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# “THE FUNCTION TREE ANALYSIS FOR NEW PRODUCT DEVELOPMENT & ITS APPLICATIONS”

## ANNOTATION

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TRIZ is a rule of technical evolution of engineering system. Many great inventions were developed by TRIZ and are very powerful for (1) patent circumvention, (2) cost reduction, (3) system improvement, (4) process innovation and (5) new product development. Modern TRIZ process is composed with Analytical Stage for analyzing system and Creative Stage for generating concepts.

One of the main directions of TRIZ evolution is how to model system. In classical TRIZ, there is no method to describe system, so the initial problem should be formulated by engineer intuition. Function Analysis is developed for the analysis of the system, and it provided more practical problems in the system. TRIZ earned its navigator to the solutions.

In 1999, I studied on the analytical part of TRIZ processes and meet a situation of predicting future system. Sometimes new technical system (Paradigm Shifting System) is not based on the analysis of previous system. For example, LCD display has same function to CRT display, but their components are totally different. There functions are very similar, but new system could hardly derive from conventional system. At that time, it is usually used function oriented search or radical trimming but new system usually earn new components and function not trimmed.

Sometimes, the function in the system was needed at the time it was developed, but technical evolution at present time is very fast. Function is gained in the first stage and transitional stage but the function’ value can be seen in the different view in other rectangle in 9 screen view.

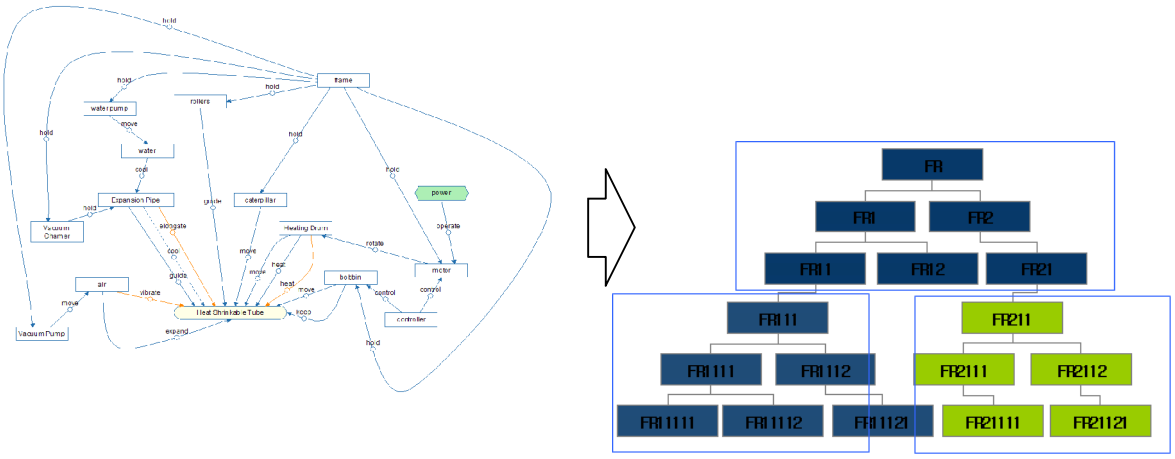
Therefore my research was naturally focused on developing new problem analysis method for new product development. I found a hint from hierarchical structure of Axiomatic Design and decided to modify the structure as a point of TRIZ view.

After I left Yonsei University, I worked as TRIZ organizer in LG-Cable, Hyundai Motors and POSCO for 10 years. I met several TRIZ experts and technical engineers

and learned from them. Fortunately I got a chance to apply and develop my theory through practical projects.

Usually Function Analysis is the most popular to describe system. Even though it can build objective model of the system but it is not enough for new product design because it is usually models existing components of present system.

Future system can be based on same structure function and component but usually the system's sets of functions are much different to conventional design. To predict future system, it is needed to study the structure of function not the component of existing system.




Function Tree is developed for describing functional structure to design future system. It starts from conventional Function Analysis and extract functions from it. It is turned to Functional Requirement and grouped as Function Module. After that it forms a hierarchical structure of sets of Functional Requirements. Function Tree could overview a system more in the philosophical view of designer.

ALGORITHM OF FUNCTION TREE

STEP 1 Extract Functions from Existing Engineering System.Rules

STEP2 Categorize Functions (STEP2)

STEP.3. Changing Functions to Function Requirements (STEP 3)

| Function Requirements | Function Module | Functions | Components |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

STEP. 4. Arrange Function Requirements (STEP 4)

STEP 5. Expand Function Tree (Optional, STEP 5)

STEP 6. Analyze Function's Performance. (STEP 6)

| Functional Requirement | Operation Time | Operation Space | Performance | Cost |
|---|---|---|---|---|
| | | | | |
| | | | | |

STEP 7. Select Scenario for Function Tree. (STEP 7)

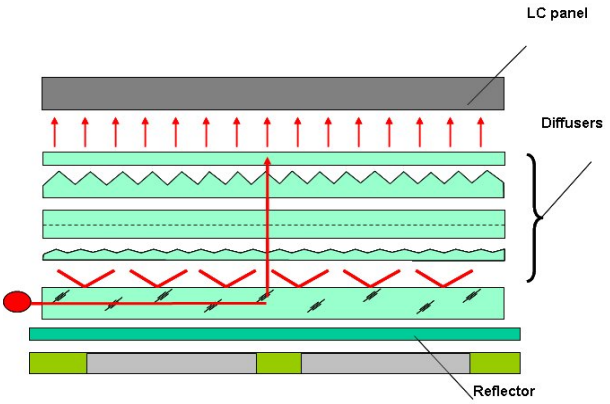
STEP 8. Build new Function Tree (STEP 8)

STEP 9. Evaluate New Design

This study has been brushed through lots of real practices in LG-Cable, and Hyundai Motors. And it is found that this modeling provides more useful problem to develop new system. In this thesis, development of new backlight unit of LCD-LED display will be discussed as an example with previous approach to resolve the problems in the system as comparative study.

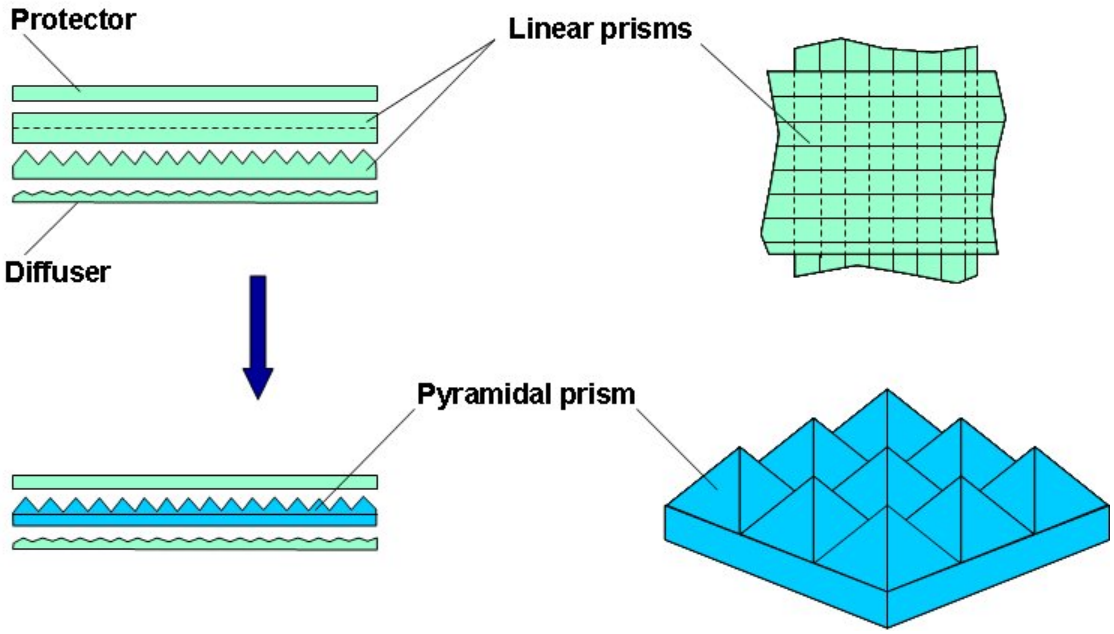
Original Backlight System (Fig.1) was very complex and it is needed to develop new concept. Originally engineers tried to apply FOS, Inventive Principles and Trimming to improve it, but they failed

Fig. 1 Backlight Unit




It was because they focused on existing functions of films (1 Diffuser and 2 Prism Film). Firstly, They merged films into one or merged it with other components in the system. But the suggested ideas were too hard to manufacture.

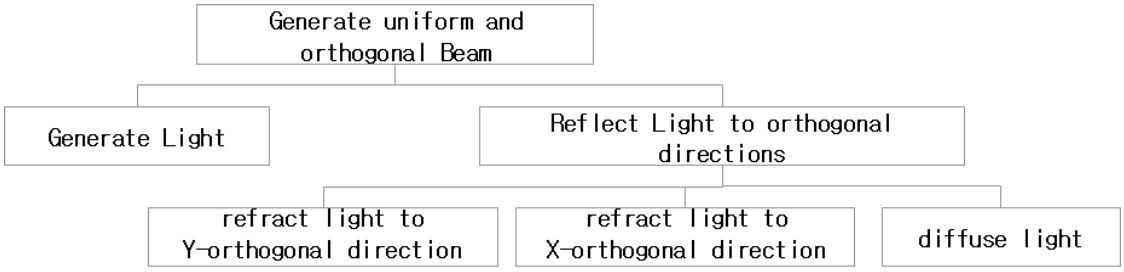
Fig. 2 Trimming Ideas




They tried again using FOS, and found an idea of using polarizing mirrors. It has two problems. It was already granted by other company, and too expensive.

It was because people usually focused on the existing functions of the system. Function Tree was applied to reformulate the system again.

Fig. 3 Function Tree




Using Function Tree, it is revealed the functions of 3 films are lower level functions of one functional requirements. Reflect Light to the Screen. Because the thickness of reflector is very thin, the light can't be reflected to the orthogonal direction. Therefore they add lower level functions as refracting light (X-Y direction) and diffuse light.

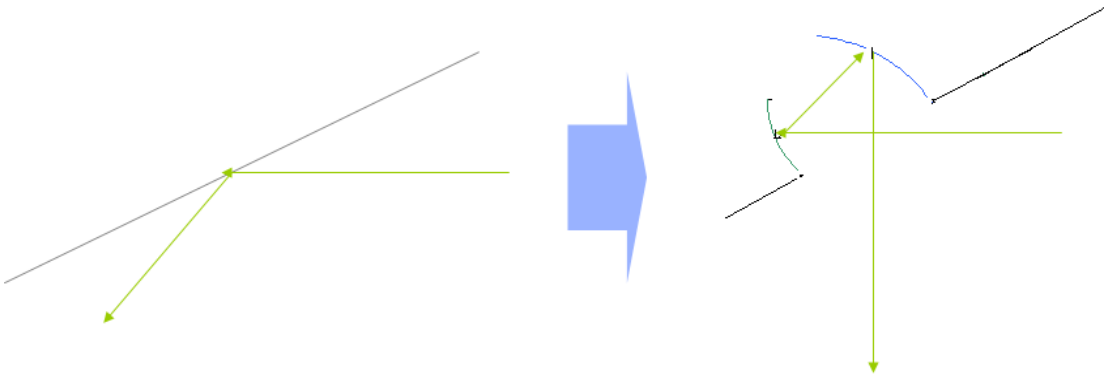
In the view of higher Functional Requirements, it is possible to generate question "how to reflect light to the orthogonal direction keeping small thickness of Backlight Unit."

One function can be divided into 2 functions which is identical.

horizontal input light → vertical output light (1 function)

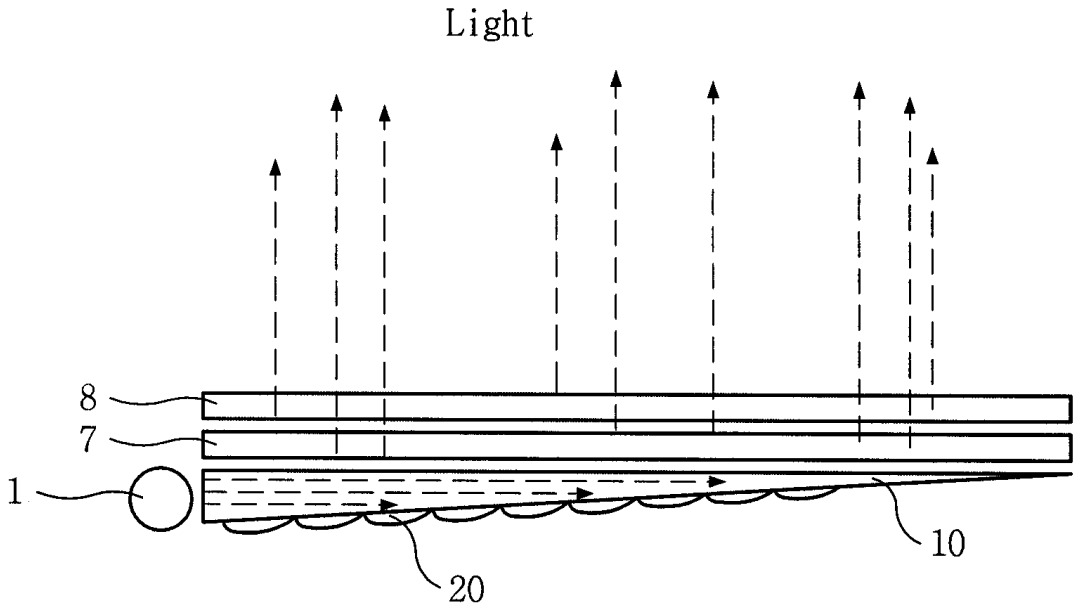
= horizontal input light → Alpha-direction light → vertical output light (2 functions)

Fig. 4 Multi-Reflection Mirror



The new concept is developed. The light does not reflect to the direction of Screen. It moves backwards and reflects again to the Screen.

Fig. 5 MULTI-REFLECTING BACKLIGHT UNIT (Whole Part)




Originally all the TRIZ tools were applied to the problems derived function modeling. It didn't find this problem because it works very well as designed in the original system.

Function Tree is not only a modeling of technical system but also designer's thinking. Every system has its own philosophy and meaning behind the function. This modeling provides chance of reformulation of system.

From 1999, this theory has been studied in LG-Cable, Hyundai Motors, and POSCO. Also it was applied to various projects as Optical Fiber, Automobile Suspension, and also eco-design areas.

Concept generation is one of the most important parts of engineering system improvement. For concept generation, many tools are developed in TRIZ but for modeling of future system, many TRIZ experts and Masters try to develop new one.

Function Tree can help engineer to develop new system from scratch (function can be benchmarked from other system) and dramatically change conventional system

because it provide problems from other point of view (not present system but super/sub system)

Function Tree can overview the system more intuitively because it starts from very few functional requirements (Function Module) and also can rank the function more effectively. From the overview, it is possible to investigate the development of function tree of the system. (Components are changed very rapidly but functions are slowly changed) Also contradiction is found easily and can be adapted to S/W industries which doesn't have any components.

With applying Function Tree, TRIZ will be effectively used to solve undiscovered problems and the area of technical forecasting part can be analyzed more systematically.

It is promising that Function Tree can contribute to TRIZ development of new product development without prototype. And it is expected more examples will be discovered in Function Tree.