

Product Innovation Management: A Case Study of New Product Development from Concept Design to Mass Production

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Abstract. Taiwanese enterprises need to uplift from OEM to ODM to their own brands, if they want to survive and create the second economic miracle. This study deals with a case study of new product development with an aim to reduce the gap between concept design and mass production. The design and development of a racing bike and a city bike is used to clarify the knowledge gap between concept design and mass production. The problems from concept design to mass production are discussed and suggestions for the management of product innovation from concept design to mass production are offered.

Keywords: Innovation Management, Product Design and Development, Concept Design, New Product Development (NPD).

1. Motivation of Study

Because the present whole world economy is not booming nowadays, it is necessary for Taiwanese enterprises to uplift from OEM (Original Equipment Manufacturer) to ODM(Original Design Manufacturer) to their own brands if they want to survive and create the second economic miracle. In addition to the core ability and consumer agreement in an enterprise, the value of a brand lies in the consumer's experience of the brand from the viewpoint of experiential economy (Yoo & Donthu, 2000). According to Tim Brown (2009), the consumer's experience of a brand comes from the manipulation of service design. Therefore, develop a brand from design service is a key to the development of enterprise's brand. Moreover, the implementation ability in innovation of designers is indispensable in the development of branding in an enterprise.

In Taiwan, there are more than 3000 students graduated from the college with their major related to design and enter the work place. However, the industry does not like to hire them mainly because their works are often not feasible for prototyping or mass production even though they may be creative and look fancy. The gap between creative design and mass production is that the design education at school only focuses on the abilities of design thinking, aesthetics, creativity, form development for designers but lacks the knowledge from concept design to mass production. The result is that the new designers do not understand the manufacturing procedure, production model, and industrial ecology, leading to the difference between creative design and mass production and the gap in innovation management in enterprises.

2. Purpose of Study

The authors attempt to clarify the knowledge gap between concept design and mass production and to discover the knowledge and techniques needed in the procedure. A model from concept design to mass production is proposed to help enterprises and young designers reduce the gap between concept design and mass production. It will also fill the gap in product innovation in enterprises. The purpose of this study is listed below:

- To find the problems from concept design to mass production using the bike innovation as an example.
- To clarify the procedure from concept design to mass production.

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- To offer suggestions for the management of product innovation from concept design to mass production.

3. Methods

In this study, a case study is used to explore the problems designers and clients may have from concept design to mass production. By data collection and comparative analysis, it is hoped to figure out the knowledge and techniques needed from during the procedure. It's a kind of logical thinking by which designers can look for the solution.

The bike design project is sponsored by YOUN LIVE INDUSTRY CO., LTD, an OEM-oriented company in Taiwan that manufacture bike parts. In this project, Arthink design was commissioned to work out two innovative bikes, a racing bike and a city bike for the 2013 taipeicycle show. The research is conducted by an action study focusing on the design and development procedure.

4. The Design and Development Process

From documents of meetings in the design project, knowledge and techniques necessary in the design and development is recorded and analysed. From the beginning, the client's demands were discussed and decided by two parties. Then Arthink design processed the design and development procedure from concept design to mass production.

4.1. Clarify the Clients Demands

From the project briefing to later meetings, the design specifications of two bikes were discussed. Generally, the demands of the racing and city bikes should reach the following objectives according to the group discussion:

- The bike frame should be innovative
- The bike should have special features
- The bike should be environmental friendly
- The bike should meet ergonomics requirements
- The bike should be flexible in size
- The bike should look fancy, with artistic paint if possible
- It should fit other accessories
- The target market is set to be Germany, Britain, France, Italy, Netherlands and other countries in Europe.

4.2. The Innovative Product Developing Process of the Design Company

The following is Arthink design's innovative product developing process and what they had done in working out the racing and city bikes.

- **Transform client's demands into design specifications**

The design specifications are based on European market specs: innovative frame shape, environmental friendly, ergonomics, flexible size, special paint design, bicycle accessories design, anti-burglar design. Two series of bikes, "Poseidon" and "Mars" based on Roman mythology, were proposed.

- **Innovative concept sketches**

The design of sketch is based on Roman mythology. The target customers of "Poseidon" (Fig. 1) are those who like racing bikes. The design is focused on streamline and sense of speed. The target customers of "Mars" (Fig.2) are those who like urban recreational bikes. The design is focused on comfortable and distinctive features.



Fig. 1: Poseidon's sketch



Fig.2: Mars' sketch

- **Body frame design**

The 3D modelings (Fig. 3 & Fig. 4) were made and refined based on concept sketch. Though they looked fancy, there were still many problems to solve.



Fig. 3: Poseidon's 3D modeling



Fig. 4: Mars' 3D modeling

- **Engineering drawings for manufacturing (Fig. 5 & Fig. 6)**

The first engineering drawings of "Poseidon" and "Mars" by Arthink design's designer were illustrated in Fig 5 and Fig 6. There existed many problems in the marking of dimensions.

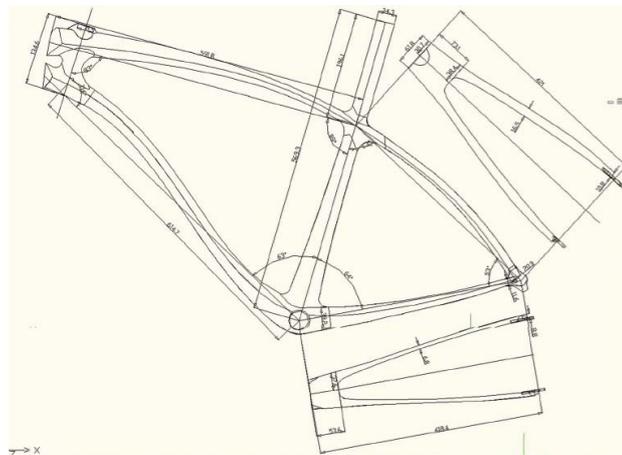


Fig. 5: Poseidon's engineering drawing

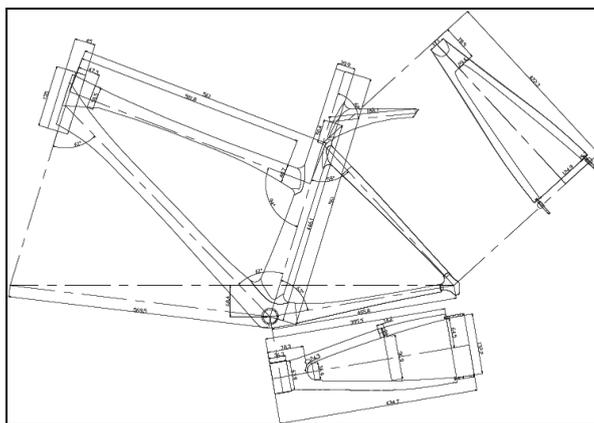


Fig. 6: Mars' engineering drawing

- **Patents results**

Bikes are often stolen in big cities and it is of no exception in European market. To cope with this problem, an anti-burglar design with App software was proposed. Moreover, instead of placing the head light on the handle bar, a headlight integrated with the fork had been worked out and applied for patents in most countries.



Fig. 7: the integral design of fork and headlight

4.3. From Concept Design to the Mass Production

- **Prototyping**

In the “Poseidon’s” design, the free-form surfaces and the creative fork were made from the current bike frame for prototyping. (Fig. 8) In the “Mars” design, it is made by similar aluminum frame tubes for prototyping because it is similar to the normal bike. Moreover, it is designed for the majestic and noble styles. (Fig. 9)

- **Mass production and planning**

A disassembly was conducted according to the prototype. Then the assembly sequencing schedule was determined for the mass production.

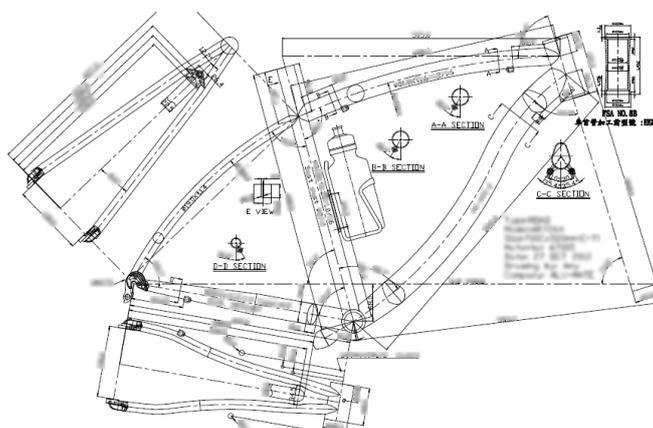


Fig. 8: Poseidon's revised engineering drawing

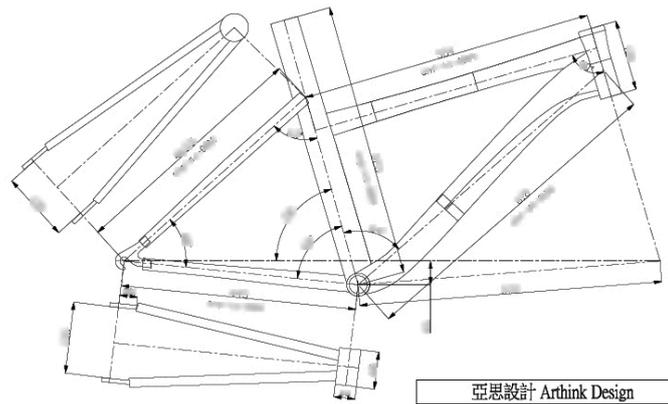


Fig. 9: Mars' revised engineering drawing

5. Problems Encountered in the Procedure

In the innovative product development of bikes, the client was limited in their ability because they are primarily an OEM manufacturer. They only had experience of assembly and mass production but didn't have any experience in new product development. On the other hand, the design company didn't have experience regarding bicycle development. In this situation, many problems were found:

- In the beginning they didn't define the material and the restrictions of bike frame, resulting in too many fancy free-form curves that were infeasible for manufacturing
- There were problems during the transformation of concept design and engineering drawings, including the dimension setting and marking. This caused the repetitive cycles for the refining of the engineering drawings and the delay in schedule
- Y.L. industry and Arthink design have the different opinions of creative design, leading to the different viewpoints in the deployment of the scope of patents.
- In the process of concept design to the mass production, the prototyping and manufacturing scheduling are the most important stages to reduce the gap between client's practical experience and designer's concept design. A smooth communication will help finish the project successfully

6. Conclusions

In the case study, the design and development of racing and city bikes were addressed. Many problems had been found during the cooperation between enterprises and design houses. In this case, Y.L. industry should define the design specifications, for example: part size, diameter size, bike's geometric restrictions, and material restrictions. In this way, Arthink design could design bicycles following the rules and reduce the number of repetitive refining. This will enhance the efficiency.

How to cultivate the designers' knowledge and design skills from design concept to the manufacturing is an important issue we cannot overemphasize. In Taiwan, the bicycle industry is a mature industry and there are many complete specifications for dimensions and geometrical specifications available in the market place. We need to know this kind of knowledge and industrial status. Reading the DM of bike industry can help designers understand obtain a rough idea of the current situation in industry.

At last, it is another issue for us to consider how to organize the design course that will reinforce the student's skills and concepts for the manufacturing of their ideas. It is very difficult and time-consuming to cultivate such kind of teaching staff. Currently, it is the most important part in the industry and the educational field. For example, the practicums in different industries and encouraging students to join a project will help students realize the situation of industry and get familiar with the practical procedure in new product design and development.

The study focuses only on the procedure from Design Concept to Manufacturing Prototyping for the check of function and details in manufacturing. In the future, many parts regarding the transformation of mass production and mechanical design are needed.

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