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A study on effectiveness of project management of software development in IT vendors for financial institutions of Japan
～ Influence investigation in PM action ～

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***ABSTRACT*:** Concerning the information-system development for financial institutions, the mass media often focuses on the effectiveness and efficiency of project management of the large-scale development projects which have big social impacts. In practice, however, there are more small-scale development projects and so called enhance projects. The enhance project refers to a project of adding a function to the original product and system and/or improving its performance. The enhance project needs different project management from large-scale development project for the following reasons. First, not only the quality assurance of added part, but also the measures for maintaining the performance of the existing part at the same level are indispensable. Second, many enhance project goals are modification requirements which directly link to urgent business necessity such as “we need to carry out performance improvement as early as possible to cope with the complaint from the client”, and “we must add a new function to compete against our rival who provided new services.” Third, the evaluation of cost effectiveness of enhance project is particularly difficult.

Thus, the objective of this paper is to study what project manager’s actions (referred to as PM actions) are appropriate for software development in IT vendors for financial institutions of Japan. Here, the authors focus on small-scale enhance projects where the total man day is less than 100 man-months from the stage of requirement definition to the stage of system testing. Concretely, the effectiveness of four types of PM actions with different reporting styles, catch-up contents, communication, and participation are studied. Then, workload, productivity, communication, morale of staff, and the ratio of the actual cost to the estimated cost are studied for each project management. The result shows that different project management from ordinary project management is more effective. It is suggested that different aspects should also be emphasized for small-scale enhance projects.

KEYWORDS: Financial-information system, PM action, Enhance (enhancement)

1. INTRODUCTION

Concerning the information-system development for financial institutions, the mass media often focuses on the large-scale development projects which have social impacts. In practice, however,

there are more small-scale projects and enhances among the total workload. Regarding the enhance[1], especially under the financial-information system in operation, the investigation becomes indispensable that not only the quality of any added or extended part should be assured, but any change or modification should not affect the existing segment. Moreover, the modification requirements in many cases link directly to urgent business necessity, such as "we need to carry out performance improvement as early as possible to cope with the complaint from the client", and "we must add a new function to compete against our rival who provided new services". Nevertheless, evaluation of the amount of investment and the performance effect is difficult for IT [1, 2, 3]. Therefore, although the enhance project has the characteristic that an immediate action is called for with a relatively quick delivery, restrictions to the development costs are severe in many cases. Under such a background, an investigation analysis is conducted on the relationship between PM[2] management and project income and outgo for IT vendors amid the stable project management.

1.1 Objectives

Under the system development for financial institutions, even if it is a small-scale project or an enhance project, it is usually necessary to conduct a close investigation at each level of requirement, design, and programming, similar to the development of an ordinary-scale project. But in the case of an enhance project, there are many occasions corresponding to more limitations on the work man day and schedule, compared with an ordinary-scale project development. Concerning project management, although there is not much difference of the work tasks probed by WBS[3] between ordinary-scale project and enhance project, more efficient management is usually called for. Based on above, the effect of PM actions on project income and outgo is investigated. It also explores the drive for SE[4] productivity in enhance or small-scale projects.

2. SOFTWARE DEVELOPMENT AND PROJECT INCOME AND OUTGO

The fundamental hypothesis of this investigation is that as project quality and input resources amount vary, the achievement value of project income and outgo would be influenced by PM actions. Further, the productivity drive of SE influenced by income and outgo is presupposed to have functional relation as expressed as below. It is drawn from the author's experience of project management.

Productivity drive of SE =

Concentration on work × Catching-up degree × working-hour assurance × Clarification of roles division

2.1 The quality management model for software development

Definite quality is assured by a testing and review regarding the development control of software according to Yamada (1993) [4]. The practice shown in Figure 1 is used for financial system SE.

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[1] Enhance (enhancement)

To make enhanced, strengthened, improved, etc. in semantics. In the field of IT, it refers to function added to a product or a system, and performance improvement. And, the performance improvement carried out to the existing system refers to as "enhanced" or "enhancement" in this paper.

[2] Project Manager (PM)

The manager of a project who takes the responsibility of the planning and execution of a project. A project manager is a person in charge who adjusts human resources, capital, equipment, goods and materials, schedule, etc. with a good balance, and manages the whole progress, in order to attain the aim of the team.

[3] Work Breakdown Structure (WBS)

The practice used when forming a plan by project management. The structure chart which divided the whole project into fine work. also call it work division structure and an operation breakdown figure.

[4] System Engineer (SE)

The engineer who does computer system design or system development. The target of business is analyzed, what kind of system is optimal is clarified to conduct design, and program code of software is developed. Moreover, the whole system is built combining hardware and software.

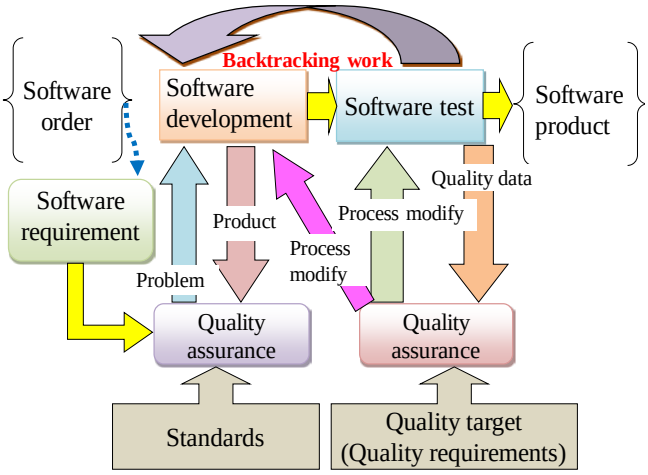

Figure1 Software quality management Model

2.2 The realization process of software quality

In order to implement the software which covered the quality requirements (quality specs) in the enhance project for financial institutions of Japan, there is a software development process in quality management. The management metrics (control metrics) promoted by Deutsch and Willis (1998) [5] to support the management of development process involves some related development resources as development effort (man-day, effort), development time (time, elapsed, calendar time), and machine availability (machine usage). The steps towards the realization of quality requirement (quality spec) for financial institutions are shown as below.

Step 1: The process of reflecting requirements specifications and quality specs into design specifications programming within the cost and schedule restrictions. Here, software development technology and development tools are utilized to build in the characteristic of quality required.

Step2: The process of reviewing design specifications and the program code of a product. Review concerns the investigation of an output by multi-parties concerned immediately after the completion of work in each production process, thus detecting an error at an early stage. In this process, the design specifications and program codes with bugs in software production will be converted into bug free software through reviewing.

Step3: The process of testing the program codes of a final product, and converting the bug-free code by reviewing at step 2 into error-free software.

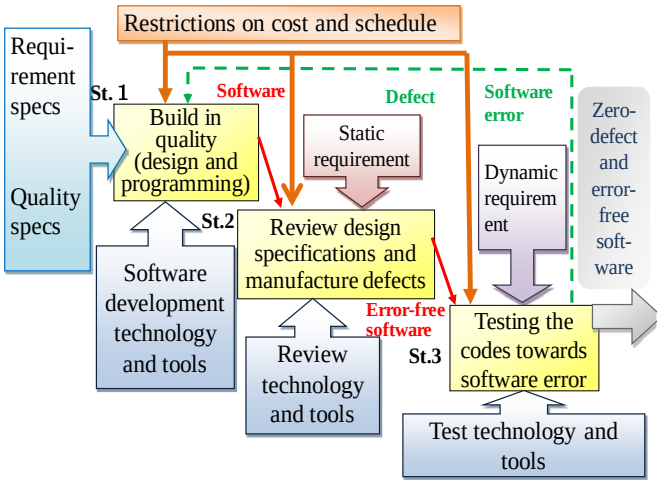

Figure 2 The realization process of software quality

2.3 The estimate accuracy and the workload

The methods of clarifying specific items of project management include WBS described above and PPP[5]. PPP is an effective method of planning a proper schedule by a phased approach along with project progress. Based on this, Kanno (1994) [6] explores the relationship between the estimate accuracy, the workload, and the implementation period shown in Figure 3.

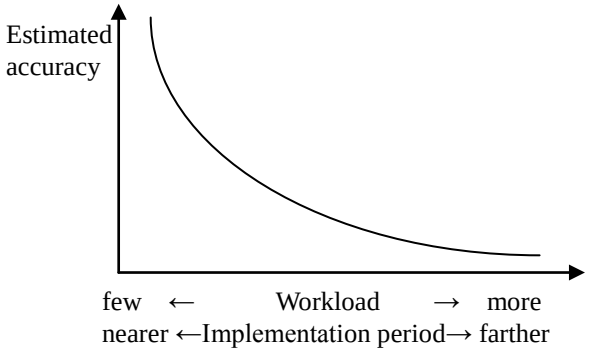

Figure 3 The relationship between the estimate accuracy, the workload, and the implementation period

[5] PPP (Phased Project Planning)

It is not partitioning the work of a project at some phases. A phase is partitioned into still smaller work and a sizing and an estimation are performed gradually. The find and measure against a problem are processed a little early by that.

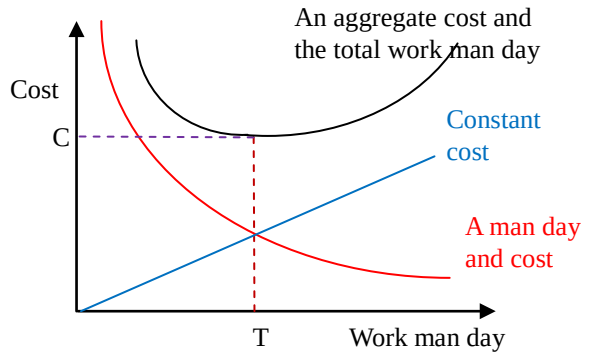

Figure 4 The relationship between an aggregate cost and the total work man day

The relationship between an aggregate cost and the total man day is shown in Figure 4. It is derived from CPM[6] and initially aimed at the optimization of the aggregate cost of a project. From the relationship between the total days and the aggregate cost, it was then developed to explore the relationship between the relationship between the aggregate cost and the total work man day. It could be applied to the small-scale projects or enhance projects of a financial institution. In addition, although there exists the capability scale of SE by the level of work SE takes part in, it was not taken into consideration in this paper as Kadono (2007, 8) [7, 8] promoted.

3. MEASUREMENT MODEL

3.1 The management index and scoring standard for every project

The management index [9] (Table 1) currently utilized in common in development / maintenance process is adopted in this measurement model to deal with the data that is collected through the process towards quality requirements (quality specifications). The indexed data is then mapped according to the scoring standard (Table 2), and the assessment score for each project is calculated.

Table 1 The management index in common in development / maintenance process [9]

Management process	Management index	Definition
Review	Review indication ratio (%)	(Indication number/Object scale)×100
	Review implementation ratio (%)	(Enforcement number /Enforcement schedule)×100
	Review speed	Object-scale /Review period
	Review-advance indication ratio (%)	(Indication bug number/ Indication bug in test)×100
	Review efficiency (%)	(Indication number / Review man day t)
Test	Test-case density	Test case number / Real source code scale)
	Test comprehensibility Ratio (%)	(The number of tested Routes / All the routes) ×100
	Desk-debugging density	Desk debugging density/Real source-code scale
	Bug extraction number	Bug extraction number
	The bug number after a release	The obstacle number to the scale within an after-release fixed period
Time for delivery	Time for delivery achievement ratio (%)	(Time for delivery achievement number / All the-completion numbers)×100
	Time for delivery delay ratio (%)	{Σ(Contract date of payment－Date of payment)/Σ(Time-necessary-for-completion days)}×100

Table 2 Scoring standard (less than: l, more than: m)

Management index	Scoring standard
Review indication ratio	5(1%l),4(5%l),3(10% l), 2(15% l),1(15%m)
Review -implementation	5(90% m),4(80% m), 3(60% m),2(40% m),

[6] CMP (Critical Path Method)

What attains a system optimization of the aggregate total cost of a project. A trade off is related, if it is going to shorten working days, a project, working days, and cost will be hurrying the work on a critical path, and cost will increase them

ratio	1(40% l)
Review speed	5(8ks/1dm), 4(8ks/1d), 3(5Ks/1d), 2(3ks/1d), 1(3ks/1dl)
Review-advance indication ratio	5(50m),4(40m),3(30 m), 2(20 m),1(20l)
Review efficiency	5(50m),4(40 m),3(30 m), 2(20 m),1(20 l)
Test case density	5(0.005l),4(0.002l),3(0.001l),2(0.0005),1(0.0001 l)
Test comprehensibility	5(90%m),4(80% m), 3(60%m),2(40%m), 1(40% l)
Desk-debugging density	5(0.005l),4(0.002l),3(0.001l),2(0.0005 l),1(0.0001 l)
Bug extraction number	5(100 l),4(125 l),3(150 l), 2(200 l),1(200 m)
The bug number after a release	5(3M:20l),4(3M:30 l),3 (3M:40 l),2(3M:50 l), 1(3M:50 m)
Time-for-delivery -achievement ratio	5(90%m),4(80%m),3(60%m), 2(40% m),1(40% l)
Time-for-delivery delay ratio	5(0.01l),4(0.05l),3(0.1 l), 2(1.0l),1(1.0 m)

3.2 The expense gap and scoring by measures

The expense GAP for every project is:

Expense GAP

= Track record value (real expense) / Estimated cost (the estimated expense)

Regarding assessment scoring, as there is a difference in SE constituted for every project, PM actions were performed by 4 measures classified as A, B, C, D, and data aggregation and analysis was done after the project was finished.

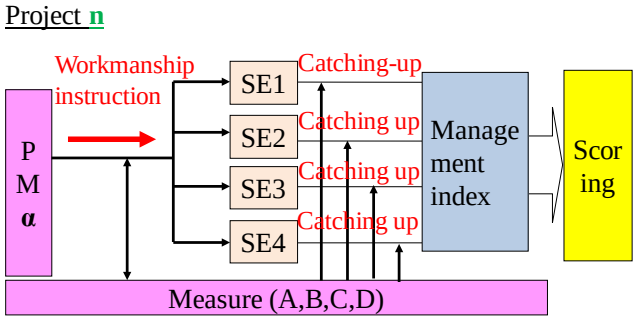

Figure 5 Assessment scoring by PM actions by classified measures

3.3 PM action measures

It has been nearly 10 years since the measure A was decided to be taken for operation. During that period, the managerial document of operation and acquisition of test result evidence are continuing increasing under the influence of system glitches in a financial institution. Despite of the characteristic that an immediate action is called with a relatively quick delivery, there exists a severe restriction on the project development costs in many cases. Thus it calls for increasing the efficiency. To examine the measure that is compatible in quality assurance and cost control, the implementation of PM actions was commissioned to the social experiment with the cooperation of financial institution and IT vendors. It was carried out by four measures shown as below.

(1) Measure A is a formal technique.

PM is required to always grasp all members' entire situation. Conduct real-time communication while utilizing the check sheets on work situation, individual conditions, staff attendance, security check, etc.

(2) Measure B aims at the difference in the productivity by PM action of allocating the time saved by efficient arrangement to other tasks through carrying out the hearing of formal PM task and scrutinizing the contents. The efficiency of arrangement is intended to focus on the hearing of technical or work contents among the check sheet contents which are reported by participants in advance.

(3) Measure C aims at the difference in the productivity as the relationship between a leader and SE changes by clarifying the roles of PM and a leader.

(4) Measure D aims at the influence to a small-scale project by the difference in productivity when PM clearly becomes a full-time administrator from a playing manager.

The catching-up by each measure is carried out on concrete workmanship instruction, consultation and supplement, the careless mistake prevention by repeating, confirmation of the possibility of a critical path, guidance due to the lack of experience, and instruction from a team viewpoint. In addition, each measure is taken on a basis of PMBOK[7]. The difference lies in the approach when carrying out project management.

Table 3 Measures of PM action

Measure	Category	PM action content
A	All-member participatory type	・Meeting is attended by all members, and PM carries out the hearing of the progress in details itself. ・Carry out all-member catching-up by active communication.
B	Guidance type (all-member)	・Meeting is attended by all members, and PM carries out the hearing of the progress in details itself, and PM carries out the hearing of the progress to details itself ・The meeting contents focus on technical or work contents, and are carried out concentrating on operation catching-up
C	Guidance type (part and necessary personnel)	・PM receives the progress report from a leader, and the communication is done with the centre of leader class. ・The meeting contents focus on technical or work contents, and operation catching-up are performed to a leader.
D	Line management type	・PM receives the progress report from a leader, and the communication is done with the centre of leader class. ・PM does not carry out catching-up directly

[7] PMBOK (Project Management Body of Knowledge)

The project management guidance defined by project management association (PMI). It discourses 9 viewpoints of management of concerned fields, and consists 5 parts as “planning”, “management objective”, “human relations”, “risk (management)”, and integrative management of above as “integration”.

4. DATA AGGREGATION AND ANALYSIS

The operation results by project management according to SLA[8] of a financial institution and IT vender is shown as the scores of measure in Figure 6. The samples are extracted at random from those projects satisfying that the development total man day from requirement definition to system test is less than 100 man-months within one year

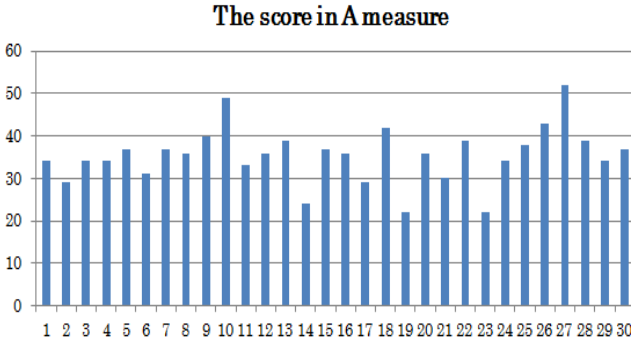

Figure 6 The scores of projects by Measure A

Scores for each projects stays within the range of 12~60 no matter what measure (A-D) is taken. The average score of 30 projects taking Measure A is 35.4, and there exists variance within the range from 52 to 22. In contrast, the result PM action by Measure B, C, D turn out to be Figure 5. By Measure B, C, D, in cooperation with finial institutions and IT vendors, operation by measures was requested to PM.

Regarding the sampling, although it was intended to examine 1 or 2 projects at the beginning, in consideration of the error, 5 projects for each were examined (Figure 7). In addition, SE 1~4 taking part in the object project are not told about the existence of enforcement for investigation, and the contents.

[8] SLA (service level agreement)

When you contract between a financial institution and IT vender, clarify the requirement (achievement) level over the content of a services, and the span and quality to offer, and agree beforehand.

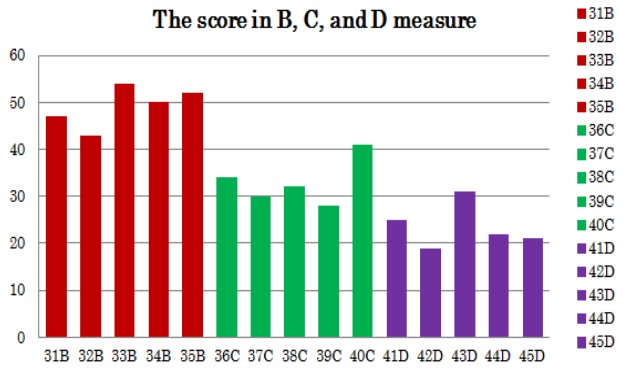

Figure 7 The score of projects by Measure B, C, D

Although there are some variances, the scores decrease in the order of B→C→D. Moreover, the average value of each measure is shown in Figure 8. Taking the average score of Measure A (35.4) as the standard (1.00), Measure B=1.39, Measure C=0.93, and Measure D=0.67.

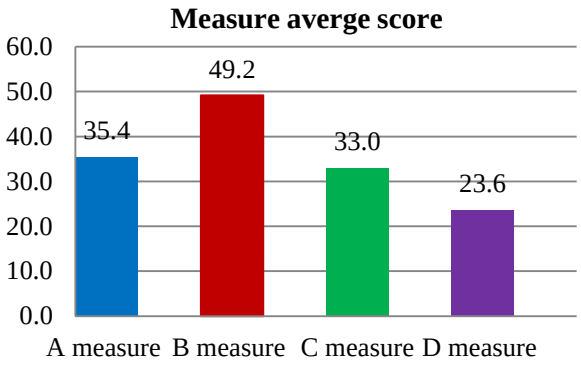

Figure 8 The average score by measures

A scatter diagram with the expense GAP for each project is shown in Figure 9a and 9b based on the scores. A convergence trend of project expense GAP is not seen in other measures except Measure A with a concentration around 1.0 within the score range of 30~40. As a characteristic, the score of Measure B is high, and the project expense GAP is small. And, although the scores of Measure C and D are low, the project expense GAP high. From data, compared with the productivity of Measure A, the productivity of Measure B is improved and that of Measure C and D decreases. Then, why did the productivity change?

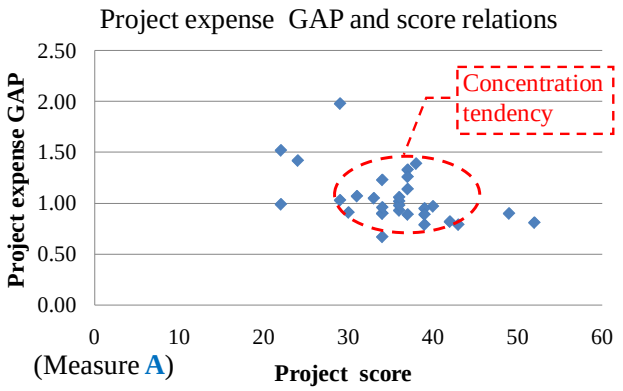

Figure 9a Project expense GAP and score relations

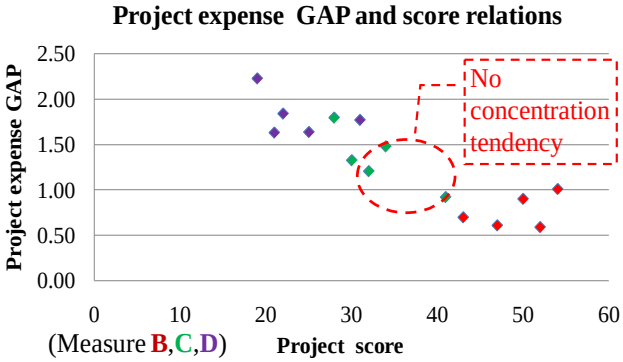

Figure 9b Project expense GAP and score relations

Regarding the estimated technic of IT venders and the practice of estimated assessment of financial institutions, since they are deployed with the same method, the difference is considered to be derived from PM action.

As Kanno (1993) [10] pointed out, concerning SE productivity, there is a close relationship between quality and manufacturing efficiency as below. And hence it is necessary to take into consideration of the influence of morals (moral) and morale (morale).

$$\text{Productivity} = \frac{\text{Value}}{\text{Workload}}$$

$$= \frac{\text{Value}}{\text{Quantity of production}} \times \frac{\text{Quantity of production}}{\text{Workload}}$$

= Value productivity × Manufacturing efficiency
(narrowly-defined productivity)
= Quality × Manufacturing efficiency

Regarding the project management or SE operational environment, the content confirm type (all-member) is supposed to be high in cost GAP/Score, but the guidance type (all-member) turns out to be higher in cost GAP/Score in practice. It seems that the influence by factors outside the SE environment should be considered.

An influence factor is examined from the flow and questionnaire on the result of project cost GAP/Score. The flow is shown in Figure 8, in which: (1) the assumption value of cost (estimated work), (3) about calculation (achievement value) of end-of-work cost, since the base and calculus for every project are the same, they also judge a drift factor to be the same and remove it from a candidate. It removes also about (4) and (5) for the same cause. Therefore, (2) is a drift factor, the quality and manufacturing efficiency which Sugano (1993) shows are closely related, and a factor is added from results of an investigation that it is affected by the influence of morals (moral). And, it added also about the degree of the burden of PM which could be seen clearly from the matrix of PM actions (Table 5) and questionnaire results (Table 6) (see next page).

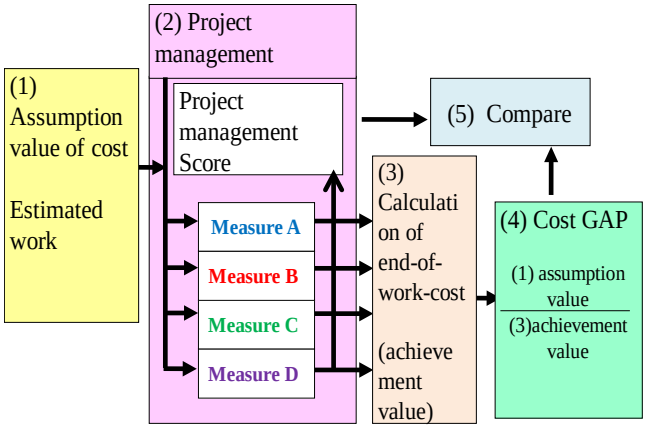

Figure 8 Project cost GAP / Score Flow

From Table 6, it could be understood that by PM action, an alteration arises in the team,, and the value of working, morals, or productivity of a project team. It could be reflected by the cost GAP/Score. The hypothesis that “as project quality and input resources amount vary, the achievement value of project income and outgo would be influenced by PM actions” is verified under narrowly-defined environment.

Table 4 Matrix of PM actions

	Report mode	Content of catching-up (follow)	Positivity by communication	Catching-up objects	assessment in cost GAP/ Score
Content confirm type (All-member)	1. PM itself hearing. 2.Individual report	1.Technical content, work content 2.content-of participation person-individual work 3. SE’s condition 4.In addition to this(motivation-maintenance)	It carries out to the information sharing of the inside and outside of a project, and a positive. positivity:◎	All-the members	2nd place
Guidance type (all-member)	1. PM oneself hearing. 2.Individual report	1.Technical content, work content 2.content-of participation person-individual work	Content center of work positivity:○	All-the members	1st place
Content confirm type (part)	1. A report is leader & SE. 2.Hearing on point-in question.	1.Technical content, work content 2.Workmanship instruction to a leader and SE.	Content center of work positivity:△	leader and SE-are nominated	3rd place
Guidance type (part)	1. A report is a leader.	1.Workmanship instruction-to-a leader.	Content center of work positivity:×	leader	4th place

Table 5 Questionnaire results on PM by Measure B, C, D

No.	Questionnaire contents (Compared with Measure A)	¼ less than	½ less than	¾ less than	no alteration	1 more than
1	How was the burden of Measure B?	0	2	2	1	0
2	How was the burden of Measure C?	1	3	0	1	0
3	How was the burden of Measure D?	4	0	1	0	0
4	How was the productivity of Measure B?	0	0	0	1	4
5	How was the productivity of Measure C?	0	1	3	1	0
6	How was the productivity of Measure D?	0	3	2	0	0
7	How was the amount of communication of Measure B	0	0	0	2	3
8	How was the amount of communications of Measure C?	0	1	4	0	0
9	How was the amount of communication of Measure D?	0	3	2	0	0
10	How were the morals of Measure B?	0	0	0	3	2
11	How were the morals Measure C?	0	2	2	1	0
12	How were the morals of Measure D?	1	3	1	0	0

Table 6 Result of Fellow-up Questionnaire on PM actions
(high >>> low: ◎→○→△→×)

	Arrangement time *1	Division of roles *2	Catching-up *3	Moral	Team productivity *4	PM burden	Assessment in cost GAP/Score
Content confirm type (All-member)	×	△	◎	○	○	△	2st place
Guidance type (All-member)	△	○	○	◎	◎	○	1st place
Content confirm type (part)	○	○	△	△	△	○	3st place
Guidance type (part)	◎	◎	×	×	×	◎	4st place

*1: Arrangement time is an aggregated value.

*2: PM, a leader, or the number of times of role change by SE

*3: The aggregated time which PM has spent on the catching-up (in order of amount)

*4: Team productivity is the aggregation of individual production of participating SE by division of the number of participants.

Furthermore, the burden of PM has been clarified to exist by this investigation. As shown by this investigation, despite the fact that the catching-up which affect the productivity, and information sharing are conducted through Measure B, it also suggests that the cost GAP / score of Measure A is lower. Based on the questionnaire, we have:

Productivity drive of SE =

Concentration on work × Working-hour assurance × Clarification of roles division × Degree of catch-up × Share of work value × Degree of PM burden

5. CONCLUSION

Many discussions have been done on that “Quality and manufacturing efficiency are related” in the pervious researches. But they are the project management practices by maintenance of the development practice to the productivity drive of SE, or a development tool, PMBOK, etc., and the chief aim lies in evasion of troubles or grasp of progress. By this research, it is clarified that by sharing the project participation sense or value, the productivity attained by former practice could be improved further. And, the burden placed on PM in the systems development for financial institutions even if it is a small-scale matter and an enhance project appear to be heavy. Although it is easy to gaze at the productivity drive of SE’s work, a proper PM workload needs to be examined from a viewpoint of management quality.

The future task will focus on the examination on the influence of PM action, and the value sharing with participating SE while collecting data continuously. Although the case where a work man day exceeds 100 man-months from requirements clarification to system testing needs to be investigated too, a new practice is needed to be

required to verify since there exist difficulties in dealing with large cost fluctuation by the same method.

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