success to conquest the “Valley of Death.”

In this study, PMs were trained from the initial period of the R&D technology themes. It was aimed to establish a smooth development process from R&D section to the product division. It is noteworthy that four in eight themes were equipped with product finally. One theme developed into a new product. The other three themes were equipped with a new technique to bring about a functional improvement in an existing product. PM candidates in the R&D section learned a project management method and were able to participate in a joint development project with product division. It was established that a technology transfer was possible and effective. This indicates that PMs trained in R&D have noticeable effect on the smooth technology transfer to business product division, and how PMs are educated in R&D is important. Training of PMs in R&D section is recommended to improve the chances of success in the new business making.

In addition, this study focused on PM training in the R&D section, however, it is possible to apply this training method in projects of other product divisions through the progressive use of a training methods, depending on a decision degree of the target. This is similar to training PMs on small projects before handing them the charge of a full-scale project in product division.

VIII. CONCLUSION

[Conclusion 1] It was confirmed that R&D section PM candidates, with basic skill in technology and social relations, was able to acquire basic project management ability suitable for R&D technology theme in short time

through the following training method a, b and c;

[Method a] Project management tools were utilized, selected and trained to PM candidates according to level of technology theme progressively in R&D section. An exclusive R&D viewpoint was adopted toward every project management tools.

[Method b] A meeting administration method was applied and trained to PM candidates as per the characteristic of R&D.

[Method c] Causes of technology theme delay were confirmed particularly for the R&D and the theme management using a risk management method was trained to PM candidates.

[Conclusion 2] It was confirmed that PMs in R&D section who are trained in project management methods can participate in other cross-functional projects of the development process for a smooth and successful technology transfer to the product division and helps to conquer the Valley of Death and the Devil’s River.

ACKNOWLEDGMENTS

We thank Professor Hiroaki Kaneko of Globis University, Professor Toshihiro Ioi, Professor Atsushi Shimoda, and Professor Akira Yamazaki of the Chiba Institute of Technology, the R&D project management study meeting members, Dr. Koichiro Nakamura, and other members of RICOH Company for their cooperation, encouragement, discussion, and assistance in accomplishing this study.

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