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

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Steven CHONG Pui-yik, Anthony IP

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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firms has revealed that (Hobday, 1995):

[1] ost 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. he 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. At 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

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. roduct 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. This 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

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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 .

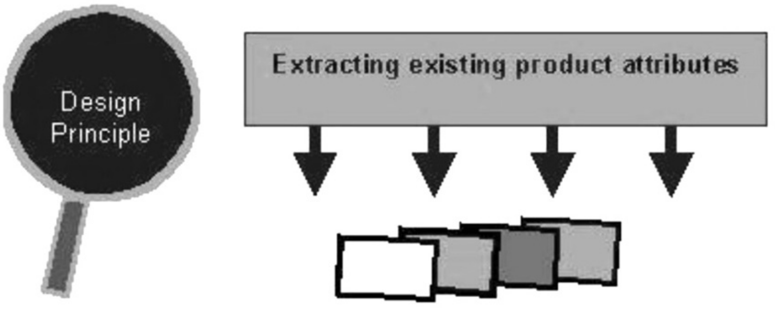
In the third stage, product attributes can be separated, dispersed and classified as attributes at different levels . This is done by integrating the Attribute Pool Model with the concept of " attributes existing at multiple levels " (Siu and Chong, 1998) . The " Production Attributes " enclose the technological 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] he 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

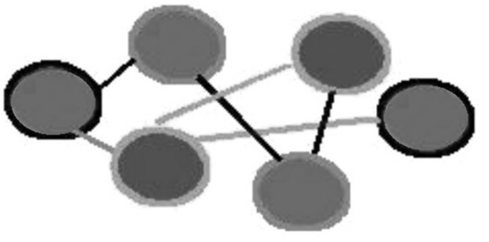
there is a technological breakthrough and/ or process innovation .

[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 .

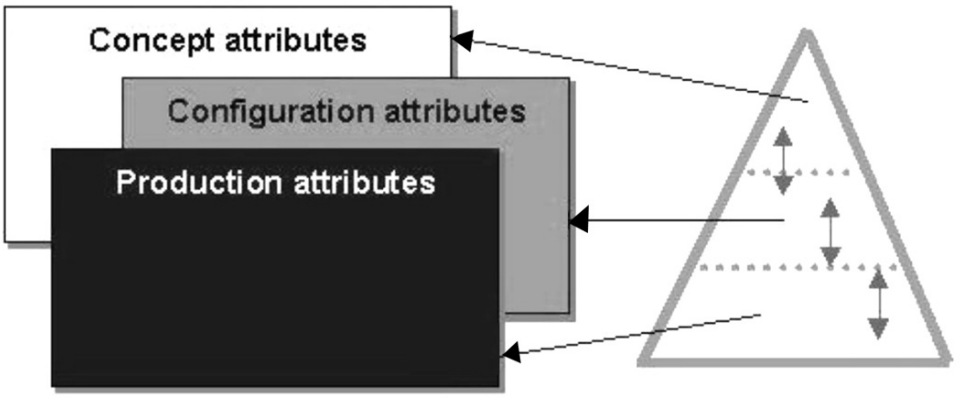
Stage 1 Documentation of Key Product Attributes



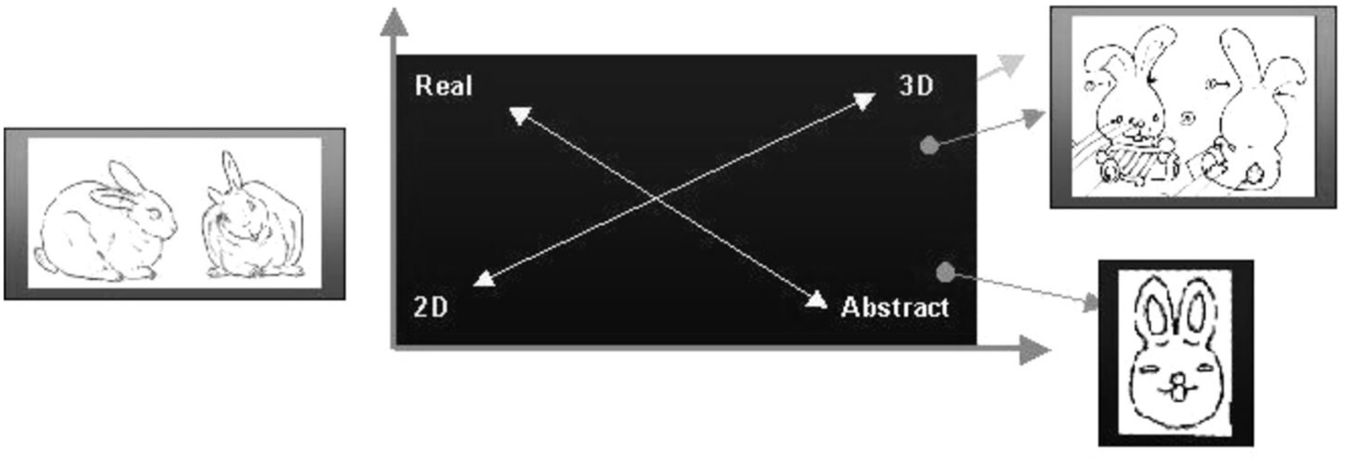
Stage 2 Establishment of Product Attribute Pool



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] he 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. xperience 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.

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, 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-*

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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" . 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

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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 .

in the "Conceptual Jewellery Platform" in the design process. The expandability of jewellery configuration was explored, as different jewellery configurations were defined within the co-relationship along the axis of two-dimensional and three-dimensional as well as the axis of icon and real figure.

4.5 Visual Mapping of Jewellery Product Attributes

As shown, a jewellery object can be configured either with the attributes of two-dimensional iconic rabbit face, or with the attributes of three-dimensional real rabbit figure or head, or even by alternatively mixing both. At this stage, Tenon has inserted a series of new attributes such as "wooden horse", "airplane", "witch" and so on to match the project theme "Rabbit for Year 1999-2000". In this project, Tenon has developed more than forty designs within six months. Every item is ready for customisation to fit some particular requirements based on a product platform approach and by adopting or exchanging new attributes or components.

5. Lessons Learnt: Findings of the Tenon Project

These results of the tested case have shown that Tenon has benefited in two aspects. Firstly, the success and failure of product attributes of the products of Tenon and the competitors can be identified and captured by the conceptual mapping model if the voice of customers is collected by Tenon. The design and development stages may be shortened if the processes are mastered and properly documented. The resources can also be minimized. Secondly, the staff from different departments involved this project have also experienced the sharing of knowledge with specialists in other disciplines in this *common* platform.

The case of Tenon has not only highlighted an alternative and effective means of improving mature product development. By exploring the *concealed* capability of the concept of attributes, it has also supported the proposition that by correlating the tangible (physical) and intangible (perceptual) attributes in design planning, the model is powerful in helping to define the best (or most desirable) product configurations.

6. Implications: Conversion of Design Experience and Knowledge

This study has shown that Hong Kong jewellery manufacturing firms have been relying heavily on the operational effectiveness, intensive skilled-labour process, skill-based experience and production know-how. But the product design and production procedures are seldom or in many cases inadequately documented. The staff and workplace experience often remain in a tacit rather than in a sharable format. For example, the knowledge of jewellery making is rarely codified for learning and haring. The acquisition of jewellery making skills as a practiced knowledge can only be realized through years of apprenticeship with a jewellery making master. In reviewing this project and its underlying argument, one key phenomenon is *magnified*. The broadened context of product attributes in design and development stage is of critical importance. The model has provided an effective framework for:

[1] ffectively codifying, distributing and integrating the tacit knowledge individually in the company;

[2] Providing linkage to product development/ product design processes;

[3] Accelerating and integrating the latter in [2] with other processes; and

[4] Creating a competitive advantage for the company in terms of organizational knowledge creation. Although the project was on a small scale, it has shown the developmental possibility of tacit knowledge in a learning process or system.

For most OEM firms, relying on tacit production know-how as a source of strategic advantage has limited their abilities. The leverage of practiced but unarticulated knowledge is low and would imply high *cost* when skilled and experienced staff leaves the organization. Conversely, the OEM firm may create its own "knowledge black-box" shielded from its competitors to sustain a design and product development knowledge base for longer term competition. Thus, the creation of knowledge is the key source of survival to every organization in the knowledge economy. It is likely that the "learning-the-given" system that leads to tangible and intangible knowledge integration put forward in this paper will become one of the significant topics for the Asian OEM firms. For them, it may well be a point of departure "*from imitator to (world-class) innovator*" (Tatsuno, 1990) in the coming decades.

References

1. avenport, Thomas H. Process Innovation: Reengineering Work through Information Technology. USA: Harvard Business School Press, 1993.

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① See Siu, Norman W.C. and Dilnot, Clive (1999) "The Challenge of the Codification of Tacit Knowledge in Designing and Making: A Case Study of CAD Systems in the Hong Kong Jewellery Industry" in *Proceedings of the 4th International Symposium on Design Thinking Research*. Department of Architecture, MIT, USA, April 23-25, 1999, pp.281-292.

② The effectiveness of conversion of tacit to explicit, explicit to tacit knowledge is in line with what Nonaka and Takeuchi (1995) describe.

③ "Cost" here implies not only in terms of the actual cost of replacing the relevant person, but also in terms of the loss of the tacit knowledge which will not stay in the firm after the knowledge-holder or -carrier leaves the firm. In many cases, these costs are "hidden" and not recorded in the accounts. The way to resolve this of strategic importance for the long-term development of a firm.

2 . Hobday, Michael . Innovation in East Asia: the Challenge to Japan . Aldershot, Hants, England; Brookfield, Vt .: E . Elgar, 1995 .

3 . Meyer, Marc H . & Lehnerd, Alvin P . The Power of Product Platforms: Building Value and Cost Leadership ., New York: The Free Press, 1997 .

4 . Nonaka, Ikujiro and Takeuchi, Hirotaka (1995) . The Knowledge-Creating Company, Oxford: Oxford University Press .

5 . OECD . Employment and Growth in the Knowledge-based Economy . Head of Publications Service, OECD, 1996 .

6 . Sanchez, Ron and Heene, Aime eds . . Strategic Learning and Knowledge Management . England: John Wiley & Sons Ltd, 1997 .

7 . Siu, Norman W .C . and Dilnot, Clive . The Challenge of the Codification of Tacit Knowledge in Designing and Making: A Case Study of CAD Systems in the Hong Kong Jewellery Industry . In: Proceedings of the 4th International Symposium on Design Thinking Research . Department of Architecture, MIT, USA, April 23-25, 1999 . 281～292

8 . Siu, Norman W .C . . Improvement of Product Quality and Production Process Performance in Jewellery Manufacturing through Integrated Craftsmanship, with Chinese abstract . In: Special Issue of The Transactions of Nanjing University of Aeronautics and Astronautics . PRC: Nanjing University of Aeronautics and Astronautics, 1998 .71～78

9 . Siu, Norman W .C . and Chong, Steven P .Y . . A New Vision of Manufacturing Paradigm: The Continuous Improvement of ‘ Multi-Layered ’ Quality in Product Innovation and Production Flexibility for Customer Satisfaction . In: Proceedings of the 3rd International Conference of ISO 9000 and TQM . Hong Kong : Hong Kong Baptist University, 1998 .483～490

10 . iu, Norman W .C . and Chong, Steven P .Y . . Design-Led Quality Development : A New Approach of the Integration of Design, Manufacturing and Marketing Processes . In: Proceedings of the World Innovation and Strategy Conference incorporating the 4th International Symposium on Quality Function Deployment . Sydney: University of Western Sydney, 1998 .451～456

11 . Tatsuno, Sheridan M . . Created in Japan: From Imitators to World-class Innovators . USA: Ballinger Publishing Company, 1990 .

12 . Von Krogh, Georg, Roos, John and Kleine, Dirk . Knowing in Firms . London: Sage, 1998 .

Articulating & Managing Design Knowledge For Hong KongMainland China: A Study on Good Professional Practices And Innovative Industrial Design Products

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Norman SIU Wai-chung, Steven CHONG Pui-yik, Elson SZETO Sing-ying

1 . Introduction: Changing Environmental Context

Since the 1960s, the Hong Kong and South China manufacturing industry has been gaining its strategic position by exporting products to markets in the core economies, maturing organizations and by bringing in significant foreign exchange . Hong Kong design products have been widely perceived as highly competitive goods based on desirable quality and value relative to costs . This achievement has been sustained by quick-responses in design modifications, articulation of marketing and consumer needs, production and related services by the Hong Kong industrial design practitioners (Sit, 1985; Kwong, 1997; Davies, 1996; Lee, 2001) . However, changing environmental dynamics have been changing since the 1980s, as Hong Kong enters the knowledge era . Shorter economic and product cycles, lowering costs and increasing competitiveness of neighbours have intensified challenges on conventional entrepreneurship . The value of design and products is increasingly difficult to establish, and the need for innovation has become more prominent . This paper will provide the background, agenda, significance and value for research in a much-needed area for a more integrated Hong Kong-Mainland economy .

2 . ong Kong Professional Design Practice vs . Manufacturing Industry: An Economic Miracle or Value in Disguise ?

Together with allied industrial professionals such as product and production engineers, entrepreneurs, marketers and management, the Hong Kong industrial designers have played an important role to respond to the needs and changes on clients, consumers and markets . They handle up-to-date materials, information and knowledge by actively involving in professional development, despite competing costs and quality, quotas, tariffs and task relocations. Having sustained against such challenges until the early 1990s, it is believed that a good practice of design has been established in the Hong Kong manufacturing industry. This is evidenced by those commercially successful local firms at the climax of business success of Vtech, GSL and Tint (Chong, 2001; Lee, 2001).

However, the nature of the values created by industrial designers are narrowly defined and under-explored due to the tacit nature of design knowledge and the implicit role of Hong Kong designers in the Original Equipment Manufacturing (OEM) culture and the Chinese Family Business (CFBs) (Sit, 1986; Siu, 2001; Chong, 2001). These industrial organizations are characterized by Heskett as a form of static interpretation of neo-classical principles (OEM) (Heskett, 1998) by means of continuous sub-contracting. Under this system, the value resulting from good practice of Hong Kong industrial designers is often in disguise.

As a result, the role of industrial designers remains vague. In the early 1990s, the property boom, escalating costs in facilities, rentals and overheads have intensified the northward migration of industries. But the nature of industrial design and the manufacturing in Hong Kong has remained unchanged, except that an easy way out has been found to sustain short-term competitiveness. Meanwhile, competitors in the region including Mainland China have stepped up their policies and initiatives by strengthening design practice, education and research by outsourcing services, by re-structuring and by creating strategic alliances (Hobday, 1995).

3. Economic Recession: A Turning Point for Hong Kong Designers?

After 1997, Hong Kong has quickly declined in competitiveness (Institute of Management Development 2000). Many of its industrial and manufacturing enterprises have difficulties to satisfy rational, higher humanistic and quickly changing aspirations for overseas, local and to some extent Mainland China customers, and to create New Growth (Chiu, 1996; Lee, 2001; Schumpeter). The deflating values of Hong Kong industrial products resulting from its over-valued dollar have been put to some serious tests. Counter deflationary measures have been taken by various players, and the Government has repeated vowed to make Hong Kong an "Innovation and Technology Centre" (Tien, 1998-1999). Visionary as it may be, this ideal has definitive gaps and misfits if rationalised with genuine competitors (Davies, 1996; Hobday, 1995). Meanwhile, the governance to re-generate new growth seems to be hampered by a misunderstanding on innovation, as well as by a resistance to rethinking neo-classicism and change (Schumpeter, 1997; Clipson, 1991; Williamson, 1995).

While industrial product design may now be at a critical juncture, many examples of innovative products can still be found in promotional activities arranged by organizations such as the Hong Kong Trade Development Council (HKTDC). These achievements have directly reflected that the well-seasoned Hong Kong industrial designers in practice must realize design ideals through pragmatism. Their positions are sustained by rich design knowledge, know-how and competencies at an individual and at firm levels. Their vast and intensive experiences in the real world are a "treasure box" waiting to be discovered, as claimed by Tak Lee, an international award-winning Hong Kong industrial designer-entrepreneur (Lee, 2001; Clark and Ip, 2000).

In order to unfold the knowledge under disguise in good practice in Hong Kong industrial product design, this research project aims to articulate and model its artifacts, environments and systems to establish a series of ideal profiles. The artifacts (outcome, attributes, typologies), environments (economic, technological, social, political) and systems (activities, patterns, structures, processes) will be identified, articulated and evaluated. Using industrial design as the core, its relationships with peripheral activities, such as marketing and product development, will be developed. Estabished methods in product definition will be used to develop comparison, improvement and systematization. Overall the approach will transform industrial design from a tacit and individual to a explicit and collective approach (Nonaka, 1995). This will enable us to develop knowledge sharing and knowledge transfer, so as to spearhead a change in industrial product design for the new millenium.

4. Knowledge Era: Literature Review & Key Research Areas

The view that prolonged industrial design and production replication such as OEM in industrial product design is a serious issue that can be resolved by design originality is more complex than analysts have claimed (Enright, 1998; Siu, 2001; Chong, 2001). Innovations such as design originality is affected by complex cultural factors, sometimes by extremely high-costs and other inherent constraints, such as scaled industries widely diverged in core economies. In Asia, many aspects of the environment and industrial governance are drastically different. These differences imply that there is a great need for alternative paradigms to resolve industrial development issues.

The experience of Japan tends to support the importance of the replication model. Industrial design in Japan was certainly rooted from highly replicative behaviours (1950s-1970s), then upgrading into higher market segments through market, product customization and quality control after the 1970s (Pine, 2000; JCTV, 1986; Zairi, 1996). With innovations focusing on applied R&D, the nature of industrial, technological, social, and economic relations are tightly intertwined with the localized conglomerates - the *keiretsu*. Most design activities are in-house ones, and have strong influence in countries such as South Korea, over large industriaes such as the *chaebols* since the

1980s and more recently even in the west .since the 1990s . The one-time Honda-Rover venture and world class alliance of Toyota-General Motors are two examples . There has been a reversal of design and production knowledge transfer from the east to the west, particularly in methods of product development, production and quality control .

In the Hong Kong-South China context, the strengths of entrepreneurism, efficient operation, replication, capitalist Chinese Family Businesses (CFBs) and the transforming socialist State Owned Enterprises (SOEs) inherited from the past may have been overlooked (Redding, 1986; Whitley, 1992) . In most studies done by non-designers, the nature of complementary and contradicting ideologies, economic systems, product definitions, industrial and design models and processes such as OEM, Original Design Manufacturing and Original Brand Manufacturing (OEM, ODM and OBM) are largely broad in coverage and vague on industrial product design .

They tend to be overly optimistic on technology- or capital-intensive solutions, without addressing the issues of long lead time and historical weakness in adhering to low technology and low level of professionalism in management (Enright, 1998; Berger & Lester, 1997; Freeman, 1997; Sit & Wong, 1989) .

Other studies done by designers are predominantly ad hoc, tacit, individual, graphic-based and loosely structured, rendering the transfer of knowledge difficult (Aldersley-Williams, 1992; Thackara, 1997; Nonaka, 1995; TDC, various years) . With the lack of models or equivalent methods to evaluate or measure success or failure, industrial design in Hong Kong is difficult to be seriously and intellectually considered as a viable form of innovation (Lee, 2001, Zairi, 1996) . Creative, innovative and qualitative exploration and collaboration crossing disciplines are needed by all the sectors of design R&D but we are liable to miss the opportunities .

Attempts on industrial product design in semi-peripheral economies such as Hong Kong's often target some of the idealized examples from the core economies (Thackara, 1997; Aldersley-Williams, 1992; Design Management Institute, various years) . But how about the adaptation, localization and customization of these ideal types ? How effective are they in industrial product design development ?Can GPDPs in industrial products become a more effective tool to enhance and create value for Hong Kong amid a major recession ? How can GPDPs be evaluated and measured against their counterparts, the BPDPs in the core economies ?Can articulation, modelling and evalutation of GPDPs help improve practice and education in industrial and other disciplines in design ?

To respond to these questions, design theories (academic and pedagogic) and practices (applications and consumption) must establish a much stronger synergetic relationship . The discovery of GPDP cases may unfold valuable lessons, the articulation of which may allow new and critical design theories and models to emerge . If design is meant to encourage pluralistic development, then the indigenous content in a set of