BFSS 로드맵의 개발

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Development of a BFSS Road-map

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Abstract

Since the Six Sigma strategy was first introduced to Motorola in 1987, it has been taken as an important business strategy to strengthen the competitiveness of leading companies in the global competitive environment. To keep growing and thriving, modern companies need to develop new businesses and find new applications while keeping existing ones on track. This situation necessitates a more effective way of discovering an optimal scenario in a business.

In this paper, we propose a Business for Six Sigma (BFSS) road-map to create new businesses. BFSS consists of five macro phases: define, identify, analyze, evaluate, and implement. We also provide an example of F electronics, a Korean electronics component manufacturer, which actually applied the BFSS road-map to analyze marketability, technological plausibility and economic potential/success in connection with its new product development.

1. 서 론

The highly competitive nature of today's global market has decreased business safety margins, accelerated the pace of market changes, shortened product lifecycles, and increased

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customer expectations. As a result, fast-developed, high-quality and low-cost products are increasingly becoming core competencies in today's marketplace. Hence, latest engineering paradigms of Six Sigma aim to help companies to improve the quality of products, increase operational effectiveness, reduce waste and costs, and increase profit and market share (Ferng and Price, 2005)

The Six Sigma quality initiative, in particular, is widely accepted as a well-structured and data-driven methodology for solving quality problems, eliminating defects and reducing variability in both manufacturing and services systems (Snee, 2004). By achieving such benefits and financial gains, Six Sigma has received wide acclaim in world-class companies such as General Electric, Motorola and Allied Signal (Harry and Schroeder, 2000).

Six Sigma has evolved in response to a fast changing business environment. Six Sigma can be applied to not only manufacturing but also every business process of a company, including office work and R&D. Its scope of application has also expanded from minimizing cost by improvement of products and processes to maximizing customer value such as new product development, expansion of customer base and new business creation. Thus, the Six Sigma approach has developed from DMAIC (define, measure, analyze, improve, control) to DFSS (design for Six Sigma).

DMAIC is a methodology used for problem-solving and continuous improvement of existing products/processes, whereas DFSS is the methodology of incorporating Six Sigma in the design of new products/processes or in the redesign of current products/processes. Companies typically begin implementing Six Sigma using the DMAIC methodology and later implement DFSS when the quality culture and experience level mature (Al-Aomar, 2006).

Several authors have considered the application of DFSS. Mader(2003) explains the DFSS methodology, its key aspects and how it enhances the design process, improving new product development. Antony(2002) presents DFSS using the Identify, Design, Optimize and Validate (IDOV) approach, which Chawdhury (2002) provides more details of the road-map.

Most of these DFSS studies have been undertaken in a manufacturing context, and are not appropriate for non-manufacturing processes. This paper therefore proposes a new Six Sigma methodology which can be applied to non-manufacturing processes, especially for business creation.

In order for a company to keep growing and survive, it needs to develop new businesses and find new applications while keeping existing ones on track. That is, the company should maximize its value through the discovery of promising businesses. Thus, we propose Business for Six Sigma (BFSS) to create new businesses and find new applications. BFSS addresses problems through a DIAEI road-map comprising a 5-step Define, Identify, Analyze, Evaluate and Implement (DIAEI) road-map. This paper defines major activities for each BFSS step and applies it to F Electronics, a Korean electronics component manufacturer, to analyze marketability, technological plausibility and economic sense in connection with its new product development. In other words, BFSS describes the process through which the company evaluates the value of a new business, derives an optimal scenario and reviews it.

2. Six Sigma Methodology

2.1 DMAIC

The Six Sigma movement started with regular Six Sigma process improvement activities incorporated by DMAIC. The DMAIC methodology should be used for an existing company product

or process that is not meeting customer specifications or is not performing adequately. This DMAIC strategy does not involve any change or redesign of the fundamental structure of the underlying process, but rather consists of finding solutions to eliminate the root causes of performance problems in the process and of performance variation, while leaving the basic process intact. The goals for DMAIC projects are usually related to reducing defects, variations, and costs from poor quality.

However, after several years of application, the DMAIC approach has encountered the following two problems (Yang, 2005):

1. Some processes are fundamentally flawed in their design, and DMAIC-based projects will not yield sufficient improvement for these processes.
2. DMAIC-based strategy focuses particularly on variation and defect reduction. So it predominantly accomplishes "do things right", but does not address the problems of higher performance levels and higher customer value, nor does it adequately address the issue of "do the right thing".

In order to overcome these deficiencies, DFSS strategy has been proposed in recent years.

2.2 DFSS

DFSS was proposed for application to the process of new product development for the manufacturing industry. It is a systematic methodology that uses tools, training, project management, and disciplines to optimize the product design process, in order to achieve superior designs to maximize customer value at Six Sigma quality levels.

In the manufacturing industry, DFSS is needed because the design decisions made during the early stages of the design life cycle have the largest impact on total cost and quality of the system. It is often claimed that up to 80 percent of the total cost is incurred in the concept development phase (Fredrikson, 1994).

While Six Sigma is widely recognized by the DMAIC acronym that represents its five standard phases, DFSS has no standard acronym. Therefore, organizations have adopted a variety of approaches that resulted in acronyms such as DMADV, IDOV, CDOV, DCOV and IDEAS

<Table 1> DFSS Road-map

Phase	Activities	Key Deliverables
Identify	• Identify customer and product requirements • Establish the business case • Identify technical requirements	• Project Charter • Competitive analysis • VOC and CTQs
Design	• Formulate concept design • Identify potential risks • Identify design parameters	• A best-fit concept • Deployment of CTQs
Optimize	• Optimize design to minimize sensitivity of • CTQs to process parameters • Error proofing • Establish statistical tolerancing	• Detailed design elements • Prediction of performance • Optimized design
Validate	• Prototype test and validation • Assess performance, failure modes, reliability, and risks • Final Phase review	• Result of testing and validating

(Soderborg, 2004). <Table 1> shows the steps, activities, and tools that should be performed in each DFSS phase for IDOV. Six Sigma is implemented in order to raise the overall value of a company. To this end, analysis and evaluation of the company's expansion into new businesses are becoming increasingly important. However, DMAIC and DFSS approaches focus on process improvement and new product development, respectively, and can not be applied to the area of new business creation. Therefore, this paper proposes BFSS as a new six sigma approach to create new businesses and find new applications.

3. BFSS Implementation Strategy

In order for a company to keep growing and thriving, it needs to create new businesses and unearth new applications while keeping existing ones on track.

Corporate values must be secured through the creation of new businesses and the discovery of new applications to cope with the drastically changing market environment and ever-shortening product life cycle, and thereby generate corporate value.

This section presents a BFSS road-map as a tool to create new businesses and unearth new applications. BFSS consists of DIAEI.

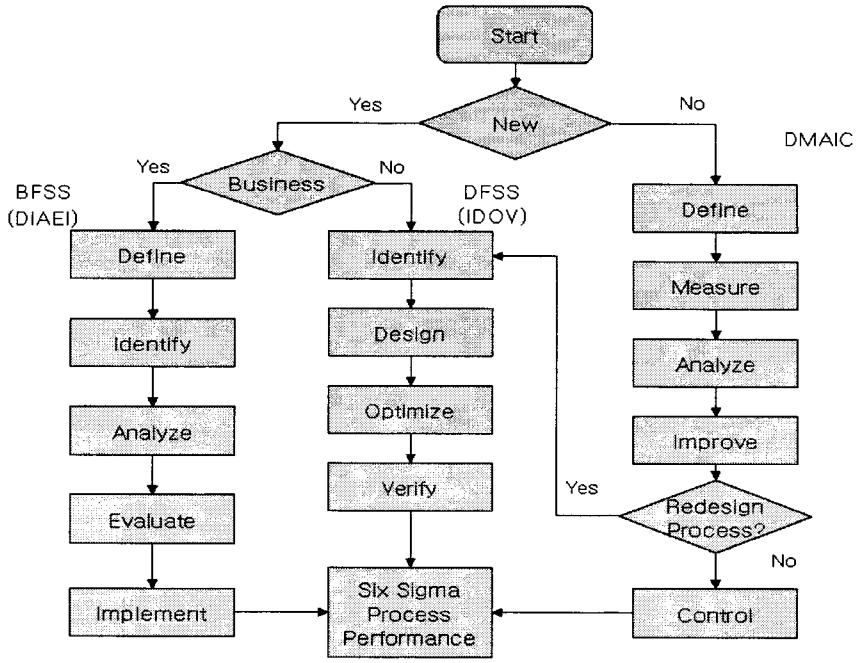
<Table 2> shows the steps, activities, and tools that should be performed in each BFSS phase. <Figure 1> illustrates the relationship among DMAIC, DFSS (IDOV) and BFSS (DIAEI).

3.1 Define Phase

This phase, unlike that in a general Six Sigma model, focuses on selecting, defining and approving a project in line with the company's medium and long-term business strategy based on its philosophy and direction. The project is selected on a top-down basis backed by a strong commitment to expansion of the new businesses.

<Table 2> BFSS Road-map

Phase	Activities	Key Deliverables
Define	• Define the opportunity • Define project scope • Develop project plans & control	• Problem/goals statement • Project scope definition • Project plan
Identify	• Identify level of Y's • Identify current status • Establish new business goals	• New business goals • Medium and long term business strategies
Analyze	• Analyze market / technology /economic prospect • Analyze capability of Implementation • Analyze corporate environment	• Market environment and customer analysis • Technological value and competitor analysis • Profit and loss forecast and financial analysis • Diagnosis of management capability
Evaluate	• Develop scenario • Perform simulation • Evaluate feasibility study	• Various scenarios • Evaluation of market, technology and economic prospect • Result of NPV and BMO analysis
Implement	• Develop business plan • Appoint Implementation leader • Close project	• Preparation of business plan • Appointment of a leader • Setup timeline for implementation and evaluation



<Figure 1> DMAIC, DFSS (IDOV) and BFSS (DIAEI) approaches

3.2 Identify Phase

This phase consists of understanding the company's strategy and deriving projects Y's that will lead to innovation through concentration of capability. New business goals for value maximization or strategies for penetration into new sectors need to be implemented by verifying its business and management environment using the core competence derived. Strategy in terms of business administration refers to activities to develop organizational resources and technology,

as well as the adjustment of internal capability to match threats and opportunities created by the external environment. Strategy serves to guide the relationship between environment and organization as it is perceived as a mechanism to control activities within the organization and help it adjust to the environment. Strategy also impacts on the fundamental structure and process, as well as the organizational performance.

3.3 Analyze Phase

This phase involves analyzing the market, technology and economic prospect and configuring core competences to be concentrated on by reviewing the company's ability to run new businesses and the external environment surrounding it.

The analysis of marketability should take into account market structure, demand and medium and long-term prospect, sales technique and organization, selection of a target market, existing and perspective competitors, and price and its trend prior to the establishment of the sales strategy. The company's strategy needs to be fully understood to decide on the method of analysis and its direction. STP (Segmentation, Targeting, and Positioning) strategy is typically used for marketability analysis, which examines the sector whose value should be identified through segmentation and targeting.

The analysis of technology prospect represents technology in value. Areas to be analyzed

include competing products, technology gap, human resources employed, production capability and facility level, procurement of materials and quality improvement. The focus should be on analyzing the technological value and reviewing its commercialization.

Economic efficiency analysis analyzes the future prospect from a current point of view and plays a critical role in deciding whether or not to go for commercialization. An estimated balance sheet, income statement and cash flow need to be produced and used for decision making.

The analysis of implementation capability and external environment is about diagnosing the managerial ability of the company and its leader. Leadership is the most important factor in pushing for new businesses and thus the possession of a leader with such leadership is critical for the company. It is also necessary to determine whether the company is financially strong enough to fund new businesses and how much further it will grow.

3.4 Evaluate Phase

This phase focuses on substantiating various scenarios for business creation based on the above analysis of marketability and technological and economic efficiency and producing detailed materials needed for decision making using NPV (Net Present Value)and feasibility study, as well as the simulation results of such scenarios. The most plausible scenario should be selected from among the various possibilities by evaluating NPV and the feasibility of each. NPV is the present value of future cash flow that will be generated from commercialization, reflecting the risks of technology, financing and market uncertainties. It is represented as formula (1):

$$NPV=\frac{CF_1}{(1+\gamma)^2}+\frac{CF_2}{(1+\gamma)^2}+\cdots+\frac{CF_n}{(1+\gamma)^2}, \quad (1)$$

where CF_i represents the cash flow from commercialization and γ the discount rate in consideration of risk.

The discount rate can be acquired from WACC (Weighted Average Cost of Capital) or CAPM (Capital Asset Pricing Model). WACC is the weighted average of the expected earning rate on capital and liability, which can be represented as formula (2):

$$WACC=\frac{K_e\times W_e+K_d\times W_d}{W_e+W_d}, \quad (2)$$

where K_e and K_d are the expected earning rate on capital and on liability, while W_e and W_d denote the capital invested and the liability invested, respectively.

CAPM can be represented as formula (3) taking into account RP (risk premium) for risk free

<Table 3> Business evaluation

A. Attractiveness of a business		B. Fitness with our company	
A1 Market size	10	B1 Financial capability	10
A2 Growth Prospect	10	B2 Marketing Capability	10
A3 Competitiveness	10	B3 Manufacturing Capability	10
A4 Risk diversification	10	B4 Technological Capability	10
A5 Industry restructuring	10	B5 Materials Procurement	10
A6 Social superiority	10	B6 Support by the management	10
Total	60	Total	60

rate and SP (size premium):

$$CAPM = Rf + \beta \times RP + SP, \quad (3)$$

where Rf denotes the risk free rate and β is a risk constant which is the ratio of change in the value of a company under evaluation to change in market value. For example, if the stock price of a company under evaluation changes 15% when the stock market changes 10%, then the risk constant is 1.5. RP denotes an excessive earning rate expected over the risk free rate, and SP is added depending on the size of the company size.

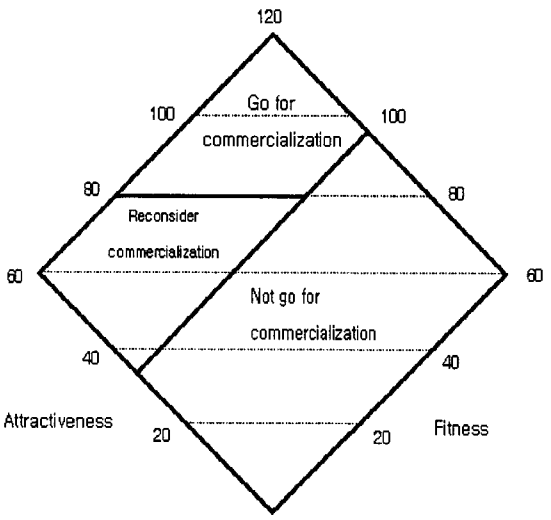
One of the ways to evaluate business feasibility used by leading companies in North America and Japan is the BMO(Bruce Merrifield Ohohe) method, originally devised by Dr. Bruce Merrifield and later modified by Prof. Ohohe, Japan. It conducts an evaluation in three steps.

Step 1 investigates the degree of attractiveness of the business in question and advances to Step 2 if the attractiveness exceeds 35 points.

Step 2 examines whether the attractive business is fit for the company and advances to Step 3 if it is. <Table 3> gives an example of the criteria by which the attractiveness and fitness for the company are evaluated.

Step 3 assesses the business feasibility (the sum of attractiveness and fitness) and calculates the possibility of commercialization success. <Figure 2> shows the evaluation of attractiveness and fitness. If the attractiveness of a business exceeds 35 points, as determined in step 1, the feasibility study is conducted in step 2.

If the business feasibility is greater than 80 points, commercialization commences. It is known that an American company under such conditions has an 80% chance to succeed in commercialization. <Table 4> shows an example of the judgment of the evaluation results.



<Figure 2> Evaluation of attractiveness and fitness

<Table 4> Evaluation results

Attractiveness	Fitness	Total	Judgment
50	30	80	Implement
40	30	70	Reconsider
30	30	60	Not Implement

3.5 Implement Phase

If a business turns out to be infeasible, alternatives should be studied. This phase includes the preparation of a business plan to execute scenarios selected as a result of the feasibility study and the establishment of a schedule and a leader to use existing methodology such as DMAIC and DFSS.

4. Case Study for BFSS

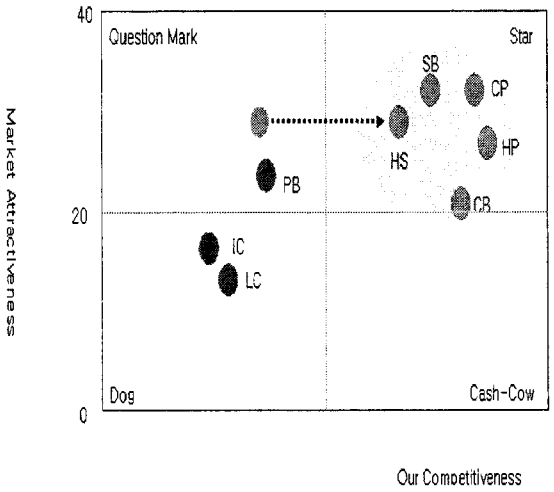
This section presents an example of F Electronics which actually applied the BFSS road-map.

Details of the BFSS road-map that was actually implemented are as follows.

Define Phase: F Electronics, a Korean electronics component manufacturer, is viewed as having no problem in its core business due to the high profitability of its products. Nevertheless, market surveys indicate that the company will suffer deteriorating profitability within 2~3 years because of the contraction of the markets for its products which will then be in the mature stage of the product life cycle. F Electronics reached a consensus that it could sustain the current profitability even 2~3 years from now only if it penetrates into newly emerging sectors. However, no discussion has been held about which sectors will maximize revenues. For this reason, profit evaluation for new businesses has become the subject of Six Sigma.

Identify Phase: This phase focuses on gaining an understanding of the company's strategy and defining Y of which new business to join. The company's strategy is to become a leader in the current electronics parts market by expanding a highly value added sector while Y is to seek a new business area with a profitability of more than 20% to diversify revenue sources. The profitability of the current business area is 10%. The result of core competence evaluation revealed that market innovation would be required for new businesses, specifically sales to market and realization of profitability through configuration of market channel.

Analyze Phase: In this phase, marketability was evaluated based on the core competence identified to select an HS product as a target product for the new business. As shown in <Figure 3>, the HS product is inferior in its competitiveness, but is highly likely to generate significant revenue due to its great market attractiveness once its competitiveness is raised.



<Figure 3> Selection of target product

<Table 5> Income statement

Unit:$	Year 1	Year 2	Year 3	Year 4	Year 5
Depreciation	578,000	884,000	884,000	884,000	884,000
Investment in equipment	2,892,000	1,529,000			
⋮	⋮	⋮	⋮	⋮	⋮
Operating profit	128,000	1,065,000	1,149,000	740,000	313,000

<Table 6> Net present value

Unit: $	Year 1	Year 2	Year 3	Year 4	Year 5
Operating Profit	128,000	1,065,000	1,149,000	740,000	313,000
Cash Flow	-2,186,000	420,000	2,033,000	1,624,000	571,000

An analysis of technical ability was conducted for commercialization. The analysis took into account customer needs, competing products and technology, quality and other factors. F Electronics was found to be 2 years behind in core technology compared to its competitors. To analyze the economic efficiency, the HS product was assumed to have been commercialized and the balance sheet, income statement and cash flow for the product were produced. To this end, comprehensive parameters were used as inputs, including the business location, scale, utility, employment of human resources, investment, material procurement and method of production. From the <Table 5>, a deficit is anticipated in the early years of business. However, the profitability is expected to improve over time.

Evaluate Phase: In this phase, 4 scenarios were derived based on an evaluation of marketability, technical ability and economic efficiency, each of which was analyzed for its business value.

<Table 6> presents the analysis result of the scenario with the largest business value. CAPM was used to acquire a discount rate required to calculate the business value. Rf was 4.2% and β, the risk constant for F Electronics, was 1. SP was therefore not considered. CAPM can be represented as follows:

$$CAPM = 4.2 + 1 \times 4 + 0 = 8.2\%. \quad (4)$$

Cash flow is equal to operating profit plus depreciation less investment in equipment, which can be calculated as follows.

$$Year1 = 128{,}000 + 578{,}000 - 2{,}892{,}00 = -2{,}186{,}000$$

$$Year2 = 1{,}065{,}000 + 884{,}000 - 1{,}529{,}00 = 420{,}000$$

Using the same relation for years 3, 4 and 5, the results shown in <Table 6> were calculated.

NPV can be calculated as follows:

$$NPV = \frac{-2{,}186{,}000}{(1+0.082)^1} + \frac{420{,}000}{(1+0.082)^2} + \frac{2{,}033{,}000}{(1+0.082)^3} + \frac{1{,}624{,}000}{(1+0.082)^4} + \frac{571{,}000}{(1+0.082)^5} = 1{,}638{,}000$$

The selected scenario underwent BMO evaluation through the application of quantification in a separate analysis <Table 7>. Details of the analysis table are not provided here due to space limitation.

Each score in <Table 7> was allocated according to pre-defined criteria. Analysis results revealed an attractiveness score of 39 points and fitness of 38. The market size was more than 3 trillion won, equivalent to 10 points, and the growth potential was 25% over the next 5 years, equivalent to 10 points.

<Table 7> Evaluation score result

A. Attractiveness of a business		B. Fitness with our company	
A1 Market size	10	B1 Financial capability	10
A2 Growth Prospect	10	B2 Marketing Capability	5
A3 Competitiveness	6	B3 Manufacturing Capability	7
A4 Risk diversification	6	B4 Technological Capability	6
A5 Industry restructuring	2	B5 Materials Procurement	7
A6 Social superiority	5	B6 Support by the management	3
Total	39	Total	38

Industry restructuring, on the other hand, was rated only 2 on a 10-point scale due to weak standardization of core technology. In terms of suitable company fit, the financial strength was sufficient but the shortage in core human resources limited the contribution to only 2 points. The BMO evaluation therefore gave an overall business feasibility score of 77 points, comprising 39 for attractiveness and 38 for fitness.

Implement Phase: The final conclusion was to reconsider the implementation. Based on this result, F Electronics appointed a new leader among its directors and studied the international standardization of the HS product and its business feasibility with the aim of restructuring the industry to establish a new business plan and complete this task.

5. Conclusion

The implementation of Six Sigma can raise the overall company value. Therefore, analysis and evaluation of the company's planned expansion into new businesses are becoming increasingly important. In this paper, we have proposed a Business for Six Sigma(BFSS) road-map. BFSS is a new Six Sigma approach to create new businesses and determine new applications. BFSS follows the DIAEI (Define, Identify, Analyze, Evaluate, and Implement) road-map and provides a process where marketability and technological and economic efficiency for a target business are analyzed to allow scenarios to be configured and business value and feasibility to be evaluated in order to select the optimal business scenario. We also presented an example of F Electronics, a Korean electronics component manufacturer, which actually applied the BFSS road-map to analyze marketability, technological plausibility and economic potential/success in connection with its new product development.

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