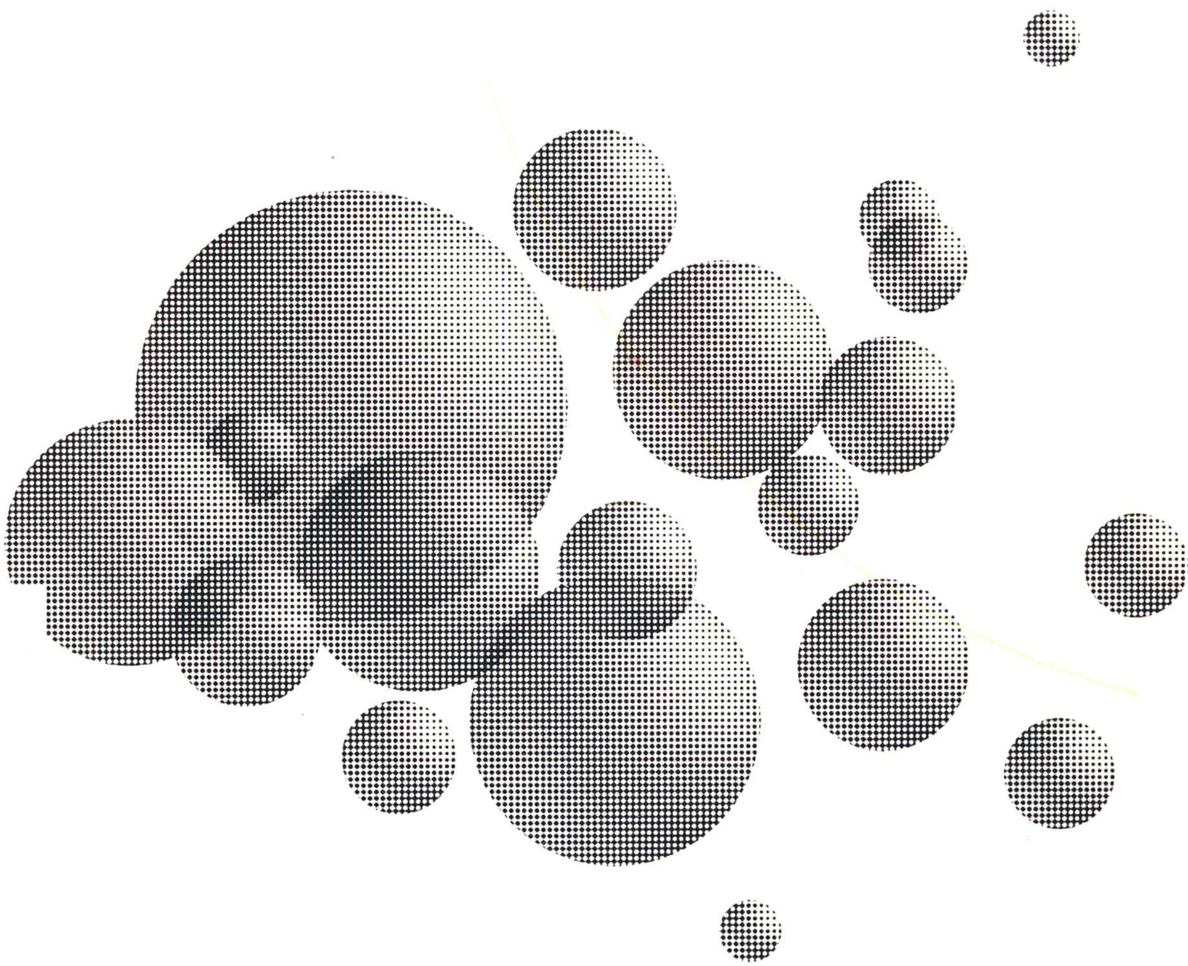
# 2001清华国际工业设计论坛 暨全国工业设计教学研讨会论文集

鲁晓波　严　扬　主编



清华大学出版

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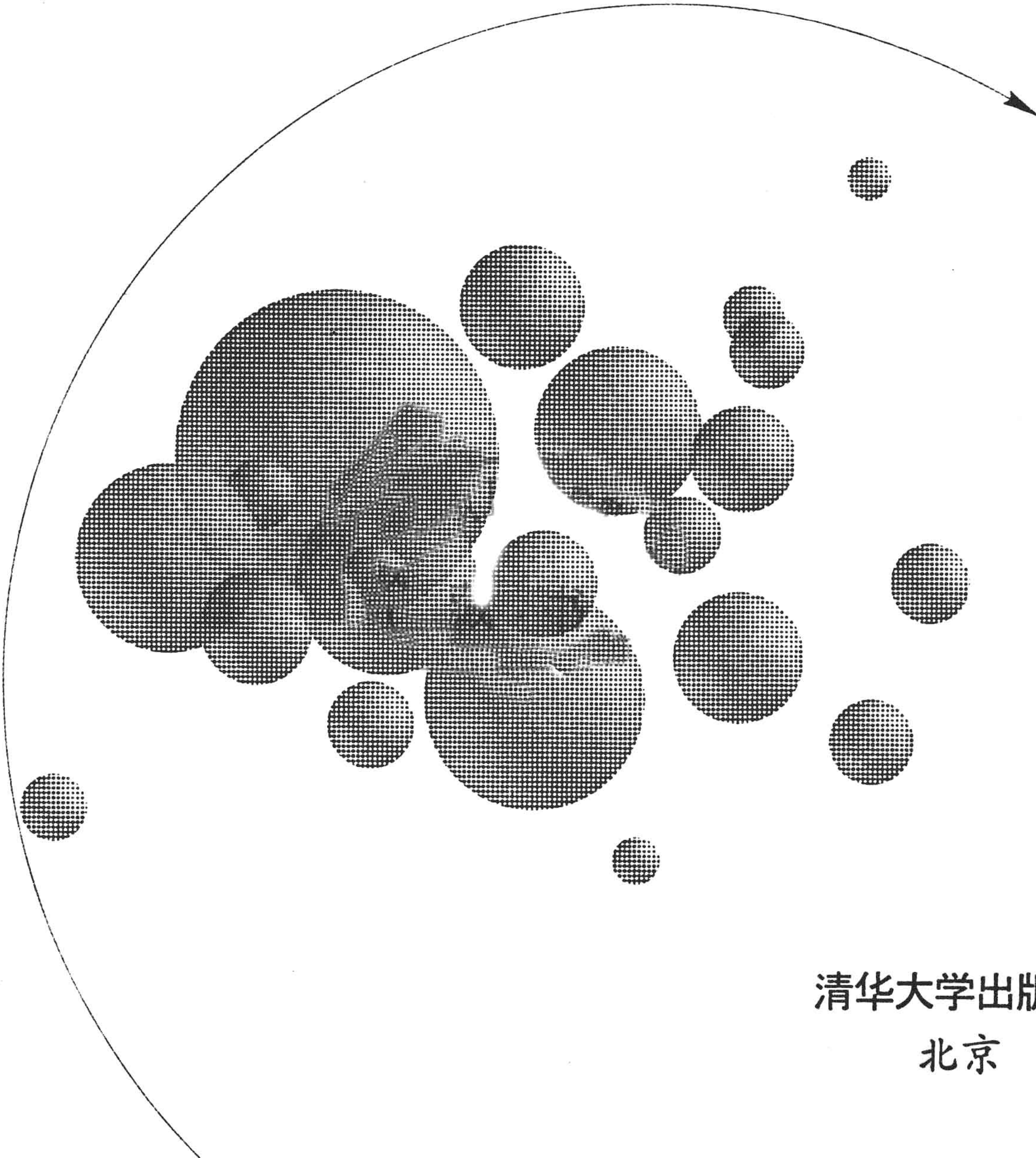

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# 序

20世纪70年代末伴随“开放”,“工业设计”的种子播入中国这片广阔的土地。

20世纪80年代,工业设计教育培育了Design的幼苗。

20世纪90年代,工业设计在中国的经济主战场上崭露头角。

20世纪末,在大连、厦门、无锡召开的连续三次全国工业设计教育研讨会上,反思设计教育的误区,总结设计理论和设计教育的理论、方法和实践的成功经验。

2001年6月3日~6月5日清华国际工业设计论坛暨全国工业设计教育研讨会的隆重召开,预示了工业设计将在新世纪知识经济时代开始崭新一页。面对工业设计战略、信息化设计、设计管理和可持续经济与消费等方面的问题,围绕“面向新世纪的工业设计教学体系、教学方法及典型教学课程案例,国际设计教育的现状与发展趋势,国内外工业设计实务与经济”等主题展开了热烈的讨论。

我国的现代工业设计正处于不断向前发展的阶段,我国工业设计在设计教育、设计实务、设计组织、企业设计应用、政府和社会对设计的推动等方面都有明显的发展,但离设计理念、设计教育、设计实务的前沿还有距离。在当今人类进入21世纪、世界经济一体化的浪潮中,让中国自主创新设计的产品与世界进行交流,某种意义上看中国产品附加值的提升,决定于我国产品设计水平的提升和自主创新设计能力的提升。

参会人士认为:未来社会的发展,需要我们的设计教育培养全才式的设计人才,全才式人才的培养关键是创造力的培养。工业设计的难点是对学生创造能力的培养与开发。创造力包括两个方面,即深度和广度,而这又是学生综合素质的核心部分。与会者从设计教育的角度,探讨了与创造力培养相关的关键问题。

参加这次论坛的代表有来自美国、英国、日本、韩国、意大利及中国台湾、香港地区以及大陆的几十所院校、设计公司的76个单位的代表三百余名。为此,此次论坛送交的论文共近三百篇,经这次论坛的学术委员会评审,精选了118篇优秀论文结集出版。论文围绕大会主题,探讨迈进21世纪的中国设计教育。随着工业设计对提升企业市场竞争力和改变人类生活方式的影响日益重要,全社会对工业设计更加重视,世界经济一体化和中国加入WTO将使中国面临新的机遇和挑战,这一切都将给工业设计教育提出许多新课题。被选载的论文为中国工业设计教育的发展写了浓重的一笔。同时还提出许多课题留在今后的设计实践、设计教育实践中继续探讨。

论文集出版了,它只代表了过去的脚步。正在思考和实践的和将要思考的是工业设计教育不可推诿的义务,希望这本论文集能引起大家的关注、批评和思考,编者之心则稍可慰藉。

论文评选委员会主席

柳冠中　教授

于清华大学美术学院

2003年4月30日

# 目　录

# A New Knowledge-based Design Tool: Converting Design Practice into Value-creating Product Attributes

LEE Tak-chi, Norman SIU Wai-chung,
Steven CHONG Pui-yik, Anthony IP①

## 1. Challenges in Competing with Knowledge

Understanding, managing and measuring knowledge in organizations has been discovered as a key source of intellectual capital and as a sustainable competitive capability (OECD, 1996:13, Von Krogh *et al.*, 1998). In *The Knowledge-Creating Company*, Nonaka and Takeuchi (1995) suggest that the source of competitiveness of [Japanese] companies has come from the integral codification and conversion of tacit and explicit knowledge across individual, group and organizational levels. Their observation on "how [Japanese] companies break away from what worked in the past and move into a new untied territories of opportunity" (1995:ix) echoes that of the competence perspective which essentially argues that creating and acquiring new knowledge will have the greatest strategic effect on competence-based competition (Sanchez, 1993; Sanchez and Heene, 1996; Von Krogh *et al.*, 1998). Some key concepts are noted here: [1] knowledge constitutes an important intangible asset for a company's competitiveness; and [2] one of the most efficient ways of managing organizational knowledge is by transforming the knowledge, which has been *implicitly* embedded in the individual and the routine and practices of the firm, into an understandable, sharable, learnable and extendible format. The enhancement made to such implicit knowledge management can particularly benefit OEM firms. A review of the current setting of knowledge structure of OEM

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① The research team has four members: Tak Lee, Norman Siu, Steven Chong and Anthony Ip. They are teaching and research staff and students at the School of Design, The Hong Kong Polytechnic University. Tak Lee is an associate professor leading several major international programmes and projects in industrial design. Norman Siu is an experienced jewellery designer, design consultant and project secretary of the *Hong Kong Jewelry Manufacturers' Association*, and a director of the *Gemmological Association of Hong Kong*. Steven Chong is a seasoned industrial designer, a team member of the Academic and Policy Concerns Group and the *Hong Kong Small and Medium Size Business Chamber*. Anthony Ip is the Project Coordinator of numerous programmes and projects in industrial design, design management and education.

firms has revealed that (Hobday, 1995): ①

[1] Most OEM firms gradually apprehend and acquire their production know-how through long-term practice in a process of learning-by-doing; and

[2] Such OEM experience is a tacit knowledge that is hard to obtain or be transferred, but can or has been retained. ②

## 2. The Hong Kong-Mainland China Original Equipment Manu-facturing (OEM) Experience: The Key Issues

Today, OEM companies must face considerable competitive pressures. As more and more similar or imitative products have been targeted at and launched into the same market segment, and the cost and price pressures have helped accelerat product maturity. Profit margins are shrinking. ③At the same time, the tradition of profit-creation through low capital investment and the intensive use of relatively low level technology in production is being challenged by the increasing demand for the capitalization of high-level human and technological resources to ensure corporate profits. The mismatch of these two variables has triggered a collapse of the traditional cost-based strategies.

Many of the Hong Kong OEM manufacturing companies are facing a crisis by relying on experience. The outcome is their inability to develop higher value-added

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① The enhancement made to such implicit knowledge management can benefit OEM firms specifically. The latecomer learning strategy is not to catch up with the technology frontier. The Asian firms would rely on articulating the available knowledge to compete rather than creating new knowledge from the laboratory. Hobday claims (1995) that learning-by-OEM is a significant means for most Asian firms to minimize the disadvantage of being technologically behind and distant to the market. By accumulating extensive OEM experience, Asian firms can evolve from original equipment manufacturing (OEM) to original design manufacturing (ODM) and even to original brand manufacturing (OBM) to develop their own path (Hobday, 1995). This is an effective means to accumulate and articulate the knowledge from OEM practices.

② How does a goldsmith know the colour and consistency of metal as it is thrust into a blazing fire? A potter achieves the smooth finish of clay as it gives up its moisture? A shoemaker understands the subtle feel of leather as it is beaten and stretched? A glassmaker decides the strength and delicacy of glass as it is filled with human breath? Tacit knowledge can only be learned through observations, imitations and actions, rather than taught, reflected upon, or verbalised. Tacit knowledge, acquired in the course of making things, is rarely made explicit, or explained, rationalised, or articulated.

③ Additionally, as production costs become *transparent*, working knowledge and experience of "how to make things well" by OEM firms will lose its competitive advantages. The stronger the cost competition from other lower cost manufacturers, the more the prices are being cut. There is a limit to the degree of application of available low technology or technical advantage by Hong Kong OEM firms. Technical know-how can only be enriched through learning-by-doing or absorption of appropriate technology from the existing stocks. Although such knowledge is conjoined with excellent flexibility and adapted to production in Hong Kong, experience-based technical know-how cannot be restricted to particular firms, regions or nations. It is an open and *transparent* asset accessible or accumulated by similar experience or know-how. It can also be bought or transferred to other regions of low-cost production such as Mainland China. For details, see *The Economist*, p. 92, May 24, 1997.

products in a knowledge-based competitive environment. Aside from low costs, their emphasis on technical process innovation and operational innovation relying on the individual experience and tacit knowledge are delimiting, discouraging or sometimes prohibiting knowledge development from upgrading total product and production know-how. As a result, organizational knowledge has been reduced to a meagre asset. This delimitation has arisen out of the culture under which the OEM firms operate.

### 2.1 Challenges in Continuously Creating New Product Concepts

Knowledge-based competition today is on the increase while skill-based and experience-based assets are diminishing. The long-term pressure on cost competitiveness inevitably pushes OEM firms to the limit of extracting more production at lower costs, and the total gross return on investment and prices will fall. In the long run, the weakness in creating new product concepts will intertwine with inability to create or enhance organizational knowledge with product development and production know-how. The Product Attribute Configuration Model (PACM) in this paper should alleviate some of these problems.

## 3. Product Attribute Configuration Model: New Approach of Offering a Wider Range of Product Configurations

The PACM is proposed by the authors to establish a practical method by which OEM firms can efficiently manipulate the physical and perceptual product attributes. This model provides a step-by-step procedure to capture a wide range of new product configurations by decoding product attributes from the existing product base and by classifying them into different levels. ①This model was applied in a Hong Kong OEM jewellery manufacturer *Tenon Jewellery Manufactory Company* (Tenon) in order to test its adaptability and usefulness. After an eight-month trial period, Tenon has successfully converted its staff's experience, skills and knowledge into organizational knowledge assets. Through this case, we find that the "limitation" of practiced production know-how in OEM can be extended, when a broader context and role of the perceptual and physical attributes in product design and development are perceived and well articulated with a systematic approach.

### 3.1 A Broader Concept of Product Attribute: Physical and Perceptual Attributes

Product is composed of many basic units and fundamental elements which can be

① Since the PACM is to study and manage the hidden physical and perceptual product attributes, the basic documentation techniques such as *Gemba* is used to collect the voice of OEM firms. Higher level techniques such as Affinity Diagram, Customer Voice Table and House of Quality are used to test the voice of customers after the product configuration was finalized.

termed as product attributes. In the design stage, the firms would try to define the fittest combination of product attributes, which is named as product configuration, after a *thorough* consideration of all possible combinations. Theoretically, product attributes constitute the physical form, function, technical, perceptual and other qualities of a product. Therefore, a broadened context of product attribute is definitely vital for the product designer and engineer in searching and defining the best product configuration in the early product planning stage.

In PACM, the product attributes encompass the tangible and physical product characteristics (i. e. product configuration, features, details, workmanship... etc), and the technical specifications of the product for production. In addition, the product attributes also include the perceptual qualities of the product (i. e. product interfaces with perception of users, orientation of a product to a particular market or targeted customers... etc). In any case, combining the physical and perceptual product attributes can more effectively define a product configuration in terms of its class, market orientation, price range, potential range of use and so on. Certainly, the configuration of the physical and perceptual attributes, which contribute the total value of the product, is not decided by the OEM firms, since most product configuration or specification in OEM business are predetermined and given by the clients.

Given that a high value-added product is based on a *fittest* product configuration, to capture a *well-fit* combination of physical product attributes and perceptual attributes is the most important procedure in the design or pre-production stage. It is proposed this procedure will be the basis of the PACM. It will explore and derive a new product configuration from the existing products in design and product development.

### 3.2 Some Fundamental Principles of the Product Attribute Configuration Model

The PACM includes four stages as shown in Figure 1. The model is designed to capture the best product configuration in the planning stages. Each stage deals with a specific problem and allows the following levels of progressive analysis and synthesis:-

(i) Analysis of the configured attributes of existing products and documentation of key product attributes;

(ii) Integration of product attributes by mapping to establish an Attribute Pool Model from which the potential

re-configuration of products can be shown;

(iii) Categorization of documented attributes at different levels via the concept of quality at different levels;

(iv) Visualizing and mapping new, feasible product attributes and configuration.

The main scope of the first stage is to derive the attributes of existing products into a documented format for the team of designers, engineers and marketers in a firm to understand, share, analyse and use in the second stage (e. g., jewellery is used as a product as a test. As the drawings of the jewellery drawn by the designers and the product objects were realized by the goldsmith in designing and making processes respectively, their ideas, knowledge and experience were embodied in their works. However, the jewellery product itself would obtain rich craft attributes such as craftsmanship. Yet these attributes may neither be totally described nor narrated in textual or verbal format). It may be difficult to measure all attributes only in technical terms and specification. Thus, the case of documenting the perceptual product attributes may vary from different products as every industrial product has its own industry-specific context of knowledge.

Design knowledge. For example, the dependent attributes or variables in the similar styles were placed in the same group where their physical characteristics so that unit gold weights, volume and sizes can be compared. At the same time, the perceptual attributes including visual attributes (like polished or textured jewellery object surfaces, in Tenon's project; through such a comparison, the inter-relationships between the proportion of shiny and textured jewellery surfaces together within a specific range of unit weight or size may then be derived) were also compared. The results indicate that the comparison of the groups of visual and textual attributes can therefore help define the hidden relationship among those physical and perceptual attributes.

Therefore, the step of manipulating the visual-format records and textual document becomes particularly important. The PACM does this by documenting the attributes in both textual and visual format using a lens of design knowledge.

In the second stage, the related products are grouped into different families and their product characteristics are primarily mapped. Sets of product attributes will be *linked* to formulate the tangible and intangible attribute sets. Here, the relationships between attribute sets are defined in terms of technical commonalties, and also in terms of their association of perceptual meanings or embodied values. After the attribute sets are correlated based on their degree of similarities, commonalties or differences, the attribute pool model is established for the next procedure.

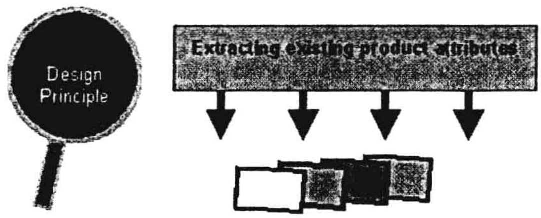
In the third stage, product attributes can be separated, dispersed and classified as attributes at different levels. This is done by integrating the Attribute Pool Model with the concept of "attributes existing at multiple levels" (Siu and Chong, 1998). The "Production Attributes" enclose the technological particularities of technical production process, the "Configuration Attributes" outline the overall product features and characteristics, and the "Concept Attributes" are key elements of the product concept. The classification of different level attributes has consolidated the following:

[1] The production attributes are tangible and measurable data. They are more stable and are encapsulated by technical boundaries in jewellery casting, polishing and soldering. These processes are difficult to be radically modified unless

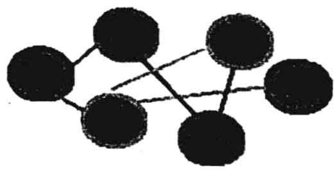
there is a technological breakthrough and/or process innovation.

[2] The configuration attributes are relatively active comparing with the physical production attributes. The latter as the new configuration attributes will contribute to the design "outcome" or "payoff" after a balance on the technical capability and new product concept is struck.

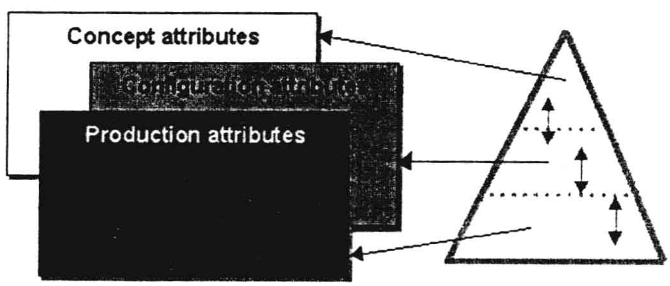
Stage 1　Documentation of Key Product Attributes



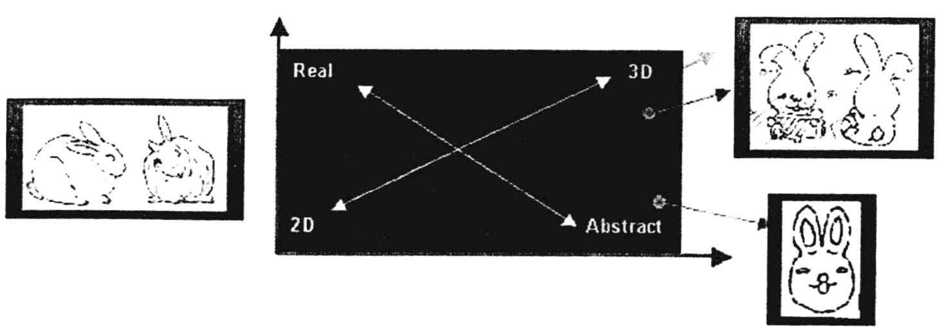

Stage 2　Establishment of Product Attribute Pool



Stage 3　Categorisation of Documented Attributes at Multi-levels




Stage 4　Wider Range of Product Configurations; Conceptual Product Platform




PRODUCT ATTRIBUTE CONFIGURATION MODEL

Figure 1　Product Attribute Configuration Model

[3] The concept attributes are created after knowledge in conducting and analysing the findings of market research is created or enhanced. But most OEM firms would need only to implement pre-determined product concept within certain cost and quality limitations. Concept attributes are related to the needs and wants of consumers, perception of value and consumption patterns and so on. They are the perceptual attributes.

The final process involves (i) selecting, (ii) mapping, and (iii) ranking the relevant sets of categorized attributes in the *best* order and to make the *best* configuration. The concept, configuration and production attributes will be linked to formulate the most feasible, desirable and new product configurations.

## 4. Experience Learnt from a Cooperation Project with a Jewellery Manufacturing Firm

To improve the practicability of this new design model, the researchers have cooperated with Tenon, a Hong Kong-based pure gold jewellery manufacturer to test the proposed procedures and approaches in Spring 1998 and thereafter. ①

### 4.1 Background of the Project

Like the other small or medium sized OEM firms, Tenon was gradually expanded and developed over the last twenty years into a jewellery manufacturing company employing over one hundred and fifty workers locally in boom times. Tenon has accumulated more than 20 years of OEM experience and good production capacity, but was facing challenges in sustaining cost competitiveness since the growing pure gold jewellery market in Hong Kong encouraged numerous new competitors to enter the same market segment on a cost-competitive basis. The market was rapidly saturated and competition was moved to cost minimization. In fact, the production cost of jewellery has become an "open secret" for most of the jewellery firms,② and price wars with cutthroat competition followed. The environmental factors have forced Tenon to accept that cost control in jewellery production can no longer sustain the competitive advantage of a firm. To confront these challenges, Tenon has determined that it has "*to improve the mature pure gold jewellery products by adding value with better product concept and config-*

① In Spring 1998 the researchers began a research project designed to explore how Tenon might translate its accumulated production know-how through the *PACM*. The goal of the project took a very simple concept by developing an animal-based jewellery series aimed at the Year of Rabbit of 1999. Tenon identified *Animal of the Year* as a saleable product theme to define the project objective.

② More detailed description on the factors of jewellery production costs are becoming *transparent* can be found in Siu (1996, 1997) and Siu & Chong (1998a, b).

uration"①. This was done by a strategic reallocation of internal resources and asset——craftsmanship of the high quality jewellery goldsmith and accumulated jewellery production know-how.

### 4.2 Documenting the Jewellery Attributes

The PACM was selected by Tenon as a means to begin this strategic plan. For the first time, the model was used to analyse the attributes of the existing jewellery products of Tenon. They were grouped, "scanned" with the lens of design knowledge, and then documented in both textual and visual formats. The similar styles of jewellery rings and earrings were grouped into different families and their characteristics (i. e. percentage of textured and shinny surface) were recorded. Through the process, Tenon has come to understand the *function* of the attributes at multiple levels. Tenon has also begun to realize "what is happening", what is working, or failing, to work technically or psychologically in a jewellery product.

### 4.3 Establishing a Jewellery (Product) Attributes Pool

In the coming stage, the researchers grouped sets of similar jewellery attributes into many jewellery attribute sets to form a "Jewellery Attributes Pool". For instance, the tangible attributes like rabbit body, ears and legs were defined. Besides joining such tangible attributes with the production attributes as technological commonalties of components, modules, parts or production process, some attribute sets may be further correlated with other attribute sets. For example, the rabbit ears-attributes might be joined with "wearing glasses and/or hats." The enlarged "rabbit head-body-hand-leg-tail" attribute set was formed in the jewellery attribute pool.

The creation of the attribute pool introduces to Tenon a rich source of information which accrues to product attributes and becomes useful to capture the best product configuration. More examples can be sought in cultural themes (i. e. "Love" and "Care"), seasonal and traditional rituals (i. e. Chinese New Year and Christmas), and *modern* rituals (i. e. wedding and engagement). When the sets of jewellery attributes are linked in turn, the interrelationship among the attribute sets in the jewellery attribute pool was established and can be identified.

### 4.4 Conceptual Jewellery Platform

The categorized and classified attribute sets are then integrated with the central concept of "attributes at multiple levels" to generate jewellery concept attributes, jewellery configuration attributes and jewellery production attributes. The researchers and Tenon working team can then communicate with drawings and textual materials together

① This statement was formulated by Tenon itself as its strategic goal after it accepted the consultancy report in which Tenon's infrastructure was reviewed. Recommendations were made by the researchers.