CHAPTER 2

LITERATURE REVIEW

2.1 Water usage in metropolitan area

On year 1998 the people who use water in metropolitan area is 7,381,779 person and the average water usage of metropolitan area is 366.66 litre / person / day (Metropolitan Waterworks Authority, 1998)

2.2 Product design and development process

Ullman, 1997 discover mechanical design process to diagram show in appendix A. The boxes in diagram show task of product development team, line and arrow show direction of process. This show many of iteration loop and terminate point.

Ulrich and Eppinger, 1995 divided product development process to five phase: Concept development, System-Level Design, Detail Design, Testing and Refinement and Production Ramp-Up. On each phase include marketing, design, and manufacturing aspects.

The design specification checklist and example of design specification sheets to identify the change in design process and help to set milestone in design process is a useful tool in design process. It is need to consider the design specification checklist to make sure that all the aspect of design specification meet the customer requirement (Oakley, 1990)

According to Ulrich and Eppinger, 1995 they proposed five procedure model for generating product concept.

1. Clarify the problem: Understand the problem or sub problem
2. Search externally: Gather information from user or external source.
3. Search internally: Gather information from specific team.
4. Explore systematically: Use classification trees to combine and organize the thinking of team.
5. Reflect on the solutions and the process: Identify opportunities for improvement.

2.3 Quality Function Deployment (QFD)

QFD method was developed in Japan in the mid-1970s in order to reduce time (mean cost) of product development and launching product. (Ullman, 1997) listed important points of QFD method below.

1. Even design team well understands a design problem, they still need to apply QFD method for all original design or redesign product. In order to know what does not know about the problem.
2. The measurable design targets for identified critical parametres is need to know and clear understand which it can be translated from customers' requirement.
3. Whatever entire problem or any sub problem can apply QFD method.
4. The limitation of human thinking many aspect of what needs to be designed and how the design will look and work in the same time. QFD method helps overcome this limitation.
5 Even QFD takes more time to complete but it will save more time in later

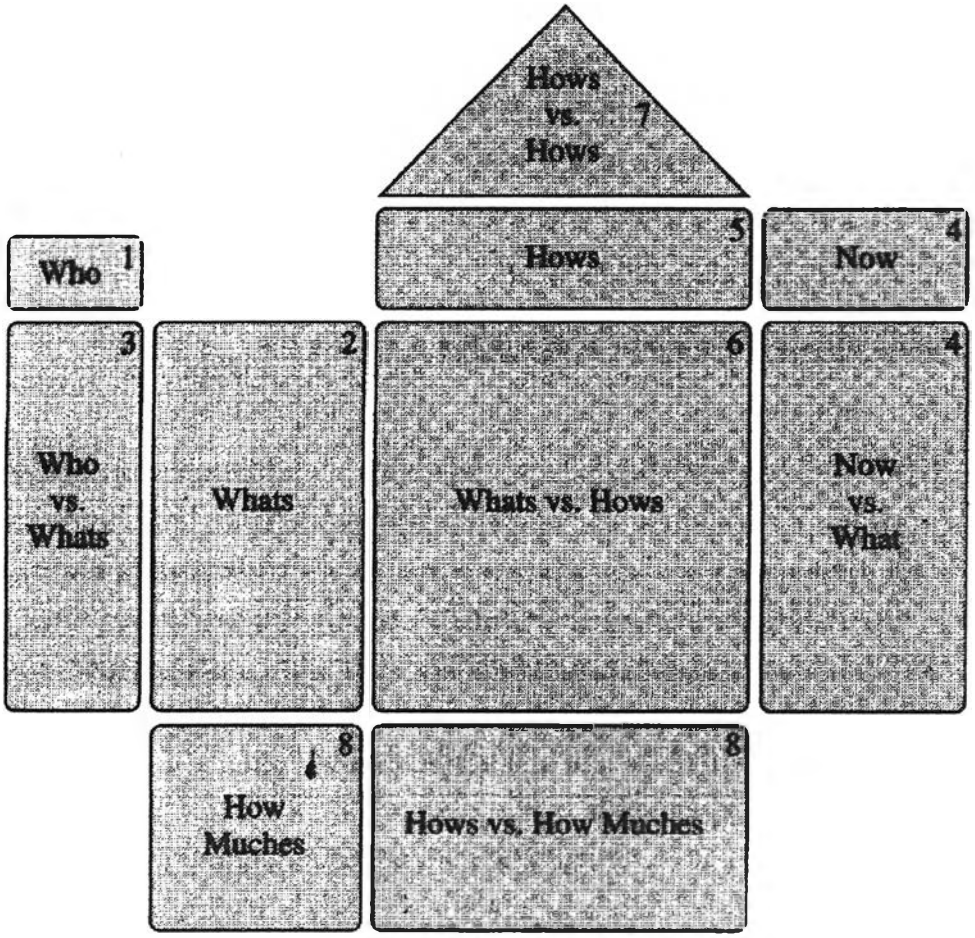

Figure 2.1 The QFD diagram

Baxter, 1995 used QFD method in translation between customers' requirement and engineering specification to balance utility, accuracy and fidelity. He suggested that not only in product planning stages. QFD techniques can be used at many levels of the organization, from high level strategic planning to component design. QFD can be used throughout the design process show in figure 2.2.

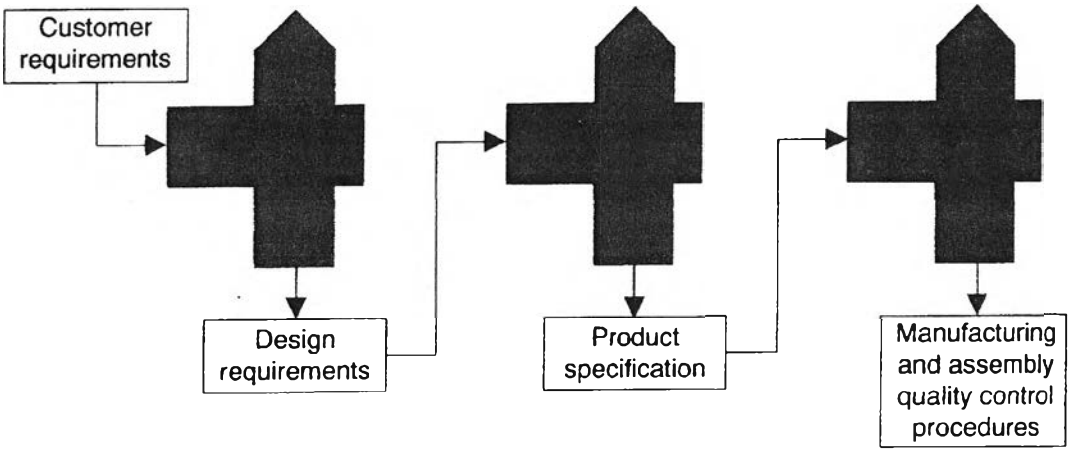

Figure 2.2 QFD diagram in product development process

Brief QFD method describe below.

1. Create matrix, show in figure 2.1, and explore who is the customer
2. Fill in the things the customer need in "What's" block
3. Fill in technical design requirement in "How's" block
4. Fill in score in "What's vs. How's" block this is relationships between customer requirements and technical parameters.
5. Prioritize the score in "How's vs. How's Much's" block
6. Benchmarking with competitive product in "Now vs. What" block
7. Ranking relative important on each engineering specification

2.4 Concept generation

According to Ullman, 1997 he suggested two method of generate product concept

1. Functional decomposition
2. Generating concepts from functions

Functional decomposition technique will break down the needed function of product as finely as possible. Because the functions of product describe what the product must do and how the product will do in characteristic of form or structure. The function must be correct in a logical order. The functions associated with the flow of energy which can be classified its type and action in system.

Generating concepts from functions is listing concepts for each function to helps generate ideas. There are two steps to generate concepts from functions.

1. Developing concepts from each function by generate as many concepts as possible for each of the functions identified in the decomposition and list them in table.
2. Combining concepts from list of concepts from step 1 to complete conceptual designs.

Develop's team can be use patents, existing products and concepts as idea sources. Using patents as idea source quite difficult in searching. The Classification and Search Support Information System (CASSIS) , a computer index to the patent numbers, can help to find the classification numbers for a specific area of interest and search for all patens issued under these numbers.

2.5 Prototype development

Product prototype will use for learning, communication, integration and milestones. The answer will be discover when develop prototype. Two frequency ask questions is "Will it work?" and "How well does it meet the customer needs?" Geometric model on computer or physical prototype can be use for testing. (Ulrich and Eppinger, 1995) He also classified two dimensions of prototype, physical and analytical, in product development process.

Physical prototypes are tangible artifacts created to approximate the product.

Analytical prototypes represent the product in a non tangible, usually mathematical, manner.

Ullman, 1997 suggested development team use physical prototypes for proof-of-concept, support evaluation by demonstrating the product characteristic, behavior and function. Figure 2.3 show design evaluation cycles between using physical prototype and analytical prototype.

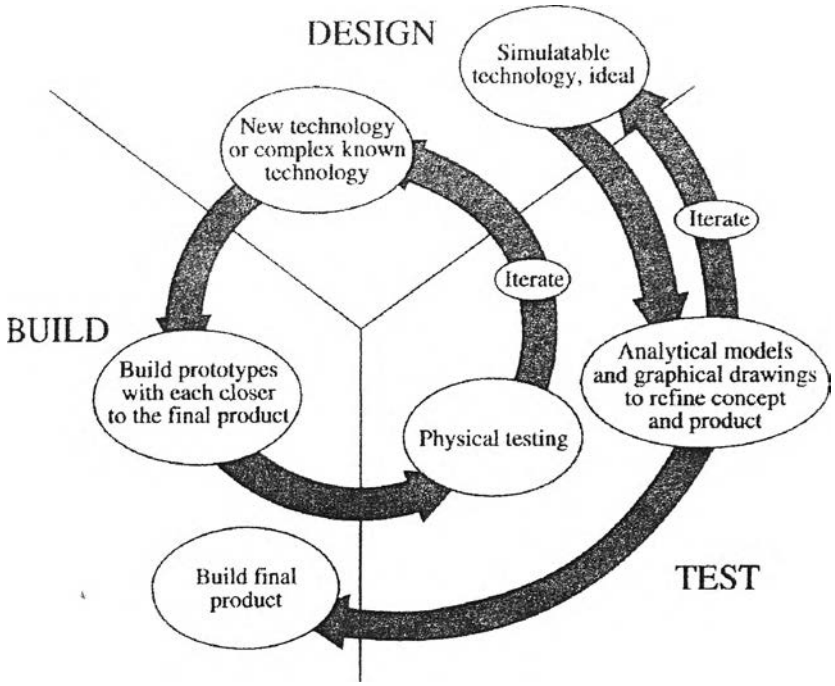

Figure 2.3 Analytical model and physical model prototype cycle

Accourding to Garbutt, 1989 the prototype which is develop by project team should follow this guide.

1. Prototype contains, for customers, the key features stated in the specification
2. Prototype give safe and satisfactory performance under normal operating conditions,
3. Prototype meets the cost target.

   Development of successful prototypes may take months, for consumer goods, or even years, for some industrial products such as aircraft.

During the development of a product a great many factors should be taken into account. The success of a new product depends on the level in which meet the demands of users, market, production and profitability (Roozenburg, 1995).

2.5 Volumetric faucet working principle relate

The research on volumetric valve and basic feasibility of volumetric valve development. Average testing information of torque using in open/close ball valve is 0.238 newton-metre. Some problem recommendation on first prototype and many types of sample ratchet design such as: external ratchet, U-shaped pawl, double-acting rotary ratchet, internal ratchet, friction ratchet, sheet-metal ratchet and pawl, jack and ratchet wrench can be uses as reference in design and build prototype (Chonwilai, 1995).

Fill valve is utilizing valve that can apply to many application to control fluid. Mostly use in washing machine for open and close water valve. The working principle of fill valve use water pressure to control itself only little force use for switch to open or close status. (Jeerapol, 1992)

There are two main utilities of volumetric faucet. First, water saving because volumetric faucet reduce water tank over filled. Secondly, volumetric faucet can be develop to bath faucet for hotel industry, control warm water in bath with volume (Chonwilai, 1995)