Design × Innovation[†]

Andy Dong*

** Faculty of Engineering & Information Technologies, University of Sydney, andy.dong@sydney.edu.au*

Abstract: The concept of design-led innovation has been introduced to draw attention to the strategic value of the practice of design and the dispositions of designers for innovation. This paper will examine academic conceptualizations of design-led innovation. Despite widespread interest in and adoption of the concept of design-led innovation, this paper highlights the lack of conceptual agreement. To enable this concept to become a workable innovation model for fields beyond creative industries, this paper proposes a 'drive-orient' model of design-led innovation.

Key words: design management, innovation and technology management

1. Introduction

By now, the strategic importance of innovations to the sustainability of companies and national economies is no longer disputed. The longevity of companies is no longer a given, even for well established market-leading ones. A study of the survival rate and returns of companies in the S&P 500 since 1957 showed that by 1997 only 74 of those firms remained, and of those 74, only 12 actually outperformed the S&P 500 [27]. The challenge for companies is both to identify new opportunities and problems to solve continuously while at the same time managing the decline of non-viable businesses before the market forces them into divestiture.

The field of design studies has begun to contribute to the scholarly research on innovation to address this tandem challenge. For the purposes of this paper, the definition of innovation, based on the concept of 'animal innovation'[1], refers to an outcome: a new product or service introduced into the market, which results in sustained changes in behavior in the market. Sustained behavior changes include new behaviors not previously practiced (e.g., routinely commenting on daily life on social media) or displacements of established behaviors (e.g., using mobile phones rather than digital cameras to take photos). Under this definition, new technologies, which are often marketed as 'innovations', do not in and of themselves constitute innovations: Incremental improvements in the resolution of digital cameras are not innovations. The requirement of sustained changes in behavior in the market is necessary to distinguish between technological improvements that cater to the gap between consumer performance expectations and product capabilities and innovations that introduce or change consumer expectations altogether. The definition used in worldwide benchmarks on the innovation-oriented activities and systems and the level of firms, regions, and states is: "the implementation of a new or significantly improved product (good or service), process, new marketing method or a new organizational method in business practices,

[†] The format of the title follows the Japanese style of describing design collaborations, generally between Western and Japanese brands, e.g., Nike × Undercover. Thus, the title signifies collaboration between design and innovation.

[1] Animal innovation is defined as, "a process that results in new or modified learned behaviour and that introduces novel behavioural variants into a population's repertoire." [52] Reader, S.M. and K.N. Laland, *Animal innovation: an introduction*, In *Animal Innovation*, S.M. Reader and K.N. Laland, Editors. 2003, Oxford University Press: Oxford. p. 3-35.

workplace organization or external relations." [1, p. 46]. Although the wording of the definition excludes the adoption of the innovation in the marketplace or sustained change in behavior, it could be assumed that these are presumed by the definition. How to achieve innovations is a matter to which design research provides solutions.

Empirical evidence, such as case studies of companies including Proctor and Gamble, Philips Electronics, and the Mayo Clinic who adopted the tools, methods, and 'thinking' skills of designers (design thinking according to Tim Brown [9]) to capture innovations [41], is beginning to point to the competitive advantages of 'good' design and design thinking for successful innovations and strategic renewal [51]. The intense competition and patent litigation between Apple and Samsung over their phone designs highlight the commercial value of 'good' design. National innovation measurement instruments explicitly include design as a separate category of 'intangible capital' investment toward innovation [17]. While innovation researchers have generally focused more attention toward achieving innovations through R&D, the organization of the firm, management capabilities, internal innovation systems, and measuring the innovation capabilities of firms [25], the value of design to innovation is increasingly gaining both commercial and academic attention [31, 32]. Supported by scholarly textbooks on new product development [10, 12, 68], wherein the practices of design take center stage, the strategic value of design in capturing innovation, especially for new products and services, is increasingly recognized.

As an indication of this trend, scholars in the fields of innovation and design increasingly cite the concept of design-led, design-driven [73], or design-inspired innovation [69] to highlight the essential link between design and innovation. The term references the practice of design as means to achieve innovation outcomes. An intellectual condensation around this concept is emerging between scholars of design and scholars of innovation. Despite the enthusiasm in the field of design research for the notion of design-led innovation, some have argued that this enthusiasm is not necessarily shared by innovation scholars as much as it is by design scholars [31, 32].

This paper offers a meta-analysis of the literature on design-led innovation. The purpose of the meta-analysis is to highlight academic conceptualizations of design-led innovation. Based on the analysis, the paper identifies 4 drivers of design-led innovation: search for meaning; tools and methods; 'designerly' dispositions; and, organizational design culture and strategy. I propose a drive-orient model of design-led innovation to respond to criticism that 'good' design in and of itself does not necessarily lead to commercial value, leading some to coin the term design for business (D4B) [2]. This paper takes a systematic view on the interaction between drivers of design-led innovation and the effectiveness with which a firm converts its design resources and capabilities into innovation outcomes.

2. Research Method

To obtain a set of scholarly publications precisely on the subject of design-led innovation, including papers demonstrating applications and outcomes (i.e., new goods and services) of design-led innovation, a literature search was performed across two databases: Scopus and Web of Knowledge. A Boolean search was conducted for articles having the terms 'design-led' OR 'design-driven' AND 'innovation' in the title, abstract, or keywords. For the purpose of this paper, the phrase 'design-led innovation' will be utilized except in reference to papers that explicitly use the term 'design-driven innovation'. Papers were not included if the content was a book review on the subject. To be considered as research on design-led innovation, I imposed two conditions on articles: they should (1) provide a specific conceptualization or definition of design-led innovation; and, (2) explicitly address

the causal influence of design tools, methods, practices, and/or cognitive strategies on innovation outcomes. For example, in the case of articles about specific innovations, articles had to deal explicitly with the causal influence of design rather than merely reporting on the design (i.e., behavior and embodiment) of the innovation. Furthermore, since the focus is on articles that expand the understanding of design-led innovation, editorial or practice-based articles were included. In addition to the scholarly papers, highly regarded books on design and innovation were included in the dataset [10, 34, 41, 73]. Finally, various instruments utilized to measure the performance of firms on innovation and national innovation systems were analyzed for their inclusion of design-related activities, if any, as inputs into innovation [1, 17, 19, 24, 43]. In total, 32 articles about design-led or design-driven were identified.

Identified papers were read to extract their claims with respect to the following three research questions:

1. What is the content of design-led innovation? This question considers the sort of activities associated with design-led innovation so as to differentiate design-led innovation from other activities associated with innovation such as R&D and capital expenditures for new equipment. Of particular interest were measurable inputs into design-led innovation.
2. What are the antecedents of design-led innovation? While there are many activities, tools, methods, and cognitive strategies associated with design, what are the individual and firm-level capabilities [32] to undertake them?
3. What are the consequences (impacts) of design-led innovation? Consequences should go beyond the commercial value of the innovation itself to include proximal and distal effects. The proximal effects relate to the performance of design-led innovation on factors associated with 'good design' [34]. The distal effects address the performance of design-led innovation on firm-level indicators such as market position and productivity and national indicators of innovation performance such as the World Ranking of Global Competitiveness and GDP per hour worked.

3. Conceptualizations of Design-led Innovation

Research in the fields of design studies and innovation has been progressing independently for quite some time. Design studies formally emerged around the late 70's with the commencement of the journal *Design Studies*. The field of innovation studies has a much longer heritage, dating back at least to Joseph Schumpeter's seminal book, which introduced the essential concept of 'creative destruction' [58]. While a history of the academic understanding of these two streams of thought exceeds the scope of this article, some scholars have recently called for these two streams of thought to converge [31, 32]. There is a growing belief, backed by empirical evidence, that the tools and methods of design and the dispositions and sensibilities of designers have causal and positive influences on innovation outcomes. Case studies of companies adopting design-led innovation highlight the transformative effects of a design-led approach [41, 73].

The sections that follow integrate past research on design-led innovation. The aim is to address the three research questions on the content of design-led innovation, its antecedents, and its impacts.

3.1 Content

Most of the literature about design-led innovation literature focuses on the processes and activities of design, that is, the content of design. The content of design includes practice-based methods for discovery and invention such as ethnography and design-by-analogy, tools and techniques for ideation and synthesis such as sketching,

modeling, and prototyping, and cognitive strategies. In contrast to business model creation, which emphasizes planning and exhaustive delineation, analysis, and evaluation of alternatives, design practice emphasizes rapid testing of generative hypotheses [15] and forming frames for complex problems as a standpoint for creating value based on a working principle [23]. Some scholars integrate all of these aspects in the concept of design thinking, which refers to the designer's sensibilities and tools and methods of design as resources for converting user needs into a product or service that would be valued in the marketplace [9]. Other scholars similarly refer to the tools and methods of design for imagining and presenting new ideas [37]. The design activities, cited by scholars, that are generally linked to design-led innovation include: primary research such as observation, information gathering, and interviews; conceptual design supported by sketching, modeling, and prototyping; system design including establishing the product architecture; and, detailed design including documentation. Of these activities, the tools and methods widely regarded generally as the most valuable contributions of design practice are design ethnography, sketching, and prototyping. The tools and methods of design ethnography are associated with the 'abstract realm' of discovery of frameworks and ideas whereas the tools and methods of sketching and prototyping bring design practice back to the 'concrete realm' where practical solutions are generated [6].

In addition to the practical, technical tools of design, many scholars view design, and by extension design-led innovation, as underpinned by a set of cognitive strategies emphasized in design. This view mirrors the strategic cognition perspective in management [46]. The most commonly cited cognitive strategies associated with design include abductive logic (the process of proposing a hypothesis to explain the data, which in design is "what might be" rather than the current or previous state of affairs) [53], analogical reasoning (identifying and carrying over knowledge from prior situations to support the current design context) [4, 74], and framing (the process of drawing associations and dissociations between the facts of the situation, assumptions, and precedence to produce a schema for their interpretation) [23]. These cognitive strategies support dealing with the uncertainty of design outcomes by producing a repertoire of synthetic knowledge in such a way as to predict what will work [4].

3.2 Antecedents

Whilst the content of design-led innovation is becoming widely known, it is much less clear whether non-design trained individuals and companies whose core business is not design actually have the capacity and competence to make use of the concepts of design-led innovation. Scholars have already pinpointed that the design research literature downplays the capability of individuals and firms to develop design as a capability [32]. Design practices and dispositions need to be developed in organizations before design can be part of generating business strategies, leading to major strategic initiatives for innovation. Scholars have thus far identified two categories of antecedents: internal organizational factors (e.g., organizational culture, idea creation and selection processes) and individual factors (e.g., experience, personality).

The need to generate valuable ideas that may be transformed into a product or service innovation is consistently a top priority for companies. Innovation scholars have identified internal organizational factors that influence the generation of novel ideas including the sharing of ideas between employees [57] and the dynamism of the company [36]. Likewise, organizational behavior scholars have identified characteristics of productive R&D organization culture including increasing the creativity of the R&D leadership [62] and R&D autonomy [66] among many factors. In an attempt to further boost the quality of R&D [61] and innovation outcomes, many organizations are now implementing design and design thinking as organizational competencies [40]. Design

management and design scholars emphasize the importance of developing programs to improve design and design thinking throughout the organization. To take one example, Martin [42] describes the creation of design-thinking coaches at Intuit to help the company's various business units apply design as a way to achieve the company's aims of Design 4 Delight. The creation of these programs helps to embed design and design thinking into an organization such that company's culture embodies a culture of design as their 'dominant logic' [8]. Beverland and Farrelly [8] further emphasize that to create this culture, employees at these companies must develop the dispositions of curiosity, cross-functional empathy, and broad observational insight. Finally, they emphasize that it is insufficient for companies simply to embed design at the 'styling' stage; rather, design must be embedded throughout and begin at the opportunity identification and strategic setting stage.

The dearth of empirical research on the operationalization of design thinking in organizations, other than descriptive case studies [39, 75], to explain their capability to convert design resources into innovation outputs prevent general conclusions from being drawn. This is an important gap in the literature.

At the individual level, design scholars have studied the practices of expert designers to understand their dispositions and strategies. A number have been identified including:

- capacity to think at multiple levels of abstraction simultaneously, such as thinking about the concept but also about the details of implementation [13]
- take a systems view of design situations, frame design problems in a unique manner, and work from first principles [14]
- have deep cultural interests [63]
- use design strategies rather than trial-and-error [3, 35]

Lawson and Dorst [38] further clarify the issue of the dispositions and strategies of designers by focusing on the strategies taken according to the degree of expertise of the designer. They argue, for example, that novice designers may operate based upon rules whereas experts may operate based upon patterns, and it would be more appropriate to ascribe a set of dispositions and strategies appropriate to the level of experience of the designer rather than a single canonical set of dispositions and strategies. There is a lack of empirical evidence on the extent to which design thinking initiatives within companies develop these individual factors though. Thus, although it is known what dispositions and strategies need to be developed at both the organizational and individual level, the extent to which they are developed remains unknown.

3.3 Impacts

In the field of design research, the outcome of the activities and processes of design is generally measured in terms of creativity [59, 60] or in the ability of the designed work to satisfy a synthetic design brief. The actual commercial success of the design is generally of less importance, if any, due to the impracticality of commercial success in the timeframe of academic research. Many years ago, Trueman and Jobber [65] proposed a 4-factor model comprised of value, image, process, and production, but did not publish empirical verification of their model. Recently, researchers have begun to link specific design characteristics to actual commercial success. In a study of award-winning end consumer mechanical products, the researchers identified that the majority of the products exhibited enhanced external interactions (80.2% exhibited new ways to interface with other products) or user interactions (68.5% presented new ways for interfacing with the end user) [56]. In contrast, only 38.1% of the award-winning products offered new functionality.

While the attributes that make a specific work of design a 'good' design may be too numerous to discuss, and, in any case, are generally specific to the type of product, i.e. a mechanical product or an architectural design, one notable conceptualization of design-led innovation is the definition by Verganti [70], [71-73] of design-driven innovation as a search for new meaning. Verganti's definition of design-led innovation emphasizes an outcome. According to Verganti, the purpose of design-driven innovation is to produce new frames for products and services, and these new frames in turn create opportunities for innovations. Firms achieve incremental innovation through 'design push' with existing technologies and breakthrough innovation through simultaneous 'design push' and 'technology push'. In other words, the outcome of design-led innovation is new meaning, and, presumably, the commercial success follows.

The empirical evidence on the value of design to commercial success of products confirms that design-led product design results in more commercial success when design attention is drawn more toward performance and quality than styling alone [55]. One study on the impact of professional design consultants on new or improved products showed that 90% were commercially successful [54]. Good industrial design positively affects corporate financial performance and stock market performance [30]. The stock performance of 166 design-led companies in the UK, tracked over the period 1994-2003, outperformed by 200% against the FTSE 100 and FTSE All-Share [20]. Overall, though, the empirical evidence on the contribution of attributes of 'good' design to business performance, rather than the benefit of design *per se* [21], remains relatively scarce [47].

National innovation assessment reports aim to collect evidence on the direct impact of design to national indicators of innovation. Many national innovation system reports now account for intangible investments in the category of "innovative property", which are investments that aim to commercialize and profit from basic research [11]. In the UK, Nesta's Innovation Index reports that design itself accounted for 12% of total investments in intangible assets in 2012 in the UK [29] and in Australia, investments in intangible capital including design contributed to 0.30% growth in multifactor productivity [18]. Unfortunately, the scope of design-related activities accounted in the data collected for these reports is based on data obtained from architectural and engineering design companies [11]. This definition would not capture the full range of content associated with design-led innovation especially when the output of the design activity is not a new good or service but a modified business model or mode of interaction with customers. These constitute important types of innovations [33], to which design could contribute in their formation. It is not that the authors of the reports view design in a limited way; rather, the definition is based on the exigencies of data collection and the practical challenges associated with obtaining reliable data about design-related investments. As design becomes an increasingly important part of innovation practices, it is hoped that national accounting systems may include data obtained beyond companies engaged in design *per se* to account for all companies investing in the content of design-led innovation.

4. Framing Design-led Innovation

The following table, Table 1, summarizes the various conceptualizations of design-led innovation based on the meta-analysis of the literature. One of the observations emanating from this selective review of the literature is that most authors do not go beyond ascribing a set of characteristics associated with design to design-led innovation. Although many of the authors cited in Table 1 are unequivocal on the positive impacts of design-led innovation, they have articulated different aspects of design and their contribution to successful design-led

innovation, from having a corporate culture of design to adopting the tools and methods of design. Further, while all authors demonstrate that design-led innovation leads to new to the market products and services, the problem is that the success is often compared to not having design-led processes. As identified in studies on the capabilities of R&D in firms, such a comparison leads to a tautology, because by comparing success through design-led with failure without design-led indeed leads to the conclusion that being design-led is critical since it was the only differentiating factor [25]. Thus, it is not conclusive the extent to which design-led innovation produces firm-level innovation effects including more competitive market positioning and productivity, and the influence of design-led innovation at the macroeconomic level to multifactor (or total factor) productivity [44]. Further research of the sort on the value of 'good design' to financial performance [30] are required for companies whose business is not design *per se*, but whose business performance relies in part on design and design thinking.

Table 1. Summary of Drivers of Design-led Innovation

	Drivers			
	New meaning	Design tools and methodologies including cognitive strategies	Individual 'designerly' dispositions	Design culture and strategy
Reference	[5, 16, 41, 42, 48, 50, 64, 70-73]	[6, 8, 10, 23, 37, 45]	[3, 8, 13, 14, 35, 48, 63, 64]	[2, 5, 8, 28, 41, 42, 67]

Similarly, reports on the impacts of innovation at the national level group design and design-related activities into a set of intangible capital investments, which as a group contribute to multifactor productivity [17, 19] and creative outputs that could be produced through design [24]. However, since the data on design is limited to data obtained from companies whose principle business is design, rather than companies whose business is not design but whose business performance relies on design, such as education or health service providers, the total value of design and design thinking to national innovation outcomes and productivity it is still unclear. A way to assess design competency and design capability on a large scale remains a challenge for design researchers, though initial attempts have been made [22].

To lay a foundation for design-led innovation, with regard to its content, antecedents, and impacts, I propose a 'drive-orient' framework for the convolution of design and innovation. In the table that follows, Table 2, the various drivers of design-led innovation are oriented toward a set of effects. These include the proximal effects of 'good design', i.e., a design that satisfies user needs, is technically feasible, financially viable, and legal [34], and the distal effects of 'innovation' as generally reported in indices of innovation performance [e.g., 24].

Each of the rows and columns in the framework should be read bi-directionally to consider the function of the *drivers* on the proximal and distal effects and the *orienting* function of the proximal and distal effects on the behavior of the drivers. Connecting the rows and columns in the table can identify new research opportunities. For example, we might ask, in a vertical reading of the table, how might the search for meaning *drive* productivity? Conversely, in a horizontal reading, we might ask, how should government procurement policy *orient* the search for new meaning in public services? Likewise, the diagram provides a way to position the outputs of design research. To take one example, specific design tools and methods such as ethnography are intended to address the human attributes of good design more than the financial aspects. In so doing, we can identify gaps in knowledge,

such as the general absence of research on the influence of government regulations on the drivers of design-led innovation [cf. 26].

Table 2. The Develop and Orient Relation Between Design and Design-led Innovation

			Drivers of Design-Led Innovation			
			Search for Meaning	Tools & Methods	Disposition	Culture
Proximal Effect	Good Design	Human			Drive	
		Technological			↓	
		Financial				
		Government	Orient →			
Distal Effect	Innovation Performance Indices	Market Position				
		Business Performance				
		GDP Per Hour Worked				
		National Productivity				

4. Conclusions and Suggestions for Future Research

Finally, I offer some preliminary suggestions for future research. The predominantly positive sentiments about design thinking in case studies on its application, both in companies whose core business is design-related and whose business is not design-related, raises the concern that design thinking and design-led innovation may become management ideologies rather evidence-based practices [49]. Evidence is required to understand when and how design-led innovation benefits, shows no benefit, or is possibly even detrimental to innovation.

Foremost, we need to understand the degrees of capabilities associated with design-led innovation and how they differentiate successful from unsuccessful companies, all of which implement design-led innovation. Researchers should be able to draw clear evidence on organizational capability for design-led innovation to persistent competency in the introduction of new goods and services. Being design-led is itself a capability, but research should go further than this high-level view. Researchers could apply, for instance, the Lawson and Dorst [38] framework for expertise in design to measure an organization's capability to implement the drivers of design-led innovation. One example of this type of research, though limited to the case study of only two companies that have 'mastered the design-drive approach to innovation', describes the companies' capacities to use technology to change the meaning of a product [16]. Likewise, researchers should investigate the evolution of these capabilities in companies, just as design researchers currently study the development of design skills in students. As stated at the beginning of this article, one of the imperatives driving innovation is maintaining the long-term survivability of a company in a very competitive landscape. To demonstrate the value of design-led innovation, researchers need to show how this capability improves a company's strategic response [7] by testing hypotheses such as, "Firms will report higher expected returns when they orient their product development toward search for new meaning as opposed to technology push."

The aim of this review is to progress from a phrase intended to capture the phenomenon of design-led innovation to a construct that captures the content of design-led innovation and its antecedents and effects. We must progress beyond proclamations on the benefits of design-led innovation toward evidence of the conditions under which design-led innovation does and does not result in innovations more quickly and with fewer problems.

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