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A Review of Research on Design Management and Dynamic Capabilities

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Design management and dynamic capabilities are not entirely new fields, and the existing literature also mentions the connection between these concepts. The relationship between these two concepts is apparent and lacks in-depth research. However, studying the relationship between design management and dynamic capabilities helps us understand the nature of design management, discovering and responding to changes. Through literature review, we can clarify the relationship between them. Design management is a dynamic capability, and it can also generate new dynamic capabilities. Design management can be a dynamic capability because it has precise characteristics of dynamic capabilities, namely sensing, seizing, and transforming resources. Simultaneously, it can contribute new dynamic capabilities because it has the conditions for generating dynamic capabilities while the organisation and management process, specific positions, paths, and complete routines. Exploring the composition of design management through dynamic capability theory is of great significance to constructing the theoretical framework and operational prototype of design management.

Keywords: design management; dynamic capabilities; systematic literature review;

1 Introduction

At present, design-led entrepreneurial activities and start-ups are constantly emerging. Design plays an essential role in linking technology, institutions, ideas, markets and users in the process of product innovation (Oakley, 1990; Mozota; 2006; Verganti, 2011; Heskett & Dilnot, 2015). Therefore,

efficiently managing design is significant in the current product innovation process, whether this process is at the project level or the organisational level (Walsh, 1996; Gieskes & Hyland, 2003; Chiva-Gómez et al. al., 2003; Liu, 2021). The crucial issues are identifying opportunities and coordinating and managing diversity resources when design management faces multiple internal and external resources in a changing environment.

When faced with a changing environment, the fundamental question of how organisations survive has attracted the attention of scholars from different disciplines, leading to a variety of organisational theories, one of which is the dynamic capability (Chiva-Gómez et al., 2003). Another critical reason design management needs to pay special attention to change is that the core assumption of design practice is changing. Because the design concepts become the future product, communication, environment, and system by practice or execution, in other words, design is to envisage the occurrence of change (Heskett, 2013). The design is about perception and grasping-focusing on discovering and dealing with customer expressions and potential needs, market trends, technology, technological changes and opportunities, and other evolving issues in the business ecosystem; it is suitable for the dynamic capabilities of sensing and seizing opportunities (Ojasalo et al., 2015).

There is much room for discussion on how design management builds its routines, identifying opportunities and resources to cope with the change (Nielsen & Christensen, 2014). In the past research on design management, much literature mentioned that design management is a dynamic capability (Jevnaker, 1998; Topaloğlu & Er, 2017; Gerlitz & Prause, 2017; Cousins, 2018), which is used as an essential capability of the organisation to respond to environmental changes. On the one hand, because design management meets many characteristics of dynamic capabilities, on other hand, management design can contribute to and enhance the organisation's dynamic capabilities. However, what is the relationship between design management and dynamic capabilities? Can design management be embedded in the framework of dynamic capabilities? These are still issues that need to be studied further. From the existing literature, design management is considered a dynamic capability when integrating the three processes of design learning, design coordination, and design skills (Dos et al., 2018). Acklin (2013) combines design management capabilities with absorptive capabilities in organisational learning and proposes an absorption model framework for absorbing and exploiting design knowledge in SMEs with little or no prior design experience. Another side, in strategic management, the dynamic capability is related to new product innovation and other processes but not design or design management; the relationship between design management and dynamic capability is undefined (Nagaraj et al., 2020).

Based on the statement that design management is a dynamic capability, firstly, this paper uses the research method of literature review to sort out the literature at the intersection of design management and dynamic capability; Secondly, analyse the relationship between design management and dynamic capabilities, and the way of action; thirdly, after literature analysis, answer the research questions:

Question 1

Why can design management be regarded as a dynamic capability?

Question 2

What is the relationship between design management and dynamic capability?

2 Review of Key Concepts

2.1 Design Management

Michael Farr first proposed design management in his book "Design Management " in 1965. He introduced this concept into the companies, and they can gain long-term competitiveness by bringing design into the company's strategy, brand, environment, and managing design projects or processes (Farr, 1965). He defined design management as the function of defining design's problems, finding the most suitable designers, and enabling them to solve problems promptly within budget.

Before the early 1990s, the design was just a link of the visual design for the product development process, by design the form of products and the materials in services to match up customers, brands and markets. In recent years, the focus of design practice has expanded from purely centring on design skills to the large-scale system level (Ceschin & Gaziulusoy, 2016). Design is no longer just intermediate steps in manufacturing, and it does not only exist in product development or visual design. People have elevated it to innovative practice, a tool, and strategy. At this moment, the content of design has changed, starting to consider design issues from the cultural, knowledge, optimization levels, and affect design management research (Mozota & Wolff, 2019).

As a design project can be completed in more diversified ways, the focus of design is no longer to solve problems but to discover problems (Verganti et al., 2020). Furthermore, design management has been regarded as a strategy.

Researchers use strategic, tactical, and operational levels to distinguish design management levels (Mozota, 2002; Chung, 1992; Cooper, 1995). Design management is a series of organization and management activities and processes (Gorb and Dumas, 1987; Dickson et al., 1995; Fernández Mesa, 2013), Dickson et al. (1995) and Jevaker (2000) proposed five evaluation dimensions of design management capabilities to establish standards for evaluating and developing design management: the basic skills, specialized skills, involving others, organizational change, and innovation skills. Since then, Liu & Rieple (2019) expanded and enriched the connotation and scope of new design management capabilities in a case study of the Chinese brand Xiaomi.Dynamic capabilities

2.2 Dynamic Capability

Teece et al. (1997, 2000) define dynamic capability as a kind of capability based on the resource-based view, and it is a term belonging to the category of corporate strategic management. It is the company's ability to integrate, build, and reconfigure internal and external capabilities to respond to rapidly changing environments. Embed organisational capabilities into existing organisational routines, structures, and processes. More specifically, these conventions are embodied in the way the organisation operates, structure, culture, and the way of thinking of senior leaders. "Existing capabilities" refers to the competitiveness of an enterprise in the current environment. The challenge for senior leaders is to cultivate and improve these capabilities or assets and be ready to reconfigure these assets as the environment changes.

Emerging research on dynamic capabilities and how dynamic capabilities provide companies with long-term competitive advantages provide a promising method for explaining organisational adaptability. As a supplement to the resource-based view, the most apparent characteristics of dynamic capabilities are absorptive ability, learning ability, collaboration ability, and resource redistribution ability. Teece et al. (1997), when proposing the concept of dynamic capabilities,

mentioned the key roles and dependent conditions of the construction of dynamic capabilities: 1) Operation in the process of organisational management Roles and models, such as coordination or integration, learning capabilities, reorganisation, and transformation; 2) Positions or resources that can affect the strategic situation, such as technical assets, complementary assets, financial assets, reputation assets, market (structural) assets, Etc. 3) Gradually form a path of dynamic formation capability, such as path dependence, technological opportunities. Subsequently, dynamic capabilities (Teece, 2007) expanded two main capabilities. One is the ability to renew the organisation to adapt to changes in a turbulent environment; the other is the ability to strategic management, which can use these capabilities to meet the requirements of the business environment. These roles and functions can be used as definite guidelines when analysing the relationship between dynamic capabilities and design management.

2.3 Design Management as a Dynamic Capability

Studying the connection between design management and dynamic capabilities helps to understand how design management can contribute to dynamic capabilities and play a more appropriate role in business. Based on this view of dealing with dynamic environments, Jevnaker (1998) represents that design management is based on organizational learning ability and emphasizes that design management is capable. Acklin (2013) expands on this theoretical basis and believes that design management ability is a dynamic capability, and the primary function of this ability is to absorb knowledge. In practice, especially for those with no or lack of design experience in the manufacturing or retail industry, through design management to establish a way of complementing knowledge can create more substantial competitiveness for enterprises; rooted in the framework of dynamic capabilities, she proposed the prototype of the Design Management Absorption Model. Design management, as one of the ways to improve product innovation performance, is also linked to the organizational learning ability in dynamic capabilities, confirming that design management capabilities can promote organizational learning capabilities, which in turn have a positive impact on the performance of small and medium-sized enterprises (Fernández et al., 2013). In the research of Dos et al. (2018), the design research literature was sorted out by way of historiographical literature review and considered that design management is a dynamic capability because it has the main characteristics of dynamic capability: 1) Design learning capability, Design coordination ability, and design skills. Design learning corresponds to the acquisition and absorption of knowledge and practical skills in dynamic capabilities and disseminates them to the entire organization; 2) Design coordination capabilities conform to the ability to coordinate activities and practices necessary for good design; 3) Design skills include a set of technologies and knowledge that produce synergy, creativity, and innovation. The above documents all mention the significant connection between design management and dynamic capabilities.

3 Research Method

Respond to the research questions, and this paper adopts a systematic literature review. SLR is generally considered better in terms of transparency because researchers can more easily verify the research results through the research settings(Aarseth,2017). SLR can treat subjectively clearly, and appropriately comprehensively and fairly. This structural method provides perfect knowledge and a complete literature summary.

3.1 Scope

3.1.1 Scope of the keywords

The search strategy of this paper disassembles the two main keywords into different combination keywords to dig deeper into various related literature. The primary combination keyword selection comes from the definition of its central concepts and the explanation related to the subject of this research (Table 1).

Table 1 Combined keywords comparison

Representative field	Selected Combined Keywords	Removed Keywords
Design Management	Product design, design thinking, design innovation, design processes, service design, design strategy,	Design-driven, design entrepreneurship, design awareness.
Dynamic Capabilities	Coordination, integration, learning capabilities, reconfigure resources, transform resources, position or assets, firm performance, design leadership, process	Resource-based view

3.1.2 Scope of searching

In this study, the Systematic Literature Review (SLR) scope shows in figure 1. Step1 is by searching the overlap of the two fields. Refer to figure 1-a. Step 2 is to find the potential connection between DM and DC by using the selected combined keywords. The step is for searching related content in DM and DC. Refer to figure 1-b. In this report, combined keywords with zero search results are removed (Table 1), and all keywords use in singular and plural at the same time when searching. The aim areas are showed in the grey part of figure 1; the database used for search are Web of Science, Scopus, and Google scholar. The selection scope of the literature is journal papers and conference papers, and the language of the literature is English.

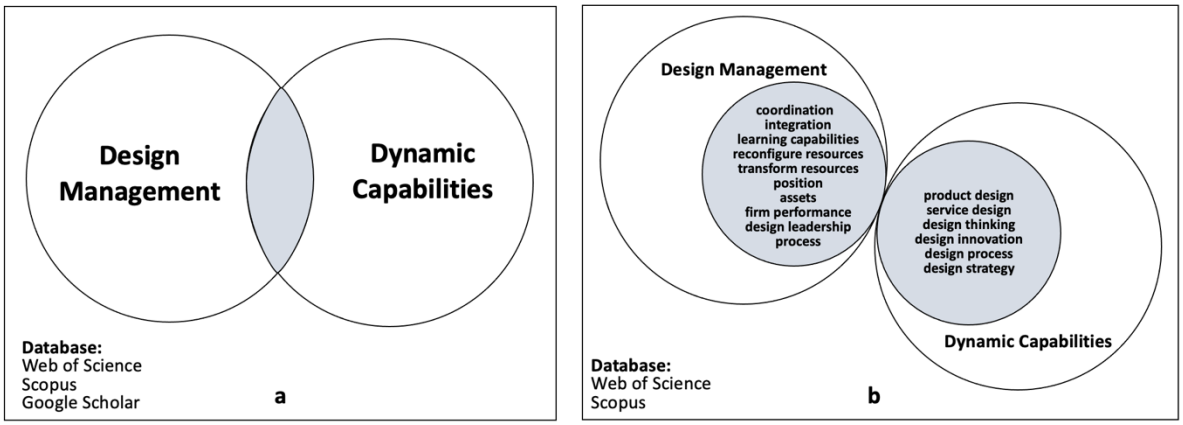

Figure 1. Mapping the scope of SLR.

3.2 Process

This systematic literature review consists of four steps: searching the overlapped literature of two concepts, searching combined keywords, review results, discussion and report.

Step 1. Searching the overlapped of two filed

The step 1 is to complete the overlapped search of DM and DC. This process will go through Web of Science and Scopus, search the title and abstract are accurately for these two keywords, and the articles we get are consistent with this research. And go through Google Scholar and use scope review to screen. 26 articles related to this research obtained (Table 2).

Table 2 Combine design management AND dynamic capabilities

Main Keyword	Web of Science	Scopus	Google Scholar	total
Dynamic Capabilities AND Design Management	13	4	2620	37

Step 2. Searching the combined keyword

The second step of the literature search is to find the research content from the DM and DC that belong to the research scope of the other part. In this step, for building the two different areas, the search strategy adopted is:

1. Main keywords DM and DC: appear in the title or abstract or keywords;
2. The combined keywords: appear in the abstract.

Since Step 2 requires exact results, Google Scholar is not used for searching. After deleting the duplicates and books section, remove irrelevant articles, such as architecture, construction, chemistry, biological engineering, agriculture, climate, software engineering, energy engineering and computer engineering. Moreover, 101 articles were obtained in the DM perspective (Table 3); and there are 24 articles obtained in the DC perspective (Table4). When we combine Tables 2, 3 and 4, we get the final results of articles is 142 (Table 5).

Table 3 Main combination search string and the combination in the perspective of DM.

Main Keyword	Combined Keywords	Web of Science	Scopus	Deleted Duplicates	Deleted Inappropriateness
Design Management	Process	570	1328	1454	126
	Coordination, integration, learning capabilities, reconfigure resources, transform resources	138	315	347	34
	Position, assets	34	79	89	22
	Firm performance	2	27	27	8
	Design leadership	1	7	9	8
Total	139				

Table 4 Main search string and the combination in the perspective of DC.

Main Keyword	Combined Keywords	Web of Science	Scopus	Deleted Duplicate	Deleted Inappropriateness
Dynamic Capability	Product design	51	12	57	13
	Design thinking	11	6	13	6
	Design process	30	9	38	5
	Design innovation	6	2	6	3
	Design strategy	32	2	33	2
	Service design	6	3	7	2
Total	25				

Table 5 The articles of systematic literature review

Step	1-Overlap in DM AND DC	2-DM perspective	2-DC perspective	Total
Article	37	139	25	142

4 Results

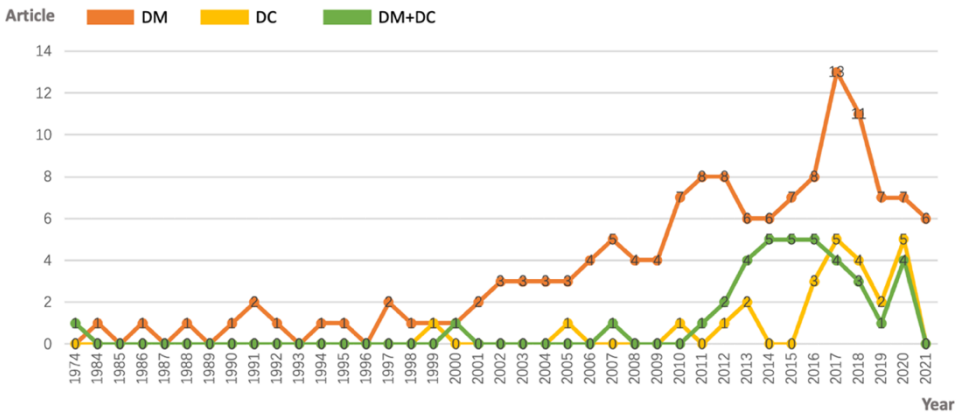

Figure 2. Publication of years Source: Table 5 search results

This study uses systematic literature review research methods to explore the relationship between design management and dynamic capabilities. The content that may overlap in the two fields is retrieved using keyword search, and a full range of articles is obtained. This discussion section divides into two subsections that answer the two research questions raised at the beginning of this paper.

As shown in Figure 1, the publication of research articles in this field revealed a general trend of a steady rise. It can seem that no matter from which perspective, high-frequency words always revolve around innovation, strategy, business, knowledge, Etc. (Figure 2). Through step 1, we first obtained five highly relevant articles (Table 6). These articles repeatedly appeared in multiple search keywords. They were also articles that most directly studied the relationship between design management and dynamic capabilities.

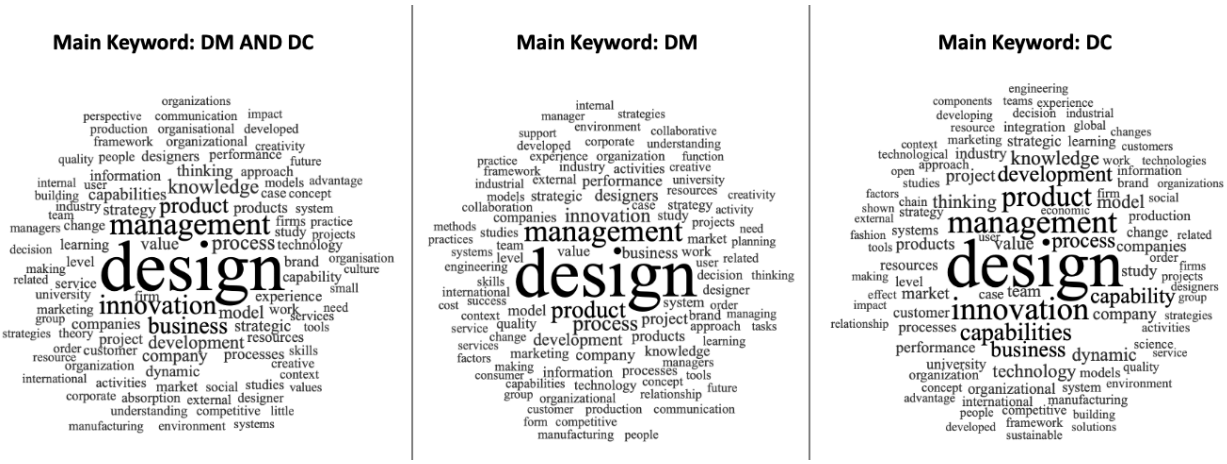

Figure 3. Words frequency statistics of search results in three scopes.

Table 6 Five main articles

	Title	Author	Paradigm	Method
1	Ambidexterity and dynamic capabilities in design management: An anatomy.	Cautela, C., & Zurlo, F, 2012	Qualitative	Case study
2	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.	Acklin, C, 2013	Qualitative	Case study
3	Design management as dynamic capabilities: a historiographical analysis.	Santos, R., Bueno, E. V., Kato, H. T., & Corrêa, R. O, 2018	Qualitative	Literature review
4	Design Management Capability Framework in Global Value Chains: Integrating the Functional Upgrading Theory from OEM to ODM and OBM	Manzakoğlu, B. T., & Er, Ö, 2018	Qualitative	Literature review
5	Design management capability and product innovation in SMEs	Fernández-Mesa, A., Alegre-Vidal, J., Chiva-Gómez, R., & Gutiérrez-Gracia, A.,2013	Mixed method	Structural equation modeling

5 Discussion

5.1 Analysis

By analysing the results of keyword searching step 1 and 2, we expanded the scope of design management and dynamic capabilities. In step 2, combined keyword search, 142 articles obtained from the DM and DC perspective.

From DM perspectives, proceed, Coordination etc., embody the function of design management in the environment, which can fully perceive and link various resources and organizations. For specific representative views, see Table 7-a and 7-b.

> **Process:** Design management can establish a connection between design and strategic management and creating opportunities.
> **Coordination, integration, learning capabilities, reconfigure resources, transform resources:** Design should participate in as many links as possible in new products development, but it is not easy to play an independent role in the competitiveness of enterprises, and it needs to rely on specific environments, parameters and standards.
> **Position, assets:** Design management plays an essential role in linking technology, market, and industry stakeholders.

Table 7-a Main articles' topic in DM perspective

Dimension	Research Topic	Author
Process	Added four design research, training, development and integration in design management audits framework,	Topaloğlu and Er (2017)
	Design add critical new insights to entrepreneurship in terms of opportunity creation; Entrepreneurial enrich design in opportunity implementation and risk-taking.	Nielsen and Christensen (2014)
	Represent DM Absorption Model for SMEs with Little or no Prior Design Experience.	Acklin (2013)
	Design can identify the meaning brought by technological breakthroughs Design-driven innovation	Verganti (2011) (2008)
	Design occupies a critical role of the preparation phase of the company's operational tasks	Gorb (1986)
Coordination, integration, learning capabilities, reconfigure resources, transform resources	Designers must participate in all stages of the NPD process. Their brand commitment, source of professional knowledge and level of professional expertise affect the success of NPD.	Manceau and Abecassis-Moedas (2019)
	DM focuses on design-related communication. Design can be used as resource, but not a single source of competitiveness and requires a combination of specific parameters and standards	Gerlitz (2016)
Position, assets	DM Capability Framework in global value chain	Manzakoğlu and Er (2018)
	A model to identifies three DM practices that can guide managers in the development of Technology Epiphanies.	Dell'Era et al. (2017)
	framework allows the exploration of industry dynamics, drivers, and the macro environment, which will lead to the identification of DM issues.	Sun and Evans (2011)
	DM framework to corporate decision-makers to link design strategy with marketing and manufacturing.	Fitzsimmons et al. (1991)

In terms of corporate management, keywords such as firm performance and leadership reflect these articles' importance to the market, consumer, and team management.

Firm performance: Design is an integral part of brand and marketing strategy, which affects consumers' choices; design management ability is an essential criterion for measuring how design affects performance.

Design leadership: The main task of the design leader is to identify opportunities for the organization, and once the organization obtains sustained competitiveness.

Table 7-b Main articles' topic in DM perspective

Dimension	Research Topic	Author
Firm performance	A framework to explain how product design is an important part of brand strategy, how to influence consumers' opinions, and describe the impact of particular brand	Townsend et al. (2013)
	Quantitative research verifies Dickson's five DM skills, proves the role of DM in prompting company performance.	Chiva and Alegre, (2009); Fernández-Mesa et al. (2013)
Design leadership	Task chronological evolution of design leadership (2015-2017): let company develop sustainably in the context of globalization of social welfare	Mozota and Wolff (2019)
	Five principles of good design leaders	Lee and Cassidy (2007)

From the DC perspective, the article is more from the perspective of product development and pays more attention to the ability of design management to perceive the dynamic environment and identify opportunities. For specific representative views, see Table 7-a and 7-b.

Product design:

The dynamic capability of the product development process depends on the coordination of work links and members.

Design thinking :

The addition of design ideas can strengthen the connection with users, enhance the knowledge absorption capacity of the team, and help effectively improve the product development process's ability to identify opportunities and seize opportunities; however, the investment and return may not be directly proportional or even Affect the team's business capabilities.

Design innovation:

Generating new dynamic capabilities is the focus of design innovation management. Accumulate resources and capabilities by increasing investment in design.

Service design: Focusing on the future allows the design to promote the organization's perception and assimilation of new opportunities.

Table 8 Main articles' topic in DC perspective

Dimension/Combined Keywords	Research Topic	Author
Product design	Design-driven organization uses DC framework, can effectively describe the strategic adopted by the design-driven organization and solve the tension in the product's DM process.	Cautela and Zurlo (2012)
Design thinking	Siemens added design thinking to the product development process for the first time and achieved effective innovation results. However, the return on investment of design thinking requires careful consideration.	Appleyard and Velazquez (2020)
	Design thinking can understand and executing users, accommodates stakeholders with different perspectives and uses their differences to find better solutions. This process is the routine of the DC: sensing, seizing, transforming.	Liedtka (2020)
	Team design thinking is a capacity-building mechanism or a dynamic capability. Solve the inertia of the organization due to cognition in a specific environment and create new knowledge resources.	Nagaraj (2020)
	Training design thinking in the organization and management, the team's ability to enhance absorb knowledge and transformation can be promoted. However, it harms the teams' business performance.	Kurtmollaiev et.al. (2018)
	There is a strong connection between design thinking and DC in sensing and seizing opportunities.	Ojasalo et al. (2015)
Design innovation	Discussing five different design innovation capabilities and analysing their mediating role between design investment and competitive performance, proved design can promote the organization's sustainable competitiveness.	Landoni et al. (2016)
Service design	The combination of future thinking and design thinking can promote perception in the process of service design innovation.	Ojasalo et al. (2015)

Based on the results of systematic literature review, this research attempts to discuss the research questions raised at the beginning of the article.

5.2 Answer the research questions

5.2.1 Question 1: Why design management can be regarded as a dynamic capability?

According to the previous literature's interpretation of design management skills (Dickson et al., 1995), design management has a dynamic capability. Therefore, design management itself is a

dynamic capability. At the same time, it can also promote the organization to produce new dynamic capabilities. For instance, through management design skills or design awareness, the designer's innate sensitivity and design method can empathize with the user's needs and identify the technical feasibility. Moreover, combined with a suitable business strategy, this knowledge can be transformed into customer value and market opportunities. These finally created competitive capabilities for the company, that is, dynamic capabilities. This capability can help organizations deal with the changing environment and make decisions different from previous practices. For example, after Siemens had strengthened the role of design management in product development, Creative Forbearance as a new dynamic capability has emerged (Appleyard & Velazquez, 2020). This approach is not similar to Siemens' previous management method. In the past, they did need to respond to the evolving technological environment continuously. Therefore the Creative Forbearance led the team to add great imagination to identifying and predicting user needs, temporarily letting go of technology leadership; And then patiently executing the design. Creative Forbearance has become a differentiated innovation capability, and it enables products and services to generate continuous market competitiveness.

5.2.2 Question 2: What is the relationship between design management and dynamic capability?

By disassembling and analysing their respective formation procedures, an effective conversion mechanism between design management and dynamic capabilities can be established. The first is to clarify the design management model and process. After summarising, we can get a routine about a specific design management type. Then compare this routine with the framework of dynamic capabilities to analyse the relationship between the two parts. After comparison, we can analyse the relationship between the two, whether it is a mutual promotion or an obstacle.

From the perspective of operation, there are still uncertainties in the existing design management model, but dynamic capabilities are a definite process: sensing, seizing, transforming (Figure 4). Therefore, after the routines of design management are clarified, they will develop under the framework of dynamic capabilities, which makes it easier to build dynamic capabilities. This approach reflects in the five main articles. We can find that the difficulty of the current research lies in the uncertainty of design. Therefore, design management does not have a general framework that can use to establish dynamic capabilities.

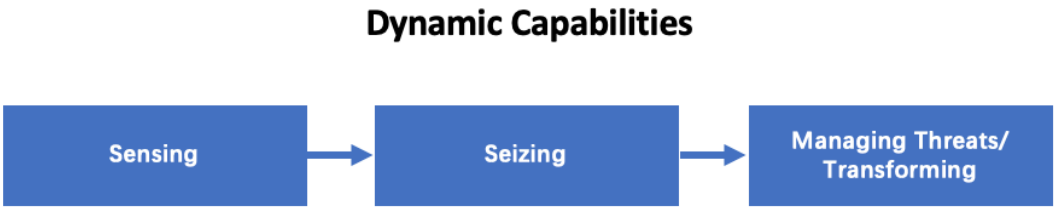

Figure 4 Dynamic capabilities Source: Teece(1997;2007)

6 Finding

6.1 Summary

From the data and discussions, we can distinguish two types of relationships between design management and dynamic capabilities:

1. Design management is a dynamic capability.
2. Design management can generate dynamic capabilities through different modes.

The first relationship bases on the design management capabilities. This relationship is the most apparent conclusion so far. Dickson and others mentioned five dimensions of design management skills: basic skills, specialized skills, involving others, organizational change, and innovation skills. Through case studies, Jevnaker explored organizational design capabilities combined with corporate leadership activities. These four capabilities are resourcing capability, combinative capability, organizational learning capability, innovation capability, design-strategic capability, and capability of protecting design-based advantage. These capabilities are distributed at different levels of design management.

Santos et al. (2018) did a comprehensive literature review. Through the literature relationship analysis of the articles with high citation rates in design management, the design management can be summarized as design learning, design coordination, and design skills, which can constitute a dynamic capability. Design learning corresponds to acquiring and absorbing knowledge and practice and disseminating it to the entire organization. Design coordination corresponds to the ability to coordinate activities and practices necessary for good design. Finally, design skills include technologies and knowledge that produce synergy, creativity, and innovation. We can more intuitively see several mainstream topics and representatives concerned in design, such as design ideas, design-driven innovation, etc.

The second type of relationship is generated by design management in a specific application scenario. The following patterns can be identified in our literature review: **design management absorption, use organizational learning as an intermediary, use ambidextrous organization as an intermediary.**

6.2 Design management absorption capability

This research trend traces back to the absorptive capacity in organisational learning capacity and uses its existing framework to develop a framework for design management absorptive capacity. Absorptive capacity (ACAP) uses in analysing diverse, significant, and complex organisational phenomena. Zahra and George (2002) proposed a reconceptualisation framework, viewing ACAP as a dynamic capability and suggests that it can be formulated and implemented with the specific intent to acquire, assimilate, transform, and exploit knowledge. Based on this framework, Acklin divides the design management process into organisational routines and processes and develops a specific model for the design management knowledge absorptive process. From the perspective of absorbing design knowledge, this absorption process divides into four stages: acquisition, assimilation, transformation, exploitation. Design management absorption prototype that can guide enterprises lacking design management experience to better use design to improve enterprise performance.

Design management involves learning, creativity and knowledge; the use of revolutionary technologies; innovation; and skills that can generate more value for products (Jevnaker, 2008;

Verganti, 2011; Dell Era et al., 2017). Through the analysis of the literary relationship between the articles with high citation rates in design management, the design management divided into three sessions as design learning, design coordination, and design skills, which can be corresponded to the characteristics of the concept of dynamic capability (Santos et al., 2018). According to Teece et al. (1997), the components of dynamic capabilities are feeling the process context, taking advantage of opportunities, and managing threats and transformations. Design learning corresponds to acquiring and absorbing knowledge while practising and disseminating it to the entire organization; design coordination corresponds to the ability to coordinate activities and practices necessary for good design. Finally, design skills include technologies and knowledge that produce synergy, creativity, and innovation (Santos et al., 2018).

6.3 Organizational learning as an intermediary

Dynamic capabilities are also seen as processes and routines that inductively help generate organizational learning (Teece et al. 1997; Eisenhardt and Martin, 2000). Design management is a series of organizational and managerial activities or practices required to realize the design process (Gorb and Dumas, 1987). Since dynamic capabilities arise from learning (Zollo and Winter, 2002; Easterby-Smith and Prieto, 2008), the organizational learning capability is a precursor of design management capability. Fernández Mesa et al. (2013) claim designed management capability as a dynamic capability can be an intermediary between organizational learning and product innovation. Therefore, organizational learning capability promotes product innovation by the intermediary role of design management capability. Furthermore, he used Dickson (1995) design management evaluation framework to verify the role of design management capability.

6.4 Ambidextrous organization as an intermediary

Ambidexterity is an ability proposed based on the need for enterprises to adapt to the ever-changing environment. That is, the ability that enterprises can explore and develop simultaneously, which is also a kind of dynamic ability. This ability is mainly used in team management (O'Reilly & Tushman, 2008).

The performance of a design project depends on the capability to coordinate and control the collaboration among many participating stakeholders. For example, designers, experts from different disciplines, different experiences, design managers, and other external partners. Coordination and control of design are part of new product development, which requires identifying different situations during the design process and allocating sufficient resources to meet design goals (Wehbe et al., 2020). Cautela studied the tension in design decision-making that is less designed in the field of design management research. From the perspective of design leaders and designers, an alternative tensions-based view of design management is proposed to use an "Ambidextrous organization" frame to deal with conflicts in design management.

Through this literature review, we have clarified the relationship between design management and dynamic capabilities and learned the transformation mechanism between them. The current framework for design management and dynamic capabilities has not been fully explained, and there are still uncertainly areas worth exploring. For example, how to build routines of different levels of design management to generate dynamic capabilities more effectively. These parts are also the next step of this research.

7 Conclusion

Due to the rapidly changing environment and the nature of design, design managers often faces uncertainty. This uncertainty comes from the uncertainty of design and the unpredictable worry about environmental changes. The concept of dynamic capabilities fits this changing state and compensates for uncontrollable worries. Under appropriate conditions, design management can explore new areas and use its capabilities to solve problems. Although the research on design management has been developing and the role of design has been recognized, the relationship between design management and dynamic capabilities has not been comprehensively studied. This research studies the most fundamental relationship with these two concepts and reports on the following research results.

First, the concepts of design management and dynamic capabilities do not have a clear subordination relationship. Design management has functions, like design skills. Conceptually, it is not only a capability but also a process and even a strategic resource. We can even understand design and management separately, which is the intersection of both academic areas of management and design. However, no matter its state, design management is full of changes and can correspond to dynamic capabilities. We are concerned that the essence of design management is "change", so when discussing its relationship with dynamic capabilities, we did not make an obvious distinction between these design management concepts.

Second, design management is a dynamic capability, but it can also create new dynamic capabilities. As a dynamic capability, it uses its management awareness, empathy, design skills, cross-functional coordination capabilities, and comprehensive thinking to solve various problems. After it successfully solves a problem, the path it solves the problem will be a routine. The combination of the factors involved, the path, the positions and the roles in the process will merge into a new dynamic capability. Because of the flexibility of design, there are many ways for design management to create dynamic capabilities. It can adjust its functions according to the different organizational levels it faces. As a preliminary study on design management and dynamic capabilities, this systematic literature review helps identify dynamic capabilities, such as a capability framework conducive to improving design management. However, due to the limitation of research methods, this research can only review and summarise the concept and framework. As for how design management contributes to dynamic capabilities, it will be the main focus of the following research.

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