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**CRITICAL SUCCESS FACTORS FOR NEW TECHNOLOGY PRODUCT  
DEVELOPMENT**

**Monografia de especialização em MBA  
em Gerenciamento de Projeto,  
apresentada a Universidade Federal do  
Paraná para a conclusão do curso de  
Gerenciamento de Projetos.**

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**CURITIBA  
2005**

## **Acknowledgement**

At first, I appreciate for Prof. Pretel and Prof. Amaro of MBA project management course that give me some precious advice and encourage me.

At second, I appreciate for the colleagues of Furukawa Industrial and Furukawa Electric that cooperate with me in questionnaire.

At last, I appreciate for my family to help me in completing this paper.

## ABSTRACT

In the electric hardware area or telecom area, the technology makes progress rapidly, and the most critical factor for new product development is getting to the market quickly. Historically, products that entered market early with adequate quality and price have proven more successful than products that got to the market later with better quality or price. New technology products have evolved to become more complex, requiring higher technology and more integration, and they take a longer time and larger investments to develop. However, at the same time, the life of products in the field is getting shorter. In order to make success in the new product development, you should analyze many factors in addition to achieve your project. The purpose of this paper is to identify the characteristics of new technology product development, and find out the best critical success factors of this kind of project in reference of existent critical success factors of general project management.

At chapter 1, it describes the history of product development, product life of new technology product to identify the characteristics of new technology product development. The project tends to be more complex, requiring more technology, but product life gets shorter. In order to gain enough return of investment (ROI) of the project, project manager takes care of product life for new product in addition to complete the project.

At chapter 2, it describes existent critical success factors for project management. It shows client satisfaction is another key factor of project success in addition to traditional project management factors as time, money and quality.

At chapter 3, it shows an example of design review check sheet. Design review check sheet is applied for standardizing the development process and visualizing project progress, responsible or authorizing person of each process. This check sheet is always reviewed with feedback of trouble and failure history. This chapter shows market research and technology analysis is important for new product development, too.

At chapter 4, I propose critical success factors for new technology product development in reference of chapter 2 critical success factors for project management. I add market research as client consultation, technology analysis and contingency plan for new technology test. As critical success

factors for new technology product development, I consider technology analysis as another key factor in addition to 4 factors (Time, money, quality and client satisfaction).

At chapter 5, it shows the questionnaire result of 10 actual project managers who work at new product development of Furukawa telecom area. The result shows this proposal is for practical use and many of them agree client satisfaction and technology analysis are one of the most important factors for new technology product development.

At chapter 6, it shows the conclusion of this paper. In addition to traditional triple factors of project management, project managers of new technology product development should take care of technology factors and market analysis. Otherwise, a project manager needs to consider the difficulty degree of new technology acquirement to define the action for uncertain factors.

# INDEX

<b>ABSTRACT</b> .....	<b>1</b>
<b>INDEX</b> .....	<b>3</b>
<b>1. INTRODUCTION</b> .....	<b>5</b>
1.1 HIGH TECHNOLOGY PROGRESS IN JAPAN .....	5
1.2 HIGHTECHNOLOGY PROGRESS OF TELECOMMUNICATION AREA .....	6
1.3 FURUKAWA ELECTRIC TELECOMMUNICATION AREA TECHNOLOGY PROGRESS .....	7
1.4 PRODUCT LIFE .....	8
1.4.1 R&D .....	8
1.4.2 IMPROVEMENT OF PERFORMANCE .....	9
1.4.3 PRODUCTIVITY .....	9
1.4.4 CUSTOMIZATION AND COST DOWN .....	10
1.5 PROJECT TYPE OF EACH STAGE .....	10
1.5.1 R&D STAGE .....	10
1.5.2 IMPROVEMENT OF PERFORMANCE STAGE .....	11
1.5.3 PRODUCTIVITY STAGE .....	11
1.5.4 CUSTOMIZATION .....	11
1.5.5 COST DOWN .....	11
1.6 FURUKAWA ELECTRIC PROJECT TYPE .....	12
1.7 CHARACTERISTICS OF NEW TECHNOLOGY PRODUCT DEVELOPMENT .....	13
<b>2. CRITICAL SUCCESS FACTORS FOR PROJECT MANAGEMENT</b> .....	<b>13</b>
2.1 ORIGIN OF CRITICAL SUCCESS FACTORS FOR PROJECT MANAGEMENT .....	13
2.2 CIRITICAL SUCCESS FACTORS FOR PROJECT MANAGEMENT .....	16
<b>3. DESIGN REVIEW CHECK SHEET</b> .....	<b>24</b>
3.1 DR SCHEDULING TEMPLATE .....	25
3.2 DR-1 STRATEGY CHECK ITEM .....	27
3.3 DR-1 DETAIL PLANNING .....	29
<b>4. CRITICAL SUCCESS FACTORS FOR NEW TECHNOLOGY PRODUCT DEVELOPMENT PROPOSAL</b> .....	<b>31</b>
<b>5. APPLICATION RESULT OF CRITICAL SUCCESS FACTOR PROPOSAL</b> .....	<b>39</b>
<b>6. CONCLUSION</b> .....	<b>42</b>
<b>REFERENCE</b> .....	<b>44</b>

## TABLE LIST

TABELE 1	DR (DESIGN REVIEW) OF FURUKAWA ELECTRIC NETWORK DEVELOPMENT DEPARTMENT .....	26
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## GRAPH LIST

GRAPH 1	PRODUCT LIFE OF TELECOM AREA HIGH TECHNOLOGY PRODUCTS .....	12
GRAPH 2	EXAMPLE OF EUROTUNNEL PROJECT .....	14
GRAPH 3	SPECIALITY OF INTERVIEWED PROJECT MANAGER .....	39
GRAPH 4	OPINION OF MY PROPOSAL .....	40
GRAPH 5	ADVANTAGE OF THE PROPOSAL .....	40
GRAPH 6	DISADVANTAGE OF THE PROPOSAL .....	41
GRAPH 7	MOST IMPORTANT KEY FACTORS .....	41

## CHART LIST

CHART 1	10KEY POINTS FOR PROJECT IMPLEMENTATION .....	17
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# 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 desires to learn from Japan to follow its growth (ex. Look East slogan by ex-Malaysian president Mr. Mahathir). In the 90-decade, the development economy model is researched and Japanese economical success is treated as ideal model for Asian countries growth. Mr. Ono and Mr. Sakurai [1] explain the typical development model as “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 this minimum wage gets higher after lacking low wagers in the market. At this phase, industrial companies of the company need to seek for manufacturing more sophisticated products with better productivity to make competition with other factories of the poorer companies that can produce low technology products with lower cost in theory.”

There are some argued points at this model, but the progress of Japanese industries can be applied for this model. Up to the 70-decade, Japanese industry had grown up with absorbing high technology that is mainly innovated in US, and made best effort to improve the efficiency of the factory and the quality of the products. The strongest points of Japanese industries are their continuous improvement of productivity and high quality control of the products. It may be applied for general Japanese industries up to the 70-decade, but high technology required industries needed to lead the technology development of the world for their further growth after catching up American or European companies with their good quality and low cost of the products. From the 80-decade, Japanese companies have dominated the world market share of some areas like as Audio Visual equipments or semi-conductor products with their original products. Even though American companies have recovered with Internet expansion in the 90-decade, Japanese companies have begun to revive with digital high technology products like as digital camera or high quality slim displays nowadays.

About high technology, there are 2 kinds of innovations. One is to create the entire core technology as original and the other is to compose of various existing technologies. It is commonly said Japanese companies are good at latter type of innovations.

At the electric hardware area or telecom area, the most critical factor is getting to the market quickly. Historically, products that entered market early with adequate quality and price have proven more successful than products that got to the market later with better quality or price. The purpose of this paper is to identify the characteristics of new technology product development, and find out the best critical success factors of this kind of project in reference of existent critical success factors of general project management.

## 1.2 HIGH TECHNOLOGY PROGRESS OF TELECOMMUNICATION AREA

About Japanese telecom area, the public telecommunication companies NTT (for national) and KDD (for international) contributed the progress to define the basic technical specification of new technology products. However the manufactures owned the initiative of new technology development of telecom area in US or Europe, the telecom operators took part in the project of new technology development in Japan. After becoming these companies as private companies at the 80-decade, they still occupy the greatest part of Japanese. They contribute the development of telecommunication technology, but it can be said a lot of these development products are not based on the global market but for Japanese market.

At the telecommunication area, American companies have innovated the new technology to lead the world. The progress of telecommunication technology is so rapid especially in these twenty years. According to Mr. Iga and Mr. Suematsu [2], the first revolution is the appearance of optical communication to substitute for microwave coaxial cable system. 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 improve the performance and quality of products to catch up the American companies and innovated their original technologies to make competition in the world market.

About the year of 1995, WDM (Wavelength Division Multiplexer) technologies are innovated to enable the cost down of optical network as Mr. Okubo and Mr. Sentsui describe in detail [3]. It helps to



expand optical network all over the world because of its dramatic costs down of long haul telecom system and many analysts said that the IT revolution required high capacity network line. These days, many telecommunication operators had installed new long haul optical line at the short term, every new WDM technology related products like as optical amplifier, DWDM optical transmitter or WDM fiber made great success.

After IT boom ended suddenly about the year of 2001, all the long haul optical systems were considered as excessive investment and some new telecommunication comers like as WorldCom or Global Crossing were corrupted because of their excess investment. Almost all the WDM market players who grew up with WDM technologies were damaged with their excessive stock, heavy investment of product machine or debt for telecommunication operators. In spite that some urban 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 can supply generic equipments / components so cheaply, many Japanese manufacturers have lost their market at the generic products but the demand for higher technology products keeps 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 telecom cable and energy cable for 70years. They have started optical product enterprise as optical fiber since the 80-decade. As NTT is the greatest customer of Japanese telecom market, mainly Furukawa has developed new products for. In addition to develop the progressive optical products for NTT or other domestic customers, Furukawa made heavy investments at R&D of optical telecom area to enter the world market.

The products of Furukawa Electric telecommunication area can be distinguished by the market direction. The first is for domestic market and the latter is for world market. The examples of first products are optical fiber, optical cable and optical connectors. Even though some kinds of their products are exported, the 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 start the development with clear identification of marketing scale, they may acquire the great benefit because other competitors have not developed yet. Relatively the business is more risky but may have more returns.

## 1.4 PRODUCT LIFE

As a new products development of consumer product company, Mr. Rosenau [4] identifies five stages as new product development.

Stage 1 Ideation

Stage 2 Concept testing

Stage 3 Product testing

Stage 4 Test market

Stage 5 Commercialization

Since telecom products are required higher technology and heavy investment for development of new products, the product cycle of telecom area is different from consumer product. As a characteristics of telecom products, Mr. Sridharan of Alcatel Network System describes as follow, “Telecommunications products have evolved over time to become more and more complex, requiring higher technology and more integration. The products, therefore, take a longer time and larger investments to develop. However, at the same time, the life of products in the field is getting shorter.” [5]

Referring to the telecom product characteristics, I have identified 5 stages of product life as follow itens.

### 1.4.1 R&D

Generally, the concept of the new technology is created at laboratory of university or R&D division of company. Sometimes nobody knows how to apply the created technology and whether to enable this new

technology to apply for new product. 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 tend to make more effort to accumulate their knowledge about the new products than commercializing.

### 1.4.2 Improvement of performance

After the new technology product is recognized to have better performance than existing technology, the market target of this new technology product can be defined. At that situation, the new product that has 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 performance of commercialized products, it is always required to launch new model or new process that can adequate better performance than existing model or process. In theory, the improvement of performance is prior to cost down or improvement of productivity when the improvement of the key performance can contribute the great cost down of entire system.

### 1.4.3 Productivity

After the benefit of the new product is recognized well at the market, the market scale grows up rapidly. At the moment, the production capacity of the new product needs to be capable of supplying for this growing up market. At the moment it is required to innovate mass production technology of this product with new manufacturing process or production machine and to improve the defect rate or loss rate sufficiently. It means the stability of the production quality is important in addition to extend product capacity. In order to gain the market share, you should improve the productivity and the process stability in addition to extend the production capacity to correspond to the market demand. The improvement of defect rate and automation of the process can lead cost down of the product and this price down has market to expand more, too.

## 1.4.4 Customization and Cost down

When there is little room to improve the key performance of the product, and many suppliers appear at the market, the product cannot be considered as new product more and there are 2 ways to survive at the market. The first one is to supply the standard products as cheap as possible and the latter is to customize the product specification to attend the demand of a niche market.

In order to be competitive with lower price of the product, there are several methods like as developing minor changed new products, improving process for cost down or transferring process for low cost factory. As a special factor of telecom industries, many technologies tend to become standardized without any patent rights, even if it is innovated by one company. In order to sell your innovated technologies, you need to open your patent rights to expand the market for the reason of telecom characteristics. Once the technology is open and standard technical specification is defined, who can supply the products that achieve this standard specification begins to enter the market, and finally who supplies with lower price occupies the great part of market share.

Nowadays, who are growing up at the telecom market are the Taiwan companies that have small development group and produce some standard products cheaply in Chinese factories.

In order to avoid the price competition with them, you need to produce specific products of niche market to attend the demand of small quantity. In the case, you should attend the original design or performance of customer requirement rapidly, and the speed and the flexibility of new product development is more important than price for better customer satisfaction.

## 1.5 PROJECT OF EACH STAGE

The typical product life model is shown at Graph-1 Product life of telecom area new technology products.

The representative projects of each product life stage are shown at follow items.

### 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

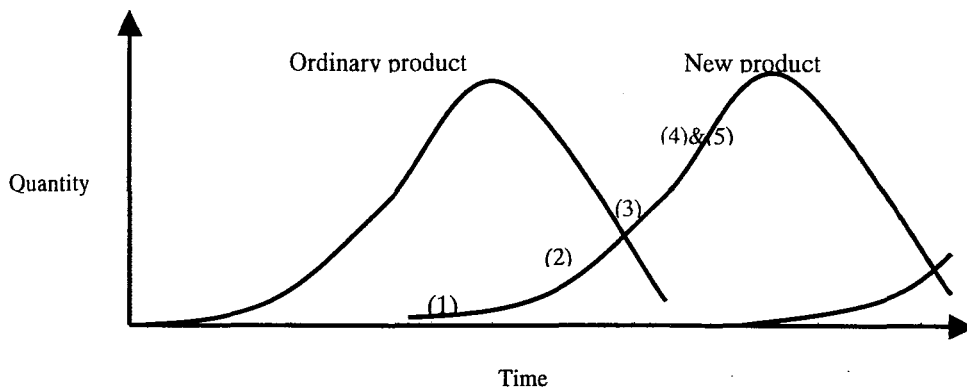
### 1.5.5 Cost down stage

Development of minor changed cost down new products

Development of global process line

New overseas factories construction

Installation of local sells office



GRAPH 1 Product life of telecom area new technology products

## 1.6 FURUKAWA ELECTRIC PROJECT TYPE

Since Furukawa Electric has greater scale of structure and makes heavier investment at the telecom R&D area than other telecom industrial companies, Furukawa should win at new technology development stage by way of rapid commercialization and improvement of productivity of new technology products. It needs to gain the return of the investment at the initial phase of the new technology product rapidly, and get ready for price competition before this technology becomes ordinary products that many companies 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 a great scale of project. 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 to organize 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 enable new products to produce with high productivity and low defects with feedback of initial production. Otherwise, it exists oversee planting project. At the project, it often takes the used production machines to oversee to transfer the ordinary technology products process for the purpose of cost down.

## 1.7 CHARACTERISTICS OF NEW TECHNOLOGY PRODUCT DEVELOPMENT

From above mentioned point of view, at the new technology product development of telecom area or electric industry, the most critical factor is getting to the market quickly with adequate quality. Products that enter market early with adequate quality and price make more successful than products that get to the market later with better quality or price. Since the pace at which technology changes are accelerating, the newer products are required higher technology to take a longer time and larger investment to develop, even if the product life gets shorter. I identify the product life of new high technology products as 5 stages as R&D, Improvement of performance, Productivity, Customization and Cost down, but the product life gets so short that each stage has started in sequence. Nowadays, the project managers of new technology product development have to take care of this entire product life in addition to achieve their own project.

At Chapter 5, it shows the Critical Success Factors for new technology product development in referring to existing theory of Chapter 3 Critical Success Factors for various project management and application example of Chapter 4 Design Review Check Sheet.

## 2 CRITICAL SUCCESS FACTORS FOR PROJECT MANAGEMENT

### 2.1 ORIGIN OF CRITICAL SUCCESS FACTORS OF PROJECT MANAGEMENT

According to Mr. Pinto and Mr. Slevin, modern project manager should take care about the customer satisfaction in addition to traditional triple constraint like as time, money and performance as follow description.

“ 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.

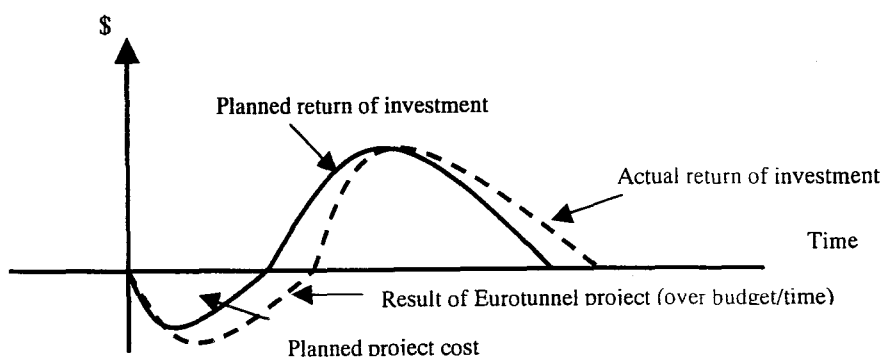


Among the implications of this new quadruple constraint is its effect on what were viewed as traditional project management roles. Concern for the client forces project managements to adopt an outward focus to the efforts. In effect, they must now become not only managers of project activities, but sales 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.” [6]

As an example to explain the customer satisfaction is a success factor of project management, they show an example of Eurotunnel project to identify what is the project success as follow description.

“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 15 billion 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. “ [7]

In my opinion, it can be said the product is in success but 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

What the research to know is what exactly are the factors that constitute success and how their measurement is 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. It means what are the critical factors that ultimately determine the likelihood of successful project completion

## 2.2 CRITICAL SUCCESS FACTORS FOR PROJECT MANAGEMENT

In order to collect the data of the study of critical success factors in the project implementation process, more than four hundred projects are reviewed to identify 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 result is composed on a ten-factor model of critical success factors for project implementation as Chart 1. 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. [8]

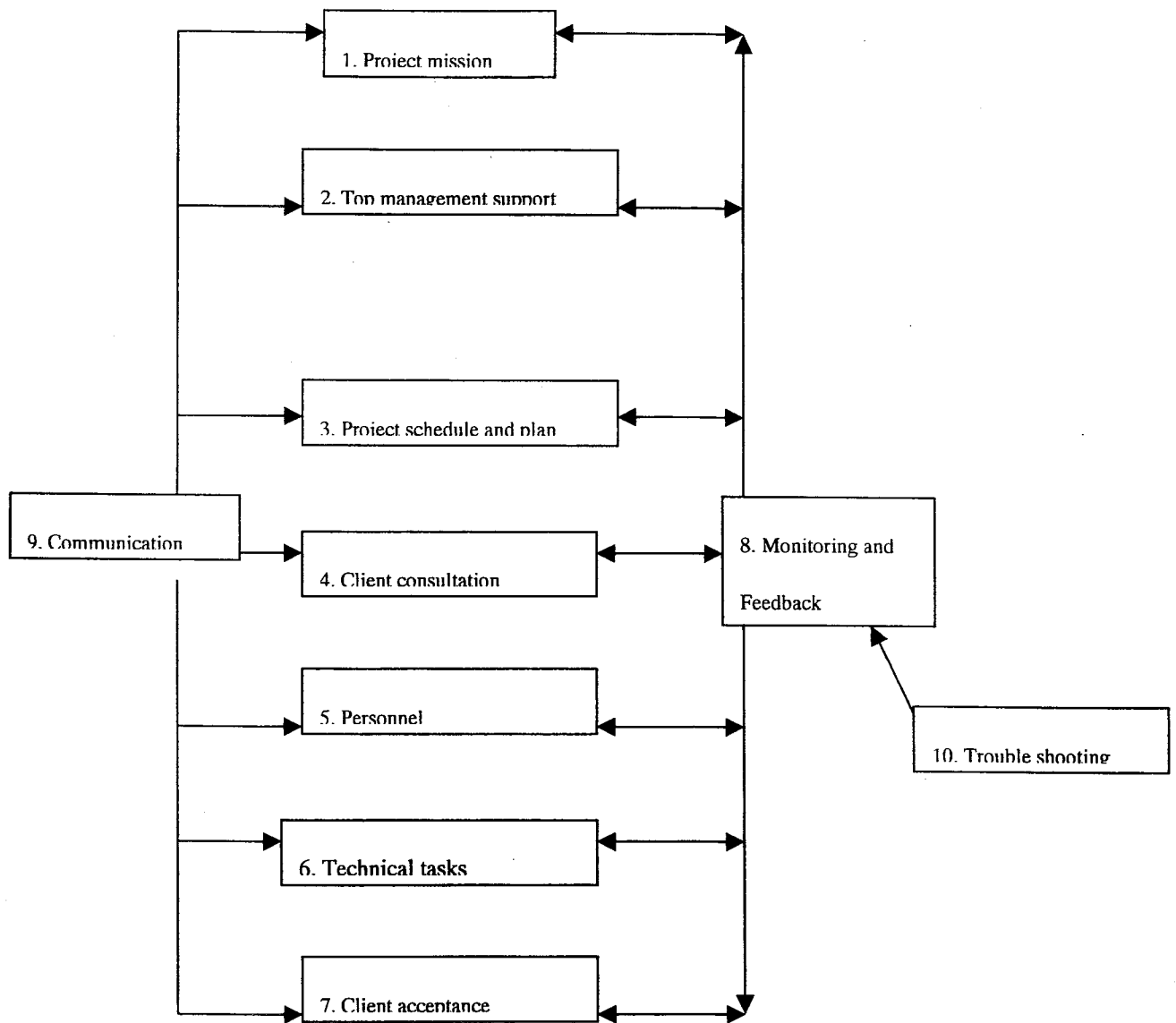


CHART 1 10key points for project implementation

### (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 for conquest of the project success 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. It 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 DESIGN REVIEW CHECK SHEET**

Japanese industrial companies relatively have good quality control system and continuous improvement activity of product quality or cost down. TOYOTA method is Japanese most famous production method that applies continuous improvement activity, and Mr. Ono expresses this method as follows.

“ The objective of operation manual is to enable inexperienced operators to operate immediately and to keep the quality of product. At TOYOTA method, even new inexperienced operator should be able to operate perfectly in 3days. To achieve it, the operation manual should be easy to understand for any kinds of people. As another rule of operation manual, it is considered as a foundation of improvement. As an operation is standardized, it is easy to identify what to improve. Operators can make idea of improvement and resolve autonomously with operation manual.” [9]

As he describes, standardizing the process makes easy to improve the operation continuously. At product development stage, a checklist is applied for standardizing the development process, and this checklist

should be improved continuously with the feedback of trouble or failure history. This checklist is called DR (Design Review) sheet, and all the check items should be examined before new product launching.

### 3.1 DR SCHEDULING TEMPLATE

The DR scheduling template of Network development department of Furukawa Electric is shown at Table-1. In Furukawa, almost all the departments have their own DR templates to be improved originally. Network development department has launched many kinds of network equipments for end users for a long time, and the DR check sheet has enough level to attend the various kinds of product development. The characteristics of network equipment development can be identified as below.

- Complex to complete all the development process
- Rapid technology evolution
- Dynamic change of market circumstance
- High performance and unique functions demanded
- High reliability demanded

In order to succeed in new product development, the project should be planned in concern of market preview and technology trend, and the project should complete in a short term with the achievement of high reliability and productivity of the product.

The entire project is separated with 4 segments as Planning, Specification Check, Sample test result check, and Production result check as shown at Table-1. A project manager who is designated by top manager is responsible for the entire project of new product development and sub project managers are responsible for each item of the 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	HMI			→		
	General Construction				→	
Manufacture	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) template of Furukawa Electric Network development department

## 3.2 DR-1 STAGE CHECK ITEMS

As first step, it checks a strategy of new technology product development. In addition to define product concept, time, budget, and human resources to complete the project, it checks the strategy of the company corresponding to the project, 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

### 3.3 DR-1 DETAIL PLANNING

After confirming the project has enough ROI at Strategy stage, it defines detail planning before executing the project. As product concept, WDS scheme, required members, budget and time are defined at Strategy stage, breakdown of the former information is required at the detail planning stage. In addition to define the detail technical specification and chronogram of the project, commercial strategy, technology trend analysis, patent information, and manufacturing form are defined.

- (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?

## **4 CRITICAL SUCCESS FACTORS FOR NEW TECHNOLOGY PRODUCT DEVELOPMENT PROPOSAL**

Referring to the Critical Success Factors of Chapter 2, I propose Critical Success Factors for new technology product development. It considers new technology products complex, requiring high technology and integration, and the development takes a long time and large investments but the life of products is short. At that

situation, the product concept in concern of both market target and technology progress analysis is extremely important for the success of new product as planning, and risk management for new technology factor is important to achieve the technical specification and reliability as execution.

## (1) Project mission

About new product development, the concept of project mission is not too different from other kinds of project. It should be obvious the benefit of new products for both companies and customers.

- 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

The upper management support is necessary at new technology product development, too. Since top manager designates the project management and authorize required resources at initial milestone (DR1), upper manager should be informed and support the entire of project. Since lead-time of development project is extremely important for the success of new product, he needs to supply additional resources immediately 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 make prototype sample and prepare the sufficient reserve of material for retry of prototype sample. Since project lead-time tends to be prior to budget, it recommends planning the time schedule and surplus material with consideration of contingency plan.

- 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

There are 2 types of project about client consultation. In case of customized product, items from 4-1 to 4-5 is required, but in case of end-user product, you should make marketing analysis in space of client consultation as items from 4-6 to 4-10.

- 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. It 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 the beginning of commercialization (It must depend on advertisement strategy)., The below items should be clear for a market analysis.

- \*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)

The client acceptance for end-user products (maybe market analysis is more correct) can be altered as following.

- 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

Since recent project of new product development tends to be more complex, a project manager should analyze which part to development in the company and which part to order to the other companies. Generally, core technology factors of new products should be developed on its own and development of other technology factors depends on cost, time and quality. In case of ordering a part of development to other companies, it should be clear who to be responsible for them.

- 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

In the view of the new technology development, the below items can be pointed out as technical evaluation.

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

About patent strategy, there are two ways either to apply the patent for getting your company products more competitive or to avoid the claim of other companies. You should acquire enough information of the related patent rights of your new technology products before deciding the patent strategy.

Generally, all the test items including long time reliability test are checked and approved at specification check stage (DR-2). Since this long time reliability test becomes bottle necked of the project time schedule, you need to consider the time to spend to complete this test before soliciting project lead-time (DR-1) In the same time, you should make clear the relationship between the degree of achievement of long time life guarantee and commercialization period.

New product should be compared with actual products and rival company products at planning stage (DR-1) to make clear the advantage and disadvantage of this product. In addition to this new product analysis, you need to identify you need to identify the technical advantage and disadvantage of your company in comparison of your rival companies. If you can overcome your week point or reinforce your strong point with the new product launching, it leads your market share to grow up. Furthermore, if you have some original technology that no one can copy, it makes your products more competitive.

The productivity is other technical key point of new technology product development. In order to achieve enough ROI of development project, you should attend the demand of new launched products sufficiently soon. Especially at Japanese market, new technology or high quality products tend to be well demanded. You should prepare enough production line to produce new products with high productivity to supply the entire demand of initial moment simultaneously.

Furthermore, the technology trend analysis is important for new technology product. You should analyze the technology trend to identify whether the applied technology lays above the technology trend direction. Especially at telecom area, technology evolution is so rapid that you cannot waste the time to develop the out of date technology. In addition to technology trend, you should pay attention to the world wide standard. Since telecom products are required the compatibility with other company products, IEEE committee defines the standard specification to guarantee the compatibilities. In case of developing new technology product, you always need to consider related standards.

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 implemented new technology 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 the predicted long lifetime reliability at the moment of commercialization is reasonable..

6-7. Some production engineers are involved in the project to consider the productivity of new developed product to prepare enough production capacity of the new developed 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 project types as a product for specific client and for end-users. As for end-users product, client acceptance can be changed for market acceptance, success of new product development is to sell more than expected to surpass the equilibration point financially. Furthermore, client satisfaction for new product is important for both types of products, too.

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

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

7-3. The new product is presented 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 minimum expected quantity and ROI surpasses the equilibration point financially.

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

## (8) Monitoring and feedback

There are two specific points about new technology product development.

About new technology evaluation, since it is difficult to predict the whole test result, some contingency plans are always required. It seems better to prepare contingency plans for all kinds of possible failures in advance, but it is efficient to make a first try and feedback the analysis data in case that risk analysis is well complicated. It considers contingency plan as reserving enough time and material to retry the sample test with feedback of first test analysis.

On the other point, the feedback of client acceptance is important. It should be better to consult with potential clients to feedback their at the moment of project planning and prototype sample evaluation.

8-1. All 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 progress, the result of new applied technology test is reported, analyzed and feed backed for other sample test immediately.

8-3. The execution 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 is required to modify, I solicit input from the project team

## (9) Communication

As one of characteristics of new technology development, some sample test result 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 project members and upper manager, but the security level of the information should be well defined.

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 project members and upper manager.

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 show problems 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 all the 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 APPLICATION RESULT OF CRITICAL SUCCESS FACTORS PROPOSAL

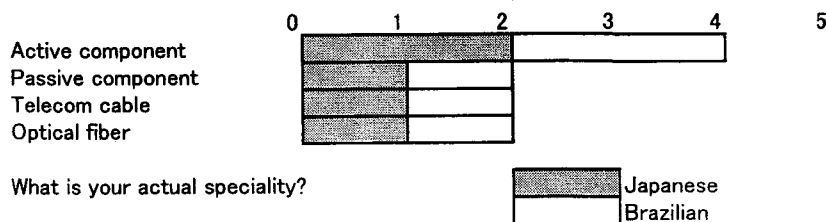
In order to examine my proposal of critical success factor for new technology product development, I have shown my description for actual 10 project managers of new product development. All of them work at telecom industrial area, and 5 managers of them work at Furukawa Electric Japan, and other 5 managers work at Furukawa Industrial Brazil. The result of questionnaire is as follows.

### (1) What is your actual specialty?

Japanese = Optical device <2>40%, Optical connector <1>20%, Optical cable <1>20%, Optical fiber <1>20%

Brazilian = Network equipment <2>40%, Passive component <1>20%, Optical/UTP cable <1>20%, Optical fiber <1>20%

Total = Active component <4>40%, Passive component <2>20%, Telecom Cable <2>20%, Optical fiber <2>20%



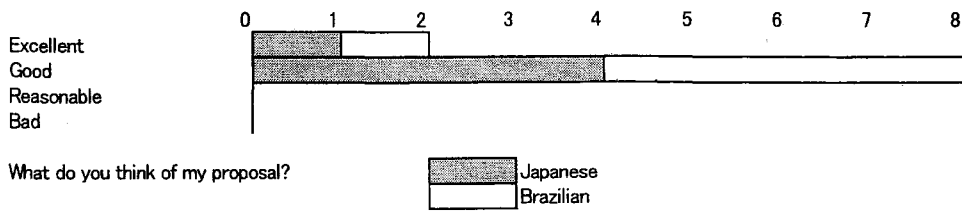
Graph-3 Speciality of interviewed project manager

### (2) What do you think of my proposal?

Japanese = Excellent <1>20%, Good <4>80%, Reasonable <0>0%, Bad <0>0%

Brazilian = Excellent <1>20%, Good <4>80%, Reasonable <0>0%, Bad <0>0%

Total = Excellent <2>20%, Good <8>80%, Reasonable <0>0%, Bad <0>0%



Graph-4 Opinion of my proposal

(3) What is the advantage of this proposal in your opinion?

Japanese = All the required factors are included <2>

Description for practical use<2>

Technology analysis (Patent, production factor, technology trend)<2>

Contingency plan for new technology factor <1>

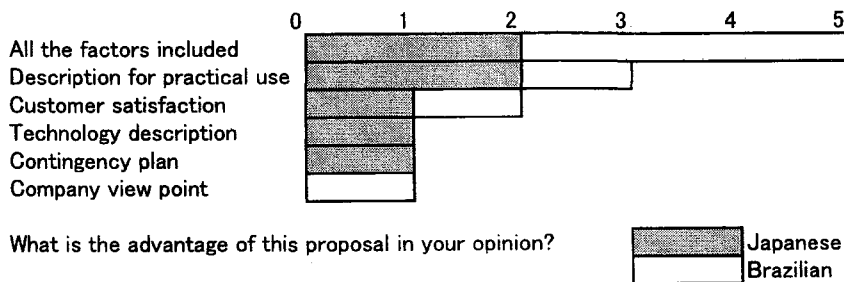
Client consultation and client acceptance <1>

Brazilian = All the required factors are included (Detail description) <3>

Description for practical use<1>

Point of view from customers (Market analysis and Rival company comparison)<1>

Point of view from companies (ROI and market share)<1>



Graph-5 Advantage of the proposal

(4) What is the disadvantage of this proposal in your opinion?

Japanese = No clear about the relationship among each factor <2>

Insufficient description about risk management<1>

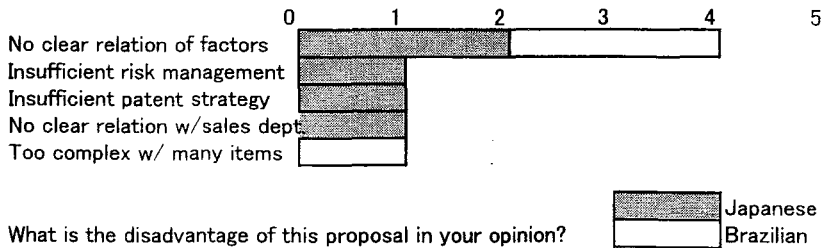
Insufficient description about patent strategy<1>

No clear about the relationship with sales department (who to owe the responsibility for ROI result)<1>

Brazilian = No clear about the relationship among each factor <2>

(Ex. Relationship between troubleshooting and other factors)

Too many items <1>



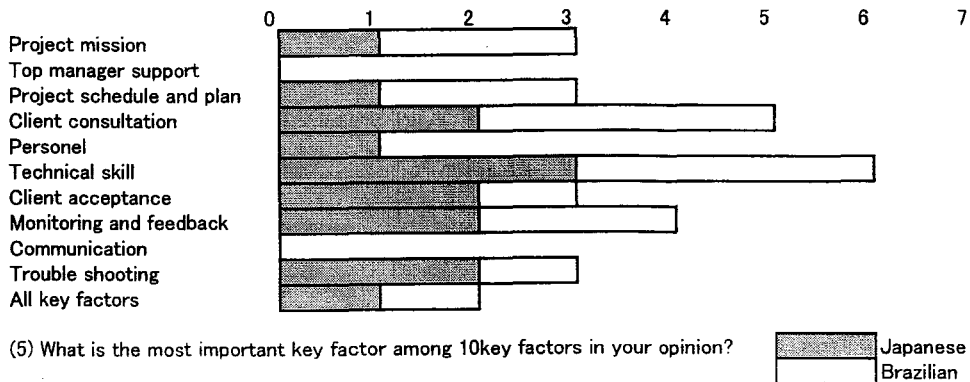
Graph-6 Disadvantage of the proposal

(5) What is the most important key factor among 10key factors in your opinion?

Japanese= 1.Project mission<1>, 2.Top management support<0>, 3.Project schedule and plan<1>, 4.Client consultation<2>, 5.Personnel<1>, 6.Technical skill<4>, 7.Client acceptance<2>, 8.Monitoring and feedback<2>, 9.Communication<0>, 10.Trouble shooting<2>, All<1>

Brazilian= 1.Project mission<2>, 2.Top management support<0>, 3.Project schedule and plan<2>, 4.Client consultation<3>, 5.Personnel<0>, 6.Technical skill<3>, 7.Client acceptance<1>, 8.Monitoring and feedback<2>, 9.Communication<0>, 10.Trouble shooting<1>, All<1>

Total= 1.Project mission<3>, 2.Top management support<0>, 3.Project schedule and plan<3>, 4.Client consultation<5>, 5.Personnel<1>, 6.Technical skill<6>, 7.Client acceptance<3>, 8.Monitoring and feedback<4>, 9.Communication<0>, 10.Trouble shooting<3>, All<2>



Graph-7 Most important key factors

They accept my proposal of critical success factors for new technology product development favorably, and they consider it as practical use. There is no obvious difference between Japanese opinion and Brazilian opinion about the key factors, and they are conscious of Client consultation and Technical skill as one of most important factors. It means the modern project manager of high technology area needs to take care of client satisfaction and technology matters in addition to complete your project with defined cost, time and quality.

I am sure it is complex the relationship among 10 factors because some items includes 2 or 3 key factors, and it is not obvious when to check the items during the project. For your practical use, it is better to breakdown these descriptions to apply for your timetable of project.

## **6 CONCLUSION**

At the high technology demanded area like as electric industry or telecom industry, new technology products are required to get to the market quickly to attend the demand. Since technology progress is accelerating, the new technology products are required higher technology to take a longer time and larger investment to develop, but the product life tends to get shorter.

In order to survive in such a critical circumstance, project managers of new technology product development should be conscious of technology factors and market demand in addition to traditional triple constraint, time, money and performance. As a technology factors, I identify the below items in reference of Furukawa Electric Design Review check sheet. These items are specifically required for new technology product development, and many actual project managers of Furukawa telecom area consider these items as one of the most important factors for project success.

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

## - Technology trend

Otherwise, as another specific point of new technology development, it needs to identify the difficulty degree of each technology factor to define the action for each technology. If it is uncertain to succeed in acquiring this technology, you should execute the pre-test, make a contingency plan, or prepare the spare time and material for retry depending on the difficulty degree.

I propose critical success factors for new technology product development in consideration of technology factors, market research and actions for new technology uncertain factors in reference of critical success factors for all type of projects and Design Review check sheet of Furukawa Electric telecom area. Many of actual project managers of Furukawa telecom area agree with my proposal favorably, and consider it as practical use. At least I can say project managers of Furukawa Electric Japan and Furukawa Industrial Brazil accept my proposal.

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