A DESIGN ON FINANCIAL EVALUATION SYSTEM OF R&D PROJECT FOR PORTFOLIO MANAGEMENT : A CASE STUDY THROUGH SIX SIGMA METHODOLOGY

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ABSTRACT

R&D has been mainly dependent on qualitative decision(such as strategy, experience etc) rather than quantitative in evaluating project benefits because of difficulty in constructing objective and reliable evaluation system. The purpose of this project is to build financial evaluation system of R&D(DFSS : Design For Six Sigma) project which is key factor for portfolio manangement and it is designed to allow both estimation of project benefits in selection phase and audit in completion. In particular the CTQs(CTQ : Critical To Quality) of this project are characterized by two, exactness of estimation and convenience for use. Firstly for the purpose of improving exactness of estimation, five project types are categorized according to general benefits and characteristics of R&D project and financial evaluation models are arranged through both references and benchmarking for some first-class enterprises. Secondly formular of financial evaluation system is computerized for convenience of use and throughout this data-base for key variables is constructed and allowed to simulate various environment.
In this way, contruction of the financial evaluation system of R&D(DFSS) project makes fact-based strategic decision possible by considering exactness of estimation and objectivity of project financial evaluation. In conclusion better R&D performance is expected by selecting core projects and optimizing the investment in the basis of this system.

KEY WORD

Six Sigma, DFSS, Financial Effect, Exactness of estimation, Portfolio

INTRODUCTION

Due to increasing market uncertainty, sudden change of technology and investment on a large scale, the risks on R&D are increasing day by day. One of fundamental issues in R&D management is how cost-benefit analysis will be maximized. In other words, it is about choosing and focusing which project for better R&D competitiveness. But R&D has been mainly dependent on qualitative decision(such as strategy, experience etc) rather than quantitative in evaluating project benefits because of difficulty in constructing objective and reliable evaluation system. This is also important reason to decrease success rate of R&D project.

In recent years, many domestic and foreign enterprises are employing Six Sigma innovation program for the purpose of overcoming crises or strengthening competitiveness. At first manufacturing area introduced Six Sigma, DMAIC roadmap and gradually transactional, R&D and Marketing area are also introducing and even developing. As R&D' role grows larger, DFSS Roadmap is much taken used for development of new product and technology. But because financial evaluation system for DFSS project benefits is not constructed properly, selection of core projects and optimization of investment throughout this leaves much to be desired. Therefore construction of reliable financial evaluation system will make it possible R&D portfolio management, that is, short and long-term balanced R&D performance management.

PREVIOUS STUDY

As shown in Figure 1, FEA(Financial Effect Analysis) system for Six Sigma project is existed and applied to evaluate financial impact. But it is designed to used in manufacturing area, mainly DMAIC project and can't help limiting to evaluate R&D(DFSS) project which has much long-term performance and intangible benefit. In case of technology valuation, University and valuation institute have been studying for the purpose of successful commercialization of technology licensing and the value of firm(Jong bum Kim, 2001). On account of this, many companies introducing Six Sigma can't evaluate financial benefit of R&D(DFSS) project and even exclude it from the subject of evaluation.

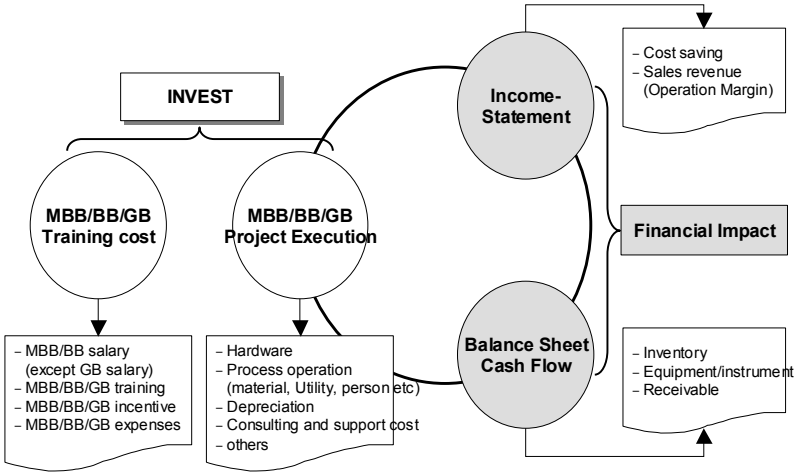

Figure 1. Cost-Benefit Model of Six Sigma project

In case of G company which is best practice in Six Sigma, the financial framework of Six Sigma project is to be centered in direct, short-term and cost saving benefits, applied mainly in DMAIC project(GE, 1998). These limits make it difficult general application which is considered intangible and long-term benefit.

The purpose of this project is to construct financial evaluation system for R&D(DFSS : Design For Six Sigma) project which leads to make R&D portfolio manangement possible. In order to improve exactness, this project considered both performance and financial models and in particular advanced right models through benchmarking.

METHODOLOGY

Project Roadmap

As can be seen in Figure 2, This project is implemented by DFSS roadmap, based on Critical To Quality(CTQ) which is exactness of estimation and convenience of use.

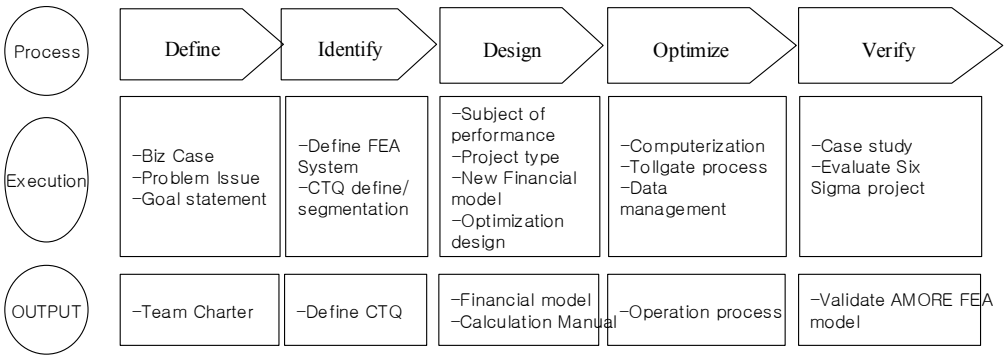

Figure 2. Project Roadmap

FEA(Financial Effect Analysis) Model of R&D(DFSS) Project

On the basis of FEA model of Six Sigma(DMAIC) in G company, new FEA model(Figure 3) is suggested to involve characteristics of R&D project which have future value and intangible benefit. According to IAS(International Accounting Standard)(Shunsuke Watanabe, 2002), R&D project in development phase is possible to be involved in direct benefit which assumes to be accounting value, but not in research phase. Namely the value of this project is categorized only as indirect(intangible) benefit.

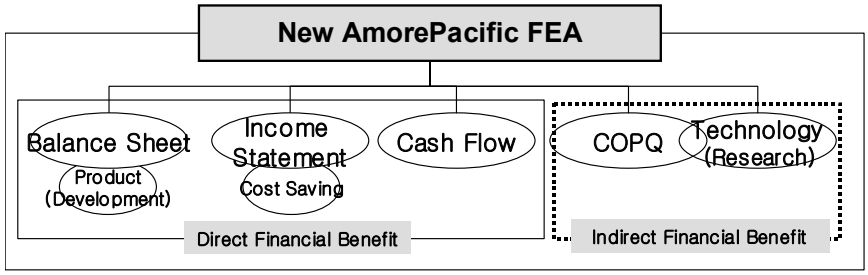

Figure 3. AMOREPACIFIC FEA MODEL

Financial Evaluation Model

R&D project can be generally divided by 5 stages according to decision process. (Boer.F.P, 1999) Criteria on financial evaluation of R&D project are different from each stage. As can be seen from the results presented in Table 1, R&D(DFSS) project can be categorized by 5 types based on project results(output).

Table 1. Types of R&D(DFSS) Project

	Development	Improvement
Product	New Product Project	Upgrade Project
Technology	Material/Technology Project	-
Process	System Project	Improvement Project

In order to evaluate financial benefit exactly, subjects of project benefit must be defined and also organized with their financial model. Through benchmarking about criteria, valuation model and so on, Design on financial evaluation system of R&D project can

be obtained as shown in Table 2.

Table 2. Design on Financial Evaluation System of R&D(DFSS) Project

Domain of financial benefit

Model		Subjects \ Project		Product		Technology		Process	
				New	Upgrade	Material/ Technology	-	System	Advance
Balance Sheet		Product (Development)	Quality-up	◎	◎	◎			
			Time to market	◎	○	△			
			C/S	○	○	△			
Income Statement	Cost Saving	Fixed/Variable cost	Material cost	◎	◎			◎	◎
			Time Reduction		◎	○		◎	◎
			Operating expenses					◎	◎
			Failure cost	△	◎			◎	◎
Cash Flow		Equipment/instrument reduction						◎	◎
		Cost of returned goods		△	◎	○			
COPQ				◎	◎	◎		◎	◎
Technology (Research)						◎			

Whereas given FEA and COPQ(Cost Of Poor Quality) model for Six Sigma(DMAIC) is used to calculate cost saving and cash flow including intangible benefit, Discount Cash Flow(DCF) one of income approach method is applied to calulate future cash flow caused by quality improvement associated with Technology Facter(Donggeun Lee, 2003).

Groud Rules

Groud rules for evaluating financial benefit are as follows.

1) Benefit must be

1-1) Reported for the current period and annualized

1-2) Directly linked to a Six Sigma project

1-3) From a documented baseline

1-4) Incremental and auditable

2) Baseline is based on long-term data implemented before(fiscal year or 12 months before project execution)(if given data is not existed, at the least 1 month data must be goottem.)

3) Whereas the time value of money is a maximum of 1 year only in case of cost saving and cash flow, throughout the product life cycle in case of incremental revenue.

4) If assumptions for project benefits other than above are needed, definition must be included.

Model related Sigma level with Technology Factor

R&D(DFSS) project for incremental revenue must be accepted only incremental cash flow due to the technology. Namely value of technology is measured by Net Present Value(NPV) of future cash flow multiplied by Technology Factor. Equation is followed.

Value of Technology = NPV * TF(technology factor)

In this project the notion of "Evaluation Rank" is suggested to assess Technology Factor effectively.

Evaluation Matrix

Considering the range of Technology Factor is differred according to industry characteristics(KISTI, 2003), value of Technology Factor(TF) is suggested to classify to three-step ranking which is linked with project type and technology level as shown in Table 3. Different models are designed and applied whether evaluation is for estimation or validation(Table 4). In particular in case of evaluation for validation, it is decided by checking up relation current technology level with Defects Per Million Opportunities(DPMO) after project completion.

Table 3. Technology Factor By Project

Industry Characteristics			Project Type		
traditianal	Electronics	New area	Material/ Technology	New Product	Upgrade
31%	35%	39%	A	-	-
28%	32%	36%	B	B	
25%	29%	33%	C	C	C
22%	26%	30%	-	D	D
19%	23%	27%	-	-	E

Table 4. Evaluation Matrix

Estimation		Validation			
Technology Level		Sigma Level	The extent of DPMO improvement		
Global	A	Above 4.5σ	100 times (A)	50 times (A)	10 times (B)
Domestic	B	3~4.5σ	50 times (A)	25 times (B)	5 times (C)
Company	C	Below 3σ	10 times (B)	5 times (C)	2 times (C)

Computerization

Performance formular is computerized for effective financial evaluation of R&D(DFSS) project. This leads to improve convenience of use and to learn continuously by building data-base. Finally it can help managers to strategic decision through simulation for market.

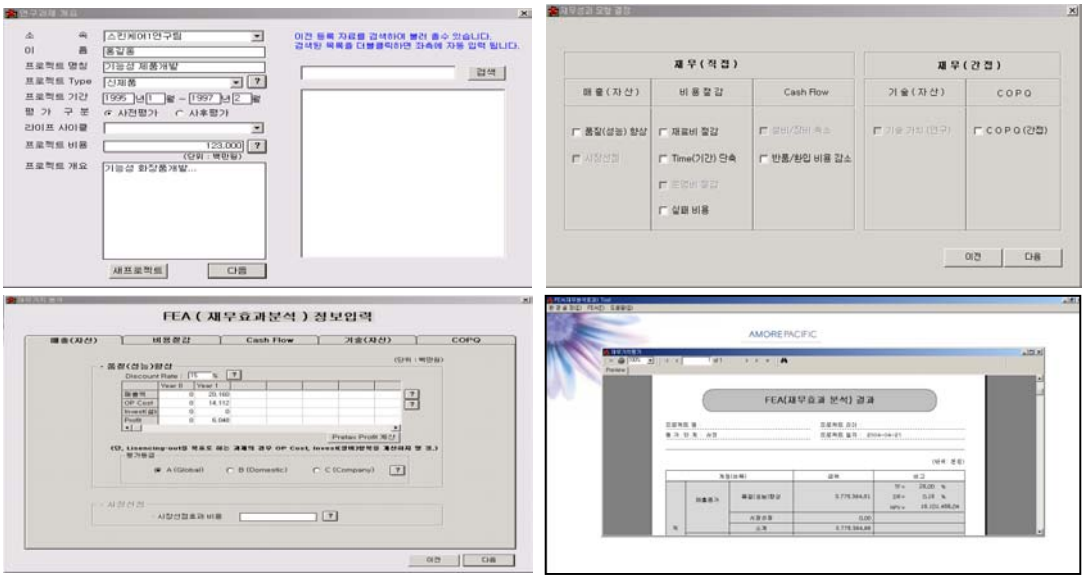

그림 4. AMOREPACIFIC FEA SYSTEM

CONCLUSION

In summary, it is possible to select and focus core project more effective by designing and computerizing new framework of financial effect analysis for Six Sigma(DFSS). As can be seen by the analysis presented for pilot projects in T company, it can be estimated financial results like Figure 5. Generally Six Sigma evaluates and verifies financial impact with tightened roadmap and tollgate in implementation phase as compared R&D project as seen in Figure 6. Hereafter all the Six Sigma projects including pilot projects will be evaluated and managed. Current Financial Effect Analysis(FEA) for Six Sigma will be evolved as well.

For the purpose of performance-driven R&D portfolio management, above all the selection of right project which allows business benefit to maximize is significant. As shown in Figure 7, selection process of R&D project is linked with FEA(Financial Effect Analysis) system developed in this project and new framework of R&D portfolio

management is developed. Finally maximazation of Econmic Value Added(EVA) in R&D can be expected throughout this integration.

Unit) 100$

	Project / Financial model	A System	B upgrade	C Technology	D Improve	E New product	F Technology	G System	비고
Direct	(conditional) assets		1,342			822			
	Cost Saving	237			578	588			
	Cash Flow								
Project Cost		237	149	149	149	149	149	162	
Total(Marginal Effect)		0	1,193	-149	429	1,261	-149	-162	
Indirect	Technology (research)			36,386			83,333		
	COPQ								

Figure 5. Pilot Project Results

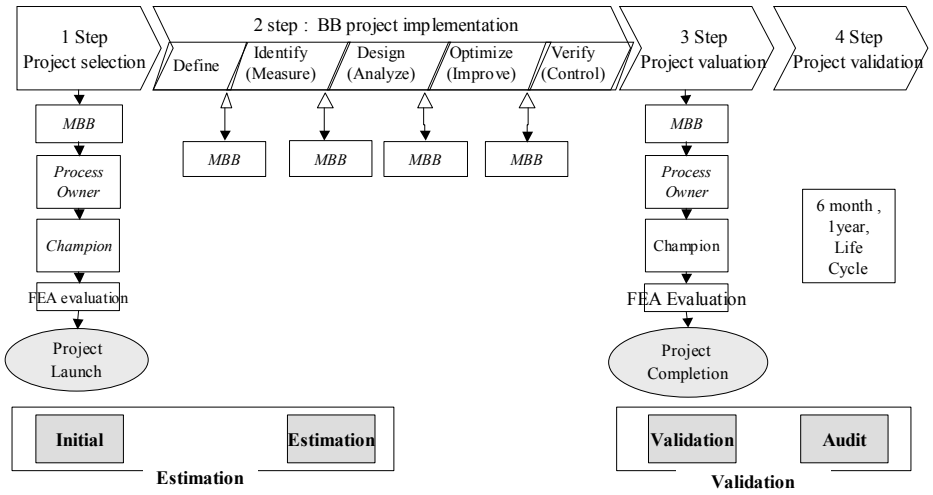

Figure 6. Project Tollgate Process

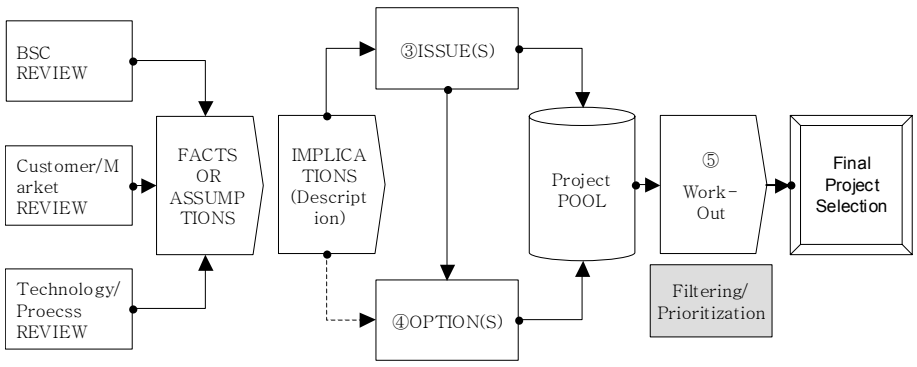

Figure 7. R&D Portfolio Framework

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