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GERENCIAMENTO DE PROJETOS A LONGA DISTÂNCIA

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RESUME

Title: Project management of development of new technology product

The IT technology had great evolution to reply the demands especially from 1990 to 2000, and many companies have promoted competition to commercialize the new technology product at first. About telecommunication product life based on the new technology, there are about 5steps of projects in my opinion. Basic conception for first step, Evolutions of performance for second step, Productivity improvement for third step, Customization of product and cost down for forth step and Expansion for overseas for fifth step. Off course, each step has several projects and each step can cross over at the product life chronogram. At this paper, I focus on the projects of new product development that use new technology to apply for all kinds of new technology demanded development of new products.

Since many projects of product development have already been done at the telecom area of Furukawa Electric that I have worked about 5years, I compare the existing Critical Success Factors with existing design review check sheet and point out the success factor of Japanese companies. In addition, I identify the specific points of Japanese companies to point out why they are competitive at development of new technology product.

In a conclusion, the below items can be pointed out as critical success factors of project of development of new technology product especially.

- Good Communication
- Lessons learned by experience
- Control of the project

1 INTRODUCTION

1.1 HIGH TECHNOLOGY PROGRESS AT JAPAN

Commonly, the progress of Japanese economy after World War II is expressed as miracle revival and many Asian companies describe to learn from Japan to follow its growth (ex. Look East slogan by Malaysian president). In 80 or 90 decade, the development economy area is studied well and Japanese success is treated as ideal model for Asian countries economy. The ideal model of development economy has said as follows. The simple industrialization of a country generates many urban jobs, which cause the population flow from countryside to urban city. The wage keeps cheap up to continue this population flow, but it gets more expensive after lacking cheap wageworkers in the market. At this phase, the industrial companies need to produce more high technology demanded products with more efficiency because other factories of the poorer companies can produce with lower cost in theory.

Off course there are many exceptions and the world does not work so simply, but the trend of Japanese industries can be applied for this model. Up to 70 decade, Japanese industry had grown up with following high technology that is mainly innovated in US and continuous progress of efficiency of the factory. It is always said that the strongest point of Japanese industries is its efficiency and high control quality of the factory like as Toyota method. It may be applied for general Japanese industries up to 70 decade, but some industries that are always requiring innovation need to lead the high technology development of the world when they catch up the leading countries. Especially high technology industries companies that produce electric electronics companies like as Sony, Panasonic, Mitsubishi, Pioneer, Sharp and so on. They absolved the most progressive electric electronic technology up to 70decade to catch the American or European companies and catch them up with their better quality. From 80 decade, they dominate some areas like as Audio Visual equipments like as CD player or high capacity DRAM with their original products all over the world and expand their bland. Even though in 90 decade American companies Microsoft and Intel create global standard at the Internet world and Japanese companies become only

suppliers and sub cast of IT revolution boom, Japanese companies have begun to recover with digital high technology products like as digital camera, DVD recorder or slim displays nowadays.

About high technology, there are 2 kinds of innovations. One is to create the core technology from zero and the other is to compose of various existing technologies. It is commonly said Japanese companies are good at latter type of innovations. I would like to point out how to organize and manage the project type development of new products deeply.

1.2 HIGH TECHNOLOGY PROGRESS OF TELECOMMUNICATION AREA

Traditionally, the progress of telecommunication area of Japan is pulled by public telecommunication companies NTT (for national) and KDD (for international), and they define the basic technical specification. Though American or European makers suppose new technologies for telecommunication operators, it is opposite to Japan. In spite of getting these companies to become private companies at 80 decade, they occupy still the greatest part of Japanese market for telecommunication operator. They contribute the development of telecommunication technology, but it can be said that a lot of these development products are not for global standard but only for Japanese standard.

Anyway, at the telecommunication area, American companies have innovated the new evolutional technology and expanded for the world. The progress of telecommunication technology is so rapid that it can be said the most progressive area in the twenty century. The progress of the technology changes the life of all the people more convenient and this change will never be stopped. At first revolution may be the appearance of optical communication to substitute for microwave coaxial cable. Optical fiber is innovated by Corning Company and many accompanied technologies are innovated by Corning and Bell Lab at the beginning. However Japanese companies have started the optical components and optical fiber enterprise after American companies have already succeeded in commercializing, they progressed their original technologies and grew up to make competition with other worldwide great companies. It is not only by Japanese makers own but also by NTT distributions. Since they make optical fiber network spread all over the country before other companies started, they lead Japanese makers to innovate better and cheaper components or cables. Thanks for NTT technology leading, so much equipments, components or optical fibers are innovated by 1995.

About the year of 1995, WDM (Wavelength Division Multiplexer) technologies appears to resolve the cost down of optical network at United States, and ordinary NTT technologies are considered as more expensive solution. It helps to expand optical network all over the world because it costs down long haul telecommunications especially and many analysts have said that the IT revolution requires high capacity network line. These days, so many telecommunication operators have installed new long haul optical line like as Asia to U.S or U.S to EU submarine optical systems at the short term, anything related to optical system can be consumed well. Especially, new WDM technology related products like as optical amplifier, DWDM optical transmitter or WDM fiber had great success.

After IT boom ended suddenly about the year of 2001, all the long haul optical systems are considered as excessive investment and some new telecommunication comers are corrupted like as WorldCom or Global Crossing because of their excess investment. Almost all the WDM market players who grew up with WDM technologies are damaged with their excessive stock, investment of excessive product machine or debt for telecommunication operators. In spite some advanced areas like as great cities of Japan have already started FTTH system (Fiber To The Home), the demand for optical systems is so limited that it cannot absolve the expanded factory capacity. In addition, new Taiwan players supply generic equipments / components so cheaply, the existing vendors have lost their market at the generic products market but the demand for higher technology products keeps relatively low up to now.

1.3 FURUKAWA ELECTRIC TELECOMMUNICATION AREA TECHNOLOGY PROGRESS

The Furukawa Electric CO.LTD. is one of the greatest companies of energy cable or telecommunication cable in Japan, and they have produced copper twined telecom cable and energy cable since 70years ago. They have started optical product enterprise as optical fiber since decade of 80. Since NTT is a greatest customer for Japanese telecom market, Furukawa is always developing new products for NTT in the competition with other players like as Sumitomo or Fujikura. In addition to develop the progressive optical products, Furukawa invests so much at R&D of optical telecom area to become a key player of world market. Thanks for this effort, it blooms at some passive components, optical amplifier or

optical semi conductor areas in addition to NTT required products like as optical cable, optical connection materials.

Since the main market is different, there are 2types of products at Furukawa Electric telecommunication area. The first is domestic market products and the latter is world market products. The examples for first products are optical fiber, optical cable and optical connectors. Even though some kinds of their products are exported so much, initial concepts of their products are always suggested by the client and developed to attend their demand. The examples of latter products are WDM related products like as optical semi conductors or optical amplifiers. Since their main market is located in U.S, they develop to attend the worldwide market demands. They always need to watch the new technology trend and start the development before appearing the demand of client. However they cannot develop with clear marketing scale, they may acquire the sweetest fruit because other competitors have not developed yet. Relatively the business is more risky but may have more returns.

1.4 PRODUCT LIFE

However the product cycle of high technology products of telecom area are relatively short, the product life is distinguished as below.

1.4.1 R&D

The conceptual bone of the product is created at Lab of university or company. Sometimes nobody knows whether to be able to commercialize but it may be recognized to utilize well. The product may be hand made and there is no or less control of the quality but it is confirmed to repeat its performance and the performance is better than existing product. Normally R&D team is built up to try to make these new products commercialize, but they make more effort to accumulate their knowledge about the new products than commercializing normally.

1.4.2 Improvement of performance

After the new product is recognized to have better performance than existing technology, some market must be appeared. At that situation, the new product with better performance is so precious that the improvement of the key performance may have more priority to dominate the market. In addition to improve the commercialized products, it is always required to launch new model or new process that has much better performance than existing model or process. In theory, the improvement of performance has more priority when the improvement of the key performance can contribute the cost down of telecom system.

1.4.3 Productivity

After the benefit of the new product is recognized at the market, the market scale grows up rapidly. At the moment, the production capacity of the new product is required to supply for this growing up market. It is required to innovate some mass production technology of product, process or product machine and improve its defect rate or loss rate dramatically. It means the stability of the production quality is important in addition to extend product capacity. The improvement of defect rate and automation of the process lead cost down and market growing, too.

1.4.4 Customization and Cost down

When there is no room to improve the key performance of the product, and many suppliers appear at the market, the product is not considered as new product and there are 2ways to survive at the market. The first one is to supply the standard products cheaper and the latter is to customize its specification to attend the demand of client rapidly.

As first solution, there are several choices like as developing minor changed new products, improving process for cost down or transferring process for low cost factory. Especially at the telecom industries, many technologies need to become standardized without any patent rights, even if it is innovated by one company like as some kinds of optical connectors or UTP cable. Because there is no way to sell your innovated technologies if they are not standard technology even though the innovated technology itself is so good. When the technology is

open and not protected by patent, anyone can enter the market, and finally who wins the market is that can supply cheaper because there is no difference at the specification, that the world technical committee standardizes all the specification. If you want to play at this standard market, you can be competitive if you can supply these products cheaper than other players.

Actually, who win the standard market at the optical components market are the companies of Taiwan who have small development group but can produce them at the low cost Chinese factories in exception of the recent launched standard technologies.

To avoid the price down competence, you need to produce specific products. In many case, it is realized as customization. For an example, you can attend the specific and niche demand that other companies do not enter, you can attend the original design or performance of the product rapidly. At the case, the marketing demand needs to connect to the product designer and factory tightly. Since the telecom market changes so rapidly that the speed and the flexibility of custom order made development can satisfy more than its price

1.5 PROJECT TYPE OF EACH STAGE

The resume of the product life is shown at Graph-1 Product life of telecom area high technology products. Since the evolution of the technology is so rapid that this product life tends to be shorter. It means you will not survive if you cannot attend the market demand correctly.

The representative projects of each product life stage are shown as below.

1.5.1 R&D stage

Study of technology contents

Theory design

Material performance test

Laboratory level manufacturing process mounting

Prototype product development

Refining of prototype product

1.5.2 Improvement of performance stage

Launch of new products with higher performance

Improvement of basic factors performance

Verification of long life guarantee of new products

Advertisement for efficiency of new technology

1.5.3 Productivity stage

Development of mass production technology of new products

Development of automation process technology of new products

Defect or loss reduction and stabilization of process

New customers investigation

1.5.4 Customization stage

Development of customized products

Installation and improvement of flexible process line

Attendance for customer new demand

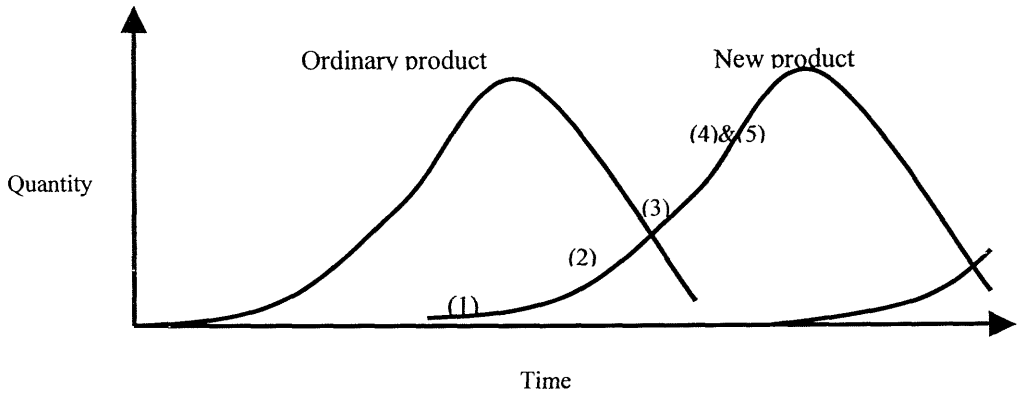
1.5.5 Cost down stage

Development of minor changed cost down new products

Development of global process line

New oversea factories construction

Installation of local sells office



GRAPH 1 Product life of telecom area high technology products

1.6 FURUKAWA ELECTRIC PROJECT TYPE

Since Furukawa Electric has relatively greater scale of structure and heavier investment to the telecom R&D area than other telecom hardware companies, it should be superior at new technology development like as rapid commercialization of new technology products and good productivity of these products, but not as out of date technology products. It can be said it need to earn the money to return the investment at the initial phase of the new technology product before this technology turns to be ordinary products that everyone can manufacture. Since short-term return of investment is required for the telecom area, new technology product development and new factory construction are always chosen as company scale projects. Generally, as new technology product development, R&D manager level person or technical sales area person is designated as project manager, and he is responsible for the commercialization of the new product with R&D department and manufacturing sector. As a new factory construction, a manager level person of production engineering is responsible for the factory construction that can produce new products with high productivity and low defects with feedback of initial production result with the corporation of process machine development sector. As exception, it exists oversee planting project may be executed. In that case, it often takes the used production machines to oversee to manufacture the ordinary technology products for the purpose of cost down.

However it exists several project types at Furukawa telecom area, the development of new technology product is focused on especially.

2 EXISTENT THEORY

2.1 CRITICAL SUCCESS FACTORS OF PROJECT MANAGEMENT ORIGIN

In theory, project managers commonly made use of concept known as the triple constraint to evaluate a project at completion. This triple constraint offered a three-legged stool for any project viability like as time (the project had to be completed within its budget limits), money (the project had to perform in the manner that was intended) and performance (the end result had to perform in the manner that was intended). Seen in the light, it was relatively easy to make some initial value judgments about any project. Time, cost and quality were the only significant questions to consider. Further, one only had to consult the project time line to assess schedule constancy, review the cost accountant report to determine budget adherence, and see if the project worked to measure performance.

Although triple constraint is simple, it unfortunately is also simplistic. It can be said it does not work in the modern business world. In an era of tremendous competition and heightened concern for customers, the triple constraint has become a dangerously out-of-date convention. In concerning the three components of the triple constraint, it is clear that the primary thrust of each of these measures is internal, that means they are intended to satisfy some interest of group internal to the organization rather than in the environment. For example, satisfying time and budget considerations are often the concern of cost accountants who are tasked with keeping cost down. Likewise, the performance criterion has often been seen as primarily an engineering concern of the challenge of making a product that works.

Historically, what was lost in the confusion was any real concern for the customer, that is, the desire to satisfy the concerns of the client for whom the project was intended. Within many companies, a fundamental conceit emerged in the assumption that once a project was completed, the public would be offered a fait accompli that they would naturally buy or use. The underlying theme of this position seemed to be an arrogant assertion as Do not tell us what you need, trust us to know what you want. The result of such attitude

was predictable as customers increasingly went to companies whose projects and products reflected a concern for them.

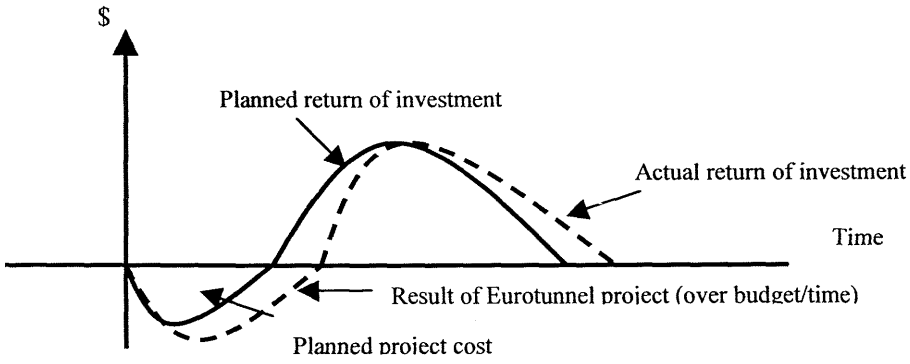
The new rules governing global business require that project management adopt a new standard by which future success will be measured, the so-called quadruple constraint. The additional feature of the quadruple constraint requires us to include customer satisfaction as one of the pillars of project success. Client, or customer, satisfaction refers to the idea that a project is only as successful as it satisfies the needs of its intended user. This addition has tremendous implications for the way we manage projects and the manner in which the success or failure of both past and future projects will be assessed. With the inclusion of customer satisfaction as a fourth constraint, project managers must now devote additional time and attention to maintaining close ties with and satisfying the demands of external clients.

Among the implications of this new quadruple constraint is its effect on what were viewed as traditional project management roles. Concern for the client forces project managements to adopt an outward focus to the efforts. In effect, they must now become not only managers of project activities, but sales representatives for the company to the client base. The product they have to sell is their project. Therefore, if they are to facilitate acceptance of the project and hence, its success, they have to learn how to engage in these marketing duties effectively.

One of the truly difficult tasks confronting any project manager lies in making reasonable and accurate assessments of project viability early in its development. In the view of the decision whether the project is success or failure, many projects that give every evidence of being instant failures may actually demonstrate themselves to be long-term successes. One example that comes immediately to mind is the well-known English Channel tunnel project, known as the Eurotunnel. Opening in 1994, nearly eighteen months behind schedule, the tunnel project was originally budgeted for 7.5 billion pounds sterling. The final bill was 15billion pounds sterling. From an internal auditing perspective, the tunnel project represents a financial failure, particularly in the light of recent news that it has defaulted looking at the project in regard to its long-term potential, one must admit that its contribution to society may be significant.

At this case, it can be said the product is in success even though the project is in failure. In the other words, it should be discussed well about total return of investment at the initial phase of the project with

consideration of any risks not to fail the product with no sufficient return of investment even though the project may finish within planned budget and time schedule.



GRAPH 2 Example of Eurotunnel Project

This case illustrates a central idea regarding product success and failure, the importance of balancing immediate assessment against long-term project viability. Clearly there are definite benefits involved in waiting until after the project has been completed and its introduced to its intended clients before assessing the success and impact of the system. On the other hand, we must be careful in not waiting so long to determine a project external impact that the possibility exists that other organizational or external environmental factors will influence the organization operations to the point where we can determine the relative impact of the project in the marketplace.

Among the important challenges involved in accurately assessing project status midstream are developing a comprehensive understanding of what exactly are the factors that constitute success and how their measurement its confounded by the often misleading information that the project manager receives during the development process, particularly in terms of time and activity completion trade-offs. The larger question, however, and one with which the bulk of this chapter must be concerned, is, What are the critical factors that ultimately determine the likelihood of successful project completion? It is simplistic to assume that accurately charting costs and schedules is all that is necessary to ensure that a project will be successfully completed. First, such a mind-set ignores one of our previous points; the quadruple constraint requires that project managers also adopt an external focus that customers demand.

The second problem with the traditional model of project success is that it ignores the findings of important research into the nature of project success. Almost every researcher who has studied the impact of

various internal and external factors on project outcomes has concluded that human, rather than traditional, factors are the primary determinant of whether a project will succeed. In other words, although no one will deny that computers, scheduling, and budget models are important elements in controlling a project, the research suggests that the larger managerial issues are typically the key determinant of project likelihood of success. Project management has always been, and remains, a people management challenge first and foremost.

2.2 CRITICAL SUCCESS FACTORS FOR PROJECT MANAGEMENT

The study of critical success factors in the project implementation process looked at over four hundred projects varying greatly in terms of the basic characteristics. A wide range of representative samples of project type included R&D projects, construction projects, information system projects, and so forth. The study validated a ten-factor model of critical success factors for project implementation. Further, it was confirmed the vital importance of managerial, behavioral, and organization issues in successful system implementation. From this research, it can be said how these factors offer new insights into the managerial nature of project critical success factors.

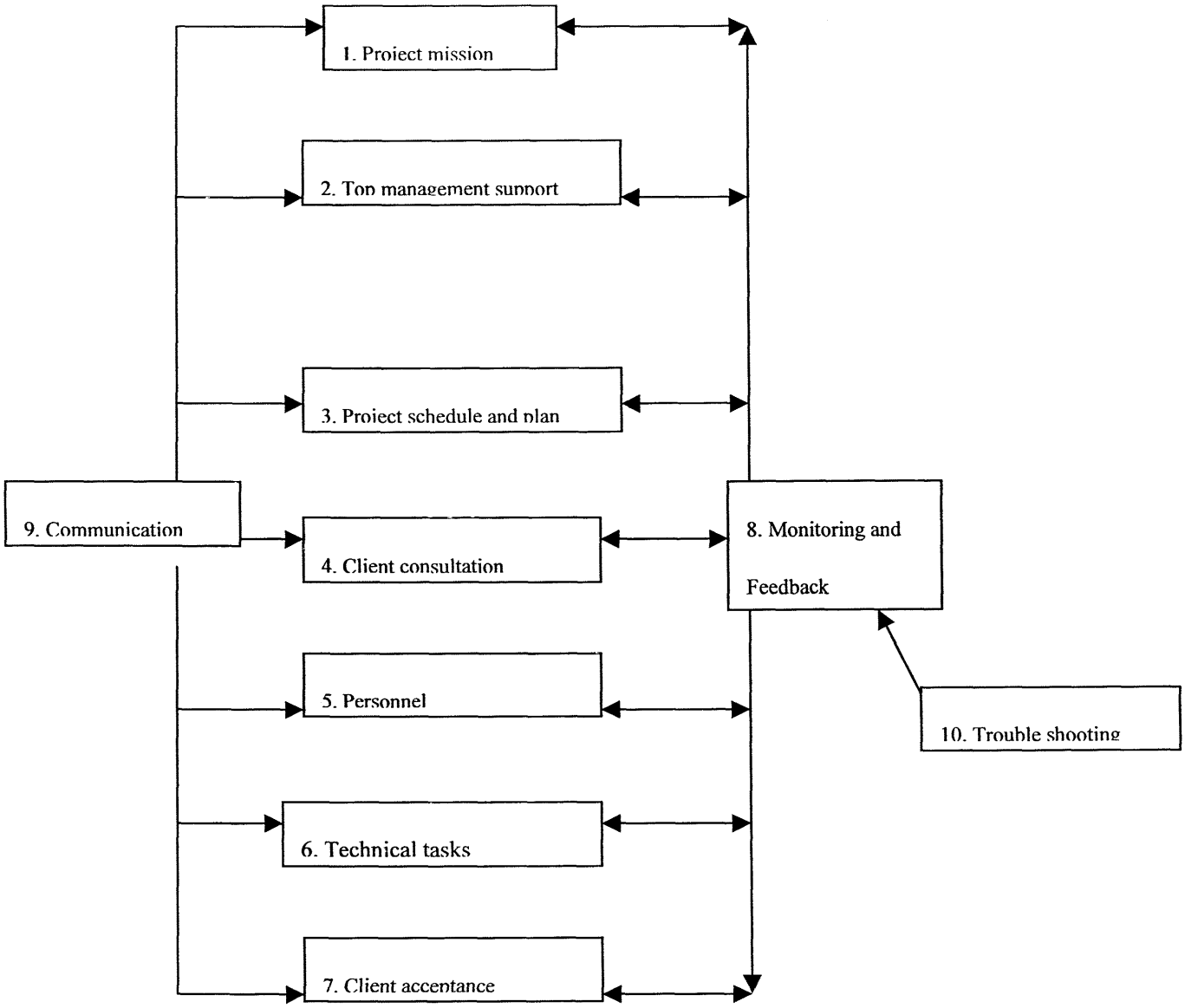


CHART 1 10key points for project implementation

(1) Project mission

The first developed factor was related to the underlying purpose for the implementation and was classified as project mission. Most of us intuitively understand the importance of conducting a feasibility study prior to project kickoff. Further, it is vital that project managers answer some fundamental questions for project managers to answer include, The basic goals of the project are clear to me and The goals of the project are in line with the general goals of the organization.

1-1. The goals of the projects are in line with the general goals of the organization

1-2. The goals of the projects are clear for the members

1-3. The results of the projects lead benefit for the organization

1-4. I believe the chance of success of the projects

1-5. I can understand the importance of benefits for the success of the projects in consideration of client.

(2) Top management support

Management support is extremely important for the success of any new project. Project managers not only depend on top management for direction and authority in running their projects, they rely on them as a safety value as well. When the project is undergoing difficulties, it is vital that top management be aware of the problems and willing to offer necessary additional aid or resources for the project manager and team. Top management support of the project may also consist of the project manager confidence in their support in the event of crisis. Among the sample issues for project managers to consider when addressing this factor are, Upper management has provided me with sufficient authority and responsibility and I agree with upper management about my level of authority and responsibility of the project.

2-1. Upper management decides whether to add other resources or budget when it is required.

2-2. Upper management is sharing the responsibility of conquest of the success of the project with the project team.

2-3. I agree with upper management about my level of authority and responsibility of the project.

2-4. Upper management will supply added resources or budget to achieve the goal or agree to change the technical specification in moment of project crisis.

2-5. Upper management has provided me with sufficient authority and responsibility to avoid the conflict with organizational manager.

(3) Project schedule and plans

Project planning refers to the importance of creating a detailed outline of the required stages in the implementation process, including work breakdown, resource scheduling, and activity sequencing. Scheduling is generally understood to refer to the tasks of creating specific time and task interdependent structures, such as critical path and Gantt charts. Project schedule and plans refers to the degree to which time schedules, milestones, staffing, and equipment requirements are specified. Further, the schedule should include a satisfactory measurement system as a way of judging actual performance against budget and time allowances. A sample of the type of statements considered in this factor include, I have identified the important manpower skills required for successful project completion and I have contingency plans in case the project is off schedule.

3-1. We know that our activities have time to spare or resources of other areas to utilize in case of emergency.

3-2. It exists a detail plan (chronogram, milestone, and necessary resources are inclusive) to complete the project.

3-3. It exists a detail-estimated budget for the project.

3-4. It is identified the important manpower skills required for successful project completion

3-5. It exists contingency plans in case the project is off schedule.

(4) Client consultation

The client is anyone who will ultimately be making use of final project either a customer outside the company or a department within the organization. The degree to which clients are personally involved in the implementation process will cause great variation in their support for the project. It is therefore important to determine whether clients for the project have been identified. Once project managers are aware of the major clients, they are better able to determine accurately if they needs are being met. Some examples of statements to consider in the client consultation factor include, I have solicited input from all potential clients of the project and The clients have information about the project progress.

4-1. The clients have some opportunity to help at the project development stage.

4-2. The clients have information about the project progress.

4-3. The project value has been discussed with the clients.

4-4. The limited range of the project has been discussed with clients. (What the project is designated not to do)

4-5. Ii is solicited input from all potential clients of the project

(5) Personnel

Personnel issues include recruitment, selection, and training. An important aspect of the project management process concerns the nature of the personnel involved. In many situations, personnel for the project team are chosen with less than full regard for the skills necessary to contribute actively to implementation success. All current writers on project management understand the role of effective project team personnel is concerned with developing a project team with the requisite skills and commitment to perform their function. Examples of statements to consider for the personnel factor include, It exists enough human resources to finish the projects and The team members understand their performance is evaluated.

5-1. Team members understand their role of the team.

5-2. It exists enough human resources to finish the projects.

5-3. The team members understand their performance is evaluated.

5-4. The work description has been written, distributed and understood by team members.

5-5. The technical and/or management training is available for team members.

(6) Technical tasks

It is important that the implementation be well managed by people who understand it. In addition, companies have to ask themselves if they have the necessary technology and training to support the development. Technical tasks refers to the necessity of not only having the necessary personnel on the implementation team, but ensuring that they possess the necessary technical skills and have adequate technology to perform their tasks. Obviously the decision to initiate a new project must be predicated on the organization ability to staff the team with competent individuals and provide the technical means for the

project to succeed. By way of illustration, examples of technical tasks statements would include, The technology that is being implemented work well and The people to execute the project know the project very well.

6-1. The specified works of the project are well managed.

6-2. The engineers or other technical people of the projects are competent.

6-3. The technology that is being implemented work well.

6-4. The applied technology (equipments, training program, etc.) has been selected with the vision of the success of the project.

6-5. The people to execute the project know the project very well.

(7) Client acceptance

In addition to client consultation at an earlier stage in the system implementation process, it remains of ultimate importance to determine whether the clients for whom the project has been initiated will accept it. Client acceptance refers to the final stage in the implementation process, at which time the overall efficacy of the project is to be determined. Too often project managers make the mistake of believing that if they handle the other stages of the implementation process well, the client will simply accept the resulting system. In fact, client acceptance is a stage in project implementation that must be managed like any other. Examples of statements referring to client acceptance would include, Potential clients have been contacted about the usefulness of the project, and Adequate advanced preparation has been done to determine how best to sell the project to clients.

7-1. It exists the acquired documents of the project to be used easily by clients.

7-2. Potential clients have been contacted about the usefulness of the project.

7-3. A project presentation is made for the clients.

7-4. The clients know who to make contact when problem or doubt appears.

7-5. Adequate advanced preparation has been done to determine how best to sell the project to clients.

(8) Monitoring and feedback

Monitoring and feedback refer to the project control process by which key personnel receive feedback, at each stage of the project implementation, on how the project is comparing to initial projections. Within many organizations that are experienced in running projects, there is little general agreement on how to track projects, what features should be tracked, and how these data should be reported. Making allowances for adequate monitoring and feedback mechanisms give the project manager the ability to anticipate problems, oversee corrective measures, and ensure that no deficiencies are overlooked. Project managers need to emphasize the importance of constant monitoring and fine-tuning the process of implementation. For our discussion, monitoring and feedback refers not only to project schedule and budget, but also to monitoring the performance of members of the team. Sample statements for the project manager to consider under the monitoring and feedback factor include, When the budget or schedule requires revision, I solicit input from the project team, and It is realized periodical meeting to monitor the project and improve the feedback to the project team.

8-1. All of the important aspects are monitored to measure the progress of the project in the complete vision. (Budget, Time schedule, Human resources and equipments utilization, Team spirit, etc.)

8-2. It is realized periodical meeting to monitor the project and improve the feedback to the project team.

8-3. The real progress is compared with the planning regularly.

8-4. The results of the project review are regularly shared with all of the people who have relationship with planning and budget.

8-5. When the budget or schedule requires revision, I solicit input from the project team

(9) Communication

The need for adequate communication channel is extremely important in creating an atmosphere for successful system implementation. Communication is essential not only within the project team itself, but between the team and the rest of the organization, as well as with the clients. As the factor of communication has

been developed for our framework, it refers not only to feed back mechanism, but to the necessity of exchanging information with both clients and the rest of the organization concerning the project capabilities, the goals of the implementation process, changes in policies and procedures, status reports, and so on. Some examples of the issues that are of concern for communication include, Input concerning the implementation effort goals and strategy has been sought from members of the project team, other groups affected by the project and upper management, and All groups affected by the project know how to make problems known to those who can deal with them.

9-1. The results like as decision, received information and necessary information of planning meeting are published and distributed for adequate people.

9-2. The individuals or groups that give information about the project have received whether the information is accepted or rejected.

9-3. When the budget or time schedule is reviewed, the alteration and the cause of the alteration are informed for all project members.

9-4. Input concerning the implementation effort goals and strategy has been sought from members of the project team, other groups affected by the project and upper management.

9-5. All groups affected by the project know how to make problems known to those who can deal with them.

(10) Trouble shooting

As several project managers have pointed out, problem areas exist in almost every implementation. The measure of a successful project implementation effort is not avoidance of problems, but knowing the correct steps to take once they develop. Regardless of how carefully the implementation effort was initially planned, it is impossible to foresee every trouble area or problem that could possibly arise. As a result, it is important that the project manager make adequate initial arrangements for trouble shooting mechanisms to be included in the implementation plan. Such mechanisms would make it easier not only to react to problems as they arise, but also to foresee and possibly forestall potential problem areas in the implementation process. Some examples of issues to be considered under the trouble-shooting factor include, The Brainstorming session has

been done to identify what kind of problems can occur, and Some actions are done immediately on members' initiative when the problem happens

10-1. Project manager does not hesitate to solicit for help of a person who is not involved in the project.

10-2. The Brainstorming session has been done to identify what kind of problems can occur.

10-3. In case of having some difficulty, the team members know where to require the help.

10-4. I am confident that all the problems should be resolved perfectly.

10-5. Some actions are done immediately on members' initiative when the problem happens.

3 METHODOLOGY

As it is known, Japanese manufacturing companies are good at its QC system and continuous improvement of cost down or quality. At product development stage, a template is applied for standardizing the process of development, and this template will be improved with the feedback of some trouble at the development process or commercialization. Generally, this template is called DR (Design Review), and all the items should be checked up before commercialization of the new developed product.

The problem of DR is that there are so many check-up items of technical area but lacking several items that are described at Critical Success Factors. In the other hand, as critical success factors of new product development project, the existent theory is lacking of technical area analysis. Adding to the insight of technical area with the analysis of existing DR template, I will try to make Critical Success Factors for project management of new technology product development.

4 RESULT OF RESEARCH

4.1 DR SCHEDULING TEMPLATE

The scheduling template of DR of Network development is shown at Table-1. In Furukawa, almost all the departments have their own DR templates and improve by their selves. Since Network development department has the most complete template among all the available templates because it has long history to improve and has developed new technology products not for specific area but for generic consumers, this template is chosen as representative. DR is separated as 4main stages, Planning, Specification Check, Test result check, and Production result check. As it is shown, a project manager who is designated by company manager (meaning division director) is responsible for the entire project of new product development and sub project managers are responsible for each item of project.

Category	Items	Responsible P	DR1	DR2	DR3	DR4
Planning	Strategy		→			
	Planning		→			
Hardware	Design Quality			→		
	Regulation			→		
	RAS, Sensor and Alarm			→		
	Thermal design			→		
	Electric wave			→		
	Operation			→		
	Compatibility			→		
	Commercialization			→		
	Cost			→		
FW/SW	Specification			→		
	Reliability			→		
	Process			→		
	Quality			→		
	Development environment			→		
	HMI			→		
Manufacture	General Construction				→	
	Assembly				→	
	Screw				→	
	Cable				→	
	Process and disposition				→	
	Supplement				→	
Inspection	First inspection				→	
	Product Inspection					→
TMP	Specification			→		
	Operation/Inspection/Maintenance				→	
Maintenance	Operation				→	
	Accident analyze				→	
	Install and adjustment				→	
	Tools				→	
	Parts				→	
	Foreign countries				→	
Parts/Units	Quality				→	
	New parts/units				→	
	Lifespan parts				→	
Reliability	Target reliability			→		
	Designed reliability				→	
	Smoking/Firing/Security				→	
	Others				→	
Document	Development			→		
	PL				→	
Patent	Application concept			→		
	Application detail				→	
	Clearance				→	
Time schedule to open DR						
Responsible person to approve (Describe the name of each stage)			CM	PM	PM	PM

CM(Company Manager) = President or person designated by president

PM(Project Manager) = CM or person designated by president

TABLE 1 DR (Design Review) of Furukawa Electric Network development department

4.2 DR-1 STAGE CHECK ITEMS

As first step, it needs to be checked a strategy of new technology development. In addition to the traditional goal setting of the project like as required time, budget, and human resources to complete the project, it should be checked whether the project fits the strategy of the company, market strategy, and risk identification. The main purpose of this stage is to check whether the development of new technology product may have sufficient return of investment or not.

(1) Is it recognized the business plan of the company?

* strategy

* objective

* business plan

Show the strategy/objective/business plan of company /department related to the product

(2) Does the new product fit the direction of business plan of the company?

How does the new product contribute to the business plan?

(3) Is it obvious the marketing research?

* Rival company, product

(Advantage/disadvantage of rival company/product)

*The share of market

*Scale and growth of market

Show the result of marketing research

(4) Is it obvious the marketing strategy based on the market research?

*Advantage of the product

(Spec, price, distribution channel, brand name, etc.)

*Priority of advantage points

*Main customers, how to sell

*Marketing strategy for expansion

Show the analysis of market strategy

(5) Is it obvious the scenario to share the market?

Ex. Adding unique spec., cost down by material change from some period

What is the plan to share the market?

(1) Is it obvious the forecast of market share, expected income and profit?

Show the forecast

(2) Is it obvious the best/worst forecast for the predictable variation?

ex. currency exchange, market growth, discount of rival products

Show the best/worst forecast

(3) Is it obvious who is responsible for the management of the project?

Who is responsible for the management of the project?

(4) Is it obvious who approves the each DR stage?

DR1 : Must be approved by company's administrator like as President/Director.

DR2,3,4 : Who is designated at DR1 can approve the each stage.

ex) DR2,3 = Project Manager, DR4 = Division Manager/Director

Show the approvable person of each stage

(5) Is it obvious who are the members of the project?

Show the members and the available hours that each member can take for the project

(6) Is it estimated the approximate total cost for the development? (Human resource, Material, Equipment, Third service)

Show the estimated cost

(7) Is it obvious the expected time to start the commercialization?

Show the commercialized time

(8) Is it obvious the return of investment schedule?

Show the return of investment schedule with the best/normal/worst scenario

(9) Is it obvious the commercialization plan to minimize the predictable risk?

Ex. of risk : defect of parts/process/SW, recall of lot/version

Show the best business plan to minimize the risk

4.3 DR-1 DETAIL PLANNING

After confirming the project has good ROI at strategy stage, it is required detail planning before starting the execution of project. Though the former stage has only scheme of WDS, required members, budget and time, it requires the detail planning of each stage. In addition to the detail specification of the new product including commercial strategy, there are several items to point out just for hardware development like as new technology trend, patent, manufacturing form.

(1) Does this product belong to actual development plan?

Show project member, budget, and actual state

(2) Is the member/budget/period in order of actual project?

Show the organized total development plan

(3) Is it clear the below items about new project?

*Concept of product

*Compatibility with the strategy of company

*Basic technology and required acknowledgement

*Marketing

(Main client, market scale, market growth, rival company, competence and how to sell)

*Member and budget of new project

Show the vision and required resource of the new project

(4) Does the new project have more priority than some actual project?

Show how to make replace or collapse the actual project

(5) Is the commercial specification of the product prepared?

It needs to include below items

* Main client

* Actual marketing scale and marketing growth

* Main Application

* Specific items that make difference from other products

* Price target

* Manufacturing (OEM/CKD/SKD/ODM)

Show the commercial specification

(6) Is it obvious the application of the product?

Show the application of the product

(7) Are there any competitors' products in this application?

What is the complaint of clients about products of competitors?

(8) Does this specification make difference from other products of rival companies?

* Technical specification

* Price

* Visual design (hardware, software)

* Technical support and after service

Show the different points.

Advantage points and disadvantage points

(9) Is it obvious the advertisement strategy?

Show the strategy

(10) Is it planned to sell in the other countries?

Show what kind of altered material /regulation is required at each country

Show the sales and technical support of the product at each country

(11) Is it planned for any expansion like as interface / number of ports / functionality?

What kind of expansion is available?

(12) Is it considered about the progress of the technology?

How to comport with the progress of technology?

What is the recent/future trend of the technology?

(13) Is it obvious the interface of the product?

Ex. Ethernet cable, serial interface, power cable or physical setting

What kind of equipment/material is required?

Are they easy to acquire for client?

(14) Is it obvious the required transport condition?

Ex) small elevator, nothing especial

What protection is required for the transport?

(15) Is it confirmed there is no difference between sales material and design specification?

(16) Is it confirmed there is no problem about the law?

(17) Is it confirmed the law/regulation concerned about the product? (FCC, CE, UL) What kind of law/regulation?

(18) Is it confirmed there is no problem about the patent? (National/international) Show the related patent

(19) Is it confirmed there is no problem about the sales politics (ex. commercial right of the area)

Show the related contract

(20) Is it clear the total process from planning to commercialization?

Show the project schedule, responsible person of each sub project, required resources and return of investment

* Time schedule of each process

* Responsibility for each process

* Required equipment/service to purchase/lend for each process

* Required man per hour for each process

* Total cost of development and period of return gain

Is it included the task of DR meeting?

Does the development process of hardware synchronize that of software?

Is it confirmed whether to use the developed units/parts to cut the development process?

5 ANALYSIS OF RESEARCH

5.1 CRITICAL SUCCESS FACTORS FOR PROJECT OF DEVELOPMENT OF NEW TECHNOLOGY PRODUCTS

The critical success factors for project of development of new technology products with consideration of DR template are shown as below. It is added technical vision and commercial success factor of new product principally.

(1) Project mission

In case of development of new products, the concept of project mission can be considered as same as generic project. Since time, budget and quality (specification of new product) may be considered as project mission, the items can be modified as below.

1-1. The new product fits the direction of business plan of the company

1-2. The specification of new product and budget/cost of project is clear for the members

1-3. The commercialization of the new product leads share-up or enough return of investment for the company.

1-4. At theory analysis, the projects may succeed in satisfying the technical specification.

1-5. The commercialization of the new product can make benefit for our clients.

(2) Top management support

At development of new technology product, the upper management support is necessary, too. Since project management and the members of project are designated by top manager at initial milestone (DR1), upper manager should be informed and support the entire of project. Especially about development of new technology, the lead-time of commercialization and its unique specification are fundamental, he needs to supply additional resources or budgets if it is necessary.

2-1. Upper management is responsible for our request of additional resources if it is necessary.

2-2. Upper management is sharing the responsibility of conquest of the success of the project with the project team.

2-3. Upper management provides me sufficient authority and responsibility of the project and I agree about my level of them.

2-4. In the event of crisis, upper management will aid me to give advice directly, provide some advisers or consultants or permit to modify planned budget, time limit or product specification.

2-5. Upper management convinces department managers of project members to give more priority for their work.

(3) Project schedule and plans

Since new technology products have fairly great probability of failure, the risk identification and contingency plan based on the lessons learned by the experience of the company is required. It is recommended to test to acquire the characteristics of the new technology before trying to makes prototype sample and prepare the sufficient reserve of material for retry of prototype sample. Since project lead-time is prior to budget, it recommends planning the time schedule with consideration of contingency plan and preparing material for contingency plan even if they cost more.

3-1. We have enough time to retry to make other prototype or resources to utilize in case of emergency.

3-2. It exists a detail plan (chronogram, milestone, and necessary resources are inclusive) to complete the project.

3-3. It exists a detail-estimated budget for the project.

3-4. It is identified the degree of difficulty of each technology to utilize and planned pre-test of the difficult technology before trying to produce prototype sample.

3-5. It exists contingency plans if initial try is failure.

(4) Client consultation

Since hardware product development is different from selling project, it is not always required the obvious client acceptance. At the case of customized product development project, the below items described as Critical Success Factors are mandatory, but if you develop new products for generic clients, you should make marketing analysis in space of client consultation.

4-1. The clients have some opportunity to help at the project development stage.

4-2. The clients have information about the project progress.

4-3. The return of investment of the project has been discussed with the clients.

(How to return the project cost like as minimum order quantity guarantee or development cost sharing)

4-4. The limited range of the project has been discussed with clients. (What the project is designated not to do)

4-5. Ii is solicited input from all potential clients of the project

Though a client acceptance is fundamental for new product development, it sometimes prefers to hide the project information to make difference from rival companies. At a development of new products for generic clients, the below items should be clear.

*Scale and growth of market

*Actual share of market

*Advantage of the new product (spec, price, distribution channel, brand name, etc.)

*Priority of advantage points

*Main customers

* Rival company, product (Advantage/disadvantage of rival company/product)

Considering above points, the client acceptance (maybe market analysis is more correct) can be altered as below.

4-6. It is known the advantage and disadvantage of rival company products.

4-7. It is clear what is the main complain of actual products (own and rival products) for potential clients

4-8. It is recognized what are the advantage points of the new product that potential clients accept.

4-9. It can be predicted to expand market scale or marketing share after the new product commercializing.

4-10. It is clear the advertisement strategy related to the new product development.

(5) Personnel

The specific points about human resources of Japanese companies are employment up to retirement and salary depending on the total work period. That is why the human resource requirement is well strict even though it becomes more flexible recently. Since sectionalism and the authority of department manager is strong, at many cases project manager cannot choose members, but only solicit the required characteristics of project members for department manager. Anyway, if project members are chosen by department managers, they should work about project with more priority as described 2-5. What is important for project manager is to analyze what kind of skill or acknowledgement is required for each member, whether to complete the project only with human resources of your company or need some part of the project to order to the other companies. Especially, it should be clear who to be responsible for the part to be developed at the other companies in case of ordering some part of project.

5-1. Team members understand their role and responsibility of the team.

5-2. It exists enough human resources to finish the projects.

5-3. The project manager understands the capacity of team members.

5-4. The work description has been written, distributed and understood by team members.

5-5. It is clear which part of the project to order to the other companies and monitored the progress of the part by responsible person of your company.

(6) Technical tasks

At view of the new technology development, the below items should be considered.

- Patent strategy
- Long time reliability
- Test items at prototype evaluation
- Comparison with rival company products
- Productivity
- Technology trend

As patent strategy, there is two ways to apply the patent to get your company products more competitive or to avoid the claim of other companies. Anyway, you should acquire enough information of the related patents of your new technology products before you start the development project, and check what kind of patents to apply or avoid claims at each stage of the project.

Generally, all the test items including long time reliability test should be checked and approved at DR-2 stage. Since the alteration of test items or contents of the test items may affect the time schedule, you need to check the test items before DR-1 approved. Especially, the entire project schedule should be considered with long time reliability test and you make clear the relationship between the degree of achievement of long time life guarantee and commercialization period (DR-3 and DR-4).

The comparison with rival company products should be identified at DR-1 to make clear the advantage and disadvantage of your products. Ideally you need to understand what is the technical advantage or disadvantage of your company in comparison of your rival companies in addition to your new developed products. If you can overcome your disadvantage or reinforce your advantage with your new technology product, it can help your market share to grow up. In addition to analyze rival company products to know what kind of technology/material/manufacturing machine is applied, estimated cost to manufacture and other know-how, you should have some unique technology that anyone cannot copy to make your products more competitive.

The productivity is other technical key point of development of new technology product. In order to make your new technology product more competitive, you should be able to supply new launched products sufficiently soon after commercialized. This might be one of specific points of Japanese market that Japanese consumers tend to purchase new launched products even though older version products are much cheaper. That means you should prepare well the manufacturing system to produce new products with high productivity to supply the entire demand of initial moment.

As last item, the technology trend analysis is required for new technology product. It means you should know the technology trend to perceive which direction this technology to go and launch the new technology above the direction. Especially at telecom area, the development of technology is so rapid that you cannot waste the time to develop the out of date technology. In addition to technology trend, you should make attention to the world wide standard. Since the telecom products must be compatible with the product of other company, IEEE committee defines the standard specification of these products. In case of developing new technology product, you should consider related standards.

In addition to technical tasks of nominal project, above items should be considered at the new technology produce development of telecom area. So that, the added and modified check items are shown as blow.

6-1. The technical critical works of the project are well managed.

6-2. The engineers or other technical people of the projects have enough acknowledgements at the applied technology.

6-3. The new technology that is being implemented has already been well evaluated or planned to evaluate.

6-4. The applied technology has been selected with the consideration of technology trend and world standard definition.

6-5. The related patent of the applied new technology is well investigated and it has defined clear patent strategy. (The acquired technology to apply or to avoid the patent)

6-6. All the test items are checked and approved by experienced person and predicted long lifetime reliability at the moment of commercialization can be accepted.

6-7. Some production engineers are included in the project to consider the productivity of new developed product and enough manufacturing capacity of the new developed product can be prepared before commercializing simultaneously.

6-8. The applied new technology stays above the direction of technology trend and the developed product will not be out of date soon later.

6-9. The related IEEE standard is investigated not to be so unique specification that the new developed product is not compatible with other products.

6-10. The applied new technology can reinforce the existent technical advantage of your company.

(7) Client acceptance

As well as client consultation, there are two ways of the project type as a project for the specific client or a project for generic customer. In case of a project for specific client, it can be considered as generic critical success factor for generic project, but development of new product for plural clients should be different. Maybe it can be called as market acceptance. As market acceptance, the success of development of new product is to sell the quantity more than expected and it is fundamental of success of product in order to be superior to the equilibration point. In addition, client satisfaction for new product is important, too.

7-1. It exists manual or catalog for client to make him easy to understand the new product

7-2. Potential clients have been made contact to explain the benefit of new product

7-3. A new product presentation is made for the clients before commercialization.

7-4. The clients know who to make contact when problem or doubt appears.

7-5. Adequate advanced preparation has been done to determine how best to sell the new product.

7-6. The new developed product has been sold more than expected and it passes the equilibration point.

7-7. Potential clients are satisfied with the new developed product.

(8) Monitoring and feedback

In addition to generic requirement of monitoring and feedback, there are two specific points about development of new technology product. At first, about technical critical items, since it is difficult to predict the result of new technology development completely, it is always required some contingency plan. It is

ideal to make the contingency plan in advance, but it is not efficient if the technical condition of contingency plan is done without feedback of first try but with original plan. So that, sometimes the best way for the contingency plan is reserving the enough time for retry and preparing material to start the sample test with the feedback of main plan.

As the other point, the feedback of client acceptance is very important. It should be better to consult with potential clients and make feedback of their opinions to confirm whether they accept the new technical specification or not at the moment of project planning or prototype sample evaluation.

8-1. All of the important aspects are monitored to measure the progress of the project in the complete vision. (Budget, Time schedule, Human resources, Equipments utilization, Team spirit, etc.)

8-2. In addition to the periodical meeting to monitor the project and improve the feedback to the project team, the result of new applied technology test is reported, analyzed and made feedback for other sample test soon.

8-3. The real progress is compared with the planning regularly

8-4. The results of the project review are regularly shared with stakeholders.

8-5. When the budget or schedule requires revision, I solicit input from the project team

(9) Communication

As well as generic project, the communication is very important for development of new technology products. Since it is seldom to make progress as it is planned, the result of some technical test can change the entire specification of the new products or time schedule of the project. In that case, the modification should be communicated with the members of the project but the security level of the information is well defined not to leak to the rival companies.

9-1. The results like as decision, received information and necessary information of planning meeting are published and distributed for adequate people under the clear procedure.

9-2. The individuals or groups that give information about the project have received whether the information is accepted or rejected.

9-3. When the budget, time schedule or technical specification is reviewed, the alteration and the cause of the alteration are informed for the members of the project.

9-4. Input concerning the implementation effort goals and strategy has been sought from members of the project team.

9-5. Stakeholders of the project know how to make problems known to those who can deal with them.

9-6. The security level of the information is well defined.

(10) Trouble shooting (risk management)

Since new technology is not always stabilized, some unpredicted result happens to appear. The important is to identify any possibility of the result at planning, and makes immediate actions when unexpected result appears.

10-1. Project manager does not hesitate to solicit for help of a person who is not involved in the project.

10-2. The Brainstorming session has been done to identify what kind of problems can occur at every phase of the project.

10-3. The action for each identified risk is planned or done.

10-4. In case of having some difficulty, the team members know where to require the help.

10-5. Some actions are done immediately when the problem happens.

5.2 SPECIFIC POINT OF JAPANESE COMPANIES

As it is known, Japanese companies are competitive at development of new technology product, as it is reflected to the former DR template. At 5-1, it is shown critical success factors with the consideration of DR template. Hence, it is analyzed external factors that influence to development of new technology products at Japanese companies.

(a) Respect for development of new technology

Since many Japanese manufacturing companies recognize the technology resource as seed of their growing, they tend to invest at R&D division heavily. In addition, at Japanese companies, experts of the technical area are much respected and companies help them to give some opportunities to improve their skill or capacity. Hence, companies can generate competitive engineers and operators, but maybe the most difference from other countries is that companies can generate experienced operators. In order to make prototype sample with adjusting manufacturing condition or install new manufacturing machine, the experience or acknowledgement of operators are very important not only at production sector but also at R&D division.

(b) Great scale of local market for new technology or high quality products

It can be said about generic products as well as specified products. Since mass media is well developed for advertisement and there are great scale of consumers that are interested in new products, it exists great scale of markets for new technology or high quality products even if they are much more expensive than generic products as example of DVD recorder, digital camera or 3G mobile phone.

As specified products like as telecom products, telecom operators lead manufacturing companies to develop new technology products by giving benefit for them by way of deciding purchasing share depending on the result of developed product. In the other hand, at U.S.A, EU or Brazil, manufacturers tend to develop new technology for their self and propose it to telecom operators. It is more risky to challenge for developing new product with heavy investment.

(c) New industrialized countries that produce ordinary products with cheaper wages near Japan

Since there are strong rival companies that can supply ordinary products more cheaply, all the Japanese companies should produce them at foreign countries like as China or Thailand, or be specialized at new technology development product. It is no way to make low price competition with Chinese or other Asian products, so that Japanese companies must be competitive at new technology products to survive.

(d) Low interest for long time investment and low pressure by stockholders

This economic environment permits Japanese companies to invest in new technology that needs long time return of investment. In addition, if it is not required short term return of investment of development of new technology product, new launched products do not need to settle much expensive price, and that creates more demand of new products at initial moment.

(e) Employment up to retirement

This social circumstance leads good benefit for skill improvement, motivation, and discipline of teamwork for workers. Since members work for the success of project but not for individual benefit, the project team can keep its direction of the project with high motivation and responsibility of each team member. The involved team members are not only interested in their responsible area but also in entire project, so that they exchange their opinions with project manager frequently to success their project. This may make difference from top down management.

(f) Continuous improvement of organization

This may be realized because of above stable employment. In addition to renew DR template with the feedback of failure analysis of project continuously, all the test result is published and documented as technical resource. This document of try and error result may avoid repeating same type of failure, and improved DR template helps project management to check the action to do easily.

Above characteristics helps development of new technology product of Japanese companies to finish the project to commercialize new technology products with high quality in short term. The key point is making project in advance with all the involved division like as purchase, R&D, product engineering, quality assurance, sells division, with competitive engineers and operators with continuous improved method with good communication.

However Japanese project management works well with above factors, there are several points to make it better as pointed out as below.

(a) Stiff organization without external vision

In order to improve the organization, it is better to input external resources or opinion, but Japanese organization tends to try to improve only with internal power. Sometimes DR template or project management method needs to be reviewed and checked by external specialists to improve more.

(b) Insufficient vision for world wide standard

It is good point that there is a great scale of local market for high technology products or that telecom operators lead to introduce new technology products, but if the new technology is well different from worldwide technology trend, this developed technology factor cannot be applied for global market. It happens especially about telecom market, and these sophisticated new products are not competitive at global market. It should be considered global market extension when product conception is discussed.

(c) Bureaucracy for new project or added investment

Even if upper manager designates the project, it is commonly required approve of plural division managers to solicit project members, use of equipment, or added investment. If project manager does not need to work about this kind of negotiation, he can focus on the project success more.

(d) Respect of technology causes poor ROI

This is not the success factor of project but factor of product, but the respect of technology can lead to develop the product that does not have sufficient market. You should confirm the scale of market to commercialize new technology products even if the technologies make possibility to develop the new concept of product, but sometimes R&D engineers discuss more about technology factors. There are so many products that has succeeded in development project but failed in product. At the definition of scope of the product, it should be discussed well not only about technology factors but also about market demand.

5.3 IMPROVEMENT OF PROJECT MANAGEMENT WITH REFLECTION OF JAPANESE COMPANY MANAGEMENT

At 5-1 it is analyzed critical success factors for project of development of new technology products, and at 5-2 it is shown the characteristics of Japanese companies that cause advantage and disadvantage of the projects.

Hence, it is described how to improve project management of development of new technology product with reference of above factors.

(a) Continuous improvement of organization and individual skills

As described, one of success factors of Japanese companies is the activity for continuous improvement. Companies should respect this kind of continuous improvement activities and help engineers/operators to learn by OJT or Off-JT in the long term. It makes your companies competitive and project management better.

(b) Frank and frequent communication

However the opinion of upper managers is important, project members should declare their opinion frankly. If you can discuss more frankly, you can shape better concepts of product or better development method. You should try to make the circumstance to discuss frequently and frankly.

(c) Feedback of the analysis of failure

As shown DR template, Japanese companies build up their own project management scheme and review the scheme with the feedback of the analysis of failure. This is very important system not to repeat same kinds of error. In addition to this feedback, this scheme should be checked by external organization to improve.

(d) Technical resources database arrangement

To shorten the development process, referring to the detail condition and result of try & error helps well. Making documentation and publishing about the technical factors analysis and all the try & error results is

very important as technical resources. It frequently happens only success result is published and so much failure data is abandoned, but the analysis of failure is more important to improve your technical resources. Anyway, if you have more database of try & error result and technical analysis of each test, you can get more competitive in that area.

6 CONCLUSION

It is identified the specific points of project management of development of new technology product and modified the existent critical success factors of project management to apply for development of new technology product in reference of DR template. However many success factors of this kind of project management of Japanese companies can be pointed out as Japanese companies specific points, the below points can be applied to improve your management of the area to success your project with more probability.

* Continuous improvement of organization and individual skills
* Frank and frequent communication
* Feedback of the analysis of failure (Lessons learned by experience)
* Technical resources database arrangement
* Steady employment of the team members to lead their responsibility and motivation
* Team members' stability to gain their experience
* Clear definition of check items of each step and responsible person to approve to forward (Ex. DR template)
* Good risk analysis and action plan for the risk
* CS (Customer Satisfaction) activity

As critical success factors for a kind of project of development of new technology product, the below items can be pointed out especially.

- Good communication

- Communication with customers to identify the demand and the satisfaction degree of new product
- Communication among the related sectors for simultaneous engineering

- Lessons learned by experience
  - OJT for engineers and operators
  - Improvement of DR template
  - Technical report about success/failure analysis
- Control of the project
  - Clear definition who/how to approve to go forward the project
  - Risk analysis and contingency plan for the failure