

Visualizing Organizational Skill for Managing IT Projects

-Capability Maturity Model Targeting to Prevent Serious Problem Projects-

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Once after serious problem project (SPP), which caused enormous influences to a software developing company (SDC), the SDC practices countermeasures not to re-produce the same tragedy. However, within several years, the same tragedy happen and the same history repeats. Moreover, most of SDCs have histories to have been survived by just supplying resources to meet with demands from system development projects without taking project risks. The managements of such SDCs seems to give up stepping up to be higher project contractors, since they cannot understand how to enhance capability of project management. One of the causes of repeating such histories might be that individual goal of organizational capability maturity for managing IT projects are not visible for individual SDC. This paper tries to visualize organizational skill for managing IT projects. Specifically, we present a new organizational capability maturity model, based on our survey. After presenting suggestions for individual SDC to step up and prevent SPP sustainably, we discusses necessity to further develop and apply the model for software industry.

Key Words & Phrases: Capability Maturity Model, Organizational Project Management, Tacit Knowledge, Best Practices, Software Industry Development, Serious Problem Project

1. Introduction

In the software industry, most of software developing companies (SDCs), whose number is said to be more than 20 thousands in Japan, have been suffering the following problems.

(Problem No.1) Serious problem projects (SPPs) occur again and again.

Even major prime contractors, which represent Japanese software industry, have been threatened often by SPPs, which brought enormous losses to their businesses. History of such incidents have been repeated as follows.

Step1) An outbreak of SPPs.

Step2) The management empowers a PMO (Project Management Office) organization and requests the PMO to carry out its orders reactively.

Step3) After successfully decreasing the number of SPPs, the management reduces resources allocated to the PMO.

Step4) As the resources decrease, the power of project risk checks and inspections degrades. The project risk check is likely to become a mere formality, because the power of the PMO are weaker than before.

As SPPs are apt to reoccur due to the situation described above, the status will return to step 2). When this happens, the management is apt to be changed due to loss caused by the SPPs. The new management may establish a new inspection regime and reporting style for the project risk check, rejecting

the system established by the former management. Thereafter the cycle shown in Figure1 repeats itself.

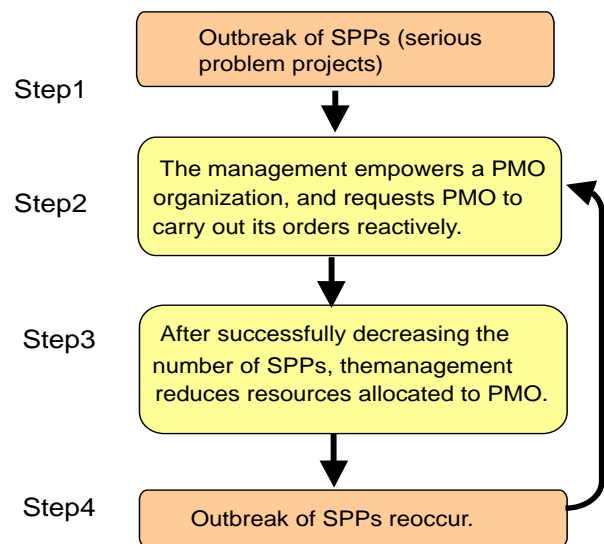


Figure 1 History of Repeating Outbreak of SPPs

(Problem No.2) Business declining due to lacking project management.

Most of the other SDCs, whose company scale are middle to small, do not aim to be major prime contractors, which take responsibility for project goals of software development. The reason is that the managements of such SDCs fear for business losses caused by project cost overruns, since Nikkei BP often said decision by the managements of SDCs to

withdraw from contracting business for software development after project cost overruns in actual. One of the causes might be that it is not visible for the managements how to set a goal and how to achieve the goal for individual SDC, to improve organizational project management skill enough to be a prime contractor. Therefore, the SDCs sink in business without taking project management risk (only taking role of regulating amount of engineer resources to receive/feed, who are required for IT system development. e.g. just supplying software engineers to IT projects in the major contractors). Thus, more than 90% of the SDCs, including some companies listed in Tokyo Stock Exchange No.1, is said to give up to step up to upper level contractors with higher business value. However, if the SDCs continue their existing business without any change, their business may be contact fraud, since governmental regulation became to be strengthened by Worker Dispatch Law.

While those SDCs facing the problems mentioned above, there are best practices where the problems are solved by another SDCs. For example, the following cases are specified by our survey.

- Best practice case by stopping dispatch business.

There is a SDC whose company scale are smaller than the major prime contractors. However, the SDC made a commitment in its management charter that it never rely upon dispatch business by supplying engineers but actual contract by taking project management risk, and have been practicing the commitment actually.

- Best practice case of preventing SPPs.

There is another SDC which successfully have been preventing SPPs by practicing organizational improvement based on lessons learned from the past SPP cases.

It is necessary for the software industry to lead individual SDC to take project management responsibility and control and prevent SPPs ideally in the last stage. For the purpose, it is necessary to clarify hierarchy of organizational skill of individual SDC for managing IT projects. In this paper, after we show data which indicate relationship between organizational responsibilities and problem projects, we review current methods for organizational skill like CMMI (Chrissis et al., 2003). In the review, after we show that they cannot sufficiently identify the organizational skill to take project management responsibility and control SPPs, we show necessity to develop a new method to clarify hierarchy of organizational skill of individual SDC for managing

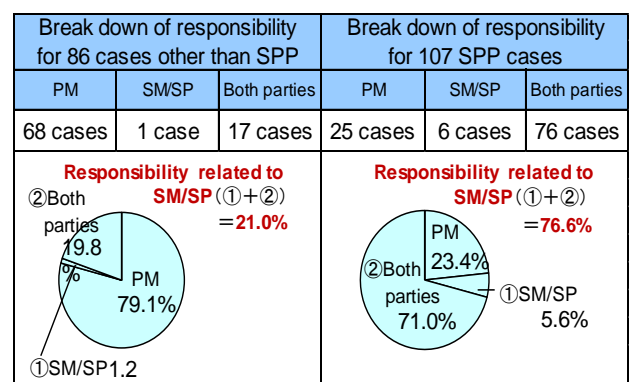
IT projects.

Thereafter, we propose a new organizational maturity model which visualize next target skill level to be accomplished so that individual SDC can recognize its current skill level and enhance the level step by step in the hierarchy of organizational skill for managing IT projects, by clarifying necessary organizational skill for each level in the hierarchy based on actual situation of the industry and our experience. Lastly, we discuss expected effects by our proposal.

2. Relationship between Problem Projects and Organization

There have been a research on relationship between projects and their organization by analyzing who are responsible for each of actual 193 cases problem projects (107 SPPs and 86 projects with less problem, which were summarized by members of IT project experts in a working group named “Project Mieruka” organized by Information- technology Promotion Agency, Japan (IPA)). In this research, the criteria of SPP is defined as either caused the delay of the customer service starting plan, resulting in enormous problems broadcasted by the news media, or caused a financial loss more than one hundred million yen) (Ohtaka and Fukazawa, 2011).

In the research, it is clarified that the ratio of cases where only project managers should be responsible decrease and, on the contrary, the ratio of cases where senior managers and salespersons should take responsibility increase in SPP compared with problem projects other than SPP, based on an assumption that responsibility of a project manager is defined in PMBOK (PMI, 2016) (Figure 2).



(note) PM; Project manager, SM; senior manager, SP; sales person

Figure 2 Break Down of Responsibility for Problem Projects

When we focus on 86 cases other than SPP in the figure, senior managers and salespersons were responsible for 21%. On the other hand, as far as the SPP cases are concerned, the senior managers and the salespersons were related to more than 76% of the SPP cases.

It is suggested that not only the project managers but also whole organization in which the senior managers and the salespersons are involved should practice project management for avoiding problem projects.

3. Surveying Current Methods

1) CMMI (Capability Maturity Model Integration)

CMMI proposes an organizational capability maturity model of SDCs focusing on engineering process. However, although it specifies five levels of the capability maturity based on sufficient process for software engineer, less process is involved in it as far as project management is concerned. For example, the CMMI just requires documents for software development plan, although the documents are not required to be produced and maintained based on process of project management (like scope, cost, time or any other management process in the PMBOK). In actual, we often observe that software products, which are developed in SDC organization with the certification of the CMMI level five, are released too late or with full of bugs. This is thought to indicate that project management of the organization is poor.

Therefore, it is difficult to undertake the CMMI as a method to identify capability maturity of project management for SDC organization.

2) OPM3 (PMI, 2013a)

Project Management Institute (PMI) shows a standard to identify capability maturity of project management in general organization by classifying targets of organizational management to “Project”, “Program” (PMI, 2008a) and “Portfolio” (PMI, 2008b) by OPM3 (Organizational Project Management Maturity Model). Four levels are defined (Standardization (S), Measurement (M), Control (C), and Continuous Improvement (I)) to identify organizational capability maturity regarding project management as illustrated in Figure 3.

Although the OPM3 may be a common standard for all industries or services including construction, medicine or any other firms, it is very hard for SDCs in the software industry to map the idea to their actual

field. Thus, even if the idea of the maturity model is understood, at least Japanese software vendors or users could not apply the idea to step up their level of project management to the higher one in the industry. Actually, there have been no report proving that higher level organization in the OPM3 could decrease SPP much more than the lower level organization in the software industry.

Portfolio				
Program				
Project				
	Standardize	Measure	Control	Continuously Improve
	S	M	C	I

Figure 3 Organizational Project Management Maturity Levels in OPM3 (PMI)

Therefore, we need a new capability maturity model which can contribute to solve the problems to step up or to prevent SPPs, by closely investigating actual software industry.

4. Surveying Actual Software industry

Among software related enterprise firm, there are small business companies whose scale is too small to organize a software development project. Major business of such companies is consulting or dispatching business of engineers with special technology including information security. If we exclude such small-scale companies, SDCs can be categorized as follows.

CAT1: SDCs which sink in dispatching business by supplying engineers, although their scale and engineering resources are sufficient enough to organize a software development projects. Such SDCs who gave up project contract business fill major part of the whole SDCs.

CAT2: SDCs which try to step up to be project contractors with decreasing dispatching business.

CAT3: SDCs which have achieved the stepping up. Most of major prime contractors are included in this category. As explained by Figure1, they suffer from periodical SPPs and repeating the same history.

CAT4: SDCs which try to prevent repeating the same

history of the SPPs.

CAT5: SDCs which have sustainably achieved preventing SPPs.

5. Identifying Organizational Skill and Proposal

Based on the categorization, there come up a question why each SDC in different category practices different business content. This may be caused not only by skill of project manager, but also organizational skill of project management (or governance) in individual SDC, as far as we surveyed. Based on this organizational skill (hereafter, we call capability maturity), individual SDC may be classified to either level in the following capability maturity hierarchy.

SDC LEVEL1: companies corresponding to CAT1.

The SDCs are sinking in dispatch business for just taking role of regulating amount of software engineer resources who are required for IT system development projects which are mostly managed not by project managers in their companies but by project managers in major prime vendor contractors of CAT3. Even if the SDCs practice project contract business, the business scale is far smaller than the whole business of the companies. The management of the SDCs give up to take project risk and make rightful project contract basically.

SDC LEVEL2: companies corresponding to CAT2.

The SDCs are trying to enhance skill of project managers in their own companies and increase project contract business by replacing legacy dispatching business to step up to be project contractors.

SDC LEVEL3: companies corresponding to CAT3.

Most sales of the SDCs are achieved by project contract business. However, the followings are often observed.

- Project checklist:

Although the SDCs “standardize” methodology to check projects, the amount of check list is too large to use it for the management to avoid outbreak of SPPs. It is also not easy for field project managers to check all items in the list without extra load.

- QA (Quality assurance team including role of PMO):
Although the QA “standardize” to practice “measure” and “control” specified in OPM3, the QA members are not necessarily relied upon by field projects. Even if some QA members are highly skilled and fully relied upon by field projects, they are just temporally involved in the QA team and will be in a meanwhile moved to business units for managing field projects,

when the business units lack resources of project managers due to increase of software development orders.

- SPPs:

Outbreak of SPPs is observed periodically. After the outbreak, the management takes countermeasures for strengthening QA activities to reduce and prevent the SPPs, by recalling the highly skilled project managers to the QA team as its members. However, for a mean after decreasing the SPPs and increasing the orders, the QA activities are to be weakened, the same historical events are re-produced (e.g. SPPs occur again).

SDC LEVEL4: companies corresponding to CAT4.

The SDCs are trying to step up to be contractors with sustainable countermeasures to prevent outbreaks of SPPs, by “continuously improving” the followings.

- Project checklist:

The SDCs have much more compact methodologies, which both the managements and field project managers can use them without extra load.

- QA (or PMO):

The managements of the SDCs continuously assign members, who are highly skilled and fully relied upon by field projects, to QA teams, even when the business units lack resources of project managers due to increase of software development orders.

- SPPs:

Outbreak of SPPs become to be observed less frequently than LEVEL3.

SDC LEVEL5: companies corresponding to CAT5.

The SDCs have achieved preventing SPPs sustainably, while practicing “continuous improvements” without termination.

Although CMMI is a capability maturity model for software firm, it is based only on engineering viewpoint. On the contrary, we propose, on management viewpoint in projects and organizations, a new model for software firm. The model, hereafter CM3 (Capability Maturity Model for Management), has a hierarchical structure from LEVEL1 to LEVEL5 mentioned above. Although the model is based on OPM3, it makes software firm much easier understand OPM3 and introduce it to individual type of SDC (e.g. vendor or user). The CM3 is specified as follows by adding necessary content to OPM3 and also eliminating unnecessary content from OPM3 for individual type of SDC.

[Maturity model for vendor]

Although “Portfolio” may be necessary axis for IT

system or software owner (user), it is not necessarily proper maturity axis for software developing contract vendor. Thus, the new model for vendor can be described as Figure 4 by elimination the “Portfolio”.

(Portfolio: not necessarily essential axis for vendor maturity)					
Program					
Project					
CM3 levels	LEVEL1	LEVEL2	LEVEL3	LEVEL4	LEVEL5
	Sinking in dispatch business	Increasing project contract business	Mostly project contract business	Trying to sustainably prevent outbreaks of SPPs	Achieved preventing SPPs sustainably
Corresponding OPM3 levels			S, M, C	I	I

Figure 4 New Maturity Model for Vendor

[Maturity model for user]

“Portfolio” may be necessary axis for user (owner). However, since the user do not practice dispatch business even if they employ software engineers, LEVEL1 and LEVEL2 are eliminated from the model. Thus, the new model for user can be described as Figure 5.

Portfolio				
Program				
Project				
CM3 levels	(note)	LEVEL3	LEVEL4	LEVEL5
		Develop software by itself or vendor contract	Trying to sustainably prevent outbreaks of SPPs	Achieved preventing SPPs sustainably
Corresponding OPM3 levels		S, M, C	I	I
(note) LEVEL1 and 2 are only for vendor				

Figure 5 New Maturity Model for User

6. Suggestion for Stepping Up to Higher Level

The followings are recommended for those who have will to step up individual SDC level, as far as we have experienced.

[SDC LEVEL1 to LEVEL2]

In order for the SDC to become from LEVEL1 (a human bank of engineers) to project contract enterprise, there must be project managers for managing software development project. Thus the SDC needs to specify proper method to develop project managers among employees in the SDC. However, the PMBOK has insufficient method to develop project managers for software development, since it lacks software specific knowledge. In spite of recent software extension of the PMBOK (PMI, 2013b), it is also difficult to say it is sufficient, since the software extension involves less tacit knowledge of experienced project managers, with which they actually have been preventing IT project failures in actual projects. Thus we recommend to use project management method specified in books named “*Mieruka* (Visualization) of IT Project” (IPA, 2008a)(IPA, 2007)(IPA, 2008b)(IPA, 2006), which have been published by IPA (Information-technology Promotion Agency, Japan). The method involves variety of practical tools such as bird-eye-view diagrams, check sheet, summary of problem projects, quantitative management tools and integration management tool. These tools are developed by visualizing tacit knowledge of expertized project managers in major prime contractors such as NTT Data, Hitachi, NEC, NS Solutions or TIS.

[SDC LEVEL2 to LEVEL3]

The SDC increases project contracts comparing to dispatching business every year by developing skill of project managers (enlarging manageable project scale and complexity) as well as increasing amount of project managers. The SDC should start trying to “Standardize” and “Measure” project management to meet the company style. The SDC should also start practicing “Control” projects by organizing QA or PMO and by evaluating skill of project managers and engineers quantitatively.

[SDC LEVEL3 to LEVEL4]

The SDC may practice countermeasures including the following organizational actions for continuous improvement to sustainably prevent SPPs.
 -QA (or PMO): The SDC organizes QA team under the top management by assigning QA members among

expertized senior project managers. The members should have much higher skill than ordinary project managers and have been highly trusted by field projects. After problems of SPPs are resolved, the top management keeps the members staying in the QA team, even when business units lack project manager resources due to increase in orders.

-Project checklist: The SDC simplifies the checklist so that both loads of the management and field projects may be acceptable level, by reducing large checklist to check items which are mandatory for SPP prevention. For example, one way to practice the reduction is to link individual check item to each case of problem project like *Mieruka* method (IPA, 2006-2008b), and eliminate check items which have no link to cases of SPPs.

-Tacit knowledge: The SDC visualize tacit knowledge which project managers have been got in their experience of SPPs, before their retirement. It is also advisable to learn how to visualize tacit knowledge by participating in research activity to practice it by non-profit based organization such as IT *Mieruka* Institute (ITMI, 2017).

[SDC LEVEL4 to LEVEL5]

The SDC establishes its own mechanism to prevent SPPs sustainably. For example, it has quantitative evaluation inventory of skill to prevent SPP in every stakeholders (e.g. not only project managers or engineers but also senior managers or sales person). A methodology to prevent SPPs sustainably may be operated by quantitative management to check correlation between stakeholder skill and risk of SPP, using the inventory. Also QA team has strong leadership for avoiding SPPs so that it may influence the management decisions. After keeping such continuous improvement, the SDC has been not suffered from any SPP for more than 10 years.

7. Expected Effects

When we forecast several tens of years ahead, the following management losses are expected, if the current SDC levels in the software industry are not changed any more. On the contrary, the software industry is expected to be developed with less management losses in the future, if it try to improve SDC levels based on our proposal.

1) The management losses due to SPP

First, the cost overrun of SPP brings magnificent

loss of the management. Although the actions to step up migration level, which are suggested as specific examples of how SDC should be in the previous section, require some investment, cumulative SPP loss caused by repeating the same SPP history may be expected to exceed the investment plus reduce profit loss (total investment) as illustrated in Figure 6.

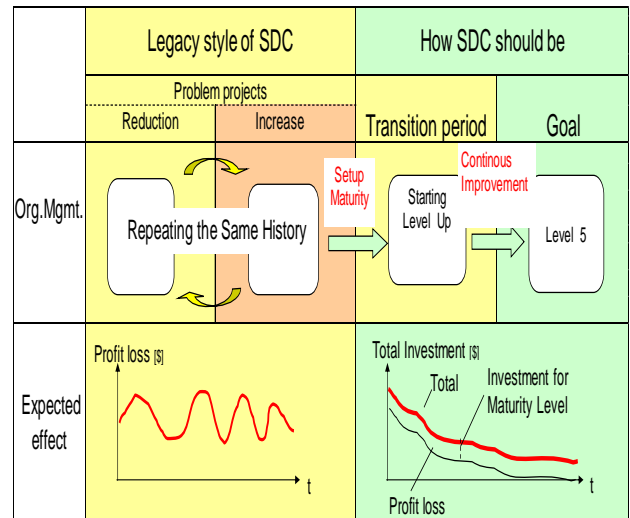


Figure 6 Expected difference (long-term profit)

Other than profit loss, the management suffers from opportunity loss due to SPPs, since much resources, who should have increased sales by other project contract, are consumed for shooting troubles of SPPs.

Moreover, the management also suffer from the loss of valuable human resources due to repeating the same SPP history, since it is often observed that some project managers or software engineers quit their jobs and move to another industry other than software, after shooting SPPs.

2) The management losses due to sinking in dispatching business

In the near future, the SDCs may lose such business, and replaced by other companies which develop software by project contracts whether they are done on shore or off shore.

If such SDCs are replaced only by off shore companies, software engineer resources in domestic market reduce, which may cause hollowing out of the software industry.

8. Conclusions

New capability model for managing projects (CM3) is proposed for individual company in the software

industry to make business progress by taking project contract responsibility and with the aim of preventing projects from serious problems sustainably. We also discussed expected business effect by using the proposal model for individual company to recognize current maturity level and step up incrementally to improved levels.

Most of existing software vendors, whose number is said to be 20 thousands in Japan, are classified to only two groups in reality. One is major contractors (LEVEL3) and the other dispatch business company (LEVEL1). Such structure of the software industry have been continued without any change for tens of years. Based on discussion of the previous section, it is hardly a wise option for the software industry to keep the existing structure also in the future. In order for the software industry to proceed to how it should be, we believe that it is necessary for the software industry to incrementally change its structure from the two groups to 5 groups corresponding to 5 levels (LEVEL1 to LEVEL5) as illustrated in Figure 7. Therefore, we continue developing the proposed organizational maturity model in research activities of IT Mieruka Institute, by aggregating much more best practices and call for participants to introduce the results.

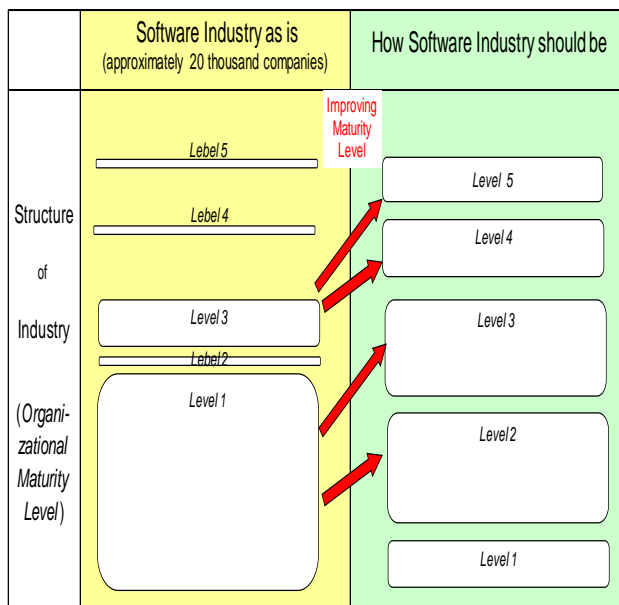


Figure 7 How Software Industry Should Be

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