COMPETITIVE PRODUCT DESIGN AND INNOVATION STRATEGY: A CASE STUDY

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ABSTRACT

The advantages of Taiwan computer and consumer electronic products are their modern appearance, diverse functions, and excellent quality. This case study of Taiwan enterprises that produce computer and consumer electronic products first explored the effective product innovation strategies used by these enterprises to cope with competition in the global market so as to build up a market advantage. Product design strategies were then compared in companies with different innovation strategies. Finally, a mapping model for product innovation and product design strategies was proposed for use by Taiwan enterprises in the computer and consumer electronics industries.

A questionnaire survey and case studies showed that innovation strategies applied in the Taiwan computer and electronics industry can be classified as Aggressive innovation type, Market innovation type, Technical innovation type, and Opportunity innovation type. These four innovation strategies and ways of product design are closely related to the scale, business type and product development conditions in enterprises. Notably, different innovation strategies have different approaches to product design. Generally, product design emphasizes "new experience" in aggressive innovation enterprises, "new value" in market innovation enterprises, "new service" in technical innovation enterprises, and "new positioning" in opportunity innovation enterprises.

The findings of this study provide a reference for product R&D and design in enterprises.

INTRODUCTION

Taiwan computer and consumer electronic products are noted for their modern appearance, diverse functions, and excellent quality. Globally recognized brands include ACER, ASUS, Benq, and hTC. However, the 2009 financial crisis had a great impact on enterprises in Taiwan and in many other countries. Therefore, R&D and product designers in these enterprises must continuously address the challenges of the changing marketing environment in order to maintain competitiveness. Moreover, they must complete new product development according to the goals set in the innovation strategy (Cooper and Kleinschmidt, 1987; Souder and Song, 1997; Ulrich and Person, 1998; Ravi, 2007; Philippe et al., 2007).

According to Hamel (2001), innovation has a large and long lasting effect on the survivability of an enterprise. For an enterprise, constant product innovation and design and successful new products provide the motivation needed to ensure the growth of business in the enterprise (Baxter, 1995; Koen and Geert, 2007). Particularly, during an economic depression, the rapid launching of new products into the market can help an enterprise maintain profitability; in many cases, it may even help an enterprise to turn a failure to success (Ulrich and Eppinger, 2004; Booz, Allen and Hamilton, 1982; Pugh, 1991; Christoph, 2007).

In 2006, Business Week published a list of the 100 most innovative companies in the world. These companies had creative ideas and provided new values in their products, user interfaces, and total services (McGregor, 2006). Case studies of enterprise innovation also show that effective execution of product innovation or service development is not only a lifeline to the survival of an enterprise but also an important motivation for maintaining competitiveness (Driva, 1997; Pawer and Driva, 1999; Mozota, 2005; 2006; Jamie and Costas, 2007).

During implementation of product innovation, close coordination among different layers of a strategic hierarchy is essential for achieving the overall enterprise strategy (Silbiger, 1993; Marxt and Hacklin, 2005; Mozota, 2005; Damanpour and Daniel Wischnievsky, 2006; Renee et al. (2007). Moreover, based on the goals set in the innovation strategy, an enterprise must integrate its innovation resources and perform new product design and development through practical design activities that are well coordinated among all divisions of the organization (Sung and Peter, 2002; Mozota, 2006; Claudio and Roberto,
Therefore, researchers have intensively studied how enterprises can enhance new product development by effectively integrating innovation (Carlsson, 1991; Griffin and Hauser, 1996; Gupta et al., 1985; Ruekert and Walker, 1987; Pinto et al., 1993; Rusinko, 1997; Song et al., 1997; Olson, 1994; Sobek et al., 1998; Handfield et al., 1999; Andi and Minato, 2003; Hsu, 2006). Many scholars also claim that integrated product design procedures can enhance performance in new product development (Carlsson, 1991; Griffin and Hauser, 1996; Gupta et al., 1985; Ruekert and Walker, 1987; Pinto et al., 1993; Rusinko, 1997; Song et al., 1997; Olson, 1994; Sobek et al., 1998).

In contrast, many studies assert that design can be an important integral resource in an enterprise and an important mechanism for integrating product development functions in the serial integral value chain of an enterprise (Baxter, 1995; Olin, 1990; Fujimoto, 1991; Bruce and Jevanker, 1998; Clark and Guy, 1998; Twigg, 1997; 1998). Additionally, Chang and Hsu (2004) and Hsu (2006) showed that Taiwan enterprises apply unique design strategies and ways of implementing product design. However, integration of innovation strategy and product design in enterprises is rarely studied, and collocations of cases of innovation and design strategies in the industry are limited.

Therefore, this study explored the association between innovation strategy and product design strategy in Taiwan computer and consumer electronics enterprises. Managers of computer and consumer electronics manufacturing firms were interviewed to achieve the following goals:

1. To explore the current status of innovation strategy execution in the Taiwan computer and consumer electronics industry;
2. To compare the innovation and design strategies applied in these enterprises;
3. To propose a conceptual model for mapping product innovation and design strategies in the Taiwan computer and consumer electronic industry.

2. LITERATURE REVIEW

2.1 Innovation strategy

Innovation strategy refers to the capability of an enterprise to build an environment that supports innovation and enables it to distinguish itself from competitors based on the unique products or services it can offer to customers (Schuler and Jackson, 1987). An enterprise can use its resources and technology in different combinations so as to create different innovation strategies, from which it can obtain, develop, and apply innovation to achieve its policies and to enhance its performance (Adler, 1989; Gilbert, 1994; Dziura, 2001). In accordance with the literature, this study divides innovation strategies into three categories:

1. An innovation strategy is classified as a technology innovation strategy if the ratio of R&D spending to total revenue exceeds that of the other companies in the same trade (Kuczmarski, 1996). Moreover, companies that apply a technology innovation strategy aggressively protect their trade marks, royalties, and patent rights (Dziura, 2001); they often introduce new technology to improve products or manufacturing procedures (Kuczmarski, 1996; Ulrich and Eppinger, 2004); and they constantly improve their production procedure and efficiency to achieve the enterprise goals (Gobeli and Brown, 1994).

2. An innovation strategy is classified as a product innovation strategy if enterprises can offer innovative products or services (Johne, 1999), redesign or improve current products, extend current product lines or add new product lines to launch unique products (Kuczmarski, 1992; Yoon and Lilien, 1985). More importantly, Products designed using these strategies are highly compatible with customer usage and consumption patterns (Atuahene, 1996).

3. Innovation strategies in management are strategies used by an enterprise to adapt to environmental change, build and manage marketing channels (Chackey, 1988; Johne, 1999), effectively solve customer complaints (Johne, 1999). They also aggressively adopt methods of enhancing organization performance such as encouraging employees to innovate by providing a good salary or employee benefits (Subramanian and Nilakanta, 1996; Higgins, 1995), or by using performance evaluations to assess innovation outcomes achieved by the R&D department (Gilbert, 1994).

Table 1 shows the ideas or theories from Schumpeter (1934), Porter (1990), Kuczmarski (1992), Subramanian and Nilakanta (1996), Chackey (1988), Johne (1999), Dziura (2001), and Ulrich and Eppinger (2004), which this study used to construct variables for the measuring innovation strategy. These theories were applied to analyze the innovation strategies of enterprises based on the results of the questionnaire survey.

Table 1: Variables for measuring innovation strategies in enterprises

<table>
<thead>
<tr>
<th>Dimensions in strategy</th>
<th>Variables to measure</th>
<th>Related literature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical innovation</td>
<td>The ratio of the amount of expense an enterprise spends on R&amp;D over the total revenue is higher than that of the other companies in the same trade</td>
<td>Schumpeter (1934)</td>
</tr>
<tr>
<td></td>
<td>Have a proper management system for the intelligent copyright</td>
<td>Johnson and Jane (1957)</td>
</tr>
<tr>
<td></td>
<td>Aggressive in patent application</td>
<td>Chackey (1988)</td>
</tr>
<tr>
<td></td>
<td>Hold sufficient key technology and patents</td>
<td>Porter (1990)</td>
</tr>
<tr>
<td></td>
<td>The number of R&amp;D personnel increased in the past three years</td>
<td>Gobeli and Brown (1994)</td>
</tr>
<tr>
<td></td>
<td>Be able to improve R&amp;D procedure to achieve the company's goal efficiently</td>
<td>Zahr (1996)</td>
</tr>
<tr>
<td></td>
<td>Be able to produce and ship commodities quickly and flexibly according to the temporary demands of the client</td>
<td>Kuczmarski (1996)</td>
</tr>
<tr>
<td></td>
<td>Introduce new technology to improve manufacturing process</td>
<td>Zahra and Bogner (1999)</td>
</tr>
<tr>
<td></td>
<td>Faster in commercializing the new technology in industry</td>
<td>Dziura (2001)</td>
</tr>
<tr>
<td></td>
<td>Be able to launch totally new products to the market quickly</td>
<td>Christensen and Raynor (2003)</td>
</tr>
<tr>
<td></td>
<td>Possess unique and highly innovative new products</td>
<td>Booz, Allen and Hamilton (1982)</td>
</tr>
<tr>
<td></td>
<td>Be able to extend current product lines</td>
<td>Yoon and Lilien (1985)</td>
</tr>
<tr>
<td></td>
<td>New products or services offered can more satisfy the customer's needs than the competitors</td>
<td>Tushman and Nadler (1985)</td>
</tr>
<tr>
<td></td>
<td>Fast in redesigning current products and uplifting product quality</td>
<td>Gobeli and Brown (1987)</td>
</tr>
<tr>
<td></td>
<td>Being the leader in the new product market</td>
<td>Holt (1988)</td>
</tr>
<tr>
<td></td>
<td>New product or technology launched is often copied by the competitors</td>
<td>Kuczmarski (1992)</td>
</tr>
<tr>
<td></td>
<td>Be able to effectively evaluate the R&amp;D personnel's innovation output</td>
<td>Atuahene-Opoku (1996)</td>
</tr>
<tr>
<td></td>
<td>Possess customer complaint disposal system to solve the customer's complaints effectively</td>
<td>Hill and Jones (1998)</td>
</tr>
<tr>
<td></td>
<td>Adopt suitable innovation strategies to cope with change in the outer environment</td>
<td>Ulrich and Eppinger (2004)</td>
</tr>
<tr>
<td>Product innovation</td>
<td>Be able to effectively evaluate the R&amp;D personnel's innovation output</td>
<td>Kobreg et. al. (2003)</td>
</tr>
<tr>
<td>Managerial innovation</td>
<td>Be able to effectively evaluate the R&amp;D personnel's innovation output</td>
<td>Subramanian and Nilakanta (1996)</td>
</tr>
<tr>
<td></td>
<td>Adopt salary, prize, and welfare systems that can encourage employees to innovate</td>
<td>Chackey (1988)</td>
</tr>
<tr>
<td></td>
<td>Possess customer complaint disposal system to solve the customer's complaints effectively</td>
<td>Johne (1999)</td>
</tr>
</tbody>
</table>
2.2 Product design strategy

Product design strategy refers to how a new product strategy affects the way a company processes its new product design (Crawford, 1994). Olson et al. (1998) considered product design strategy an effective way to achieve organizational objectives by efficiently allocating and coordinating design resources. In light of this, Oakley (1990) claimed that design strategy and enterprise policy are mutually dependent. Based on the three fundamental strategies included in the Porter competition strategy (Porter, 1980), Mozota (1990) described goals for design strategy, including design for cost, design for image, and design for focus.

In contrast, a study of successful cases by Kelly (1992) proposed the strategic palette concept of analyzing design strategy in terms of twelve strategic factors. Song and You (1999) further argued that design strategy is a practical response to the innovation activities of an organization. Based on the strategic factors suggested by Kelley (1992), Song and You (1999) proposed ten product design innovation factors but went a step further by defining product design strategy as a policy based on a series of related strategic properties and established to achieve the innovation goal of an enterprise and to help it achieve a competitive advantage by providing a unique design.

Based on the above concepts, a design strategy can be considered an approach to achieving the goal of product innovation in an enterprise. To achieve its performance goals, an enterprise must analyze customer needs and the influences of competitors and must efficiently apply its core R&D capability through its design team (Hsu, 2006). Taiwan computer and consumer electronic products boast modern product form, innovative functions and outstanding quality and have introduced many famous products and brands in the global market. Based on the concepts of product design strategic factors discussed in Song and You (1999) and in Hsu (2006), the author explored how product design benefits companies in the Taiwan computer and consumer electronic industry by helping to implement the innovation strategies needed to achieve their goals in the product market and to maintain an advantage in new product development.

3. METHODOLOGY

The two stages of this study were a questionnaire survey and case studies.

(1) Stage 1: A questionnaire survey was performed to explore the innovation strategies used by companies in the Taiwan computer and consumer electronic industry. At this stage, literature review and questionnaire surveys were performed. The purpose of the literature review was to understand the meaning and content of innovation strategy. Table 1 shows the dimensions and variables used to design the questionnaire for measuring innovation strategy. The subject pool included 1000 product development departments of electronic and computer companies in the industry database. Thirty of these companies were chosen for a pilot test, the results of which were then used to refine the questionnaire survey. After initial contact and follow-ups, 284 questionnaires (28.4% of the total distributed) were collected for data logging.

The principal component analysis method of factor analysis was used to define the major dimensions of innovation strategy based on the data obtained for enterprises in the Taiwan computer and consumer electronic industry. Cluster analysis of factor scores for 284 enterprises then revealed four major innovation strategies. Among these enterprises, Table 2 shows that 65 were Aggressive innovation type; 58 were Market innovation type; 79 were Technical innovation type and 82 were Opportunity innovation type.

<table>
<thead>
<tr>
<th>Types of innovation strategy</th>
<th>Aggressive</th>
<th>Market</th>
<th>Technical</th>
<th>Opportunity</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of enterprise</td>
<td>65</td>
<td>58</td>
<td>79</td>
<td>82</td>
<td>284</td>
</tr>
<tr>
<td>Percentage (%)</td>
<td>22.89</td>
<td>20.42</td>
<td>27.82</td>
<td>28.87</td>
<td>100</td>
</tr>
</tbody>
</table>

(2) Stage 2: Design and R&D managers were interviewed to explore the practical design strategies and approaches to product design in the industry.

Subjects: Three companies were randomly selected for each innovation strategy specified in Stage 1. Totally, twelve product R&D managers or creative directors were interviewed. Table 3 list the titles and departments of the interviewees and their major products.

Survey questions: A semi-structured questionnaire was used to prepare for the questions discussed in the interview. The content of the survey included the innovation and R&D organization, impacts on product designs of market competitors, advantages and policy for responding to market competition, methods of coordinating R&D divisions, and strategies and ways of implementing R&D innovation and product design.

Interview procedure: Each enterprise selected for interview was called in advance to make an appointment and to ensure that the interviewee clearly understood the purpose of the interview. All interviewees completed their interviews, and all provided the requested data.

Data analysis of the interview data: The recording data and notes gathered from the interview were converted to text. The content of the product innovation strategy was also analyzed and integrated according to the basic data and innovation strategies observed in these enterprises. Table 4 compares the status and scale of enterprises for each innovation strategy.

Table 3: Department, title, and major products of the interviewees
### Table 4: Status and scale of enterprises classified by innovation strategy

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Acer</td>
<td>1976</td>
<td>100/0%</td>
<td>1520.0</td>
<td>8,500</td>
</tr>
<tr>
<td>Asus</td>
<td>1980</td>
<td>100/0%</td>
<td>1400.0</td>
<td>12,000</td>
</tr>
<tr>
<td>Benq</td>
<td>1984</td>
<td>90/10%</td>
<td>1250.0</td>
<td>20,000</td>
</tr>
<tr>
<td>Genius</td>
<td>1983</td>
<td>65/35%</td>
<td>620.0</td>
<td>4,600</td>
</tr>
<tr>
<td>MSI</td>
<td>1986</td>
<td>15/75%</td>
<td>900.5</td>
<td>15,500</td>
</tr>
<tr>
<td>Wistron</td>
<td>2001</td>
<td>1/0%</td>
<td>500.0</td>
<td>4,000</td>
</tr>
<tr>
<td>Compal</td>
<td>1984</td>
<td>0/90%</td>
<td>1284.5</td>
<td>25,000</td>
</tr>
<tr>
<td>Moshi</td>
<td>2004</td>
<td>10/90%</td>
<td>200.5</td>
<td>150</td>
</tr>
<tr>
<td>PQI</td>
<td>1997</td>
<td>30/30%</td>
<td>500.5</td>
<td>800</td>
</tr>
<tr>
<td>Melioon</td>
<td>1997</td>
<td>10/30%</td>
<td>120.5</td>
<td>400</td>
</tr>
<tr>
<td>Pegatron</td>
<td>2007</td>
<td>40/40%</td>
<td>520.0</td>
<td>900</td>
</tr>
<tr>
<td>Toongin</td>
<td>1979</td>
<td>35/60%</td>
<td>200.0</td>
<td>135</td>
</tr>
</tbody>
</table>

### 4. ENTERPRISE CHARACTERISTICS IN EACH INNOVATION STRATEGY TYPE

#### 4.1 Enterprises in aggressive innovation type

1. **Acer**: Acer emphasizes the B2C business type that features multiple suppliers, product lines, and channels. Their innovation strategy, which is executed by the Concept Development Section, is user-oriented and dominates the R&D and design of desktop computers, notebooks, and digital home appliances. Currently, Acer is the second largest notebook computer manufacturer (Hsu, 2009a).

2. **ASUS**: The product innovation strategy applied by ASUS emphasizes flexible product specifications, providing a good value for users, and providing good pre-sale services. Product innovation and design is executed by its Industrial Design Department. Its innovation strategy emphasizes a flexible product development procedure and a manufacturing model aimed at minimizing risk and maximizing benefit in the enterprise. In the Taiwan information industry, ASUS is currently the leading enterprise in terms of B2C business value and technology (Liao, 2009).

3. **Benq**: The innovation strategy applied by Benq combines development of core capabilities in product R&D, IT technology, and experiential marketing. They fix the position of their digital life products at innovation in order to upgrade their brand image and to achieve an integrated product line. The Digital Lifestyle Design Center integrates the design resources of Benq to encourage innovation. Their goal in the global market is to enhance “Enjoyment and Quality to Life” for computer users. (Hsu, 2009b).

#### 4.2 Market innovation enterprises

1. **Genius**: Genius is a world famous mouse and joy sticker manufacturer. At Genius, the Industrial Design department, responsible for the design and development of all products, is a core division for new product R&D. The innovation strategy of the company is expressed by the slogan “Live with Ideas”. They have also made efforts to increase added value in their products. With these concepts, they have created B2C product lines for work, amusement, music, and video commodities (Lee, 2009).

2. **Moshi**: Moshi adopts a rapid and flexible product innovation strategy. Their products are characterized by simplicity, delicacy, fashion, and hi-tech. The Industrial Design Department at Moshi is in charge of product innovation and coordinates with the marketing department (Chen, 2009b).
to launch new products and services efficiently. Its two most famous brands are Moshi and Aevoe (Wong, 2009).

3) PQI: In terms of product market share, PQI is one of ten largest memory product manufacturers in the world. Its innovation strategy is technology R&D-oriented. The company aggressively pursues innovation in products and services and has won many international design awards in recent years (Huang, 2009).

4.4 Opportunity innovation type enterprises

1) Meiloon: Meiloon is the largest ear phone and multimedia speaker manufacturer in Asia. Its innovation process OR Its innovation strategy emphasizes innovation and quality. At Meiloon, the Product R&D Department is responsible for product design and development. By providing highly differentiated B2B services and by establishing good product positioning, Meiloon has become a major supplier of multimedia products in Asia (Chou, 2009).

2) Pegatron: Pegatron provides R&D and production of many different brands of notebook computers. “Leading the technical trend in the future” is their innovation strategy. At Pegatron, the Product R&D Department is responsible for design and innovation of B2B products. By integrating Electronics Manufacturing Service (EMS) with Original Design Manufacture (ODM), Pegatron has become a leading Design and Manufacturing Service (DMS) company (Chang, 2009).

3) Toongin: Toongin designs and manufactures professional audio products. Their innovation strategy emphasizes speed and professionalism in the launch of new ear phone products into the middle and advanced B2B market with moderate prices. At Toongin, the Technical Department controls product design and mechanical development. Most of its sales are in Japanese and American markets (Hsu, 2009c).

In terms of the enterprise scale in the Taiwan computer and consumer electronics industry, enterprises with capital exceeding 1000 million US dollars are classified as large scale; those with capital between 201 and 1000 million US dollars are classified as medium scale; those with capital of 200 million US dollars or less are classified as small scale (Table 4). Table 5 compares the interviewed computer and consumer electronic enterprises in terms of enterprise scale, major business type and product development type.

Table 5: The scale, major business type, and product development type of enterprise cases

<table>
<thead>
<tr>
<th>Type</th>
<th>Enterprise scale</th>
<th>Major business type</th>
<th>Product innovation type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Big scale</td>
<td>B2C</td>
<td>Computer and peripherals</td>
</tr>
<tr>
<td></td>
<td>Medium scale</td>
<td>B2B</td>
<td>Mobile communication</td>
</tr>
<tr>
<td></td>
<td>Small scale</td>
<td></td>
<td>Consumer electronic product</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Web products</td>
</tr>
</tbody>
</table>

Notes: 0 means the type to which the enterprise belongs.

5. ANALYSIS AND DISCUSSION

Analyses of the interview results in the case studies revealed 18 product design strategies: improving product design and development procedure, enhancing product quality, including added-value in products, reducing production cost, simplifying manufacturing and maintenance, reinforcing marketing information and adaptation ability, enhancing company and brand image, reinforcing technical cooperation, improving R&D labor division in companies, developing new target markets, increasing investment in design and R&D, developing unique product form, enhancing the design image of the enterprise, increasing product diversity, designing a good man-machine interface, developing unique product functions, emphasizing social and cultural representation, and emphasizing environmental design. Table 6 lists these design strategies and enterprises that adopted them.

Table 6: Analysis of design strategies used by enterprise cases

<table>
<thead>
<tr>
<th>Design strategy</th>
<th>Enterprise case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improving product design and development procedure</td>
<td>Acer, Asus, Benc</td>
</tr>
<tr>
<td>Uplifting product quality</td>
<td>Acer, Benc, Asus</td>
</tr>
<tr>
<td>Including added-value in products</td>
<td>Compal, Moshi, PQI</td>
</tr>
<tr>
<td>Reducing product production cost</td>
<td>Meiloon, Pegatron, Toongin</td>
</tr>
<tr>
<td>Making it easy to manufacture and maintain</td>
<td>Acer, Benc, Asus</td>
</tr>
<tr>
<td>Reinforcing marketing information and adaptation ability</td>
<td>Compal, Moshi, PQI</td>
</tr>
<tr>
<td>Enhancing company and brand image</td>
<td>Acer, Benc, Asus</td>
</tr>
<tr>
<td>Reinforcing technical cooperation</td>
<td>Compal, Moshi, PQI</td>
</tr>
<tr>
<td>Improving R&amp;D labor division in companies</td>
<td>Meiloon, Pegatron, Toongin</td>
</tr>
<tr>
<td>Developing new target market place</td>
<td>Acer, Benc, Asus</td>
</tr>
<tr>
<td>Increasing the investment in design and R&amp;D</td>
<td>Compal, Moshi, PQI</td>
</tr>
<tr>
<td>Developing unique product form</td>
<td>Meiloon, Pegatron, Toongin</td>
</tr>
<tr>
<td>Uplifting design image of the enterprise</td>
<td>Acer, Benc, Asus</td>
</tr>
<tr>
<td>Adding diversity to products</td>
<td>Compal, Moshi, PQI</td>
</tr>
<tr>
<td>Designing a good man-machine interface</td>
<td>Meiloon, Pegatron, Toongin</td>
</tr>
<tr>
<td>Developing unique product functions</td>
<td>Acer, Benc, Asus</td>
</tr>
<tr>
<td>Emphasizing the social and cultural representation</td>
<td>Compal, Moshi, PQI</td>
</tr>
<tr>
<td>Emphasizing environmental design</td>
<td>Meiloon, Pegatron, Toongin</td>
</tr>
</tbody>
</table>

Notes: 0 means that the enterprise case adopts the design strategy.

Table 6 shows that enterprises are most likely to apply the following six innovation strategies: improving product design and development procedure, uplifting product quality, including added-value in products, reducing product production cost, making it easy to manufacture and maintain, and reinforcing marketing information and adaptation ability. This indicates that
Aggressive innovation strategies are most likely to develop where enterprises strive to provide their product users with new experiences. These enterprises are characterized by highly diverse design strategies (Hsu, 2009a; Liao, 2009; Hsu, 2009b). The above analysis shows that enterprises that adopt Aggressive innovation strategies are most likely to develop new product lines that are distinctive in the marketplace. They make efforts maintaining competitive product prices, flexible product price, and increase product diversity (Lee, 2009; Chen, 2009a; Cheng, 2009).

Fig. 1: Mapping of innovation strategy and product design strategy

5.1 S1: Design features in aggressive innovation enterprises

Figure 1 shows that the Aggressive innovation type enterprises in the Taiwan computer and consumer electronics industry are Acer, Benq, and ASUS.

In terms of innovation strategy, these three enterprises emphasize product R&D and technology investment. All three are market leaders and have wider product lines compared to other companies. Aggressive innovation enterprises are outstanding in applying their technical innovation ability to diversify their products and to meet consumer requirements. Moreover, the service innovation in the channel and diverse marketing promotional measures make their products highly competitive. That is, these enterprises become market leaders by emphasizing technology innovation and design. In product design, products of these three enterprises are unique in their application of new product design trends and in their constant search for new market opportunities. By providing attractive products, these enterprises tend to maintain their dominant role in the product market in their innovation strategy. They take advantage of their brand image and popularity developed over a long period, they constantly modify their sales system, and they adopt aggressive strategies to introduce innovative new products in the market. They also make efforts maintaining competitive product prices, increasing the proportion of subcontractors, and launching new market regions. More importantly, innovation strategy enterprises strive to provide their product users with new experiences. These enterprises are characterized by highly diverse design strategies (Hsu, 2009a; Liao, 2009; Hsu, 2009b).

5.2 S2: Design features in market innovation enterprises

Figure 1 shows that Market innovation type enterprises in the Taiwan computer and consumer electronics industry include Genius, MSI, and Wistron.

For innovation strategy, three enterprises in this group emphasize incremental innovation. That is, based on the observed life cycle of products in the market, they respond to the target market to reduce their production costs and extend their product lines so that they can simultaneously launch new products and expand market share.

To satisfy the needs of their target consumers, Market innovation strategy enterprises must achieve competitive advantages in product appearance, function, and price. That is, they must focus on the market resource and on the targeted user groups, product line, and regional market. They maintain product market share by responding rapidly to market changes and by setting a flexible product price.

Compared to Aggressive innovation enterprises, Market innovation enterprises have fewer product categories but more varied product specifications. Their goal is to provide a new sense of value to their consumers. Moreover, because of their centralized design resources, these enterprises are superior to their competitors in terms of efficiency, quality, speed, and profitability.

Notably, design strategies are centrally distributed in these enterprises. The product design strategies used by market innovation enterprises are intended to enhance company and brand image, develop new target markets, increase investment in design and R&D, develop unique product forms, enhance the design image of the enterprise, and increase product diversity (Lee, 2009; Chen, 2009a; Cheng, 2009).

The above analysis shows that Market innovation type enterprises tend to be medium size in terms of company scale. Their major business types are B2C and B2B2C. These enterprises also concentrate on developing products that are distinctive in the marketplace. More importantly, they are dedicated to responding to market changes efficiently and to enhancing product value to increase their profits. This innovation type falls between Aggressive innovation and Opportunity innovation. Therefore, Market innovation enterprises feature characteristics of two other enterprise types. That is, the design strategy adopted by Market innovation enterprises is "new value design".

5.3 S3: Design features in technical innovation enterprises
In terms of innovation strategy, these three enterprises emphasize new technology and new product specifications that enhance consumer perceptions of their service quality and product quality.

Enterprises that apply a technical innovation strategy aggressively design and develop new products. They stress innovation in function, texture, and machining methods and expect a customer consensus that their products and services are superior. In this way, they encourage consumers to try their new products while expanding their product lines. By doing so, enterprises with technical innovation strategy can expand market share by challenging market leaders and other competitors.

Technical innovation type enterprises mainly apply the following design innovation strategies: enhancing company and brand image, reinforcing technical cooperation, improving R&D labor division in companies, designing a good man-machine interface, and developing unique product functions (Chen, 2009b; Wong, 2009; Huang, 2009).

These three enterprises apply these strategies because they are successful in the Taiwan computer and consumer electronics industry. All are medium size enterprises in which B2B2C is the major business type. All three enterprises expect to increase their market share by providing innovative services. Practically, they first choose a specific product in the market place as the goal of technical innovation. They then use their product design proficiency to enhance their R&D efficiency. Meanwhile, they offer design, R&D and manufacturing services to their clients to enhance the competitiveness of their products. Therefore, the design strategy adopted by technical innovation enterprises is characterized by "new service design".

5.4 S4: Design features in opportunity innovation enterprises

Figure 1 shows that Opportunity innovation type enterprises in the Taiwan computer and consumer electronics industry include Melioon, Pegatron, and Toongin.

Regarding innovation strategy, these three enterprises avoid competition with market leaders. For example, they concentrate on niche products such as ear phones, LCD monitors, and speaker systems.

Enterprises of the innovation type emphasize wide variety in a single product line so as to increase added value in their products. That is, they tend to increase their product line depth. When their products achieve a market advantage, they rapidly launch new products to increase their competitiveness. All three enterprises tend to expand their channels by using the media to promote and attract dealers.

In terms of product design, the strategies applied by these enterprises emphasize social and cultural representation, environmental design, technical cooperation by division of labor in R&D, and development of new target markets (Chou, 2009; Chang, 2009; Hsu, 2009c).

All three enterprises are relatively small in terms of market share. Since their major business type is B2B, they specialize in specific products. By combining key technologies and skills with their own positioning strategies, they achieve high profits and competitive prices. Their advantage in flexible R&D enables them to increase the depth of their product lines. Moreover, since many of their products have a high wash out rate in the market, they can concentrate on those with high added values so that they can make profits quickly. Therefore, they can make profit without diverse product designs, unlike Aggressive innovation enterprises. Therefore, this design strategy can be referred to as "new positioning design".

CONCLUSIONS

Enterprises in the Taiwan computer and consumer electronic industry can be classified into four innovation types according to the strategies they use to cope with global competition: Aggressive innovation, Market innovation, Technical innovation, and Opportunity innovation. In terms of market share from largest to smallest, the order of these categories is Opportunity innovation (28.87%), Technical innovation (27.82%), Aggressive innovation (22.89%), and Market innovation (20.42%). The innovation strategies used by enterprises in the Taiwan computer and consumer electronic industry depend on their scale, business type and product category.

This study revealed 18 product design strategies and ways, including improving product design and development procedures, improving product quality (i.e., added-value), reducing production cost, simplifying manufacturing and maintenance, reinforcing marketing information and adaptation ability, enhancing company and brand image, reinforcing technical cooperation, improving R&D labor division, developing new target markets, increasing investment in design and R&D, developing a unique product form, enhancing the design image of the enterprise, increasing product diversity, designing a good man-machine interface, developing unique product functions, emphasizing the social and cultural representation, and emphasizing environmental design. All of the surveyed enterprises in the Taiwan computer and consumer electronic industry adopted six of these strategies: improving product design and development procedures, improving product quality (including added value), reducing product production cost, simplifying manufacturing and maintenance, and reinforcing marketing information and adaptation ability. These six design strategies can therefore be considered essential for a successful product in the Taiwan computer and consumer electronic industry.

Analysis of the innovation strategies and design strategies used by the surveyed enterprises in that Taiwan computer and consumer electronics industry revealed that their innovation strategies tend to be either radical or incremental and that their design strategies tend to be multiple or exquisite. These two axes can be used to map innovation strategy and design strategy.

(1) Enterprises of Aggressive innovation type feature new experience in their product design. They implement diverse design strategies, and they aggressively develop diverse new products and look for new market opportunities. They offer new products and services to attract new customers. Moreover, they develop many different innovative products. Last but not the least, the products they offer give users a totally new experience and new feelings.

(2) Market innovation enterprises create new values in their product design. They concentrate on developing distinct products in the market place. They also make
efforts to improve the efficiency of their response to market changes, and they increase profitability by adding market value. These enterprises combine the characteristics of the Aggressive innovation type and the Opportunity innovation type.

(3) Technical innovation enterprises offer new services in their product design. Their technical innovation goals are to use their advantages in product innovation and service and to choose specific products in the market. Their professional skills in product design enable highly efficient product R&D. Finally, they take advantage of the design, R&D, and manufacturing technology used by other companies in the sector to improve the competitiveness of their products and services.

(4) Opportunity innovation enterprises feature new positioning their design process. Their advantage of flexibility in product R&D enables them to increase the depth of their product lines. Their products have a short life cycle and high added-value, which enable rapid profit in the market.

In recent years, the global market of computer and consumer electronic products has been fiercely competitive. Therefore, only enterprises that can innovate, respond rapidly, and maintain advantages in product design can survive in the market. Hopefully, this case study of companies in the Taiwan computer and consumer electronic industry can provide a reference for product R&D and design.

REFERENCE

Hsu / Competitive Product Design and Innovation Strategy: A Case Study


