

Volume 2 // THREE: 2008
ISSN 1751-9853
http://www.emeraldgroup.co.uk/journals

ACES The Journal

Design and the Art of Management THEMED ISSUE

THE DENVER BIENNIAL
OF THE AMERICAS
Bruce Mau

DESIGN THINKING
Bauer and Eagen

DANCE AND ORGANIZATIONAL LEARNING
Rowe and Smart

BUILDING DESIGN CAPABILITY
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INTERACTION DESIGN AND INNOVATION
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DESIGN METHOD AND COLLABORATION
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DESIGN PROCESSES AND TOOLS
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THE ARTIST ENTREPRENEUR
Fletcher

Aesthesis:

International Journal of Art and Aesthetics in Management and Organizational Life

is published by

the **Aesthesis** project

The Aesthesis Project was founded in January 2007 and is a research project investigating art and aesthetics in management and organizational contexts. The project has its roots in the first Art of Management and Organization Conference in London in 2002, with successive conferences held in Paris, Krakow and The Banff Centre, Canada. From those events emerged an international network of academics, writers, artists, consultants and managers, all involved in exploring and experimenting with art in the context of management and organizational research. The Aesthesis Project will be developing extensive research and artistic projects internationally, with academic research fellows and associate creative practitioners, publications and consultancy.

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Jonathan Vickery, Centre for Cultural Policy Studies, University of Warwick, Coventry, UK

Ceri Watkins, Essex Management Centre, University of Essex, Colchester, UK

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aesthesis@essex.ac.uk

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ISSN 1751-9853

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Design and the Art of Management — *themed issue*

Ken Friedman, Laurene Vaughan and Jonathan Vickery

The editors of *Aesthesis* have been thinking of new approaches to 'the art of management' – or perhaps thinking about new ways to approach old problems. It seemed natural for us to think of design and design thinking as central to this intellectual endeavour – design is the process by which designated problem-solvers address the problems of legitimate stakeholders using innovation and creativity. But design is more than just problem solving. Design engages the sensibility, and designed artefacts take their shape in terms of feeling and form as well as function. The papers submitted for this issue on design, management, and organization covered all those areas and more.

In different shapes and guises, the articles in this issue all merge on the subject of 'design thinking', whether looking at 'tools', processes, experience or interactions. In terms of subject matter, the term 'design' in this issue emerges as a dynamic element of investigation into organizational learning, collaborative networks, product development, organizational resource management, service capability development, strategic urban planning, organizational creativity, contemporary art, and the conceptual-philosophical content of the epistemic functions of design that give us frameworks to think, create, assess, analyse and evaluate. Design always involves three great questions. How do we make things? How do we make things work? How do we make things work better?

Nobel Laureate Herbert Simon (1982: 129) defines design as the process by which we '[de]vise' courses of action aimed at changing existing situations into preferred ones.' Creating something new or reshaping something that exists for a purpose, meeting a need, and solving a problem, are courses of action toward a preferred situation even though we may not yet be able to articulate this preferred situation. This definition therefore covers most forms of design.

Design is not necessarily an outcome, but rather a process. The verb 'design' describes a process of thought and planning, and this verb takes precedence over all other meanings. The word 'design' had a place in the English language by the 1500s; its first written citation dates from the year 1548. Merriam-Webster (1993: 343) defines the verb design as 'to conceive and plan out in the mind; to have as a specific purpose; to devise for a specific function or end'. Related to these definitions is the act of drawing, with an emphasis on the nature of the drawing as a plan or map, as well as 'to draw plans for; to create, fashion, execute or construct according to plan'.

The American architect and designer Buckminster Fuller (1981: 229-231) describes design as the difference between a 'class-one evolution' and 'class-two evolution'. Class-one evolution is natural evolution according to Darwin, the natural phenomena studied through evolutionary biology. Class-two evolution involves 'all those events that seem to be resultant upon human initiative-taking or political reforms that adjust to the change wrought by the progressive introduction of environment-altering artifacts' (Fuller 1981: 229). Design is both intrinsic and essential to human development in a fundamental sense, but also creates artefacts that change the very context of that development.

One argument for the importance of design is the increasing number of areas now subject to human initiative. The vast range of technologies that surround us mediate most of the human world and influence our daily lives. These include the artifacts of information technology, mass media, telecommunication, chemistry, pharmacology, chemical engineering, and mechanical engineering, along with the designed processes of nearly every service industry and public good now available other than public access to nature. Within the next few years, these areas will come to include the artifacts of biotechnology, nanotechnology, and the new hybrid technologies.

Fuller's metaphor of 'the critical path', which was the title of his last book (1983), articulated a scenario where our world is as much subject to disintegration as it is development or growing better. The way that the new artificial world affects the natural world has immense ramifications that parallel Fuller's idea of class-two evolution. This is what Victor Margolin (2002) called 'the politics of the artificial', where design has become so intrinsic to our environmental development that we need seriously to assess its power, and create new boundaries, ethics and agreed protocols.

Design plays a role in the evolution of an increasingly manufactured world, from ordinary objects to advanced technology. The design process takes on new meaning as designers take on increasingly important tasks. These tasks are important not because designers are more visible and prestigious, but because design has greater effects and wider scope than ever before. Despite this scope and scale, however, robust design solutions are always based on and embedded in specific problems. In Jens Bernsen's (1986) memorable phrase, the problem comes first in design. Each problem implies partially new solutions located in a specific context. The continual interaction of design problems and design solutions

generates the problematics and knowledge of the field.

Design as an activity translates utilitarian, symbolic, and psychological needs into functions; it translates needs and wants into ideas; and it translates these ideas into the structural descriptions and entities to produce required functions that satisfy needs. As such, design always serves strategic goals on some level, large or small. The different forms of professional design practice require a process incorporating the strategic and managerial aspects of design as well as the hands-on developmental application of design. These move from thinking, research, and planning at one end of the process, on to manufacture, assembly, packaging, and presentation at the other.

For business firms, design is a comprehensive part of an integrated process that links selecting challenges and solving problems to developing products and marketing them successfully. For business firms, design is a comprehensive part of an integrated process that links selecting challenges and solving problems to developing products and marketing them successfully. The immaterial forms of design process have long been hidden, and now we are in the midst of a transition. Getting from one point to the next in this complex map of process, project, and product requires 'design thinking'. Design is in the business literature and designers are being brought in to organizations as they seek new ways of being, working, and producing. It is an exciting time of evolution. The literature on design thinking and the role and contribution of design to the fields of organizational and business development is expanding – and this issue of *Aesthesis* is part of this process.

REFERENCES

- Bernsen, J. (1986) *Design: The Problem Comes First*, Copenhagen: Danish Design Council.
Fuller, B. (1981) *Critical Path*, New York: St. Martin's Press.
Margolin, V. (2002) *The Politics of the Artificial: Essays on Design and Design Studies*, Chicago: University of Chicago Press.
Merriam-Webster, Inc (1993) Merriam-Webster's Collegiate Dictionary (Tenth edition), Springfield, Mass.
Simon, H. (1982) *The Sciences of the Artificial* (second edition), Cambridge, Mass.: MIT Press.

Ken Friedman is Dean of Design at Swinburne University, Melbourne, Australia
KenFriedman@groupwise.swin.edu.au

Laurene Vaughan is Research Leader in the Design Research Institute, RMIT University, Melbourne, Australia.
laurene.vaughan@rmit.edu.au

Jonathan Vickery is an editor and designer of *Aesthesis*, and creator of the Masters in International Design and Communication Management at Warwick University.
J.P.Vickery@warwick.ac.uk

Building Design Capability through Design Resource: the Case of Duck Image

Tung-Jung Sung and Pai-Yu Chang

In the study of design, most people are inevitably drawn to the processes of 'inventive' productivity – origination, creation, planning, implementation for the purposes of developing a product, system, image or component. And most attention is usually awarded to the *object* of design, the celebrated qualities that express the inventiveness of design – distinctive form, innovative structure, compelling aesthetic appearance, effective ergonomics, and so on. In the last few years, however, more attention has been paid to the *contexts* of design and its productive processes – both management contexts (the immediate business or industrial environment facilitating production) and socio-cultural contexts (the various markets, and users and their social and consumer culture or sub-cultures). However, the 'organizational' dimension of design productivity does not attract a great deal of attention. Saying that 'designers produce design' is a deceiving truism, as (most) designers only work effectively within specific organizational configurations – and more importantly for our paper, there are organizations that understand how their organizational life is *active in the design production process*, and organizations that think of themselves merely as the industrial *site* or facility for design productivity.

How does an organization 'think' strategically about its relation to the design production processes active within it? How does it understand and use both the latent and manifest design knowledge and skills beyond the limited orbit of its individual designers, design teams and IT design databases?

This paper will explore the way that strategic thinking in an organization can increase by a shift from a fixation with its external competitive environment to its own organizational condition, in order to capitalize on its existing range of design competencies. We will be considering how *design resources*, often considered peripheral, can be a source of essential and *strategic design capability* for the organization. To do this we will be drawing on an extensive case study of the Taiwanese design consultancy, Duck Image Corporation. The organizational principles we will be discussing are relevant far beyond 'design companies', but in this case a design company provides a rich example of an organization that has really thought through our central issues of concern. The unlikely named 'Duck Image' is a company in receipt of over 40 international design awards that include the Golden award at the 2006 iF Product Design Awards; the 'Best of the best' at the 2006 Reddot Design Awards; and was a Gold Winner at the IDEA awards for five years (from 2003 to 2007).

The central aim of this paper then is to assess how the company Duck Image identified and utilizes valuable design resources to extend and develop distinctive design capabilities. What this study finds is based on some established observations: first, that company reputation can represent a crucial and valuable design resource in so far as it can enhance other tangible and intangible design resources. We identify how this can be done. Second, the innovation and application of new materials can represent a vital and distinctive design capability in so far as it can augment other design capabilities. Design capability is internally involved in a range of tangible and intangible design resources. We identify, in turn, how design resources affect design capabilities; we do so specifically concerned with the business of design consultancy but our tabulated analysis is, we hope, useful far beyond this context. Accordingly, we will discuss in brief the implications of our analysis, and suggest several avenues for future research.

INTRODUCTION

Taiwan is an economy that, since the 1970s, has had to keep moving, developing and extending its industrial capacities in the global marketplace. Vast changes in the global economy have necessitated that Taiwanese companies, if they are to remain internationally competitive, aim to develop at the highest level. The global economy is not forgiving if we fail to do that. Consequently in recent years, Taiwanese firms have worked hard at R&D and innovation, and have performed well at international design competitions. At the 2006 iF Product Design Awards, Taiwanese firms won no less than sixty-five awards (including 2 gold awards), second only to Germany, the sponsoring nation. Of these awards, twenty-one were developed by *design consultancy companies*. These Taiwanese design companies are particularly interesting with regard their cross-sectoral range of professional aspirations and willingness to step out beyond international design conventions. Taiwanese design consultancies (hereafter we will refer to them generically as 'design companies') do not 'play safe' and are pushing ahead determined to pass the level of innovation and management competency established by global industry leaders in Europe and America. It's our task here therefore to explore the factors that generate this new developing aspiration and these new competencies. In this study, we first examine two major research areas mentioned above – organizational resource and capability. Following that, we identify the specific content of design resource and capability. Finally, we adopt the resource-based view (RBV) theory and illustrate how the design company Duck Image engages a strategic organizational process in utilizing valuable design resources to construct a range of distinctive design capabilities.

Based on RBV theory, an organization can be understood as a combination of resources. These resources evidently not only shape the effectiveness and efficiency of the organization, say a firm, but also have an impact on its success and growth (Collis and Montgomery 1995). In contrast to Porter's (1985) competitive strategy analyses, focusing on the firm's external competitive environment, RBV establishes the need for a fit between the external market context in which a company operates and its internal organizational capabilities. Furthermore, RBV suggested that differences in the firms' performance are related to the variances in the firms' resources. Basically, the RBV theory can help us to explain why various companies in the same industry have varied performances and why some companies can continuously outperform their competitors. Thus, this study will expand the RBV theory to explore the contents of design resources and design capabilities in the following sections.

THE RESOURCE-BASED VIEW

RBV theory emphasizes that internal resources and capabilities are crucial sources of a firm's competitive advantage (Barney 1991; Wernerfelt 1984). Basically, a firm's competitive advantages derive from their cumulative strategic resources (such as their valuable assets and capabilities). From this point of view, RBV treated resources as the basic unit of analysis for competitive advantage, and capabilities as the result of complex combinations of different resources (Amit and Schoemaker 1993; Grant, 1991). Grant (1991) has pointed out that these capabilities are not only a combination of the resources, but also a complicated coordination process among various resources. The characteristics of a firm's resources are the valuable attributes that can include uniqueness, specialism and 'ambiguity' (a strategic recognition of the value of the uncertain or undefined); the characteristics of a firm's capabilities are the valuable attributes that can include rareness, inimitability and non-substitutability (Amit and Schoemaker 1993; Barney 1991; Collis and Montgomery 1995; Grant 1991; Wernerfelt 1984). Table 1 shows us the attributes and characteristics of resources and capabilities respectively.

Table 1: Attributes and characteristics of resources and capabilities

Item	Attribute	Characteristics	Description	Author(s)
resources	valuable	uniqueness	the improvement of business efficiency and effectiveness	B, C, D, E
		specialty	the fitness of organizational routines or processes	A, B, C, D, E
		ambiguity	the degree of intangibility and complexity	B, C, D
capabilities	distinctive	rareness	the degree to which something is unavailable to competitors	A, B, C, E
		inimitability	the degree to which something is not imitable by competitors	A, B, C, D, E
		non-substitutability	the degree to which something is not replaceable by other capabilities	A, B, C, E

Note: A = Amit & Schoemaker (1993); B = Barney (1991); C = Collis & Montgomery (1995); D = Grant (1991); E: Wernerfelt (1984)

Design Resources

Our 'resources' are thus regarded as a key source of a firm's competitive advantage, 'design resources' can be identified discretely as a specific source of a firm's competitive advantage. Spivey et al. (1997) pointed out that the development of new products can involve certain categories of information resource (whether internal and external information), infrastructural resource (such as a technology portfolio or human resources), but also funds and even time. Turner (1990) has classified these design resources in terms of *tangible resources* (for example, design manpower, professional facilities, design funds) and *intangible resources* (we could say, technological knowledge and inter-industrial relationships). In an empirical study of design resources, Sung (1997) also found the categories of tangible and intangible analytically useful. Although previous studies have undertaken various perspectives or approaches to the classification of design resources, in this study we adopt a general approach, wherein tangible design resources represent physical design production-based assets and intangible design resources represent knowledge and professional or industrial relationship-based assets. We define design resource as a whole in terms of tangible or intangible valuable resources, which can be acquired or deployed in a firm's design activities. As shown in Table 2, tangible design resources consist of design manpower, design funds, and profes-

sional facilities, while intangible design resources comprise design experience, company reputation, management mechanisms, and relationship with suppliers and clients.

Design Capabilities

In an organization, capabilities can be defined as the repeatable patterns of action that employ assets to perform value chain activities (Sanchez et al. 1997: 7). Such repeated patterns of action are significant to the development of dynamic capabilities (Eisenhardt and Martin 2000). The notion of design capability in this study indicates the robust design capacity, which is firm-specific and embedded, presenting repeated patterns of design actions in a firm. Design capability is likely to enhance a firm's ability to gain sustainable competitive advantages by deploying or reconfiguring design resources so as to satisfy the requirements of specific targeted markets and customers. Bettis and Hitt (1995) further explained that the robust design capacity can effectively emerge as an organizational response to rapid environmental and technological changes. Swan et al. (2005) further classified robust design capabilities into four dimensions: functionality, aesthetics, technology, and quality, as shown in Table 3.

Table 2: Types of design resources

Type	Item	Description	Author(s)
tangible design resources	design manpower	professional designers and other support employees	A, B, C
	design funds	a sum of money whose principal or interest is allocated for design objectives	A, B, C
	professional facilities	design-related facilities (e.g., measuring equipment, computer hardware or software, or factories)	B, C
intangible design resources	design experience	experience with regard to designing various design-projects or products	A, B, C
	company reputation	high esteem in public opinion (acquired by means of high quality of design service or winning international design awards)	A
	management mechanisms	an informative or integrated process, technique, or system for achieving a result	A
	supplier relationship	relationship with the suppliers of design materials or production processes	B
	client relationship	relationship with various clients	A, B

Note A = Turner (1990); B = Spivey et al. (1997); C = Sung (2001)

Table 3: Four dimensions of design capabilities

Dimension	Item	Author(s)
Design function	> versatility with respect to functionality	Swan et al. (2005)
	> adaptability to various environments	
Design aesthetics	> presenting specific semantic information	Swan et al. (2005)
	> providing positive visual experience	
Design technology	> extension of core product technologies	Swan et al. (2005)
	> integration of various product technologies	
	> innovation and application of new materials	
Design quality	> prevention of production problems	Garvin (1984); Swan et al. (2005)
	> improvement in the usability of products	
	> improvement in the durability of products	
	> conformity to various design specifications	

Design Function Capability

Swan et al. (2005) argued that products can be designed to be robust with respect to a range of uses. Design function capability mainly involves designing products with similar technology but with the versatility and adaptability to be extendable to a substantial product family. In essence, design function capability renders designed products adaptable to different users and environments. Therefore, design function capability comprises two major components: *versatility* and *adaptability*.

Design Aesthetics Capability

Generally speaking, and as observed by countless design theorists, aesthetic-based design capability can play a central role in driving design productivity by creating differentiation, communication, and motivation, and it can do this in many different ways (Bloch 1995). At the same time, of course, aesthetics provides designed products with the crucial visually informative capability. With regard to aesthetic presentation, Eckman and Wanger (1994) argued that the judgments of consumers are often affected strongly by four apparent visual characteristics of products: silhouette, color, shape, and pattern. Capabilities concerning design aesthetics, therefore, include color match, shape forming, and pattern presentation. Swan et al. (2005) also pointed out that capabilities concerning design aesthetics entail those that improve product values through semantic – a positive intelligible message. In addition to discussing aesthetic presentation, Swan et al. (2005) emphasized the effectiveness of design aesthetics and explained it as a capability that involves psychological, physical and physiological know-how. For them, design aesthetics capability comprises two major components: the presentation of specific semantic information, and the provision of positive visual experience.

Design Technology Capability

On the whole, innovative design technological capabilities offer a future-oriented vision with respect to the next generation of products (Marsh and Stock 2003). The main function of design technology is the determination of the core product technology and materials that satisfy the current and future technical and customer requirements (Swan et al. 2005). Furthermore, Swan et al. (2005) argued that design technology capability should emphasize a range of product knowledge across various generations with core components, parts, or materials for product development. Therefore, design technology capability comprises three major components: the *extension of core product technologies*, *integration of different product technologies*, and *innovation and application of new materials*.

Design Quality Capability

Within the spectrum of design activities, design quality refers to the capacity for solving and preventing future quality problems in the design stage. Swan et al. (2005) emphasized that this capability can proactively prevent deviations from the established requirements at other stages, such as manufacturing, assembly, or customer usage. With regard to a user's perspective, Swan et al. (2005) pointed out that design quality of products is often assessed by their usability. Therefore, an improvement in the usability of products can be regarded as the main constituent of design quality. Garvin (1984) proposed eight different quality dimensions: performance, features, reliability, conformance, durability, serviceability, aesthetics, and perceived quality. At the beginning stages of design, several design companies describe to customers the various performance characteristics associated with these quality dimensions. In this study, we define design quality as the capacity to conform to various design specifications. Furthermore, since both reliability and consistency are associated with the relationship between manufacturing and design, it can be interpreted as the means of preventing production problems. Moreover, since we have tentatively explored the dimension of aesthetics and established the correspondence with the notion of design aesthetics capability, this research excludes aesthetics per se from design quality. Finally, serviceability and perceived quality (the perception of the consumer) has little relation with design quality, and are therefore put to one side in this discussion. Therefore, to summarise, design quality capability comprises four major components: *preventing production problems*, *improving the usability of products*, *increasing the durability of products*, and *conformity of various design specifications*.

On the whole, this study illustrates the characteristics of design resources and design capabilities as follows:

- 1) **Valuable design resources:** According to the RBV of the firm, design resources that a firm is able to acquire or deploy must be valuable with respect to uniqueness, specialism, and 'ambiguity' (or strategic approach to the uncertain). Design resources can be divided into two categories: *tangible design resources* and *intangible design resources*.
- 2) **Distinctive design capabilities:** Consistent with the proposal of Swan et al (2005), the components of design capabil-

ity can be classified as *design function*, *design aesthetics*, *design technology*, and *design quality*. In general, a firm can leverage its design resources to generate distinctive design capability with respect to their rareness, inimitability, and non-substitutability, and thereby, create sustainable robust competitive design advantages.

As mentioned earlier, by extending the concept of RBV with respect to resources and capabilities, we will now examine the specific contents of design resources and design capabilities; and we will explore the impact of design resource on design capability by means of a case study.

DUCK IMAGE

Duck Image Corporation is a Taiwanese design company founded in 1995. The company is located in Tai-Chung along the main western coastal plain of Taiwan. Tai-Chung is the central hub for Taiwan's machinery industry with a complete upstream and downstream industrial system. Duck Image provides a wide range of design services such as product design, commercial design, packaging design, web design, and architectural concepts. Despite the complexity and inherent specialisation of these different areas, Duck Image exemplifies a number of principles of Eastern philosophy, one such being *simplicity*. We have selected Duck Image for a number of reasons. Duck Image is a design consultancy and service-oriented company, and their developing interdisciplinary expertise has allowed us to examine a wide range of issues regarding design resources and design capabilities. Secondly, in recent years (2003–2007), Duck Image has positioned itself on the international stage, receiving international design awards, including seventeen iF Design Awards, thirteen Reddot Design Awards, nine G-mark Design Awards, and one IDEA Design Award (2006). Duck Image is the first Taiwanese design company to obtain the 2006 IDEA Gold award for designing a specific product (see Figure 1); they also received the 2006 iF Golden Awards (see Figure 2) and the 2006 Reddot 'Best of the Best' award (see Figure 3). Our third motivation for studying Duck Image is that in contrast with the 3C industry (computer, communication and consumer electronic) that many Taiwanese design companies are immersed within, most of Duck Image's clients are in the traditional industries (such as textiles, materials, light metals, and sporting and recreational industries). Lastly, in the periods 1995/1997 to 2006/2007, the growth rate of Duck Image's average annual revenue increased forty fold, as shown in Table 4.

Table 4: The profile of design resources and design capabilities in Duck Image

Category		Dimension				
		Year(s)	1995 ~ 1997	1998 ~ 1999	2000 ~ 2005	2006 ~2007
Design Resource		Number of clients	4	10	11	10
		Revenue (US\$/year)	50,000	166,000	260,000	2,000,000
		Customer Contribution (US\$/year)	12,500	16,600	23,600	200,000
		Business type	personal studio	small design firm	medium design firm	integrated design firm
		Design manpower	1	3~4	6 ~ 12	35~50 with various business functions (e.g., design, finance, management, public relations, and brand sectors)
Design Resource		Design funds	Balance (sole proprietorship)	Balance (joint venture with shareholders)	2000-2003 as 1998-1999 2004-2005 increase in design revenue	Increase in design revenue (e.g., introduction of foreign investment and an increase in design income)
		Professional facilities	Computer-related professional facilities	Computer-related professional facilities	Adding Materials Research and Development facilities [e.g., dust-free laboratory, 2005]	Adding Aesthetic Perception Center
		Design experience	3C, leather goods and textiles	3C, leather goods and textiles	3C, hand tools, leather goods, textiles, and medical professional products	3C, hand tools, stationery, leather goods, toys, sporting professional facilities, textiles and medical professional products
		Company reputation	Good service reputation	Good service reputation	Receiving the iF, G-mark, and Reddot international design awards (2003) Receiving the iF material Award (2005)	Awarded the IDEA Gold award (2006) Awarded the iF Gold award (2006) Awarded the Reddot "Best of the Best" award (2006)
		Management mechanisms	N.A.	Single functional management	Multi-functional management	Management by professional managers Internal knowledge of the management platform
Design Capability		Supplier relationship	General partnerships (good relationships with mold, materials, processing, and production suppliers.)	General partnerships (good relationships with mold, materials, processing, and production technology suppliers.)	General partnerships (good relationships with mold, materials, processing, and production technology suppliers.)	Strategic alliance with national R&D center (e.g., the ITRI, MIRDC, and PIDC).
		Client relationship	Design consultancy Trade relationship	Design consultancy Trade relationship	Signing loyalty and sharing profit of product sales with clients	Signing loyalty and sharing profit of product sales with clients Strategic alliance with the customer
		Versatility with respect to functionality	N.A.	N.A.	Use product of dual function (e.g., Luxo, bicycle light and flashlight)	Use product of dual function (e.g., I-111 Bicycle Light)
		Adaptability to various environments	N.A.	N.A.	For different climatic conditions (e.g., Luxo Bicycle Light can be used in both sunny and rainy day.)	For different weather conditions (e.g., Construction Fence can withstand 16-degree winds.)
		Presenting specific semantic information	N.A.	N.A.	Transferring some stereotype images from other products (e.g., 007 Flash Drive is shaped with a combination lock.)	Transferring some stereotype images from other products using special symbols to products (e.g., applies Tai-chi symbol on Tai-chi Ball Toy to imply product function)
Design Capability		Providing positive visual experience	N.A.	N.A.	Employing dual semantic code (e.g., MS 2400 Baby Scale use fluent curves and simply symmetrical form to translate both soft and precise image.)	Employing dual semantic code (e.g., Construction Fence can be installed lights and embedded plant to beautify the site environment.)
		Extension of core product technologies	N.A.	N.A.	Adopting core technology as a product platform (e.g., VAM-5101 Vacuum Anti-moisture dry box and VAM-6101 Vacuum Anti-Moisture Violin Dry Box apply the same 'vacuum' technology.)	Adopting dual core technologies as a product platform (e.g., Luxo Bicycle Light and Inhhil-I-111 Bicycle Light use the same TPR flexible bracket, and aluminum shell technologies)
		Integration of various product technologies	N.A.	N.A.	Integration variety of technologies into products (e.g., Solar Power Vest applies both solar and fabric technologies)	Integration variety of technologies into products
		Innovation and application of new materials	Applications of metal and plastic tooling applications of special materials (textiles and leather goods)	Applications of metal and plastic processing and tooling applications of special materials	Application of other materials in traditional products (e.g., applies TPR material to Tension Flash Drive) Establishing own materials laboratory in 2003.	Application of ABS material to Construction Fence
Design Quality		Prevention of production problems	Preventing production problems by operators	Preventing production problems by suppliers	Integration mechanical consultants and material labs (e.g., Carbon container could save the costs on storage and transportation)	The integration of materials companies and mechanical consultants (e.g., converting wind into the power energy)
		Improvement in the usability of products	N.A.	N.A.	Emphasizing lightweight with a new material (e.g., FRP Wrench adopting glass fiber to reduce 20% weight and hand hold fatigue to improve the comfort of the user.)	Adding product functions to provide users' convenience (e.g., Car battery Reviver and Charger can directly entangle body in power lines.)
		Improvement in the durability of products	N.A.	N.A.	New application on materials (e.g., using stainless steel material to Manimo Flash Drive)	Adopting modular parts (e.g., Construction Fence can be partially repaired with the replacement of defective parts.)
		Conformity to various design specifications	N.A.	N.A.	Achieving vacuum effect (e.g., to fit IPC / JEDEC preservation standard in Vacuum Dry Boxes)	To fulfill with the relevant national and international safety standards

DUCK IMAGE'S DESIGN RESOURCES AND DESIGN CAPABILITIES

Design resources in Duck Image

During its early years, Duck Image started its design service business in a one-man design studio. Owing to the background of the founder (currently, the Design Director) who has considerable practical experience in design, especially with regard to plastic products, metal parts, fabric, and tooling, Duck Image undertook its first design project (a briefcase) in 1995. As stated earlier, Duck Image is located in the central region of Taiwan. The advantages of the location enable Duck Image to avail itself of more opportunities to adopt and integrate sophisticated technologies such as precision machinery into its design process, more so than its competitors. By 2002, Duck Image had become a small design company with six employees. At the time, because of its excellent design service reputation, some of Duck Image's clients were willing to sign an annual design consultancy contract. This contract not only provided Duck Image with a steady and considerable revenue stream, but provided a framework for the company to develop a particular relationship with its clients. In addition, Duck Image invested particular effort to the innovation and application of new materials. This commitment played a significant role not only in Duck Image winning its first iF award in 2003, but also in further increasing its basic annual revenue. Winning renowned international design awards such as the iF, Reddot, or G-mark awards, provided the means for leveraging the company's reputation quickly, which in turn created greater opportunities to undertake new or different design projects. Duck Image also discovered that receiving a renowned international design award is tantamount to an effective design service strategy that attracts clients for business restructuring and brand building. Duck Image then strategically focused on the clients in the traditional industries (rather than the 3C industries) and convinced them to participate in their international design competition aspirations. Duck Image received eleven international design awards in the year 2005 alone. Consequently, Duck Image, now something of an idol of the mass media in Taiwan, regularly exhibited its design works in public, deliberately boosting in public as well as industrial profile. Duck Image was convinced that awards mean more projects. Simply put, a high-profile reputation enabled Duck Image to gain both direct benefits (such as annual revenue) and indirect benefits (such as industrially diverse design experience).



Figure 1 : Construction Fence (2006 IDEA Gold Winner)



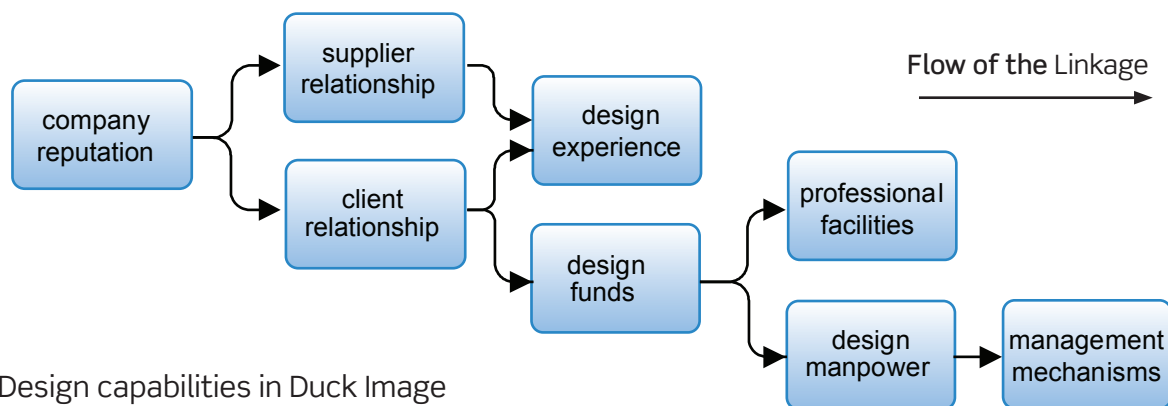
Figure 2 : Luxo Bicycle Light (2006 iF Golden Award)



Figure 3 : Wind-Power Bicycle Lamp (2006 reddot Best of the Best)

In recent years, Duck Image's international awards success attracted much attention from potential clients with new materials seeking design outsourcing. In particular, Duck Image had cooperated with a number of national R&D centers in Taiwan, such as the Industrial Technology Research Institute (ITRI), the Metal Industries Research and Development Centre (MIRDC), and the Plastic Industries Development Centre (PIDC), and through this cooperation built strategic alliances involving access to new materials and related advanced technologies. In terms of their management structure, Duck Image is simple, largely on account of its small business scale. However, since 2006, in response to increased competition from overseas and other domestic design service providers, Duck Image rapidly expanded its design manpower (from 12 to 35), which prompted a management re-structure. Through this process the founder was forced to introduce a professional management system and established an internal design-knowledge management platform to efficiently improve design performance and effectively manage design knowledge – maintaining the priority of design over general management administration.

So far we have conveyed the way that Duck Image's tangible design resources comprise *design manpower, design funds, and professional facilities*, while its intangible design resources consist of *design experience, company reputation, management mechanism, and relationships with clients and suppliers*. Furthermore, using the Duck Image case, we infer that a particular design resource can augment other design resources. For example, the industrial—public reputation of a company can play a vital role in strengthening the relationship between a firm and its clients or (suppliers), and the stronger the client (or supplier) relationship, the greater the effective access to design funds and design experience. Consequently, larger design revenues will allow the firm to expand the design manpower and improve professional facilities that could facilitate better design performance. As shown in Figure 4, owing to the augmentation of design manpower, certain management mechanisms should be adjusted accordingly and diverse experience or knowledge related to design thereby accumulated.



Design capabilities in Duck Image

Design function capability

The design director of Duck Image explained “Compared with other designers, the designer who has greater design experience usually performs better with regard to design function capability.” Considering the Luxo Bicycle Light [Figure 2] and Infini I-111 Bicycle Light [Figure 5] as examples: as well as the standard functionality of a bicycle light, the two products employ a thermoplastic rubber (TPR) with high flexibility, and the fixed bracket allows each flashlight to be lit individually. Adding to this versatility, the company's ability to adapt to different environments is indicated by such elements like the waterproof silicone rings. The success of these two design projects depended not only on design experience, but on the design manpower possessing engineering-related knowledge. The design director of Duck Image has also stated: *‘To adapt to different environments, products often have to be tested under various experiments (such as the durability test); therefore, the success of these tests not only relies on professional facilities such as a material laboratory, wherein to carry out the experiments, but also the support of external suppliers. For example, the resistance of the housing to corrosion in Luxo Bicycle Light [Figure 2] can be verified by means of the equipment of the professional salt spray test at ITRI.*

As a result, professional facilities and supplier relationships at Duck Image are related to its adaptability to various environments. Therefore, design manpower, design experience, and company reputation with respect to design resources, are cumulatively related to design function capabilities, while professional facilities and supplier relationships are related to the company's adaptability to various environments. The relationship between design resources and design capabilities in Duck Image are depicted in Table 5.

Figure 4: Linkages of Various Design Resources in Duck Image

Design aesthetics capability

In light of the capability of transferring specific semantic information, the 007 Flash Drive [Figure 6] uses a combination lock with an anti-theft steel wire and a stainless steel cap that ensure the uncompromised preservation of the data. The design of the product provides a visual metaphor of security, along with the specific semantic information for the user. Moreover, the Tai-chi Ball Toy [Figure 7], which won the Reddot and iF awards, not only applies the ‘Tai-chi’ code to the product form, but also incorporates the principles of harmony, symmetry, and continuous circulation to the function thereby, enhancing the user’s dexterity and hand-eye coordination. With regard to the capability of providing positive visual experiences, the design director of Duck Image stated: ‘The capability of transferring specific semantic information is essentially a result of professional design training. In earlier years, I had employed only a single semantic code in design projects. However, I have tried to utilize dual or multiple semantic codes for product design after graduating from the graduate design school.’

The MS 2400 Baby Scale is a case in point. On the one hand, the product, [Figure 8] which possesses a soft and fluent curved form, provides the user soft, safe, and precise images that differentiate it from the traditional scale; on the other hand, the design of spread-end edges represents a ‘high-tech’ appearance. It must also be noted, that winning international design awards lends credibility to the company’s aesthetic judgment, and goes some way to convince the client of aesthetic-related concepts. To conclude, design manpower, design experience, and company reputation are associated with the capabilities of design aesthetics.

Table 5: The relationship between design resources and design capabilities at Duck Image

Design Resource		Dim.	Tangible			Intangible				
		Item	design manpower	design funds	professional design facilities	design experience	company reputation	management mechanisms	supplier relationship	client relationship
Design Capability		Dim.	Item							
design function	> versatility with respect to functionality		◇			◇	◇			
	> adaptability to various environments		◇		◇	◇	◇		◇	
design aesthetics	> presenting specific semantic information		◇			◇	◇			
	> providing positive visual experience		◇			◇	◇			
design technology	> extension of core product technologies		◇	◇		◇	◇	◇	◇	◇
	> integration of various product technologies		◇	◇		◇	◇	◇	◇	◇
	> innovation and application of new materials		◇	◇	◇	◇	◇	◇	◇	◇
design quality	> prevention of production problems		◇		◇	◇	◇	◇	◇	◇
	> improvement in the usability of products		◇		◇	◇	◇		◇	◇
	> improvement in the durability of products		◇		◇	◇	◇	◇	◇	◇
	> conformity to various design specifications		◇		◇	◇	◇	◇	◇	◇

Note: ◇ indicates there is an association between two items.

Design technology capability

The design of the Vacuum Anti-Moisture Violin Dry Box [Figure 9] and the Vacuum Anti-moisture Dry Box [figure 10], products that have won 5 international design awards, were occasioned by the extension of core product technologies; both possessed the same core technology—a built-in pump for creating a vacuum that integrates the pump and hermetically sealed technologies. Furthermore, with regard to the integration of various product technologies, the Air Cushioned Infant Scale [Figure 11] is an example of a product that integrates the pressure-detection technique with the air-cushioned pad technique. Moreover, Duck Image successfully applied the TPR material to the Tension Flash Drive [Figure 12] in 2005 and the fixed bracket of the Luxo bicycle light [Figure 2] in 2006, which demonstrates its capability of innovation and application of new materials.

Figure 5: Infini I-111 Bicycle Light (2007 iF Award)



Figure 6: 007 Flash Drive (2006 Reddot Award)



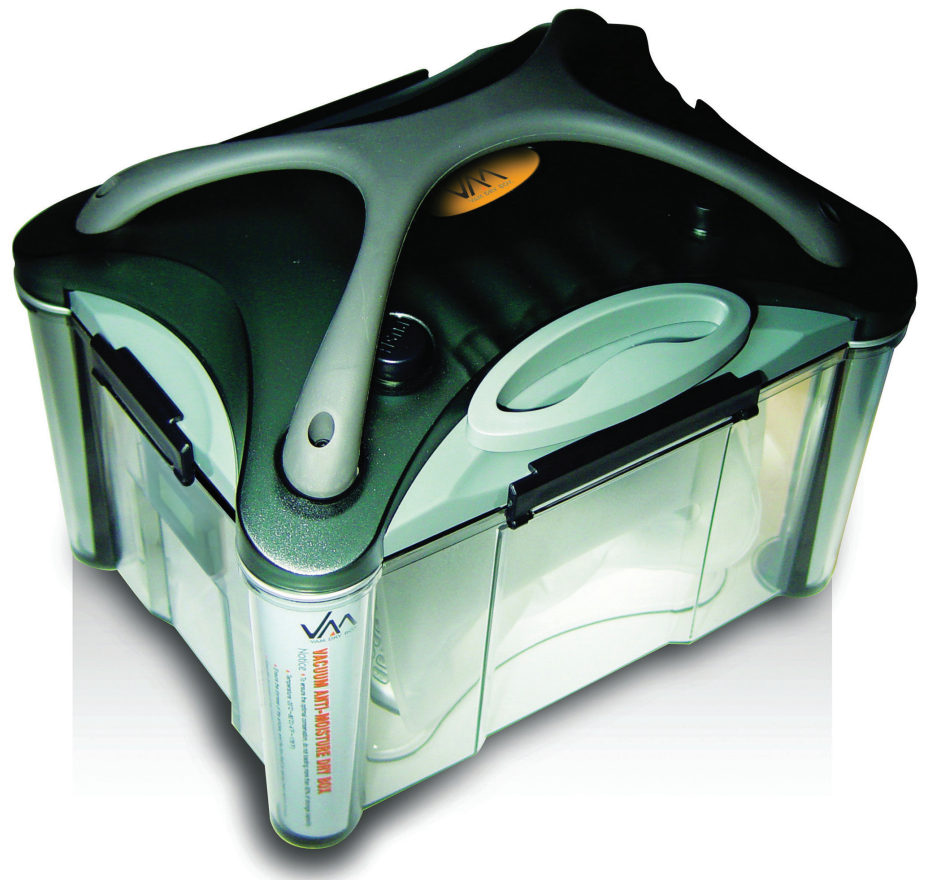
Figure 7: Tai-chi Ball Toy (2006 iF Award)

We discovered that design manpower, design funds, design experience, company reputation, management mechanisms, supplier relationship, and client relationships influence the overall design technology capability in Duck Image. Through its 'design experience' with respect to a series of next generation design projects, Duck Image accumulated know-how of diverse core technologies of products. The design director of Duck Image pointed out:

'Design manpower plays an important role with respect to design technology capability at Duck Image. And when a particular designer is interested in applying innovative technologies to new design projects, the design-related manpower (such as, mechanical engineering consultants or material scientific experts) provides expertise or support for finishing the sample test in time. In addition, the designer may also employ internal design knowledge management (DKM) platform in order to find alternative solutions.'

In contrast with other dimensions of design capabilities, 'design funds' often have indirect effects on the performance of design technology capabilities at Duck Image. Since design projects in the traditional industries often involve various material and production technologies, they occasionally need to be outsourced for the samples to be created. It is also important to note that the extension of core product technologies often needs to be authorized by the clients. At the same time, 'client relationship' and 'supplier relationship' have significant effects on the integration of various product technologies, since clients and suppliers regularly provide Duck Image with various integrated solutions for products. As for the innovation and new application of new materials, Duck Image has strategic alliances with the ITRI, MIRDC, and PIDC. These agreements facilitate the access of Duck Image to the most advanced materials. Thus, professional facilities and the relationship with suppliers and clients are associated with the innovation and new application of new materials at Duck Image.

Figure 10: VAM-5101 Vacuum Anti-moisture Dry Box (2005 G-mark Award, 2005 Reddot Award, and 2006 iF Award).



To conclude, design manpower, design funds, design experience, company reputation, management mechanisms, supplier relationship, and client relationship are associated with the overall design technology capability at Duck Image, while professional facilities and supplier relationship are associated with a few of them.

Design quality capability

In order to avoid any discrepancy between production and design specifications, Duck Image has successfully conducted the capacity test of energy storage for the Wind-Power Bicycle Lamp project [Figure 3]. This achievement demonstrated that it is capable of preventing production problems. Duck Image further adopted the carbon fiber sheet on the project of Carbon Container [Figure 13] with flat-shaped raw materials that could be conveniently stocked in warehouses during the transportation. Furthermore, Duck Image adopted FRP rather than the traditional metal for the grip of the FRP Wrench [Figure 14]

Table 6: Samples of the argument of the capability of 'innovation and application of new materials' on other design capabilities in Duck Image

Dimension	Item	Description
design function	> versatility with respect to various functions	Luxo Bicycle Light [Figure 2] applies TPR material to achieve multi-purpose function of flashlight and bicycle light
	> adaptability to various environments	Infini I-111 Bicycle Light [Figure 5] applies silicone sealed ring to make it water proof
design aesthetics	> presenting specific semantic information	007 Flash Drive [Figure 6] applies metal housing to allow users have visual sense of strength of the product
	> providing positive visual experience	Construction Fence [Figure 1] applies plastic material to enable it to beautify environment with backlight at night
design technology	> extension of core product technologies	To apply with TPR material as core technology on Luxo [Figure 2] and Infini I-111 [Figure 5] Bicycle Light
	> integration of various product technologies	Air Cushioned Infant Scale [Figure 11] integrates the pressure-detection technique with the air-cushioned pad technique.
design quality	> prevention of production problems	Carbon container [Figure 13] applies with flat-shaped raw materials and semi-finished products to facilitate their inventory
	> improvement in the usability of products	FRP Wrench [Figure 14] applies glass fiber material that can save 20% weight and reduce user's fatigue
	> improvement in the durability of products	Manimo Flash Drive [Figure 15] applies stainless steel shell and silicone ring to achieve waterproof effects
	> conformity to various design specifications	VAM-5101 Vacuum anti-moisture dry box [Figure 10] reaches sealing effect with silicone gasket to preserve content items, and are consistent with international norms of electronic components preservation



Figure 8: MS 2400 Baby Scale (2003 iF Award)



Figure 9: VAM-6101 Vacuum Anti- moisture Violin Dry Box (2005 iF Award and 2005 Reddot Award)

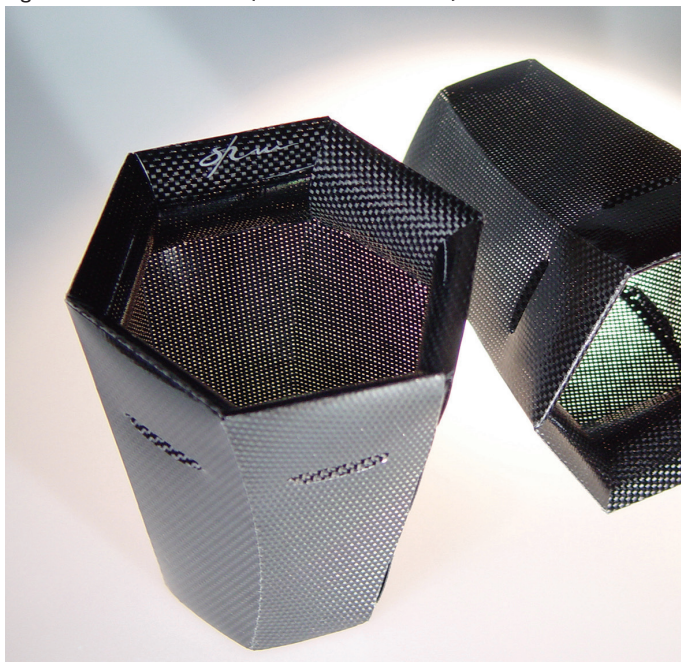
Figure 11: Air Cushioned Infant Scale (2008 iF award, 2008 Reddot Best of the Best)



Figure 12: Tension Flash Drive (2005 G-mark Award, 2005 Reddot Award)



Figure 13: Carbon container (2005 IF Material Award)



that resulted in 20% loss of total weight as well as reduced exhaustion-effect of the user's hand. This demonstrates the company's capability with respect to improving the usability of products. With regard to the capability of increasing the durability of products, Duck Image employed stainless steel to manufacture the case of the Manimo Flash Drive [Figure 15] in order to prevent scratches from appearing on the surface. In several industries, design projects are expected to follow specific design standards. For example, since the critical design requirement of the Vacuum Anti-moisture Dry Box [Figure 10] is to meet the specification of the real vacuum effect, the product has to pass the test of IPC/ JEDEC anti-moisture preservation. Furthermore, the CORCEL O-04E Car Battery Reviver and Charger [Figure 16] needs to fulfill the relevant safety standards for electrical appliances.

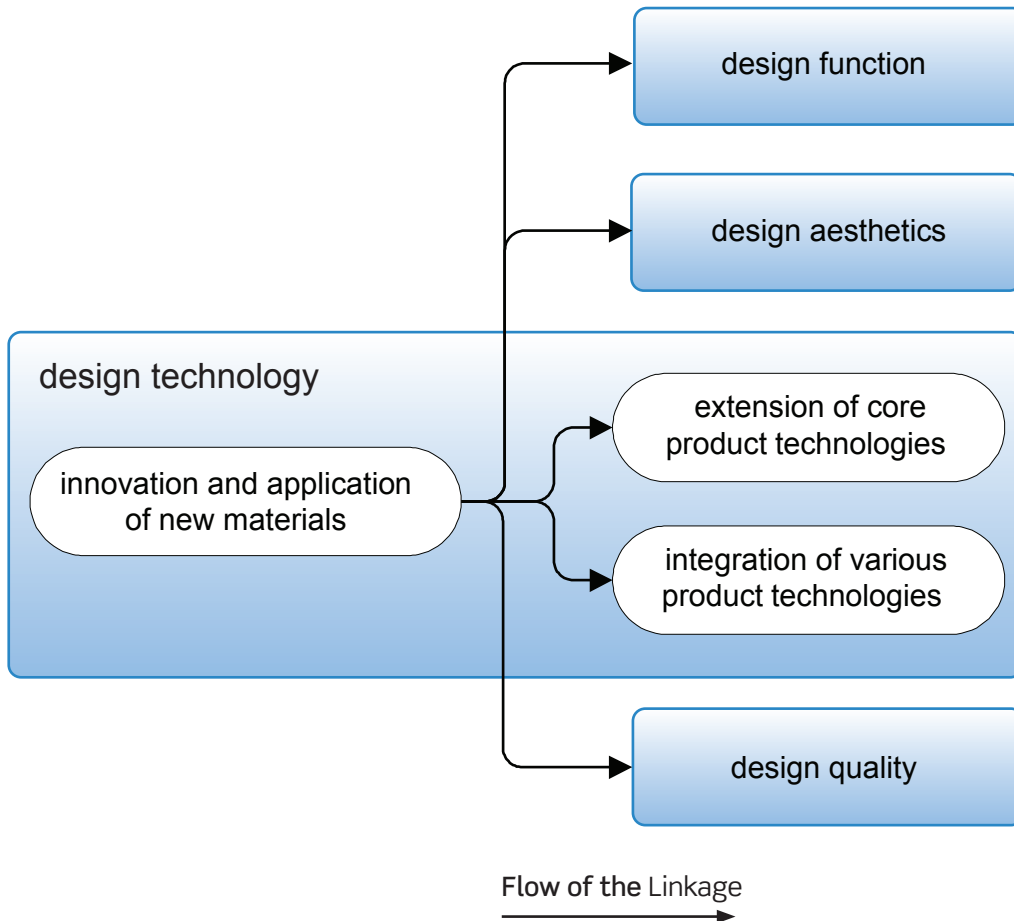
Considering 'design manpower' and 'professional facilities' as examples, to reach a high-level quality in the products, the various measurements largely depend on various professional facilities and design-related human resources. Certainly, it is necessary for the designer to have substantial design experience in order to be able to enhance the final design quality. Furthermore, a high-profile reputation reminds a company of the importance of sustaining expected standards of quality. The design director of Duck Image pointed out:

'Although different industries have different levels of requirements of the overall design quality, the requirements of the clients or suppliers can enhance our overall design quality capability.'

Thus, 'supplier relationship' and 'client relationship' are associated with Duck Image's overall design quality capability. In addition, the main functions of a design audit system, as one of their chosen management mechanisms, include the prevention of production problems, conformity to various design specifications, and improving the durability of products. To sum up, *design manpower, professional facilities, design experiences, company reputation, relationship with suppliers and clients* are all related to the design quality capabilities at Duck Image.

We found that the innovation and application of new materials constitutes one of the most distinctive design capabilities possessed by Duck Image. The reason is that this design capability can reinforce other design capabilities, as shown in Table 6. Consequently, the relationships between the four dimensions—design function, design aesthetics, design technology, and design quality—of design capabilities can be depicted as in Figure 17.

Figure 17: Linkages of Various Design Capabilities in Duck Image



DISCUSSION

As stated earlier, our study found that company profile and reputation (not always conceptualised as 'brand') can be a valuable design resource, and the innovation and application of materials one of the most important and distinctive design capabilities. With regard to the former, the study discovered that 'company reputation' is related to the tangible or intangible elements associated with Duck Image, as shown in Figure 4. The creation and innovative application of materials is related to the extension of core product technologies and the integration of various product technologies, with respect to design technology capabilities as well as the three other dimensions (design function, design aesthetics, and design quality) that they encompass. The relationships between design resources and design capabilities at Duck Image are shown in Figure 18.

CONCLUSION

In summary, our study found that Duck Image's tangible design resources include design manpower, design funds, and professional facilities, while its intangible design resources comprise design experience, company reputation, management mechanisms, and supplier and client relationships. Among them, company reputation is a crucial and valuable design resource. Moreover, Duck Image's design capabilities can be categorized into four dimensions: functionality, aesthetics, technology, and quality. The innovation and application of new materials is a vital and distinctive design capability at Duck Image. In the case of Duck Image, we also found that company reputation can enhance other tangible and intangible design resources, while the innovation and application of new materials can augment other design capabilities.



Figure 14: FRP Wrench (2004 G-mark Award and 2005 iF Material Award)



Figure 15: Manimo Flash Drive (2005 G-mark Award)



Figure 16: CORCEL O-04E Car Battery Reviver and Charger (2007 iF Award)

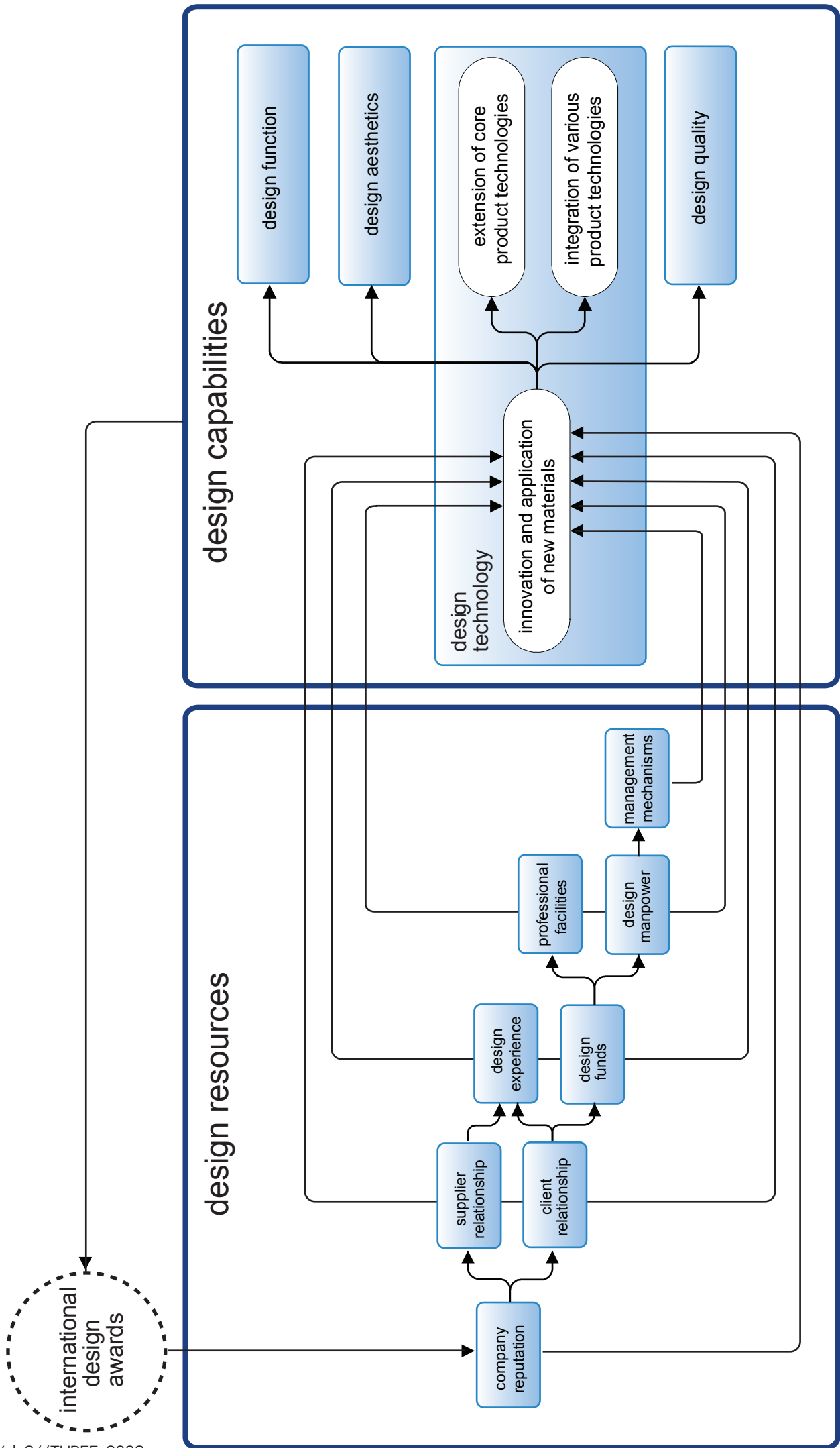


Figure 18: The Linkages between Design Resources and Design Capabilities in Duck Image

Design Management Practices

Although improvement in certain design resources and design capabilities is a central challenge that a company counters during its growth phase, it is necessary for Duck Image to establish an effective design resource and capability management mechanism to maintain a higher level quality of design service in design consultancy business. Winning design awards enhance Duck Image reputation's as a first-class design company; however, many unpredictable factors can prevent a firm from winning design awards (Gemser and Wijnberg 2002). Therefore, in terms of the practical implications of design management, Duck Image may need to discover other alternatives to sustain its public and industrial reputation. Furthermore, in order to respond to changes in fast-paced and competitive conditions, it is also important for Duck Image to consider how to effectively leverage design resources and adjust design capabilities in order to build its dynamic competence (Prahalad and Hamel 1990). Therefore, we suggest that Duck Image find the appropriate balance between investing in design resources versus design capabilities in the long run.

Limitations and Future Research

This study was conducted with regard to the Taiwan design consultancy business, and to some degree limited to the design business environment of these industrial sectors in Taiwan. Although the design resources and design capabilities possessed by firms and the market characteristics that condition firms' operations may differ with respect to geographic area and business types - which may pose certain limitations with respect to the widespread applicability of the findings - this study should shed light on the generic impact of design resource on design capability. Although the study has attempted to collect relevant information as far as possible by means of various channels - certain inferences were subjective with regard to the interviewee. Finally, exploring design resources or design capabilities through multiple cases or by comparing those in different countries, by means of the model presented in this study, is another promising direction for future research. //

REFERENCES

- Amit, R. and Schoemaker, P. J. H. (1993) 'Strategic and organizational rent', *Strategic Management Journal*, 14(1): 33-46.
- Barney, J. B. (1991) 'Firm resources and sustained competitive advantage', *Journal of Management*, 17(1): 99-120.
- Bettis, R. A. and Hitt, M. (1995) 'The new competitive landscape', *Strategic Management Journal*, 16 (Special Issue): 7-19.
- Bloch, P. H. (1995) 'Seeking the ideal form: Product design and consumer response', *Journal of Marketing*, 59(3): 16-29.
- Collis, D. J. and Montgomery, C. A. (1995) 'Competing on resources: Strategy in the 1990s', *Harvard Business Review*, 73(4): 118-128.
- Eckman, M. and Wagner, J. (1994) 'Judging the attractiveness of product design: The effect of visual attributes and consumer characteristics', *Advances in Consumer Research*, 21(1): 560-564.
- Eisenhardt, K. M. and Martin, J. A. (2000) 'Dynamic Capabilities: What are they?', *Strategic Management Journal*, 21 (special issue): 1105-1121.
- Garvin, D. A. (1984) 'What does "Product Quality" really mean?', *Sloan Management Review*, 2 (1): 25-43.
- Gemser, G. and Wijnberg, N. M. (2002) 'The economic significance of industrial design awards: a conceptual framework', *Design Management Academic Review*, 2(1): 61-71.
- Grant, R. M. (1991) 'The resource-based theory of competitive advantage: Implications for strategy formulation', *California Management Review*, 33(3): 114-135.
- Marsh, S. J. and Stock, G. N. (2003) 'Building dynamic capabilities in new product development through intertemporal integration', *Journal of Product Innovation Management*, 20(2): 136-148.
- Porter, M. E. (1985) *Competitive advantage: Creating and sustaining superior performance*, NY: The Free Press.
- Prahalad, C. K. and Hamel, G. (1990) 'The core competence of the corporation', *Harvard Business Review*, 68(3): 79-91.
- Sanchez, R. and Heene, A. (1997) 'Reinventing strategic management: New theory and practice for competence-based competition', *European Management Journal*, 15(3): 303-317.
- Spivey, W. A., Munson, J. M., and Wolcott, J. H. (1997) 'Improving the new product development process: A fractal paradigm for high-technology products', *The Journal of Product Innovation Management*, 14(3): 203 - 218.
- Sung, T. J., (1997) 'Assessing the Impact of Design Resources on Business Performance of Taiwan's Design Firms', *Journal of Yunlin Institute and Technology*, 6(2): 173-180. [in Chinese]
- Swan, K., Kotabe, S. M., and Allred, B. B. (2005) 'Exploring robust design capabilities, their role in creating global products, and their relationship to firm performance', *The Journal of Product Innovation Management*, 22(2): 144-164.
- Turner, R. (1990) 'Design into management' in Gorb, P. ed. *Design management*, London: London Business School.
- Wernerfelt, B. (1984) 'A resource-based view of the firm', *Strategic Management Journal*, 5(2): 171-180.

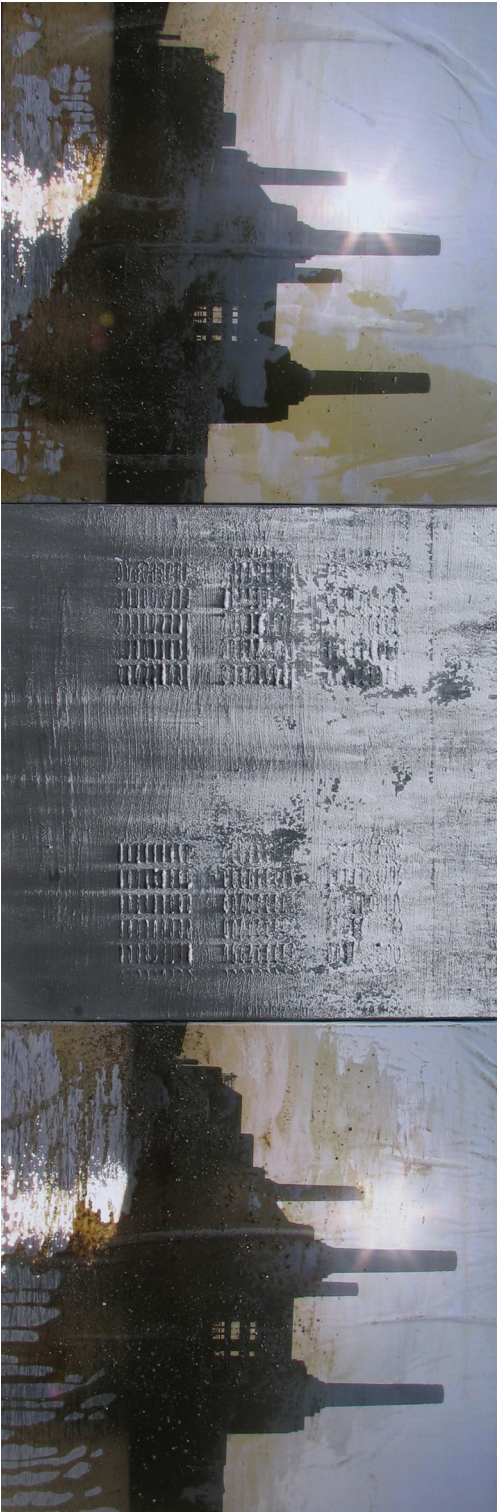
Acknowledgements

This study received partly financial support from the National Science Council of the Republic of China Government, under Grant No. NSC 96-2628-E-011-005-MY2.

All images courtesy of Duck Image, Taiwan.

Tung-Jung Sung and Pai-Yu Chang
Graduate School of Design
National Taiwan University of Science
and Technology
Taiwan

sungtj@mail.ntust.edu.tw



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