

A Study of Lean DFSS through the Creative Value Design

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Abstract

Six Sigma uses DMAIC (Define, Measure, Analyze, Improve, Control) methodology as the process of a solving problem. Enterprises already propelling Six Sigma successfully, such as Motorola, GE and consulting companies, also traditionally propose DMAIC methodology. But, from activating Six Sigma, enterprises and Six Sigma consulting companies propose Six Sigma methodology matching indirection part of office and R&D part. As an example, DFSS (Design For Six Sigma) is part of R&D application in GE.

This study investigates Six Sigma methodology corresponding to the Right Process of the kernel factor. Especially for the optimum design of R&D, the study revises the definition of DFSS and the general organization through Lean DFSS methodology research and analysis.

Key Words: Six Sigma, Lean DFSS Methodology, R&D

1. Overview

1.1 Purpose of Study

Developing a competitive product is essential for innovating corporate competitiveness. This is the most crucial activity that companies have to pursue vigorously to ensure their survival and growth. However, the rapid change in the market and the technology is making them difficult to successfully develop new products. And no matter how successful the products may be, the lifespan of the products is getting shorter amid the changing market and the pattern of consumption, and therefore the technological change makes such products to be commonplace.

Differentiation strategy, like creative value design, is required for successful development of a new product, and for this, a methodology to solve a problem that has not occurred yet is also necessary. Most existing studies have focused on the solution of the problems that already happened, while the methodology to solve problems that may happen in the future remains meager.

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For manufacture or production, companies are using methodologies such as TQC, TPM, Six Sigma and such, but there is no regular method in developing new products. Instead, companies are using the method that they developed on their own or relying on individuals.

Products are made through the process of manufacture, but information is produced by R&D. The existing development process that is not standardized is causing the scattering of information, which prevents the company from achieving development. To make it worse, sometimes the improvement of partial optimization has adverse effects on the entire project.

Therefore, it is urgent to craft the process of new product development to optimize the overall process, ranging from product planning to mass production, or from the comprehensive viewpoint to the attainment of achievement in developing a new product. This study presents the methodology to solve the problem that will happen in the future by using the 4th Generation R&D Strategy which is the “strategy of technology development designed to create value based on market integration.”

The Lean DFSS methodology is classified into different processes, such as product planning (Marketing for Six Sigma), technology development (Technology for Six Sigma), product development (Redesign Six Sigma), and process development (Process for Six Sigma). In this study, we try to analyze the crucial factors that affect the successful development of a new product for suggesting the measure to ensure the development of new products.

1.2 Scope of Study

3P (Right Product, Right People, Right Process) is important for companies to have viable competitiveness. 3Ps are also important factors that should be considered for successful usage of Six Sigma. In this study, we consider the methodology to solve the problem of Six Sigma with the right process to ensure the solution of problems in 3 Ps. Specifically, we try to define and establish the basic concept of Lean DFSS (Design for Six Sigma), which is the methodology to optimize the process of developing new products that companies need to create values out of.

2. Theoretical Background and Study on the Literature

2.1 Concept and Definition of New Product

Generally, the concept of new product refers to a product that a function absent from other products in narrow sense. This means that the new product is produced by a totally different method. But in broad sense from a company’s strategic standpoint, a new product also includes the improved versions of existing products or those of the competitors. It may also include all products produced for the first time by a particular company when that

company took over such products or the product lines from other companies.

Crawford (1991) defined new product as the “product for which the company needs new marketing, a product which has the real change except the one in the simple promotion.” On the other hand, Cooper (1993) defined new product as the “product that is commercialized by the corresponding company, which is new to that company regardless of the existence of product similar to the one in the existing market.”

As the above indicates, the concept of new product can be defined differently depending on the viewpoint, and in general, it can be classified into categories, such as innovative product, remodeled new product and product newly viewed by the company.

2.2 The 4th Generation R&D Strategies for the Successful Development of New Product

Robert G. Cooper (1996) said that the failure to figure out the demand of the customers at the early stage of developing a new product accounts for around 45% among the reasons of failure in new product development. Therefore, it is important at the planning stage of new product development to analyze and understand the demand of the market and the customers to improve the chance of developing a successful new product.

For successful development of new product, the demand of the customers has to be fully reflected at the stage of planning, so that they the products can be sold in the market. This strategy for new product development is pursuing the development of technology to create values based on market integration, and it is called “the 4th generation R&BD (Research & Business Development) strategy.”

2.3 Concept and Definition of Lean Process

Professor James P. Womack at MIT in the United States defined the production method adopted by Toyota as “a lean system that does not allow any waste” when he was analyzing the competitive power of Japan in 1990s. Lean production is a process to find, understand and remove various wastes in our activities, including the production. Lean production system gets rid of a variety of obstacles in the production process, and is a production method to produce high quality products in a timely manner by ensuring the continued improvement through the participation of workers.

In this study, we use the value stream mapping, depending on the process designed for the new product development to define the value-added process and non-value-added process, concepts used to detect and eliminate various wastes in the development of a new product.

2.4 Process of Solving the Six Sigma Problem

The Six Sigma activity, which Motorola started in 1987, uses the DMAIC for the process to solve the problem. The methodology of new Six Sigma is capable of solving not only

the problem that already occurred, but also the problem that may happen in the future in advance. DFSS (Design For Six Sigma), which is proposed by GE, is the methodology developed for the new Six Sigma.

GE classifies DFSS into DFSSc (Design For Six Sigma Commercial) for transaction and service, DFSSp (Design For Six Sigma Product) for product development, and DFSSi (Design For Six Sigma Innovation) for the process re-design, as shown in Figure 1.

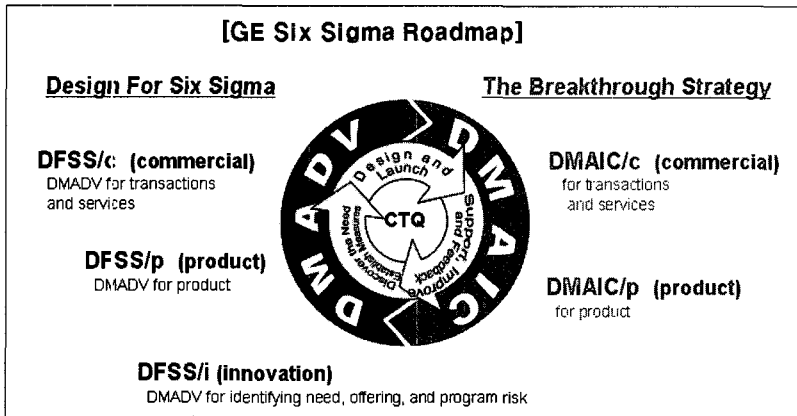


Figure 1. GE Six Sigma Roadmap

2.4.1 DMADV Roadmap

As the methodology to solve the problem, DMADV, which is invented by GE, develops a remodeled new product. DMADV is driven by the stage of “Define,” “Measure,” “Analyze,” “Design” and “Verify,” as shown in Figure 2.

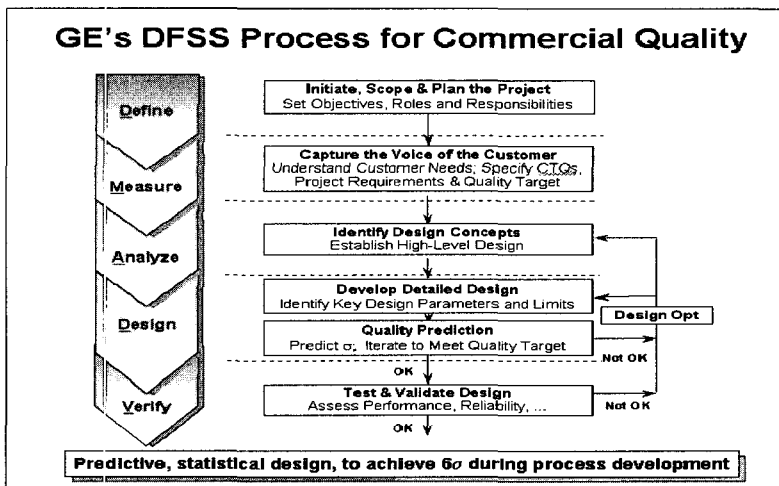


Figure 2. DMADV Roadmap

2.4.2 IDOV Roadmap

The process to solve the problem used for the development of a new product or new process is driven by the stage of “Identify,” “Design,” “Optimize” and “Validate,” as shown in Figure 3.

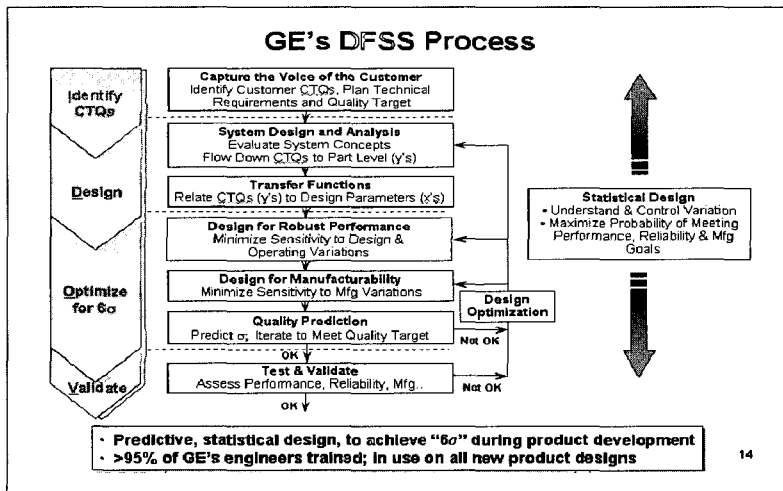


Figure 3. IDOV Roadmap

2.4.3 MAIC and IDOV Decision Tree

MAIC, MADV and IDOV can be connected and used as shown in Figure 4, when the project connects and runs the Six Sigma project with manufacture and development at the same time.

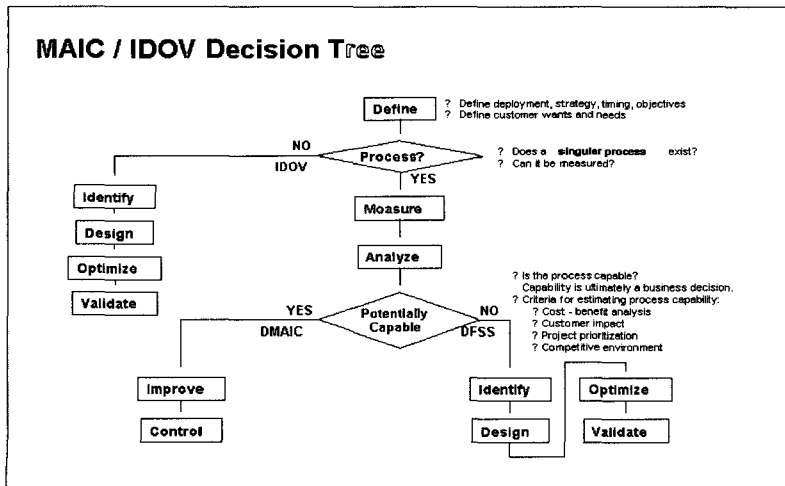


Figure 4. DMAIC & IDOV Decision Tree

3. Main Subject

3.1 Concept & Definition of Lean DFSS Methodology through the 4th R&D Strategy

Most companies are applying DMAIC, the Six Sigma methodology developed by Motorola, to solve the problem. For the DFSS, which is designed to optimize the development of new product and process, GE proposed IDOV and DMADV Roadmap for the first time, and the new Six Sigma methodologies are being studied to suit the specific characteristics of the company on a continued basis.

In this chapter, we try to suggest Lean DFSS methodology for the optimization of developing a new product and the process, ranging from product planning of the new product to mass production.

Lean DFSS methodology allows all people involved in the new product development to perform works in the same way as it standardizes the method and the procedure of work. The methodology also reduces the scattering phenomenon that occurs during the course of work between the developers, and as a result, improves the quality of the developed product.

The details of Lean DFSS methodology are as followed:

- (1) Setting up the strategy for creating a new value based on the 4th generation R&D strategy (Creative Value Design Strategy)
- (2) Establishing the process of innovative process (Design Innovation Process)
- (3) Executing the structural system of product depending on the stage of design (Design Breakdown Structure)
- (4) Setting the goal of development depending on the stage of design (Design Key Performance Index)
- (5) Using the check list to see whether the goal of development was achieved (Design Checklist)
- (6) Applying the design standard to figure out the level depending on the level of Design Scorecard (Design Scorecard)
- (7) Conducting the design review for the decision making for each stage (Design Review)
- (8) Applying the Manuals & Template to execute Lean DFSS (Design Manuals & Template)

3.2 Creative Value Design for Lean DFSS Process

Figure 5 shows the Lean DFSS Process that links the process of new product development, including the product planning stage, technology development stage, product development stage and process development that aims at the new product development. The follow-

ing describes the major details of each stage.

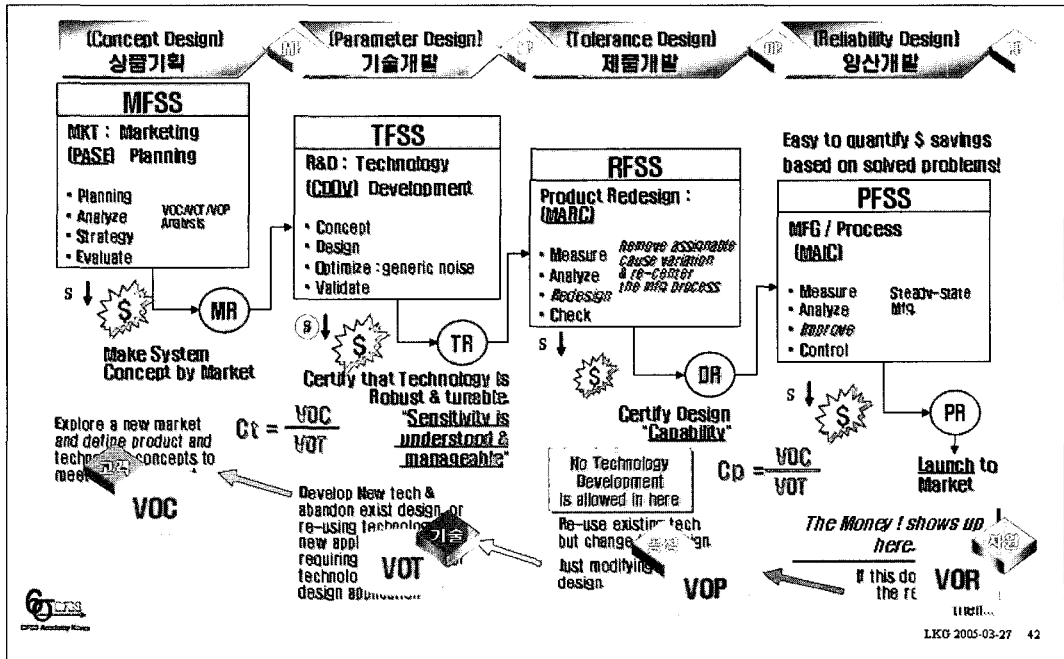


Figure 5. Lean DFSS Roadmap

3.2.1 Product Planning (MFSS; Marketing for Six Sigma) Stage

This is the stage for product planning by using the plan and the developing strategy that is designed for the new product, based on the analysis of customers' requirements. The product planning team supervises this stage with the departments, such as sales, development, purchase, manufacturing and participating. Therefore, the concept design for the new product will be carried out at this stage to create a new value by analyzing the requirements of the customers as well as the environment, market, trend of the competitors, cost analysis and so on.

3.2.2 Technology Development (TFSS; Technology for Six Sigma) Stage

A decision on the development is made at this stage by means of the plan and the developing strategy for the new product. The new product is determined whether it is capable of bringing about financial achievement or not by analyzing the requirements of the customers, market, environment, trend of the competitors, cost and so on.

3.2.3 Product Development (RFSS; Redesign for Six Sigma) Stage

The decision on whether the product can be made according to the designed concept is

verified at this stage. Prototypes are made at this stage, including the confirmation on the quality realized by the short-term manufacturing process, as well as the technical verification.

3.2.4 Process Development (PFSS; Process For Six Sigma) Stage

All relevant departments, including marketing, development and manufacturing departments, will participate in this stage. All details are transferred to the manufacturing department once the mass production verification stage completes. In addition, DR (Design Review) is conducted to make decisions for each stage.

3.3 Execution of Lean DFSS Methodology Depending on the Stage

The process of driving Lean DFSS, founded on the process of new product development, is the method to link the EPI (engineering process innovation), which is the activity to innovate the developing process, to the Six Sigma, as shown in Figure 6.

DIP(Design Innovation Process) is composed of 4 steps of Mega Process, 16 steps of Major Process, 64 steps of Sub Process and detail activity.

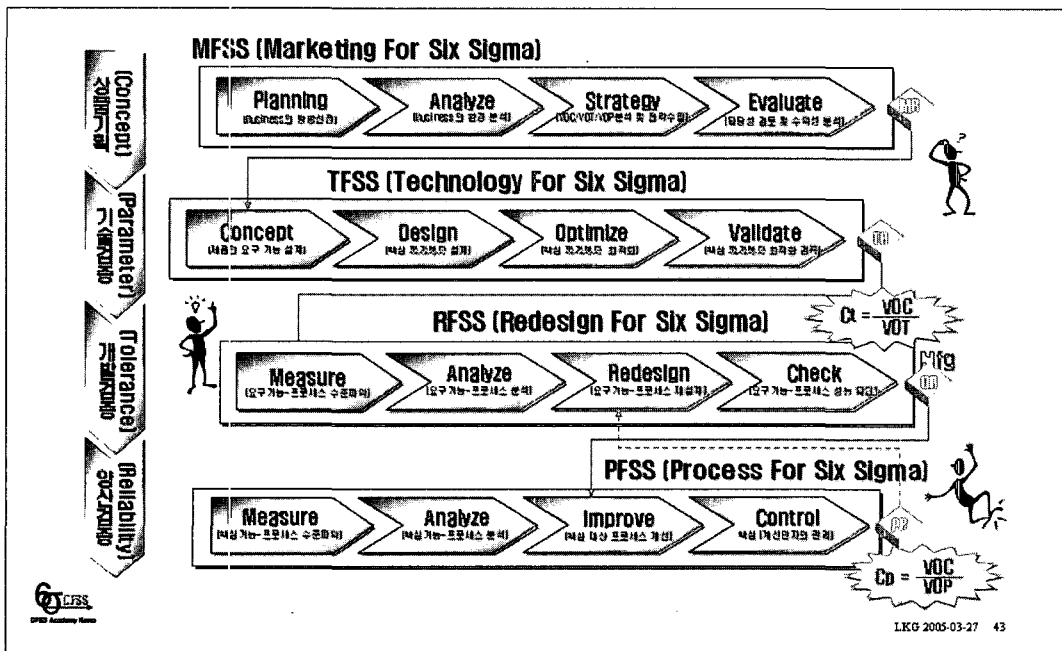


Figure 6. Design Innovation Process

3.4 Lean DFSS Decision Tree

In the aforesaid study on the literature, we mentioned that MAIC and IDOV are used together when the project is running. Likewise, DMAIC and Lean DFSS can be used together

in two different stages, as shown in Figure 7.

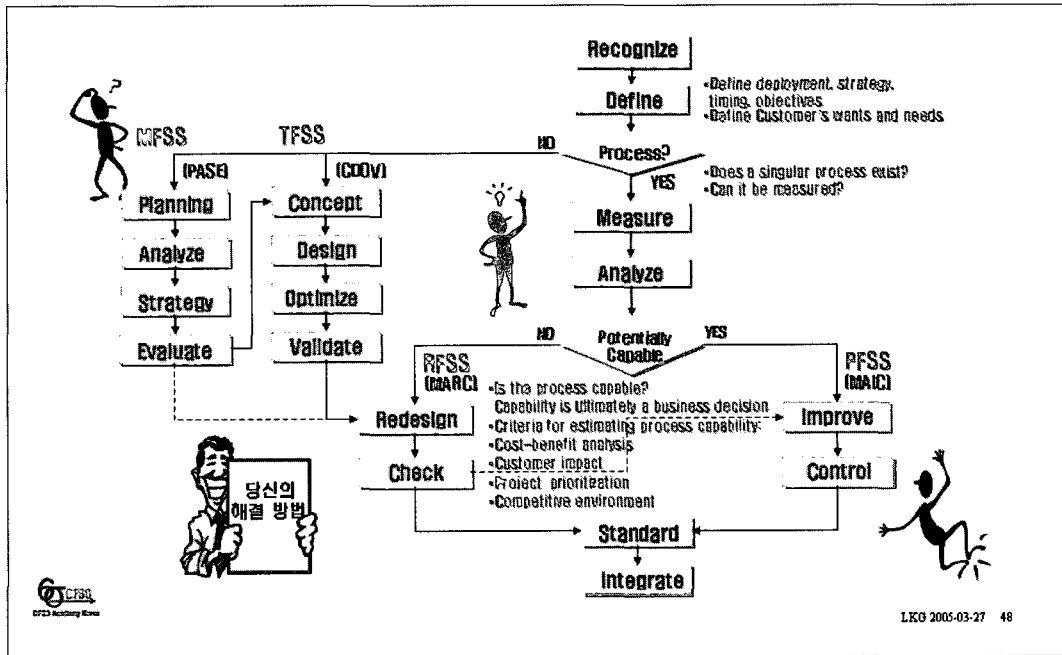


Figure 7. Lean DFSS Decision Tree

4. Conclusion

The Six Sigma DMAIC methodology initially focused on solving the problem that already happened in the field of manufacturing, but was difficult to be applied to R&D and office work area, which deal with the creative matter of solving the problem that will occur in the future.

The quality of newly developed product will meet the standard of Six Sigma under Lean DFSS, if the new product that customers want is planned and product quality viable in the market is developed. Then strict management is assured during the entire process, including the PFSS stage for transferring to the mass production stage through thorough analysis of the customers and the market from the MFSS stage where the plan for new product development is set up.

Lean DFSS through the 4th Generation R&D Strategy, presented in this dissertation, should be operated using DIP (Design Innovation Process), DBS (Design Breakdown Structure), DKPI (Design Key Performance Index), DCL (Design Checklist), DSC (Design Scorecard), DR (Design Review), DMT (Design Manuals & Template), composed of 4 steps of Mega Process, 16 steps of Major Process and 64 steps of Sub Process, along with the

Creative Value Design Strategy, as shown in Figure 8.

Creation of new value and improvement of competitive power are expected to be achieved if the Lean DFSS methodology based on this 4th generation R&D strategy is applied to the new product-developing project of the company.

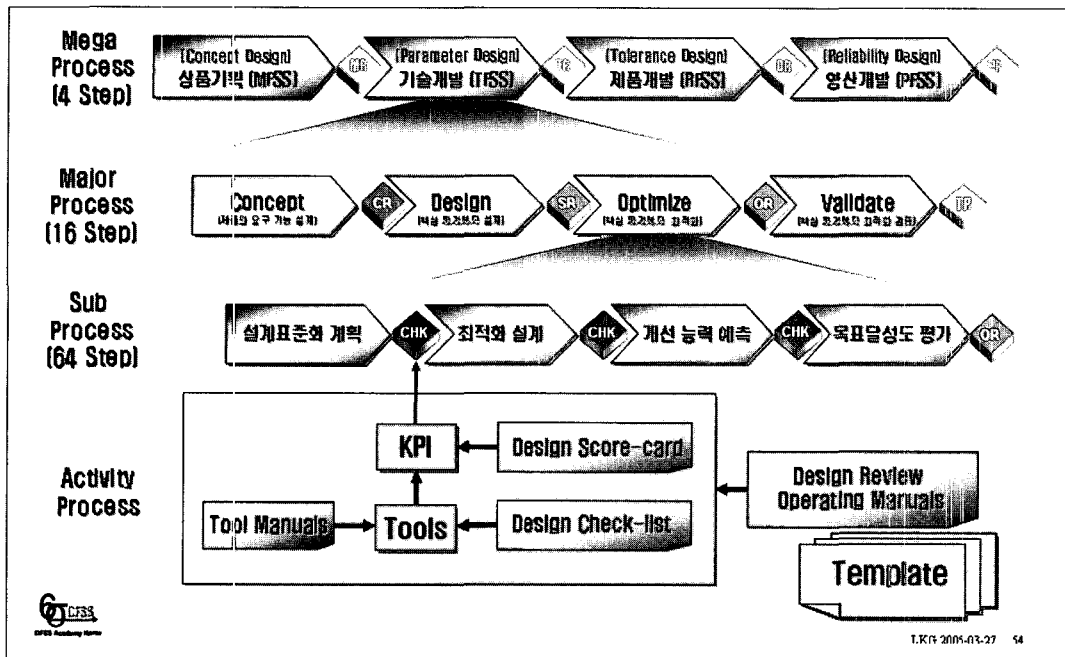


Figure 8. Lean DFSS Process

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