

A Conceptual Framework of Dynamic Design Management Capability

LIU Sylvia Xihui

Hong Kong Polytechnic University, Hong Kong

Sylvia.liu@polyu.edu.hk

doi: 10.33114/adim.2017.61

In the past decade, academic researchers and industrial practitioners developed various methods to set up a frame linking “good design” to “good business”. In most cases, their interest lay in the industrial economy and focused on the manufacturing industry. In the knowledge economy, dynamic capability is the new feature a firm should prepare for the new age. Design management capability is assigned new meaning in the emerged context. It’s time to develop a new framework of design management capability to reflect the dynamic nature of the knowledge economy. The relationships between design management capability, design awareness, business performance and design organization were explored in depth in previous studies. This is the time to integrate them into a holistic framework, to illustrate the relationships with explicit definitions of input, output and capability building. Through reviewing the previous studies and the emerged topic of dynamic characteristics in the knowledge economy, a conceptual framework is proposed here as a basis for further study.

keywords: design management capability; design collaboration; business performance; design awareness

Introduction

In 1974, Thomas J. Watson Jr., former CEO of IBM, stated that “good design is good business”. Subsequently, he achieved a reputation as a successful CEO leading the most explosive company growth to date. Today, given that the knowledge economy is the reality, design has significantly changed its role from product styling in the last century to the core of strategy in the new century, called design-driven innovation (Verganti, 2006).



This work is licensed under a Creative Commons Attribution-NonCommercial-Share Alike 4.0 International License.

<https://creativecommons.org/licenses/by-nc-sa/4.0/>

Steve Jobs, CEO of Apple, indicated that “design is the fundamental soul of a manmade creation”, and emphasized the importance of design (Peters, 2003). The above statements about the role of design in business in different centuries imply three things. First, good design is a result of a CEO’s design awareness. Second, good design could lead to good business performance. Third, in the knowledge economy, the importance of design has increased significantly.

These matters are all in the scope of design management, which contributes to competitive advantages and strategic flexibility (Kotler & Rath, 1984; Bruce, Cooper & Vasquez, 1999; Chiva & Alegre, 2007, 2009; Acklin, 2010). To link the knowledge structure of design management and a guideline demanded by industrial implementation, the concept of design management capability has been developed. It is the capacity to deploy design resources in an adequate and dynamic way (Fernández-Mesa, et al., 2013; Acklin, 2010, 2013). It constructs the dynamic capability of an organization (Teece, Pisano & Shuen, 1997; Acklin, 2013). With it, a company could sense and respond to emerging opportunities in a timely manner, and create new value (Teece, 1998; Jevnaker, 2000). In the past decade, design management capability has been studied with diversified foci, and some basic frameworks have been established. However, the dynamic perspective is seldom taken in the previous studies and it is recognized as a critical factor influence the performance of design and innovation in a business organization. In this paper, a conceptual framework was proposed based on reviewing previous related studies to reflect the dynamical factors of design capability. A conceptual framework was suggested to raise a discussion about the issues. These led to the initial ideas of developing a research agenda of design management capability.

Design Management Capability

In the past decade, two streams of design management capability were evident. One was from academic research, specifically, a list of design management skills proposed by Dickson through quantitative methods. In Dickson’s (1995) study, the factors assessing design management capability were well developed with a discussion of CEO’s design awareness in small- and high-growth firms. However, the proposed relationships between design awareness, design management capability and business performance were not validated. The role of design was still viewed in a conventional way, a part of the product development process, instead of taking a leadership role in innovation activities in the digital economy (Cooper, et. al, 2009). Therefore, the relationships should be studied in the updated context and the factors of relevance to design management capability should be redefined.

The dynamic features of design management capability have only been reported more recently (Fernández-Mesa, et al., 2013; Acklin, 2010, 2013). There has been reference to deploying design resources and organizing design teams to fulfil a task, which effectively requires design collaboration (Christensen and Rosenbloom, 1995; Verona and Ravasi, 2003). However, this dynamic feature was rarely considered in previous studies. To properly capture the dynamic features of design management capability, it is necessary to identify its underlying factors and to thereby develop a taxonomy to describe its contribution.

Although the relationships between design collaboration and the other three dimensions have been studied, quantitative validation of the framework was not provided (Jevnaker & Bruce, 1998; Jevnaker, 2000, 2005; Song, et al., 2010). As a consequence, a quantitative method of research is proposed in this study.

Another stream is a guideline for assessing design management capability to lead industrial practice. The representative outcome of the stream is the Design Management Staircase, which was developed by Design Management Europe (Kootstra, 2009), and based on the Design Ladder (reported by Danish Design Centre in 2003). The design management staircase consists of four levels of design awareness and related factors. However, with assessment being the primary objective, firms have no clear direction for defining design strategies. A framework, linking design awareness to organizational preparation and implementation, is required to guide the development of a strategic plan. In the knowledge economy, the previous framework and knowledge structure has to be updated, and a substantial basis for it should be developed through quantitative methods. To develop the research of design management capability further in the new economy paradigm, a review of previous studies and definition of its possible directions for further studies in the future is needed (Figure 1).

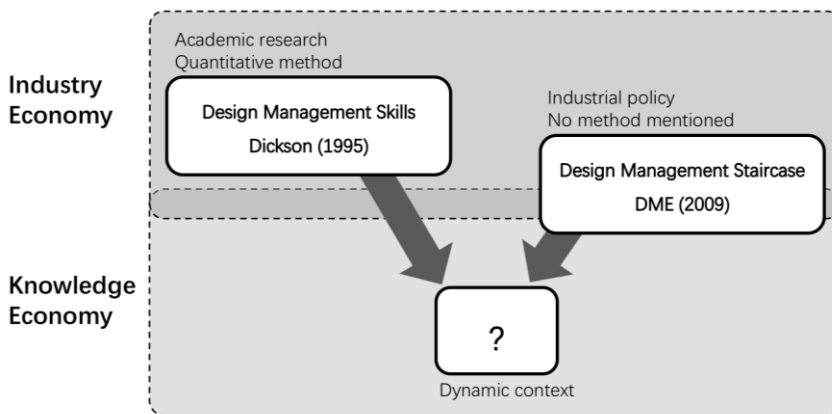


Figure 1 The changed economic paradigms of design management

A Dynamic Context

In 1995, Dickson proposed an index of design management capability consisting of five skills and a scale for measuring them (Dickson, et al., 1995). Based on this index, the relationships between the design management capability, product innovation, and business performance were studied in the past decade (Figure 2). According to the performance evaluated as result, these studies can be classified into four types: design management capability related studies, business/firm performance, product innovation and financial performance (Table 1).

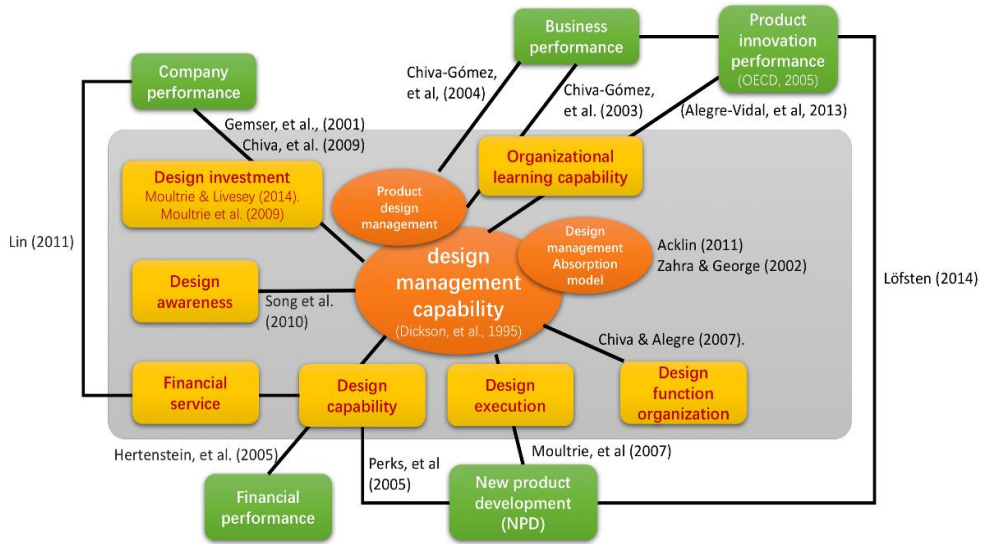


Figure 2 Emerged topics and their relationship with design management in previous studies

Based on Dickson’s design management skills, design awareness and design function organization has been studied to explore the relationships between design management capability, strategic design management and functional design management (Borja de Mozota, 2003). Furthermore, its relationships with a design management absorption model were studied. These studies reflected the unique value of design management capability, contributing both to the academic framework for building knowledge structure in the field and guiding the practice in industries.

Table 1 Previous studies based on the Design Management Skills reported by Dickson (1995)

Performance	Dimensions	Related studies
Design management capability		
Design management capability	Design management absorption model	Zahra & George (2002); Acklin (2011)
	Design function organization	Chiva & Alegre (2007).
	Design awareness	Song, <i>et al.</i> (2010)
Business/firm performance		
Business performance	Product design management	Chiva-Gómez, <i>et al.</i> (2004)
	Product design management, organizational learning capability	Chiva-Gómez, <i>et al.</i> (2003)
	Product innovation performance, new product development	Löffsten (2014)
Company performance	Design management capability, design investment	Gemser, <i>et al.</i> (2001); Chiva, <i>et al.</i> (2009)
	Financial service, design capability	Lin (2011)

Product innovation		
Product innovation performance	Organizational learning capability, design management capability	Alegre-Vidal, <i>et al.</i> (2013)
New product development	Design execution, design management capability	Moultrie, <i>et al.</i> (2007)
	Design capability	Perks, <i>et al.</i> (2005)
Financial performance		
Financial performance	Design management capability, design capability	Hertenstein, <i>et al.</i> (2005)

The second category is business/firm performance. Factors evaluating business performance and firm performance are quite similar, since a firm is a business organization. The only difference is that firm performance has more factors related to organizational performance. Dimensions discussed in this category are divided into four types. The first type is the core ones, including design management capability, product design management and design capability. Secondly, organizational issues, especially organizational learning capability. Third, relationships with other performances, particularly those emphasizing product innovation. Finally, its relationships with financial issues, such as financial services and design investment. Besides the core dimension of design management capability, other dimensions were studied to explore their relationship with business performance. These studies developed a new notion that design management capability can contribute to better business/firm performance or product innovation performance through enhancing organizational capability, such as organizational learning or design investment.

In the third category, product innovation is the performance used as result of evaluation. Its performance is evaluated by product innovation performance as a result and new product development as a process. Beside the relationships shown in the above category, there are two dimensions emphasized especially in this category. One is design capability, another is design execution. This implies that product innovation performance can be improved by enhanced design management capability and operational capability, such as design capability and design execution. The fourth category is financial performance. It links to design management capability and design capability.

All the dimensions studied are related to static features, and located in industry economy. Among the listed 14 studies in Table 1, 12 of these were published between 2001 and 2011. In the knowledge economy, the dynamic environment of innovation and business is the characteristic. Acklin and Fust (2014) proposed four modes of design management, these being simple, integrated, dynamic and entrepreneurial (see Table 2). According to their findings, the previous studies were based on simple or integrated modes, with an emphasis on product or project. As a result of the dynamically changing environment in the knowledge economy, a dynamic mode of design management is critical for sustaining competitive advantages through developing knowledge, design competences and capabilities (Zahra & George, 2002). Furthermore, in the entrepreneurial mode of design

management, design takes leadership in exploring opportunities, developing and managing an organization, and integrating resources (Acklin & Fust, 2014). However, design management capability in the emerged two modes was rarely studied in the past.

Table 2 Taxonomy of design management modes (Acklin & Fust, 2014)

DM-Mode	Simple Mode	Integrated Mode	Dynamic Mode	Entrepreneurial Mode
Goals	Effective/efficient design (project) management	Orchestration of touch points across function	Sustainable competitive advantage	Exploiting new business opportunities
Design capabilities	Sourcing, briefing, designers; managing and evaluating design	Planning, coordinating, aligning infusing design	Designing the capabilities of the firm; de/re-linking; (re-) configuring resources	Creating, recognizing, evaluation, exploiting opportunities
Contributions to corporate strategy	Improved products, appearances, etc.	Coherent positioning	Strategic flexibility and competitive advantage	New business segments, new business ventures

The Developed Four Dimensions

Concerning design management capability in a dynamic context, its contribution and value is defined as the capacity to deploy design resources in an adequate and dynamic way (Fernández-Mesa, et al., 2013; Acklin, 2010, 2013). With it, a company could sense and respond to emerging opportunities in a timely manner, and create new values based on it (Teece, 1998; Jevnaker, 2000). Taking a close look of design management capability developed in the past decade, dimensions for further study of its performance in the new economic paradigm can be explored. As a result, four dimensions are reported. They are design awareness, design management capability, design collaboration and business performance.

Design awareness

The close relationship between design awareness and design management capability has been reported in the two representative studies, Dickson's design management skills and DME' design management staircase. The initial question of Dickson's research was to understand the CEO's role in design management. This can be defined as the relationship between a CEO's design awareness and design management capability in the firm. In DME's design management staircase, the CEO's design awareness was the decision factor to classify the four stages on the staircase. This implies that the academic frame, or practice-based frame, of design management capability are both tightly related to design awareness. Later, this is also proven by Song's study (Song, et al., 2010). In Heskett and Liu study of managing design in SMEs, design awareness was also reported as a key factor of

assessing levels of design management (Heskett & Liu, 2012). Later, the factor was combined with the design ladder and developed into a new index (Storvang, et al., 2014).

The main basis for design awareness was the four levels in the Design Management Staircase (DMS), which was the result of a survey conducted by Design Management Europe and developed from the Design Ladder established by the Danish Design Centre in 2003 (Kootstra, 2009). The four levels include 1) no design management (DM); 2) DM as project; 3) DM as function; and 4) DM as culture. Both the DMS and the Design Ladder are utilized popularly to assess design and design management capability in industries. It uncovered a positive correlation between design management rating and business performance, although causal links have yet to be determined. Another set of criteria was developed by Min Jeong Song in 2010. His study focused on the design awareness of the CEO and its correlation with support for design (Table 3). Both studies have linked design awareness with design management capability and business performance. However, until now, the positive correlation between design awareness and business performance has not been proven by quantitative study.

Table 3 Two sets of factors assessing levels of design awareness

Design Management Staircase (Kootstra, 2009)	Design Awareness of CEO (Song, et al., 2010)
1) 1) Aware of the benefits of managing design effectively;	6) CEO's interest in design and design management.
2) 2) Place and role of design;	7) Design is viewed as a necessary factor for business success by CEO.
3) 3) Design in business or marketing plans and objectives;	
4) 4) Methods of decision-making;	
5) 5) Allocated design resources.	

Design collaboration

The dynamic characteristic of organizational capability is developed based on two viewpoints, resource-based and capability-based. This is shown by the dimensions reported in the previous studies, such as design function organization with resource-based viewpoint, and design capability with capability-based viewpoint. There is organizational learning capability linking the two viewpoints, since the capability can be improved and enhanced via various resources. As a result, the topic focuses on the way and the types of design resources obtained. This is defined as design collaboration in this paper.

The concept of design collaboration evolved continuously in the past thirty years. In the 1980s, it focused on internal organization, the collaboration between designer and manager. Later, the research scope was extended to the relationship between internal and external design. Entering the new century, the issues of design collaboration were broadened to openness of organizational structure, means for participants, and related strategies with a capability-based view or organizational view (Table 4).

Table 4 Three facets of design collaboration research

Key topics	Previous studies	Viewpoints
Internal design (1980s ~)		
Designer's role	Walsh & Roy (1985)	Personal view of design
Manager's role	Gorb & Dumas (1987)	
General practice	Dumas & Whitefield (1989)	
CEO's role	Dickson, <i>et al.</i> (1995)	
Internal & external design (1990s ~)		
The relationship between internal and external design	Bruce & Morris (1994); von Stamm (1997); Twigg (1998); Bruce, <i>et al.</i> (1999).	Organizational view
Design architect and its influence on companies	Chiva & Alegre (2007); von Stamm (2008); Filippetti (2010); Abecassis-Modedas, <i>et al.</i> (2012).	
Design is a fixed sub-process of NPD	Perks, <i>et al.</i> (2005).	
Design collaboration (2000s ~)		
Collaboration divided by two dimensions: (1) the predominant means of participation (closed vs. open); (2) the predominant governance structure (hierarchical vs. flat)	Pisano and Verganti (2008); Snow, Lettl & Miles (2011).	Capability-based view
Innovation strategy map (Open/close; incremental/ step change)	Chesbrough (2006)	
Number and typologies of partners	von Hippel (1988); Lundvall (1992); Brown and Eisenhardt (1995); Szulanski (1996); Laursen and Salter (2004); Laursen and Salter, 2006; Pisano and Verganti, 2008; Enkel <i>et al.</i> , 2009; Keupp and Gassmann, 2009.	Organizational view
Phases of the innovation process actually open	Gassmann and Enkel (2004).	
Direction of openness: inbound and/or outbound	Lichtenthaler (2008).	

Business performance

There are three main indices of design influence on business performance (Table 5). Firstly, the financial performance of business. Secondly, product innovation performance as the measurement of design outcomes. Thirdly, the overall firm performance. The evolution of the indices implies an increased design impact on business.

Table 5 Three sets of factors evaluating business performance

Performance	Set of factors	Previous studies
Financial performance	- Sales	Davidsson (1989);
	- Return on capital employed	Zahra (1991);
	- Return on assets	Delmar (1996)
Product innovation performance	- Replacement of products being phased out	OECD (2005);
	- Extension of product range within main product field through new products	Fernández-Mesa et al. (2013)
	- Extension of product range outside main product field	
	- Development of environmentally-friendly products	
	- Market share evolution	
	- Opening of new markets abroad	
Firm performance	- Opening of new domestic target groups	
	- Financial performance	Chiva-Gómez et al. (2003);
	- Manufacturing and storage costs	Chiva & Alegre (2009);
	- Product profitability	
	- Corporate image	Löfsten, H. (2014)
	- Delivery time and after-sales service	
	- Growth	
	- Size	

Studies on the relationships in the previous studies

In the 1990s, Dickson defined a set of factors about design management skills and discussed its relationship with design awareness and business performance, especially small, high growth firms (Dickson, 1995). Entering the new century, the topic of dynamic design management enabled by design collaboration emerged. It focused on the relationships between design collaboration and other three dimensions, these being design awareness (Jevnaker, 2000; Song, et al., 2010), design management capability (Jevnaker, 2000, 2005) and business performance (Jevnaker & Bruce, 1998; Mathieu, 2001). The study of the relationship between design awareness and business performance then emerged, represented by the design management staircase (Kootstra, 2009). As a result, all the topics in these studies can be clustered into four dimensions, these being design awareness, design management capability, design collaboration and business

performance. Although the relationships among the dimensions has been stated or predicted in these studies, they were not proven with quantitative validation.

Design collaboration (DC) and business performance (BP)

With fresh and creative ideas, external design was valuable for innovation and business success (Jevnaker & Bruce, 1998). Usually, collaboration creates more options for risk, cost and quality of design (Mathieu, 2001). However, this linkage has yet to be proven through quantitative study.

Design management capability (DMC) and design collaboration

In the past fifteen years, there has been an increased emphasis on the dynamic characteristic of design management. Jevnaker (2000) stated that design management should integrate competencies in a dynamic way to nurture multidisciplinary networking and build on a creative mix of talents and content. The critical importance of a dynamic collaboration among designers and business firms should be built in cognition of companies. The contribution of design collaboration to dynamic capability is described explicitly by Jevnaker (2005: 44): "...the firms' "dynamic capabilities" were highly relational and activity-based, and were accumulated as more or less hidden treasures of constructive work relations." Quantitative validation is needed to prove the relationship.

Design collaboration and design awareness (DA)

In accordance with the Russian psychologist Vygotsky (1986), design-collaborating experiences can serve as "generators" of consciousness. With good design awareness, design leaders will be more open to design collaboration (Jevnaker, 2000; Song, et al., 2010). However, to date, the relationship hasn't been supported by quantitative validation.

Design management capability and business performance

As a consequence of the accelerated evolution of the role of design in the past decade, design was transformed from a sub-process of new product development (NPD) to process leader (Perk et al., 2005; Maciver & O'Driscoll, 2010). Accordingly, the importance of design management capability and its impact on business performance has been upgraded significantly, since design management relates to the organizational and managerial practices of a company to attain good design through efficient processes (Gorb and Dumas, 1987; Dickson et al., 1995; Ahire & Dreyfus, 2000; Best, 2010; Fernández-Mesa, 2013).

The initial study of the topic was conducted by Dickson in 1995. The set of factors of design management skills was small, yet high growth firms were reported in the study. This formulated the basis for further studies. In 2013, Fernández-Mesa gave a quantitative validation of the relationship between design management capability and product innovation performance. However, it applied Dickson's factors of design management capability directly and ignored the transformed role of design, from a sub-process of new product development (NPD) to process leader (Perk et al., 2005; Maciver & O'Driscoll, 2010). The evaluation of business performance focused on product innovation performance, rather than taking a broader view to understand design impact.

Design management capability and design awareness

A CEO's involvement in design was also a domain topic in Dickson's study (1995). Design leaders can foster the dynamic design capability of an organization (Jevnaker, 2000; Bruce & Bessant, 2002). In Song's study, the linkage between design awareness and design leaders' support for design was proven in a quantitative way. However, its linkage to design management was not tested (Song, *et al.*, 2010). The relationship was reported as "design attitude" to describe the integrated thinking of design and management (Boland Jr, *et al.*, 2008). Although the relationship between design awareness and support for design was proven in a quantitative way, its relationship with design management was not tested (Song, *et al.*, 2010).

Design awareness and business performance

Jevnaker reported that design champions can make new sense of business through design collaboration. This is a leading edge of a firm (Jevnaker, 2000). The linkage was reported by the DME in their survey in 2003. On the other hand, through design projects, managers could understand the value of design in their business (Brazier, 2004). In the proposed dimension of business performance, the broader factors such as product innovation performance, brand and service, etc., will be involved.

Through reviewing previous studies on the hypotheses, the research gaps were revealed (Table 4). The gaps were divided into three types: 1) the definition of the dimension is too narrow and factors involved are limited; 2) the linkage between the dimensions was not proven; 3) the linkage might be proven qualitatively, but not quantitatively.

Table 6 A summary of current studies on the six hypotheses and the gaps that will be filled by the proposed research

The relationships	Existing body of knowledge	Gaps
Business performance & Design collaboration	Design collaboration leads to better business performance.	Not proven by quantitative study.
Design management capability & Design collaboration	They are complementary to each other.	Not proven by quantitative study.
Design awareness & Design collaboration	The interaction between design awareness and design collaboration.	Not proven by quantitative study.
Design management capability & Business performance	The importance of design management capability and its impact on business performance is upgraded significantly.	The linkage wasn't proven.
Design awareness & design management capability	Design leaders can foster design capability.	The linkage wasn't proven.
Design awareness & business performance	Good design awareness contributes to better business performance.	Narrow definition of business performance

A Conceptual Framework of Design Management Capability

Based on the above discussion, a conceptual framework of design management capability is proposed to reflect the dynamic feature of it in the knowledge economy and linking the design awareness as input to business performance as output (Figure 3). According to Table 4, some of the relationships have been reported in the previous studies, but they have not been proven with quantities methods. Others may have been mentioned, but without any evidence, and have not been proven.

The conceptual framework consists of four dimensions, these being design awareness, design collaboration, design management capability and business performance. *Design awareness* is viewed as input of design management. It includes design awareness of a CEO, managers and staff members. Although its relationships with design management capability and business performance have been studied in the past, there is not an explicit framework to illustrate the relationship and there is no base for duplicating the theory in another context. *Design collaboration* will represent the flexibility of design capability through dynamic relationships with various resources. As a new dimension proposed in the framework, its relationships with the other three will be studied to define the factors contributing to dynamic characteristics. Instead of separating the performance into business, firm and product innovation, the new dimension will integrate all the factors and view them at different levels. For the dimension of design management capability, besides the existing factors, new factors will be explored via expert or industrial interviews to reflect the current practice in the knowledge economy. Later, the key factors will be defined through quantitative methods.

The proposed conceptual framework not only represents a new structure to develop the understanding of design management capability in the knowledge economy, but also shows the possible directions of research in the topic. With this study, a new framework of design management capability will be established with validation. It will set up a solid basis for the related studies in the academic fields and guide the practice in industries with explicit factors.

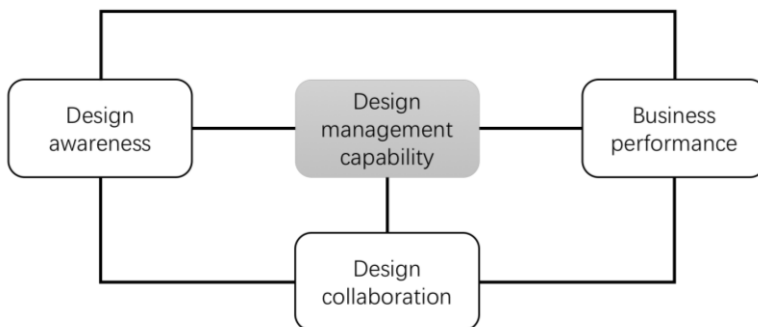


Figure 3 A conceptual framework

Conclusion

In the past decade, academic researchers and industrial practitioners developed various methods to set up a frame linking “good design” to “good business”. In most cases, the context was the industrial economy and the focus was on manufacturing industry. In the knowledge economy, dynamic capability is the new feature a firm should prepare for in the new age. Design management capability is assigned new meaning in the emerged context. It’s time to develop a new framework of design management capability to reflect the dynamic feature in the knowledge economy. The relationships between design management capability, design awareness, business performance and design organization have been studied sufficiently in the previous studies. It’s the time to integrate them into a holistic framework to illustrate the relationships with explicit definition of input, output and capability building. Through reviewing the previous studies and the emerged topic of dynamic characteristics in the knowledge economy, a conceptual framework is proposed in this paper as a basis for further study.

In the conceptual framework, design management capability is the center entities, while business performance is the outcomes of it for evaluation. Design collaboration was utilized to inclusive the dynamic factors, such as relationship in co-design, integration of design resources and dynamic team management. Design awareness as the reflection of mindset of design and design management will impact on the investment in design, which will influence the design management capability and design collaboration. The relationships of the four entities have been reported in previous studies, however, they were neither proven nor proven by quantitative methods. The conceptual framework was reported for a holistic mapping of design management capability and its function in business management. It is a basis for a further study of the topic with quantitative methods and the outcomes will be applied in industries efficiently.

References

- Abecassis-Moedas, C., Ben Mahmoud-Jouini, S., Dell’Era, C., Manceau, D., & Verganti, R. (2012). Key resources and internationalization modes of creative knowledge-intensive business services: The case of design consultancies. *Creativity & Innovation Management*, 21(3), 315-331. doi:10.1111/j.1467-8691.2012.00646.x
- Acklin, C. (2013). Design management absorption model: a framework to describe and measure the absorption process of design knowledge by SMEs with little or no prior design experience. *Creativity and Innovation Management*, 22(2), 147-160.
- Acklin, C. (2011). The absorption of design management capabilities in SMEs with little or no prior design experience Paper presented at the Nordic Design Research Conference, Helsinki.
- Acklin, C. (2010). Design-Driven innovation process model. *Design Management Journal*, 5(1), 50-60.
- Acklin, C. and Fust, A. (2014). *Towards a dynamic mode of design management and beyond*. Paper presented at the 19th DMI: Academic Design Management Conference; Design Management in an Era of Disruption, London.
- Brazier, S. (2004). Walking backward into design: support for the SME. *Design Management Review*, 15(4), 61-70.
- Brown, S.L. and Eisenhardt, K.M. (1995). Product development: past research, present findings and future directions. *Academy of Management Review*, 20(2), 343–378.
- Bruce, M., & Bessant, J. (2002). *Design in Business. Strategic Innovation through Design*. Edinburgh Gate: Pearson Education Limited.

-
- Bruce, M., Cooper, R. and Vasquez, D. (1999). Effective design management for small businesses. *Design Studies*, 20, 297-315.
- Bruce, M. and Morris, B. (1998). A comparative study of design professionals. In M. Bruce and B.H. Jevnaker (Eds.), *Management of Design Alliances. Sustaining Competitive Advantage* (pp.39-64). Chichester: Wiley.
- Chiva, R. and J. Alegre (2009). Investment in design and firm performance: the mediating role of design management. *Journal of Product Innovation Management* 26(4), 424-440.
- Chiva, R. and J. Alegre (2007). Linking design management skills and design function organization: An empirical study of Spanish and Italian ceramic tile producers. *Technovation*, 27(10), 616-627.
- Chiva, R., Alegre, J. and Lapedra, R. (2004). A model of product design management in the Spanish ceramic sector, *European Journal of Innovation Management*, 7(2), 150-161.
- Chiva, R., Camisón, C., and Lapedra, R. (2003). Organizational learning and product design management: towards a theoretical model. *The Learning Organization*, 10(3), 167-184.
- Christensen, C.M. and Rosenbloom, R.S. (1995). Explaining the attackers advantage – technological paradigms, organizational dynamics, and the value network. *Research Policy*, 24(2), 233-257.
- Cooper, R., Junginger, S., & Lockwood, T. (2009). Design thinking and design management: a research and practice perspective. *Design Management Journal*, 20(2), 46-55.
- Davidsson, P. (1989) Continued entrepreneurship and small firm growth, *PhD dissertation*, EFI, Stockholm School of Economics, Stockholm.
- De Mozota, B. B. (2003). *Design Management: Using Design to Build Brand Value and Corporate Innovation*. Skyhorse Publishing Inc.
- Delmar, F. (1996). Entrepreneurial behaviour and business performance, *PhD dissertation*, EFI, Stockholm School of Economics, Stockholm.
- Dickson, P., Schneier, W., Lawrence, P. and Hytry, R. (1995). Managing design in small high-growth companies. *Journal of Product Innovation Management*, 12(5), 12.
- Dumas, A. and Whitefield, A. (1989). Why is design difficult to manage? *European Journal of Management*, 7, 1.
- Enkel, E., Gassmann, O., Chesbrough, H. (2009). Open R&D and open innovation: exploring the phenomenon. *R&D Management*, 39, 311-316.
- Fernández-Mesa, A., Alegre-Vidal, J., Chiva-Gómez, R. and Gutiérrez-Gracia, A. (2013). Design management capability and product innovation in SMEs. *Management Decision*, 51(3), 547-565.
- Filippetti, A. (2010). Harnessing the 'Essential Tension' of Design: the Complex Relationship between the Firm and Designer Consultant. In: Series, W.P. (Ed.). *Munich: MPRA Munich Personal RePEc Archive*.
- Gassmann, O. and Enkel, E. (2004). Towards a theory of open innovation: three core process archetypes, paper presented at *R&D Management Conference*.
- Gemser, G., & Leenders, M. A. (2001). How integrating industrial design in the product development process impacts on company performance. *Journal of Product Innovation Management*, 18(1), 28-38.
- Gorb, P. and Dumas, A. (1987). Silent design. *Design Studies*, 8, 150-156.
- Hertenstein, J. H., Platt, M. B., & Veryzer, R. W. (2005). The impact of industrial design effectiveness on corporate financial performance. *Journal of Product Innovation Management*, 22(1), 3-21.
- Heskett, J. and Liu, X. H. (2012). Models of developing design capacity: perspective from China, *Proceedings of the DMI 2012 International Research Conference*, Edited by E. Bohemia, J. Liedtka and A. Rieple, August 8-9 2012, Boston, USA (pp. 225-238).
- Jevnaker, B. H. (2005). Vita activa: on relationships between design(ers) and business. *Design Issues*, 21(3), 25-48.
-

-
- Jevnaker, B. H. (2000). Championing design: perspectives on design capabilities. *Design Management Journal: Academic Review*, 1, 25-39.
- Jevnaker, B. H. and Bruce, M. (1998) Design alliances: the hidden assets in management of strategic innovation, *The Design Journal*, 1(1), 24-40.
- Keupp, M.M. and Gassmann, O. (2009) Determinants and archetype users of open innovation, *R&D Management*, 39(4), 331-41.
- Kootstra, G. L. (2009). *The incorporation of design management in today's business practices: An analysis of design management practices in Europe*. Design Management Europe.
- Kotler, P. and Rath, G. A. (1984) Design: a powerful but neglected strategic tool. *Journal of Business Strategy*, 5, 16-21.
- Laursen, K. and Salter, A. (2006). Open for innovation: the role of openness in explaining innovation performance among UK manufacturing firms. *Strategic Management Journal*, 27, 131-150.
- Laursen, K. and Salter, A. (2004). Searching high and low: What type of firms use universities as a source of innovation? *Research Policy*, 33(8), 1201-1215.
- Lin, M. (2011, May). Capacity of product design, financial service and performance of small and medium manufacturing enterprises. In *2011 International Conference on Computer and Management (CAMAN)* (pp. 1-5). IEEE.
- Lichtenthaler, U. (2008). Open innovation in practice: An analysis of strategic approaches to technology transactions. *IEEE Transactions of Engineering Management*, 55(1), 148-157.
- Löfsten, H. (2014). Product innovation processes and the trade-off between product innovation performance and business performance. *European Journal of Innovation Management*, 17(1), 61-84.
- Lundvall, B.Å. (Ed.), (1992). *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*. Pinter, London.
- Maciver, F. and A. O'Driscoll (2010). Consultancy designer involvement in new product development-mapping a novel design leadership process. *International Product Development Management Association Conference*. Universidad de Murcia.
- Mathieu, V. (2001). Product services: from a service supporting the product to a service supporting the client. *Journal of Business & Industrial Marketing*, 16(1), 39-58.
- Moultrie, J., & Livesey, F. (2014). Measuring design investment in firms: Conceptual foundations and exploratory UK survey. *Research Policy*, 43(3), 570-587.
- Moultrie, J., Livesey, F., Malvido, C., Beltagui, A., Kul Pawar, Riedel, J., & C.k.h., J. (2009). Design funding in firms: a conceptual model of the role of design in industry. *Design Management Journal*, 4(1), 68-82.
- OECD (2005). *The Measurement of Scientific and Technological Activities: Guidelines for Collecting and Interpreting Innovation Data: Oslo Manual*, 3rd ed. Prepared by the Working Party of National Experts on Scientific and Technology Indicators, OECD, Paris.
- Perks, H., Cooper, R., & Jones, C. (2005). Characterizing the role of design in new product development: an empirically derived taxonomy. *Journal of Product Innovation Management*, 22(2), 111-127.
- Peters, T. (2003). *Re-imagine!* London: Dorling Kindersley Limited.
- Pisano, G. P. and Verganti, R. (2008). Which kind of collaboration is right for you, *Harvard Business Review*, 86(12), 78-86.
- Snow, C. C., Fjeldstad, Ø. D., Lettl, C. and Miles, R. E. (2011). Organizing Continuous Product Development and Commercialization: The Collaborative Community of Firms Model. *Journal of Product Innovation Management*, 28(1), 3-16.
- Song, M. J., Nam, K. y., & Chung, K. w. (2010). The Chief Executive's Influence on Corporate Design Management Activities. *Design Management Journal*, 5(1), 61-71.
-

-
- Storvang, P., Jensen, S. and Christensen, P. R. (2014). Innovation Through Design: A Framework for Design Capacity in Danish Context. *Design Management Journal*, 9(1), 9-22.
- Szulanski, G. (1996). Exploring Internal Stickiness: Impediments to the Transfer of Best Practices within the Firm. *Strategic Management Journal*, 17, 27-43.
- Teece, D. J. (1998). Capturing value from knowledge assets: The new economy, market for knowhow, and intangible assets. *California Management Review*, 40(3), 55-79.
- Teece, D. J., G. Pisano, and A. Shuen (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, 18(7), 537-533.
- Twigg, D. (1998). Managing product development within a design chain. *International Journal of Operations & Production Management*, 18(5), 508-524.
- Verganti, R. (2006). Innovating through design. *Harvard Business Review*, 84(12), 114.
- Verona, G. and Ravasi, D. (2003). Unbundling dynamic capabilities: an exploratory study of continuous product innovation. *Industrial and Corporate Change*, 12(3), 577-606.
- von Hippel, E. (1988) *The Sources of Innovation*. New York: Oxford University Press
- Von Stamm, B. and Bettina (2008). *Managing Innovation, Design and Creativity*. England: John Wiley & Sons Ltd.
- Vygotsky, L. S. (1986). *Thought and language* (A. Kozulin, Trans.). Cambridge, MA: MIT Press.
- Walsh, V., & Roy, R. (1985). The designer as 'gatekeeper' in manufacturing industry. *Design Studies*, 6(3), 127-133.
- Zahra, S. A., & George, G. (2002). Absorptive capacity: a review, reconceptualization, and extension. *The Academy of Management Review*, 27(2), 185-203.

About the Author

Sylvia Xihui Liu is a research assistant professor in School of Design at Hong Kong Polytechnic University. Before, she was design manager at Nova Design, and drafted national design policy. Her research areas are design value and design policy.