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Design, the Language of Innovation: A Review of the Design Studies Literature

Abstract There is a vast body of research exploring the myriad ways design can contribute to business success. For example, businesses seeing to generate new products, services, processes, models, and strategies as part of their efforts to innovate often turn to design for support and leverage. But how clearly have scholars defined the relationship between design and innovation? Is it even possible to explain the connection between the two? In this article, we investigate whether the design literature published over the past thirty years contains an answer to these questions. We organize our findings into clusters describing the key roles that design activity plays in the innovation process, how designers personally play a part, and the internal and external factors that contribute to design/innovation associations. We also introduce the notion that design language – be it visual, methodological, or procedural – has become not only an organizing principle that supports innovative initiatives, it has become the language of innovation itself.

Keywords

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1 Eusebi Nomen and Barcelona Design Centre (BDC), *€ Design—Measuring Design Value: Guidelines for Collecting and Interpreting Design Data* (2014), 1–40, available at <http://www.measuringdesignvalue.eu/index.php>; Brigitte Borja de Mozota, “The Four Powers of Design: A Value Model in Design Management,” *Design Management Review* 17, no. 2 (2010): 44–53, DOI: <https://doi.org/10.1111/j.1948-7169.2006.tb00038.x>; Ailbhe McNabola, “The UK Design Council: Putting a Value on Design,” *Design Management Review* 24, no. 4 (2013): 22–23, DOI: <https://doi.org/10.1111/drev.10259>; Design Council, *Leading Business By Design: Why and How Business Leaders Invest in Design* (London: Design Council, 2013), 1–90, available at <https://www.designcouncil.org.uk/resources/report/leading-business-design>; George Cox, *Cox Review of Creativity in Business: Building on the UK’s Strengths* (London: Her Majesty’s Treasury, 2005), available at http://webarchive.nationalarchives.gov.uk/+http://www.hm-treasury.gov.uk/independent_reviews/cox_review/coxreview_index.cfm.

2 Mary M. Crossan and Marina Apaydin, “A Multi-Dimensional Framework of Organizational Innovation: A Systematic Review of the Literature,” *Journal of Management Studies* 47, no. 6 (2010): 1154–91, DOI: <https://doi.org/10.1111/j.1467-6486.2009.00880.x>.

3 Tony Davila, Marc J. Epstein, and Robert D. Shelton, *Making Innovation Work: How to Manage It, Measure It, and Profit from It* (New Jersey: Wharton School Publishing/Pearson Education, 2006); Tony Wagner and Robert A. Compton, *Creating Innovators: The Making of Young People Who Will Change the World* (New York: Simon and Schuster, 2012); Lucia Rampino, “The Innovation Pyramid: A Categorization of the Innovation Phenomenon in the Product-Design Field,” *International Journal of Design* 5, no. 1 (2011): 1–14, available at <http://www.ijdesign.org/index.php/IJDesign/article/view/645>; Bruce S. Tether and Abdelouahid Tajar, “The Organisational-Cooperation Mode Of Innovation and Its Prominence Amongst European Service Firms,” *Research Policy*

Introduction: Why This Review?

For decades – in the case of the UK, since the formation of the Design Industries Association in 1915 – industry has been hearing about the value of good design and good designers. Many scholars have investigated and recognized the role that design and designers play in new product, service, and value creation, and ultimately, in business success.¹

Innovation – defined as a process and an outcome² – has been even more widely hailed as a factor contributing to ongoing business success. It has been the subject of a variety of research studies,³ and a growing number of these are paying particular attention to the connection between design, innovation, and business performance.⁴

Innovation researchers have tended to focus on particular domains, such as public policy or financial performance,⁵ or on certain specific types of innovation, including technological, radical, or design-driven.⁶ However, rarely do authors indicate precisely how design specifically contributes to innovation, or indeed whether that relationship can be precisely defined. In this article, we investigate whether the design studies literature contains answers to those questions.

This task is not without its challenges, given how liberally the words “design” and “innovation” are used throughout the literature. In order to build a comprehensive yet focused understanding of the contribution and value design can create for innovation in business, we undertook a review of the relationship between design and innovation reported in design studies literature during the last thirty years. Our review includes research examining the relationship between design, innovation, and business success, studies focusing on the roles played by design in the innovation process and the results it produces, and on the factors contributing to notions of the link between design and innovation more generally.

A larger project, called “Design Values: The role of design in innovation” – funded by the Arts and Humanities Research Council (AHRC) – determined the scope of the present research. One aim of that project was to understand design disciplines’ perspectives on design and innovation, and so we limited our review to studies looking at innovation through the lens of design exclusively. Our main goal with this review was to establish how design academics have attempted to understand and portray the design/innovation connection over the last thirty years. We acknowledge that there are other studies in the domains of engineering, management, and business that have dealt with this same relationship. However as that literature addresses the relationship from those points of view, we have chosen not to include it. This review presents the contributions design academics and practitioners have made towards answering an open question regarding the value design offers to innovation processes and outcomes.

We present the results of our review in three parts. The first describes the methodology we followed and the initial findings we drew from the literature. The second presents our analysis of the most relevant studies. The third discusses an interpretive mapping of our findings, and includes proposals regarding areas for future research.

Research Methodology

To carry out this review, we followed a two-part research methodology, which we detail here.

Part One

The first stage of our research involved a protocol-driven search procedure of eight

design journals popular among design academics and important to the discipline according to Gerda Gemser and her colleagues.⁷ We complemented this by performing a design study search of the Social Science Citation Index (SSCI) within the “business” and “management” categories.

The set of terms we used to search the databases intentionally represents the variety of ways that scholars express the design/innovation connection, including design’s contribution to innovation within the framework of the “Design Value” project. These terms were “design for innovation,” “design to innovation,” “design and innovation,” “design into innovation,” “design in innovation,” and “innovation design.” We avoided more specific terms like “design-led innovation” or “design-driven innovation” partially because they tend to be summative – we wanted to see if those terms emerged in the review. The journals we searched were

8

. **Table 1** lists the databases we used to conduct this search and the design journal sources of the papers we cite in this review.

Table 1. List of design journals and databases used in our search.

Journal	Database
Design Studies	ScienceDirect Freedom Collection
Design Issues	Academic Search Complete (EBSCOhost)
Journal of Engineering Design	Business Source Premier
International Journal of Design	ABI/INFORM Complete (ProQuest)
The Design Journal	Taylor & Francis Social Science and Humanities Library
Journal of Design Research	Inderscience Publishers
Design Management Review	ProQuest Arts & Humanities Full Text New Platform Wiley Online Library
Design Management Journal	ProQuest Arts & Humanities Full Text New Platform Wiley Online Library

For our search of the SSCI database, we used the same set of terms in the “topic” field. We performed the complementary search in the SSCI database to identify relevant studies addressing the relationship between design and innovation from a design perspective not published specifically in design journals. We did not include papers from the business and management literature that addressed the relationship between design and innovation from a management perspective on our list – just the ones we judged were conducted using design as the lens.

We carried out this protocol-driven search in October of 2014. It resulted in a list of 126 papers, including 9 duplicates (which we removed). We then screened the remaining 117 papers by reading the abstracts. We eliminated papers where the relationship between design and innovation was not addressed explicitly, or only marginally, or in a way that did not contribute to our review objective.⁹ We eliminated one paper not written in English. We also excluded papers that referred to design and innovation as topics in curriculum development, because they did not provide any research-based insight into the relationship between design and innovation.¹⁰ Finally, we also eliminated papers that used the combined term “design and innovation” to label the product development process only in very specific contexts, such as knowledge management systems design, green design, and project management software design.

37, no. 4 (2008): 720–39, DOI: <https://doi.org/10.1016/j.respol.2008.01.005>.

4 James Utterback et al., *Design-Inspired Innovation*

Publishing Co. Pte. Ltd., 2006); Donald A. Norman and Roberto Verganti, “Incremental and Radical Innovation: Design Research vs. Technology and Meaning Change,” *Design Issues* 30, no. 1 (2014): 78–96, DOI: https://doi.org/10.1162/DESI_a_00250; Leon Cruickshank, “The Innovation Dimension: Designing in a Broader Context,” *Design Issues* 26, no. 2 (2010): 17–26, DOI: https://doi.org/10.1162/DESI_a_00002; Mike Hobday, Anne Boddington, and Andrew Grantham, “An Innovation Perspective on Design: Part 1,” *Design Issues* 27, no. 4 (2011): 5–15, DOI: https://doi.org/10.1162/DESI_a_0010; Mike Hobday, Anne Boddington, and Andrew Grantham, “Policies for Design and Policies for Innovation: Contrasting Perspectives and Remaining Challenges,” *Technovation* 32, no. 5 (2012): 272–81, DOI: <https://doi.org/10.1016/j.technovation.2011.12.002>; Barry Wylant, “Design Thinking and the Experience of Innovation,” *Design Issues* 24, no. 2 (2008): 3–14, DOI: <https://doi.org/10.1162/desi.2008.24.2.3>; Cabirio Cautela, Alessandro Deserti, Francesca Rizzo, and Francesco Zurlo, “Design and Innovation: How Many Ways?,” *Design Issues* 30, no. 1 (2014): 3–6, DOI: https://doi.org/10.1162/DESI_a_00244; Vivien Walsh, “Design, Innovation and the Boundaries of the Firm,” *Research Policy* 25, no. 4 (1996): 509–29, DOI: [https://doi.org/10.1016/0048-7333\(95\)00847-0](https://doi.org/10.1016/0048-7333(95)00847-0).

5 Nomen and BDC, € *Design—Measuring Design Value*, 1–40; McNabola, “The UK Design Council,” 22–23; Youngok Choi, Rachel Cooper, Sungwoo Lim, and Martyn Evans, “National Support for Design: Developing Propositional Models,” *Design Management Review* 21, no. 4 (2010): 60–69, DOI: <https://doi.org/10.1111/j.1948-7169.2010.00096.x>.

6 Norman and Verganti, “Incremental and Radical Innovation.”

This screening resulted in the removal of 27 papers from the list, leaving 90 in the dataset (see Table 2). The distribution of papers in this table is worth noting. Among the design journals, by far the largest number of papers came from

. Surprisingly, given the strong emphasis on innovation as a driver of commercial success and economic growth over the last thirty years, we found very few or no articles on design and innovation in six of the eight design journals considered. For this reason, we conducted a second review of papers in the design journals, which we discuss in Part two.

Table 2. Protocol Driven Search – results after second screening.

We searched for journal content published between 1984 and 2014. When a journal's first publication date was after 1984, we began our search from the date of its first publication.	Fields Searched	"Design for Innovation"	"Design to Innovation"	"Design and Innovation"	"Design into Innovation"	"Design in Innovation"	"Innovation Design"	Total by Source
Design Studies	TI, AB, KW	0	0	0	0	0	1	1
Design Issues	TI, AB, KW	0	0	4	0	0	2	6
Journal of Engineering Design	TI, AB, KW	0	0	0	0	0	0	0
International Journal of Design	TI, AB, KW	0	0	0	0	0	0	0
The Design Journal	TI, AB, KW	0	0	3	0	0	0	3
Journal of Design Research	TI, AB, KW	0	0	0	0	0	0	0
Design Management Review	ALL	0	1	32	0	2	9	44
Design Management Journal	ALL	1	0	7	0	1	3	12
Web of Science – SSCI Social Science Citation Index	TI, AB, KW	1	1	13	0	2	7	24
	Total by Term	2	2	59	0	5	22	
	Total Number of Papers Found	90						

7 Gerda Gemser, Cees de Bont, Paul Hekkert, and Ken Friedman, "Quality Perceptions of Design Journals: The Design Scholars' Perspective," *Design Studies* 33, no. 1 (2012): 4–23, DOI: <https://doi.org/10.1016/j.destud.2011.09.001>.

8 Although engineering is a different form of design, *Journal of Engineering Design* has a reputation for covering the relationship between design research and product design that we considered relevant to this review.

9 For example, Paul Mickelthwaite and Anne Chick mention both design and innovation when they explain a particular product

Part Two

We built this search on the initial protocol-driven search combined with a "snowball" approach – we looked at references listed in the 90 papers retained from the first search. Similar literature reviews, for example that of Davide Ravasi and Ileana Stigliani,¹¹ have used this combined search strategy. The efficiency and effectiveness of snowballing has also been studied.¹²

Our second review of the design literature yielded an additional 19 papers, each of which provided some insight about the potential design has to contribute to innovation.¹³ The final group of 109 papers – 90 from our initial search and 19 from the design article review – we then complemented with 14 documents – papers, research reports, and government reports – cited in the literature as influential in the design sector. This comes to a total of 123 references, including papers and reports. Appendix A contains a complete list of these results.

Analysis

We read the 123 articles in full, and undertook a manual analysis of each. We created a summary card for each article detailing its explicit reference to either the design/innovation relationship or a contribution made by design to innovation. This extensive reading and initial analysis to create the summary cards led us to divide the articles into two groups: 76 we considered relevant, and 47 we deemed irrelevant and eliminated. The most common reasons for eliminating an item were

- The terms “design” and “innovation” were used conjointly to name job positions, organizational areas, or processes without any definition, description, or discussion of the relationship between design and innovation.¹⁴
- “Design” and “innovation” were used conjointly to allude to the process of developing innovative products and services, but no explanation was provided regarding the relationship between design and innovation. For example, in some references the adjective form of innovation was used to qualify the results of the design process – “innovative products” or “innovative services” – but there was no further discussion of the relationship.¹⁵
- The terms appeared conjointly in brief editorials presenting journal articles, minus any further discussion. Several of those articles are part of this review. The majority of these editorials were in¹⁶
- Despite containing relevant keywords and content, we eliminated book reviews because, in general, they were very brief and they did not present evidence that supported this review.¹⁷

Following this review, we performed a second analysis utilizing the summary cards. This involved manually clustering the insights from the summary cards into groups according to how they explain the relationship between design and innovation and the focus of their findings. We present our initial findings in the following section; we will explain the second analysis later in the article.

Initial Findings

It is important to note that much of the literature we identified was not based on empirical, quantitative evidence – it was either narrative analysis of case studies, which varied in quality and methodology, or was based on the authors’ own experiences and the underlying assumptions built over a long history of experiential validation. Some papers were purely critical/historical discourse that did not need robust empirical support. This is a factor we consider important for the academic design community as well as for the findings from this analysis. The qualitative nature of the papers reviewed is reflected in the analysis we did and the conclusions drawn. In sum, we classified 58 percent of the papers as Literature, Experiences, Examples, and Opinions (LEEO). Our review contains more LEEO pieces than any other kind. LEEOs could be literature reviews, theory development, opinion pieces, experience with case studies, or small academic and professional anecdotes. Of the remaining literature we analyzed, 32 percent came under the heading of Qualitative Studies. Our selection of qualitative studies papers gather, structure, and analyze qualitative data in a variety of ways, including interviews, case studies, observations, and focus groups. The remaining 10 percent of the papers we called Quantitative Studies. Quantitative studies papers analyze the relationship between design and innovation using quantitative data, surveys, mathematical models, economic models, and other methods involving numbers and figures. To us, these three types of analysis form the foundation upon which academic

development process, but as independent areas of work, and there is not a clear sign of development of the relationship between the terms. Paul Mickelthwaite and Anne Chick, “Remarkable Pencils Ltd.: Breaking Out of the Green Niche,” *Design Management Review* 16, no. 3 (2005): 23–28, DOI: <https://doi.org/10.1111/j.1948-7169.2005.tb00199.x>.

¹⁰ Examples in this category are Sandra Shield and Richard Coughlan, “Designing the MBA of Tomorrow,” *Design Management Review* 18, no. 3 (2007): 55–62, DOI: <https://doi.org/10.1111/j.1948-7169.2007.tb00214.x>; Naomi Gornick, “What’s It Like Out There? The Value of Industry-Based Research Projects in a Graduate Curriculum,” *Design Management Journal (Former Series)* 13, no. 3 (2002): 70–76, DOI: <https://doi.org/10.1111/j.1948-7169.2002.tb00322.x>; Andrej Kupetz, Martin Mangold, and Miriam Selbeck, “Managing Complexity: The Executive MBA at the Zollverein School,” *Design Management Review* 18, no. 3 (2007): 82–89, DOI: <https://doi.org/10.1111/j.1948-7169.2007.tb00218.x>.

¹¹ Davide Ravasi and Ileana Stigliani, “Product Design: A Review and Research Agenda for Management Studies,” *International Journal of Management Reviews* 14, no. 4 (2012): 464–88, DOI: <https://doi.org/10.1111/j.1468-2370.2012.00330.x>.

¹² Trisha Greenhalgh and Richard Peacock, “Effective-

Methods in Systematic Reviews of Complex Evidence: Audit of Primary Sources,” *BMJ* 331, no. 7524 (2005): 1064–65, DOI: <https://doi.org/10.1136%2Fbmj.38636.593461.68>.

¹³ These nineteen papers came from the following sources: *Design Studies* (2), *Design Issues* (5), *Journal of Engineering Design* (2), *International Journal of Design* (4), *The Design Journal* (3), and *Journal of Design Research* (3).

¹⁴ For example, see Thomas Lockwood, “Integrating Design into Organizational Culture,”

doi.org/10.1111/j.1948-7169.2004.tb00159.x; Chialin Chen, “Design for the Environment: A Quality-Based Model for Green Product Development,” *Management Science* 47, no. 2 (2001): 250–63, DOI: <https://doi.org/10.1287/mnsc.47.2.250.9841>; Scott Henderson, “‘Designed’ in Taiwan,” *Design Management Journal (Former Series)* 14, no. 2 (2003): 36–41, DOI: <https://doi.org/10.1111/j.1948-7169.2003.tb00039.x>; and Lavrans Løvlie, Chris Downs, and Ben Reason, “Bottom-Line Experiences: Measuring the Value of Design in Service,” *Design Management Review* 19, no. 1 (2008): 73–79, DOI: <https://doi.org/10.1111/j.1948-7169.2008.tb00110.x>.

¹⁵ For example, see Erica L. Plambeck and Terry A. Taylor, “Implications of Breach Remedy and Renegotiation Design for Innovation and Capacity,” *Management Science* 53, no. 12 (2007): 1859–71, DOI: <https://doi.org/10.1287/mnsc.1070.0730>; Michael Shulver, “Operational Loss and New Service Design,” *International Journal of Service Industry Management* 16, no. 5 (2005): 455–79, DOI: <https://doi.org/10.1108/09564230510625769>; Roberto M. Saco and Alexis P. Goncalves, “Service Design: An Appraisal,” *Design Management Review* 19, no. 1 (2008): 10–19, DOI: <https://doi.org/10.1111/j.1948-7169.2008.tb00101.x>; Carol Moore, “Declaring Victory: Toward a New Value Proposition for Business Design,” *Design Management Review* 15, no. 2 (2004): 10–16, DOI: <https://doi.org/10.1111/j.1948-7169.2004.tb00156.x>.

¹⁶ For example, see Earl N. Powell, “Paying Attention—Intentionally,” *Design Management Review* 16, no. 4 (2005): 5; Thomas Lockwood, “An Industry in Motion,” *Design Management Review* 18, no. 3 (2007): 5; Thomas Lockwood, “Market Leadership Is Indeed Built and Sustained by Design Creativity,” *Design Management Review* 18, no. 1 (2007): 5; Thomas Walton, “Responsible Design Is Good Business,” *Design Management Review* 16, no. 3 (2005): 6–9, DOI: <https://doi.org/10.1111/j.1948-7169.2005>.

Three initial points stood out while we were creating and reviewing the summary cards for the seventy-six documents we obtained during the first part of our search.

The first – and most prominent – was that there are a wide variety of meanings attributed to design inside organizations, and as a result, a variety of impacts design may have beyond pure styling activities.¹⁸ This vastness and variety has also affected the work designers do. According to Christian Marxt and Frederik Hacklin, “the originally very limited term ‘design’ (‘Konstruktion’) has evolved into a broader meaning. A designer has suddenly been transformed into a developer or even an innovator.”¹⁹ Unsurprisingly, our read of the articles in depth revealed that there is a close relationship between the meanings people associate with design, their understanding of what design is for, and the (perceived) contribution design makes to innovation. An organization’s definition of design and what it can do will often affect the role design plays in innovation – creative idea generation or product design refinement, for instance – and the contributions those roles make to innovation processes and outputs. An organization’s notion of design also appears to determine where (and when) design is used in the innovation process. The implication here is that the potential for design practices to contribute to innovation is not only

as stakeholders implicitly and specifically situate d
in the organizational innovation process.

A second point, related to the first, is that stereotypes surrounding the definitions of design and innovation also influence the reporting of the roles that design can play in innovation. For example, Earl N. Powell²⁰ argues that associating design with aesthetics and innovation with something new is not the best way to define those terms, but is a common practice. According to Anthony Pannozzo,²¹ another stereotype is considering innovation only in terms of technology and neglecting design activity as a possible source for innovation. These stereotypes and related meanings are part of the reason why the relationship between design and innovation is not clear.²² These stereotypes tend to assume that design and innovation are strongly associated, but also that they differ.²³ The combination of various meanings, a tradition of stereotyping design and innovation, and assuming a relationship between the two inhibits a transparent evaluation of the contribution of design to innovation.

Thirdly, many authors asserted that design methods used during the innovation process contribute to furthering business strategies.²⁴ There were repeated calls for design to be used much earlier on in the product development process, challenging the perception that design only adds aesthetic value to finished products. Some asserted that design should become a core value inside organizations.²⁵ The final report of a recent European research project claimed that the role of design in innovation has changed from being an “add-on process” associated with aesthetics, to being an “integrator of functional, emotional, and social utilities” and “a central axis at the very outset of the innovation process.”²⁶ In keeping with this, Deborah Mrazek and her colleagues note that “innovation and design managers are working their way up the corporate ladder and into executive boardrooms.”²⁷ For some organizations, the concepts of design and innovation are harder to nail down and quantify than activities like procurement, operations, and finance. As a consequence, the innovation process remains somewhat mysterious to management, and designers at these firms are stymied by the limited impact they have on business decisions. Thus, while design is increasingly advocated as a strategic activity rather

Principal Findings

After we had read each article in full and generated an analysis card for each, we clustered the content into groups and subgroups according to how they explain the relationship between design and innovation.

In the first group, we clustered insights related to the roles that design plays in innovation processes and its contributions to the resulting outcomes. Group one also includes specific information about how trained designers contribute specifically to the innovation process and why designers are considered particularly well-suited contributors to innovation.

In group two, we clustered findings describing internal and external factors impacting where and how the design/innovation relationship emerges.

Figure 1 presents an overview of the two clusters.

We now discuss these groups in turn.

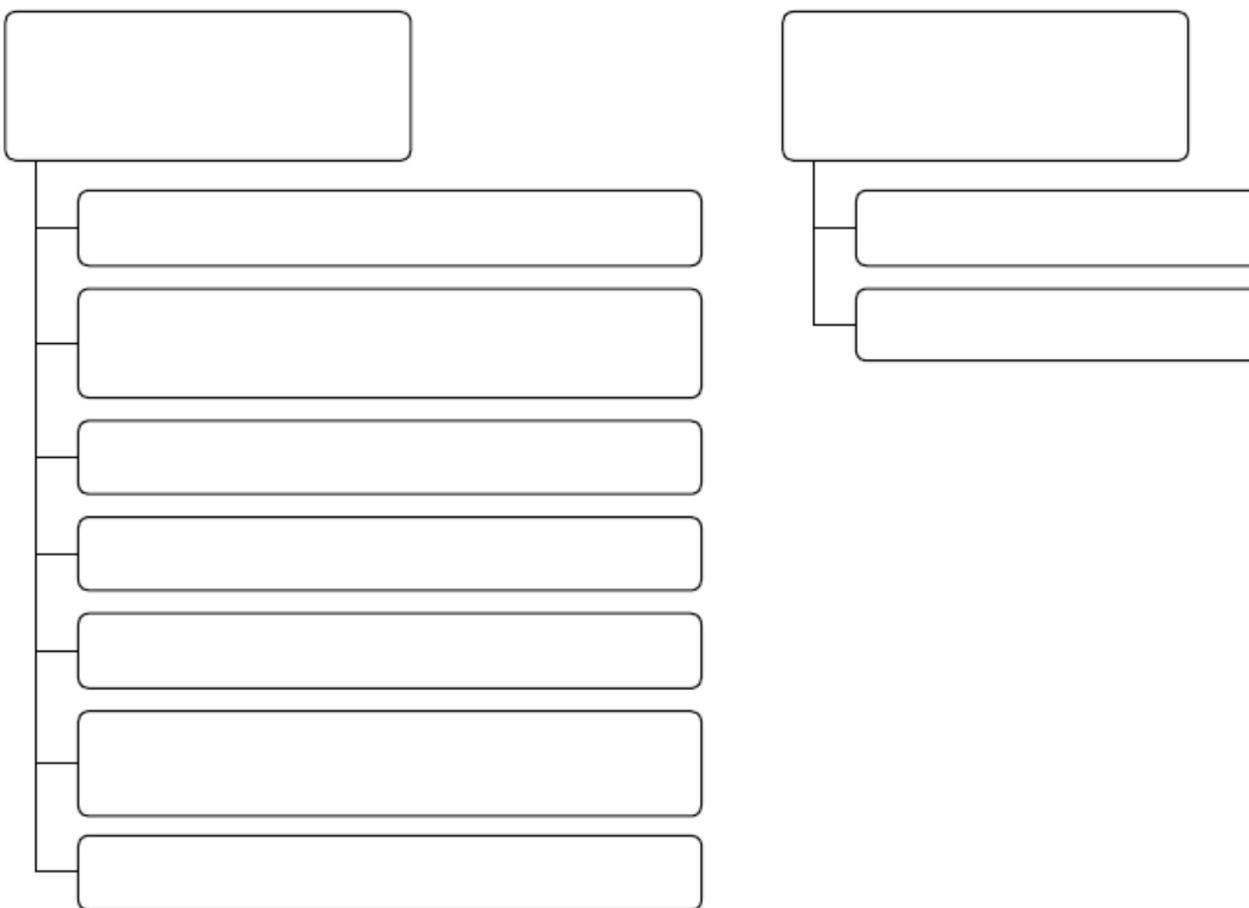


Figure 1 Clusters of literature analysis to illustrate the roles design and designers play in innovation, and the factors that impact the design/innovation relationship. Copyright © 2018 Ricardo J. Hernández, Rachel Cooper, Bruce Tether, and Emma Murphy.

Roles of Design in Innovation

The roles design activity plays in innovation and how that activity contributes to the success of innovative products and services are far from clear and precise in the design studies literature. Herbert Simon²⁸ famously defined design as the process of changing existing states into preferred ones. The word design, however, can denote many different things. It typically indicates the form or shape of an object. The particular tools, methods, and techniques designers use to create these forms – often in collaboration with clients and employers – also come under the umbrella term of design. The process of collaborating with clients, users, and other stakeholders is sometimes referred to as design. Of course, design is also a field of research and professional activity.

As we shift from more concrete notions to more abstract ones, the nature of what design actually is, and is doing, shifts and changes. In this way, it is easier to use the umbrella term “design” to refer to all of the above (and more). But this

1 (2004): 6–9, DOI: <https://doi.org/10.1111/j.1948-7169.2004.tb00144.x>; Earl N. Powell, “Chaos and Innovation,” *Design Management Review* 16, no. 2 (2005): 5.

17 David E. Nye, “Imagining Consumers: Design and Innovation from Wedgwood to Corning,” by Regina Lee Blaszczyk (book review), *Business History Review* 74, no. 3 (2000): 514–16, DOI: <https://doi.org/10.2307/3116450>; Terrence H. Witkowski, “Imagining Consumers: Design and Innovation from Wedgwood to Corning” by Regina Lee Blaszczyk (book review), *Journal of the Academy of Marketing Science* 30, no. 1 (2002):

vagueness is actually part of the reason why it is challenging to ascertain the role that “design” plays in innovation.

Many documents make claims about design being a fundamental component of a successful innovation process, but there are few explicit descriptions or quantifiable analyses of how design actually contributes. According to Mike Hobday,

92–93; John Friend, “Organization Transitions and Innovation Design,” by Peter Clark and Ken Starkey (book review), *The Journal of the Operational Research Society* 39, no. 11 (1998): 1063–64,

available at <https://www.jstor.org/stable/2583207>; I. J. G. Verhallen, “Book Reviews: *Organization Transitions and Innovation Design*, by Peter Clark and Ken Starkey,” *Organization Studies* 10, no. 1 (1989): 125–28, DOI: <https://doi.org/10.1177/017084068901000109>; Bettina Van Stamm, “Managing Innovation, Design and Creativity,” by Bettina Van Stamm (book review), *R&D Management* 34, no. 2 (2004): 226–27, DOI: <https://doi.org/10.1111/j.1467-9310.2004.00334.x>.

18 Anonymous, “Design as Interface: As Professionals See It,” *Design Management Journal (Former Series)* 13, no. 1 (2002): 56–61, DOI: <https://doi.org/10.1111/j.1948-7169.2002.tb00299.x>; Robin Roy, Johann Riedel, and Stephen Potter,

from *Investment in Design and Product Development*, *The Design Journal* 1, no. 2 (1998): 3–16, DOI: <https://doi.org/10.2752/146069298790225145>; Bettina von Stamm, “The Role Of Design in Innovation: A Status Report,” in *The Handbook of Design Management*, ed. Rachel Cooper, Sabine Junginger, and Thomas Lockwood (London: Bloomsbury Academic, 2013), 316–30; Walsh, “Design, Innovation and the Boundaries”; Marco Bettiol and Stefano Micelli, “The Hidden Side of Design: The Relevance of Artisanry,” *Design Issues* 30, no. 1 (2014): 7–18, DOI: https://doi.org/10.1162/DESI_a_00245.

19 Christian Marxt and Fredrik Hacklin, “Design, Product Development, Innovation: All the Same in the End? A Short Discussion on Terminology,” *Journal of Engineering Design* 16, no. 4 (2005): 420, DOI: <https://doi.org/10.1080/09544820500131169>.

20 Earl N. Powell, “Fear of Failure,” *Design Management Review* 15, no. 1 (2004): 5.

21 Anthony Pannozzo, “The (Ir)relevance of Technology: Creating a Culture of Opportunity by Design,” *Design Management Review* 18, no. 4

Anne Boddington, and Andrew Grantham, “design has been poorly conceptualized, researched, and taught by innovation studies.... As a result, the social sciences in general, and innovation studies in particular, have a very poor conceptualization of design as a creative economic activity at the firm, industry, and wider economic levels.”²⁹ This vagueness is significant, because empirical evidence has also shown that “design is one of the four main drivers of innovation and productivity in the United Kingdom, and probably in all advanced economies.”³⁰

Therefore, we present our analysis with one caveat. Because there was no consistently, clearly defined notion of the relationship between design and innovation in the documents we reviewed, we were forced to make certain assumptions and work with implicit ideas. The roles we categorize here are the result of a kind of pooling of common ideas in the absence of concrete explanations or empirical findings. Although there may be a number of grey areas that we have not included, we still consider our classification a valid and valuable endeavor. There is a need to define the roles that design plays in innovation more explicitly. Our clusters serve as a contribution to this discussion.

Some scholars have advanced the idea that the nature of innovation varies over the lifecycle of a product or industry.³¹ According to this definition, there is a fluid phase at the beginning of the lifecycle when a variety of product configurations or design concepts can emerge. Firms might compete to develop the dominant design or decide to remain flexible to be able to quickly imitate a competitor. After a dominant design emerges, the lifecycle moves into a more targeted phase. Companies normally shift their investments in this phase towards incremental product innovations and place a stronger emphasis on process innovation to drive down costs. These stages are mainly related to product development, but are also applicable to service and industry development. Vivien Walsh³² argues that design can contribute to innovations taking place in both stages. During the fluid phase, technology and functionality are the main concerns, which are the realm of engineering design.

During the later stages – the period of specialization – design is used as a differentiator – new designs set the product apart from its competitors or from earlier models. This type of differentiation is closely related to styling. Designers and firms might make moderate changes to the external appearance of a product, change its packaging, or improve sales support as strategies to achieve differentiation in the market. Styling is mainly related to marketing, and is often only applied at the end of the new product development process. As scholars Gaia Rubera and Cornelia Droge point out, “such design innovations can become more important as product technology standardizes, which means that the value of design innovations is greater when low technology innovation permits standardization to take place.”³³

Another means of achieving this is through modular design of standardized technologies.³⁴ An example of this phenomenon is the printing industry offering few technological options, but a large range of products in the market differentiated by design innovations. Once technologies have become standardized, differentiation through product appearance, aesthetics, and usability can become very important. Rubera and Droge observe that differentiation in one product can affect

the company’s other products or categories. “The positive effect of design innovation rests in part on its ability to stimulate new demand by creating excitement and interest. Firms adopt design innovation to assign a new meaning to the brand image. This positive effect is likely to be higher in the case of corporate branding because of halo effects – introducing one design innovation may be sufficient to raise the image of all the company’s products since all bear the corporate name.”³⁵

Micki Eisenman³⁶ argues that design can work as a communication mechanism to advance technological differentiation through aesthetic change. In earlier stages of innovation, the purpose design serves is to explain new technology to users and entice them to adopt the product and extend its potential uses.³⁷ In ensuing stages, production efficiencies are the focus of innovation efforts, and as Eisenman notes, design “has the least importance in terms of organizational processes.”³⁸ In later stages, when product demand is in decline – because adoption reaches saturation, for example – design can be used to explain small incremental innovations to users and stimulate sales. Fresh designs can mask “the absence of any meaningful technological change,”³⁹ and encourage the replacement of older models with new ones. Firms achieve this, according to Eisenman, by reinforcing the idea of technological progression and “promoting various second-order meanings that extend the original functionality of the technology,” enabling consumers “to express aspects of their identities via their acts of consumption.”⁴⁰

Much of the differentiation described here results from the application of the visual language and communication that the activity and practice of design offers to decision-making situations. One might suggest that this visual language is an evolution of design practice to become a language used for innovation.

An increasingly important domain of design practice and activity is concerned with exploring and understanding product/user interactions. Tailoring these is a way of connecting customers, products, and brands, according to Thomas Walton.⁴¹ The ability to understand, anticipate, and design the interactions between users and products becomes especially important where strategic target groups are concerned.⁴² In an article on one firm’s exploration of what it means for a firm to become “design-driven,” author Roger Martin⁴³ highlights how user-centered design practices – hands-on, iterative, collaborative activities – enable organizations to learn about and respond to real customer needs. According to Brigitte Borja de Mozota,⁴⁴ using collaborative techniques to understand user behavior is fundamental to accelerating the product development process, and hence the overall innovation process.

On a separate but related front, Alonzo Canada, Pete Mortensen, and Dev Patnaik⁴⁵ argue that the use of design via distinctive aesthetics not only enables differentiation in the marketplace, it also contributes to the adoption of embedded technological innovations. They provide a set of six generic design strategies that enable firms to introduce new technologies to the market. This “interplay between design and business strategy, wherein design methods are used to inform business strategy, and strategic planning provides a context for design” is what the scholars call design strategy.⁴⁶ Their article uses examples ranging from cars with hybrid tech, to luggage made from advanced materials, to the explosion in portable technology devices to demonstrate that more and more firms are using design tools and techniques to advance their strategic technological aims.

Design practices play another important role in encouraging users to adopt innovations. According to Rubera and Droge, companies can innovate by modifying functions or modifying forms.⁴⁷ Innovations associated with functions are recognized as technological innovations, while innovations that affect the form and

23 Bettina von Stamm, “Innovation—What’s Design Got to Do with It?,” *Design Management Review* 15, no. 1 (2004): 10–19, DOI: <https://doi.org/10.1111/j.1948-7169.2004.tb00145.x>.

24 Mark Churchman and Thomas Marzano, “How to Make Sure a Brand Behaves Itself,” *Design Management Review* 19, no. 3 (2008): 74–79, DOI: <https://doi.org/10.1111/j.1948-7169.2008.tb00132.x>; Laura Weiss, “Developing Tangible Strategies,” *Design Management Journal (Former Series)* 13, no. 1 (2002): 33–38, DOI: <https://doi.org/10.1111/j.1948-7169.2002.tb00296.x>.

25 Ulla Hovgaard Ramlau, “In Denmark, Design Tops the Agenda,” *Design Management Review* 15, no. 4 (2004): 48–54, DOI: <https://doi.org/10.1111/j.1948-7169.2004.tb00182.x>; Antonia Ward, Ellie Runcie, and Lesley Morris, “Embedding Innovation: Design Thinking for Small Enterprises,” *Journal of Business Strategy* 30, no. 2/3 (2009): 78–84, DOI: <https://doi.org/10.1108/02756660910942490>.

26 Nomen and BDC, “Design—Measuring Design Value,” 15, 29, 39.

27 Deborah Mrazek et al., “The Holy Grail of Design Measurement,” *Design Management Review* 22, no. 2 (2011): 7, DOI: <https://doi.org/10.1111/j.1948-7169.2011.00121.x>.

28 Herbert A. Simon, *The Sciences of the Artificial*, 3rd ed. (Cambridge, MA: MIT Press, 1996), 111.

29 Hobday et al., “An Innovation Perspective on Design, Part 1,” 14–15.

30 Mike Hobday, Anne Boddington, and Andrew Grantham, “An Innovation Perspective on Design, Part 2,” *Design Issues* 28, no. 1 (2012): 27, DOI: https://doi.org/10.1162/DESI_a_00137; NESTA, *The Innovation Index: Measuring the UK’s Investment in Innovation and Its Effects* (London:

aesthetics of the product are seen as design innovations. By helping the customer “make sense of embodied technological innovation,”⁴⁸ “design can reduce the anxiety and uncertainty that inhibits technology adoption. An appropriate product form helps consumers activate a new categorization schema, thus maximizing the success of the product itself.”⁴⁹

This role characterization illustrates again that design acts as a language connecting producer, consumer, and product.

National Endowment for Science, Technology and the Arts, 2009), 4.
31 James M. Utterback and William J. Abernathy, “A Dynamic Model of Process and Product Innovation,” *Omega* 3, no. 6 (1975): 639–56, DOI: [https://doi.org/10.1016/0305-0483\(75\)90068-7](https://doi.org/10.1016/0305-0483(75)90068-7); James M. Utterback, *Mastering the*

Dynamics of Innovation, 2nd. ed (Cambridge, MA: Harvard Business School Press, 1996).

32 Walsh, “Design, Innovation and the Boundaries of the Firm.”

33 Gaia Rubera and Cornelia Droge, “Technology versus Design Innovation’s Effects on Sales and Tobin’s Q: The Moderating Role of Branding Strategy,” *Journal of Product Innovation Management* 30, no. 3 (2013): 451, DOI: <https://doi.org/10.1111/jpim.12012>.

34 “A modular product architecture is a special form of product design that uses standardized interfaces between components to

ture.” Ron Sanchez and Joseph T. Mahoney, “Modularity, Flexibility, and Knowledge Management in Product and Organization Design,” *Strategic Management Journal* 17, no. S2 (1996): 66, DOI: <https://doi.org/10.1002/smj.4250171107>.

35 Ribera and Droge, “Technology versus Design Innovation’s Effects,” 452.

36 Micki Eisenman, “Understanding Aesthetic Innovation in the Context of Technological Evolution,” *Academy of Management Review* 38, no. 3 (2013): 332–51, DOI: <https://doi.org/10.5465/amr.2011.0262>.

37 *Ibid.*, 339.

38 *Ibid.*, 338; Utterback and Abernathy, “A Dynamic Model.”

39 Eisenman, “Understanding Aesthetic Innovation,” 339.

40 *Ibid.*

41 Thomas Walton, “Identifying the Creative Frontiers in Consumer Products and Branding,” *Design Management Review* 16, no. 2 (2005): 6, DOI: <https://doi.org/10.1111/j.1948-7169.2005.tb00186.x>.

42 Anonymous, “Design as Interface,” 49.

43 Roger L. Martin, “The Innova-

Many describe design as a process of transformation. For some, this means transforming ideas into concepts⁵⁰ – “a conscious decision-making process by which information (an idea) is transformed into an outcome, be it tangible (a product) or intangible (a service).”⁵¹ Thomas Lockwood refers to design as a resource that helps organizations make creative ideation more concrete.⁵²

To others, the transforming medium of design practice⁵³ plays a pivotal role in the innovation process. As Robert Whitman Veryzer, Stefan Habsburg, and Robert Veryzer note, design “is one of the primary means by which new technology is transferred out of the R&D lab and into the market in the form of new and usable products.”⁵⁴ They present as an example the success of the innovations embedded in Apple products due to the use of a “systems-inspired design approach” in the form of “intuitive operations, user-friendly graphical interfaces, and the ease with which components can be put together.”⁵⁵ Ying Liu, David Summers, and Bill Hill assert that design practices have the power to transform creative input into valuable disruptive innovations.⁵⁶ The UK’s Design Council presents innovation as the process of turning “ideas into value” where design is “the connection between creativity and innovation.”⁵⁷

Giving form to abstract insights, prototyping, and visualizing disruptive concepts are all key contributions of design practice to the innovation process.⁵⁸ Design practices like these provide structure to more than the product development process. Design languages – which include not only ideation and visualization tools and techniques, but also design process language – enable organizations to transform novel, emergent ideas into viable streams of development. The language of design scaffolds the innovation process, and in this way, its language becomes the language of innovation itself.

Much of the literature pointed to design researchers as contributors of valuable information and knowledge to the innovation process. Our review revealed a number of perspectives on design research and the kinds of information it can provide.

First and foremost among the authors in our review was the finding that design research generates valuable user insights. The user-centered design approach is supported by methods that enable designers not only to investigate how people live and behave in particular situations – and hence discover what their real needs are – but also to design in cooperation with users and evaluate outcomes with them.⁵⁹ From this perspective, Peter Jones⁶⁰ says that when the design process is embedded in the innovation process, it plays a major role – especially at the beginning – focused on capturing valuable information from potential users and helping to translate that information into concepts.

The role played by design research in innovation is also partially that of a risk assessment and management tool, according to Naomi Gornick and Mark Jones and Fran Samalionis,⁶¹ ostensibly made possible thanks to direct user observation and involvement. Patrick Reinmoeller⁶² presents a similar perspective, considering

A report by Eusebi Nomen and BCD Barcelona Design Centre⁶³ suggests that the important role that design research plays in the innovation process came as a consequence of changes in people's perceptions and understanding of what innovation is and does. Essentially, when innovation was seen as a linear process of scientific and technological development, design was tasked with making the resulting technologies presentable, principally through styling. That notion has

since evolved – the innovation process takes place within a complex system and among multiple and diverse actors. Design research (focused on the user) can serve to integrate multiple perspectives with the aim of providing new and better experiences. Cabiro Cautela and his colleagues explore the idea of a dynamic relationship between design science and innovation that is capable of adapting to new interpretations, new uses, and new innovation stream potential.⁶⁴

Another group of authors interpret design as a research process more specifically aimed at uncovering new futures, new ways of living, and future societal and cultural trends. This is a much wider perspective than that focusing on users in the present.⁶⁵ In this group, Roberto Verganti in particular has pushed the notion of design as a research process oriented towards defining emerging patterns in society that can lead to radical innovations (in meaning).⁶⁶ According to Verganti, design-driven innovations are new products and services which embed radical concepts that do not come from market requirements or technology opportunities – they arise from the possibilities that new ways of living and new futures bring.⁶⁷ Here, design research is an active process involving a variety of actors. Together, they explore how society is changing and build propositions laden with meaning for future living. It is a process that creates perceptions, rather than products and services, where designers play an important role producing and managing information.⁶⁸ This research process is carried out away from actual users because, according to Verganti and Donald A. Norman, it is not possible to produce radical innovations in meaning based on the experience of current users.

This idea of design-driven innovation is also presented by Pannozzo,⁶⁹ but with a different interpretation. For Pannozzo, design can contribute to innovation by creating new segments of the market where existing technologies can be exploited. Verganti's conceptualization of design as a way to identify emerging behaviors or behavioral patterns is shared by Pannozzo.

Design research in the context of innovation is a means of articulating what is, and what is possible. It enables innovators to eliminate inappropriate alternatives, and serves to address and integrate the multiple components of complex systems. The language of design research – its methodologies, its models, its aims, its findings – defines and describes the avenues that lead to innovation.

Probably the most common role that scholars attributed to design practice in relation to innovation was as the facilitator of generative thinking. Many of the articles we review here referred specifically to design thinking in this regard. Lisa Carlgren, Maria Elmquist, and Ingo Rauth, for example, present a comprehensive review of papers that describe how design thinking approaches support innovation. Even though design thinking has itself been defined in various ways, most design thinking practitioners share the view that design thinking is an iterative, accelerated problem recognition and solving process, used to identify requirements and engage in user-centered prototyping, experimentation, and validation "inspired by

45 Alonzo Canada, Pete Mortensen, and Dev Patnaik, "Design Strategies for Technology Adoption," *Design Management Review* 18, no. 4 (2007): 32–41, DOI: <https://doi.org/10.1111/j.1948-7169.2007.tb00092.x>.

46 Ibid., 33.

47 Rubera and Droge, "Technology versus Design Innovation's Effects," 451.

48 Ibid.; Violina P. Rindova, and Antoaneta P. Petkova, "When Is a New Thing a Good Thing? Technological Change, Product Form Design, and Perceptions of Value for Product Innovations," *Organization Science* 18, no. 2 (2007): 217–32, DOI: <https://doi.org/10.1287/orsc.1060.0233>; Eisenman, "Understanding Aesthetic Innovation."

49 Rubera and Droge, "Technology versus Design Innovation's Effects," 451.

50 Marzia Mortati and Beatrice Villari, "Bridging Languages: New Challenges for Future Designers," *Design Management Review* 23, no. 4 (2012): 72–80, DOI: <https://doi.org/10.1111/j.1948-7169.2012.00214.x>.

51 von Stamm, "The Role of Design in Innovation," 319.

52 Lockwood, "Integrating Design into Organizational Culture."

53 Naomi Gornick, "Convergence: New Management Imperatives and Their Effect on Design Activity," *Design Management Review* 17, no. 2 (2006): 35–43, DOI: <https://doi.org/10.1111/j.1948-7169.2006.tb00037.x>; von Stamm, "Innovation—What's Design Got to Do with It?"; Donald W. de Guerre, Daniel Séguin, Alicia Pace, and Noel Burke, "IDEA: A Collaborative Organizational Design Process Integrating Innovation, Design, Engagement, and Action,"

a designer mindset and ways of working.”⁷⁰ Similar definitions of design thinking are given by Antonia Ward, Ellie Runcie, and Lesley Morris, and by Tim Brown.⁷¹

In terms of how design thinking contributes to innovation, we identified two approaches in the literature.

The first defines design thinking as a problem solving process that enables design teams to generate and explore multiple alternatives and select the most suitable among them.⁷² The generative process uses iterative experimentation involving a variety of stakeholders, including development teams, management, and users.⁷³ Lisa Carlgren, Maria Elmquist, and Ingo Rauth call this a “learning process” characterized by “rapid customer feedback cycles.”⁷⁴ Prototyping tools and design

Systemic Practice and Action Research 26, no. 3 (2013): 257–79, DOI: <https://doi.org/10.1007/s11213-012-9250-z>.

⁵⁴ Robert Whitman Veryzer, Stefan Habsburg, and Robert Veryzer, “Managing the Challenge of Design for Innovation,” *Design Management Journal (Former Series)* 10, no. 4 (1999): 29, DOI: <https://doi.org/10.1111/j.1948-7169.1999.tb00273.x>.

⁵⁵ Ibid., 30.

⁵⁶ Ying Liu, David Summers, and Bill Hill, “Truth Designed: Transformation through Design Integration and Transparency,” *Design Management Review* 20, no. 1 (2009): 8–15, DOI: <https://doi.org/10.1111/j.1948-7169.2009.tb00220.x>.

⁵⁷ Design Council, *Design for Innovation: Facts, Figures and Plans for Practical Growth* (London: Design Council, 2011), 2, available at [https://www.designcouncil.](https://www.designcouncil.document/DesignForInnovation_Dec2011.pdf)

[document/DesignForInnovation_Dec2011.pdf](https://www.designcouncil.document/DesignForInnovation_Dec2011.pdf).

⁵⁸ Gardien, “Navigating the Innovation Matrix: An Approach to Design-Led Innovation,” *International Journal of Design* 3, no. 1 (2009): 68, available at <http://www.ijdesign.org/index.php/IJDesign/article/view/305>.

⁵⁹ Martin, “The Innovation Catalysts.”

⁶⁰ Peter Jones, “When Successful Products Prevent Strategic Innovation,” *Design Management Journal (Former Series)* 13, no. 2 (2002): 30–37, DOI: <https://doi.org/10.1111/j.1948-7169.2002.tb00306.x>.

⁶¹ Gornick, “Convergence”; Mark Jones and Fran Samalionis, “From Small Ideas to Radical Service Innovation,” *Design Management Review* 19, no. 1 (2008): 20–26, DOI: <https://doi.org/10.1111/j.1948-7169.2008.tb00102.x>.

⁶² Patrick Reinmoeller, “Dynamic Contexts for Innovation Strategy: Utilizing Customer Knowledge,” *Academic Review* 2, no. 1 (2002): 37–50.

⁶³ Nomen and BDC, € *Design—Measuring Design Value*.

visualization methods are central, and innovative in their own right, according to some.⁷⁵ Brown says ⁷⁶ design thinking helps those seeking the most appropriate solution to imagine and give form to the experiences that they want to offer to the users.

The second approach defines design thinking as a problem solving process that positively impacts stakeholders’ abilities and skills, and also helps companies embrace the innovation process overall. Carlgren and her colleagues⁷⁷ argue that, beyond directly contributing to the innovation process, learning design thinking skills can improve leadership skills and motivate employees to undertake innovation processes with a better attitude. Martin⁷⁸ contends that design thinking tools and techniques can better orient companies towards user needs and speed up the product development process. Similarly, Rachel Cooper, Sabine Junginger, and Thomas Lockwood recognize how design thinking enables a variety of actors to “create new visions and alternative scenarios that can reorient the organization around the people it serves,”⁷⁹ which also influences the direction of their future innovations.

Visualization tools and methods received some special attention among the authors in our review. Design Council scholars Ward, Runcie, and Morris state that design thinking creates value by helping “companies put the strategy into their vision” and “put the vision, or more explicitly, the visual, into their strategy.”⁸⁰ Visualization is a commonly-used tool in the innovation (design) process; educating companies about design’s role in innovation often leads to a visual representation of the company’s overall innovation strategy. Visualizing innovation strategy in this way can have a positive impact on the entire process, thanks to the perspective on the business it provides to a wide variety of innovation actors.⁸¹

Carlgren, Elmquist, and Rauth⁸² suggest that design thinking approaches can make a company seem more open and flexible, and that this attracts collaborators that will in turn positively impact the process.

Once again, we see that design language becomes the language with which stakeholders can create, develop, explain, and implement innovative initiatives that shape their offerings and their organizations alike.

Much of the literature in our review characterizes design as a tool, or set of tools, for articulating and integrating concepts, people, and functions,⁸³ and even integrating different types of innovation.

Firstly, the visual and digital communication methods and processes used by design teams bridge the gap between producers and customers very effectively.⁸⁴ Its ability to connect providers to users has been shown to benefit service design processes.⁸⁵ Advances in digital environments also facilitate virtual interaction between producers and consumers who engage in “open” innovation projects⁸⁶ —

the OpenIDEO platform being a good example of this. Design acts as the bridge mainly during the initial stages of radical innovation, according to Walsh.⁸⁸ When innovation shifts into phases characterized by incremental changes to established products and services, the role of design also changes.

Secondly, design practice often serves as an internal interface – it enables stakeholders from a variety of departments to meet and interact to achieve the company's innovation goals. Borja de Mozota⁸⁹ argues that design activity can modify the innovation process by improving the communication between functions in the organization, leading to better coordination and integration. This stems from the way that design activity often mediates between technological requirements and marketing demands. Design activity includes collaboratively creating visual tools – rough sketches, mockups, models, and drawings – potentiating the

communication, coordination, and integration between functions, and enhancing the production and circulation of knowledge within and between projects.⁹⁰ According to Borja de Mozota there is a correlation between robust interdepartmental communication and acceleration of the new product development process. Erik Abbing and Christa Gessel note that "the role of design in innovation is changing from making the innovation look pretty in the end to being a source of meaningful new directions for growth. Design's function is to merge the various disciplines involved in the innovation process into a synergetic team, and to combine visionary inspirational ideas with tangible and concrete solutions."⁹¹

Thirdly, design activity integrates the knowledge emerging from different sectors of company activity, notes Vivien Walsh.⁹² To underscore this, she quotes Christopher Freeman, who said, "Design is crucial to innovation in that it is the domain of creativity where ideas are devised but also where the coupling occurs between technical possibilities and market demands or opportunities."⁹³ According to Jane Millar, Adrian Demaid, and Paul Quintas,⁹⁴ innovation based on "technology fusion" – where new technologies are developed based on hybrid combinations of existing technologies – involves a massive amount of knowledge from a wide variety of internal and external actors. By helping the organizations involved to integrate their efforts and offering coherence – in the form of an outcome – to their collective knowledge, design activity enables this type of innovation to occur.

In sum, design activity in this literature has become a "tool in the toolbox of innovation" that can act as "the bridge between technological, service, user-centered, and social innovation because, at its core, design is a human-centered process."⁹⁵ Eusebi Nomen and the Barcelona Design Centre call design the "integrator of functional, emotional, and social utilities."⁹⁶ Another notable assertion is that design can help to change physical spaces to encourage and favor collaborative and innovating thinking where much of the transformation occurs.⁹⁷

Yet again, we find that design tools, techniques, methods, and the teaching of its mindset enables stakeholders to undertake innovative development processes and produce innovative outcomes. Design and design languages enable many different kinds of stakeholders to find and articulate their place in the innovation process.

While most of the documents we reviewed treated design as a discipline, we found that several authors focused specifically on designers as a class of professionals. These authors found that designers' contributions to innovation relate to the role that design activity plays and highlight the skills that designers use in practice.

According to one scholar,⁹⁸ a creative designer's professional skills are precisely the skills needed for them to be successful innovators. In addition to the

Norman and Verganti, "Incremental and Radical Innovation."

66 Norman and Verganti, "Incremental and Radical Innovation," 95.

67 Verganti, "Innovating through Design"; Verganti, "Design, Meanings, and Radical Innovation."

68 Verganti, "Innovating through Design."

69 Pannozzo, "The (Ir)relevance of Technology."

70 Lisa Carlgren, Maria Elmquist, and Ingo Rauth, "Design Thinking: Exploring Values and Effects from an Innovation Capability Perspective," *The Design Journal* 17, no. 3 (2014): 405, DOI: <https://doi.org/10.2752/175630614X13982745783000>.

71 Ward et al., "Embedding Innovation"; Tim Brown, "Design Thinking," *Harvard Business Review* 86, no. 6 (2008): 84–92, available at <https://hbr.org/2008/06/design-thinking>.

72 Cruickshank, "The Innovation Dimension"; von Stamm, "The Role of Design in Innovation"; Kevin Clark and Ron Smith, "Unleashing the Power of Design Thinking," *Design Management Review* 19, no. 3 (2008): 8–15, DOI: <https://doi.org/10.1111/j.1948-7169.2008.tb00123.x>.

73 Martin, "The Innovation Catalysts."

74 Carlgren et al., "Design Thinking: Exploring Values and Effects," 413.

75 Clark and Smith, "Unleashing the Power."

76 Brown, "Design Thinking."

77 Carlgren et al., "Design Thinking: Exploring Values and Effects."

78 Martin, "The Innovation

ability to produce novel solutions, von Stamm calls “a willingness to take risks, accepting high levels of ambiguity and uncertainty, thinking out of box, a passion to drive the idea through to conclusions and the ability to inspire passion in others” the characteristics of designers as creative professionals.⁹⁹ She asserts that designers are ideally suited to work in the context of innovation because they have the right education, skills, and mindset. They are divergent thinkers, who are also observant, ingenious, confident, and persistent. Weiss¹⁰⁰ also highlights their trained, iterative problem-solving approach as an asset to the innovation process. Ward and her colleagues¹⁰¹ discuss designers’ effective use of visual and communication tools, which they say reduces misinterpretations, provides stakeholders with a clear understanding of the business and its position in relation to its customers and other actors, and – ultimately – improves innovation decision making as a result.

Catalysts.”

79 Rachel Cooper, Sabine Junginger, and Thomas Lockwood, “Design Thinking and Design Management: A Research and Practice Perspective,” *Design Management Review* 20, no. 2 (2009): 49, DOI: <https://doi.org/10.1111/j.1948-7169.2009.00007.x>.

80 Ward et al., “Embedding Innovation,” 80.

81 Antonia Ward and Jan Dekker, “Managing Design in SMEs,” *Design Management Review* 20, no. 3 (2009): 46–53, DOI:

<https://doi.org/10.1111/j.1948-7169.2009.00021.x>.

82 Carlgren et al., “Design Thinking: Exploring Values and Effects.”

83 Brigitte Borja de Mozota, “Design and Innovation: Coordination through Design,” in *Design Management: Using Design to Build Brand Value and Corporate Innovation* (New York: Allworth Press, 2003), chap. 6, eBook.

84 Weiss, “Developing Tangible Strategies.”

85 Lucy Kimbell, “Designing for Service as One Way of Designing Services,” *International Journal of Design* 5, no. 2 (2011): 41–52, available at <http://www.ijdesign.org/index.php/IJDesign/article/view/938>.

86 Leon Cruickshank, *Open Design and Innovation: Facilitating Creativity in Everyone* (London: Routledge, 2014).

87 Open IDEO is a community of innovators and entrepreneurs using design thinking to connect and engage people who address complex social, economic, and environmental challenges. For more information, see <https://openideo.com/>.

88 Walsh, “Design, Innovation and the Boundaries of the Firm.”

89 Borja de Mozota, “Design and Competitive Edge.”

90 Borja de Mozota, “Design and Innovation: Coordination through Design”

91 Erik Roscam Abbing and Christa Van Gessel, “Brand-Driven Innovation,” *Design Management Review* 19, no. 3 (2008): 52, DOI: <https://doi.org/10.1111/j.1948-7169.2008.00052.x>.

Designers’ trained ability to work with and understand users is another crucial skill (which is strongly related to design as a research process). The focus designers put on users¹⁰² and the collaborative work they do helps organizations more deeply understand their customers’ needs. Designers learn to interpret, translate, and negotiate requirements with users in iterative cycles while seeking an optimal and novel solution.¹⁰³ Their ability to collaborate – and in some cases even co-create – with users differentiates designers from other professionals.¹⁰⁴ This contribution helps to make innovations friendlier and easier to use, thereby easing their adoption, asserts von Stamm.¹⁰⁵ According to Marzia Mortati and Beatrice Villari, designers’ ability to work with users by translating their needs into products and services helps to “drive relationships, citizen participation, cooperation from companies to institutions, and organisational transformation.”¹⁰⁶

Alexander Peine and Andrea Herrmann present innovation as “a process of social learning that focuses on use-design linkages.”¹⁰⁷ This process, they say, is affected by the “scripts” designers inscribe into technical products that shape the relationships users have to them and the uses they find for them.

Verganti¹⁰⁸ argues that designers act as knowledge and information gatekeepers and brokers during the innovation process. This means that designers not only contribute to the innovation process by producing prototypes and artifacts representing the temporal and final outcomes of the process, but they also have influence on how information related to those artifacts, visual aids, and prototypes flows between the actors involved in the process. Paola Bertola and José Carlos Teixeira present a similar view of designers, calling them “knowledge integrators” in global corporations, or “knowledge brokers” in local companies.¹⁰⁹

Kenneth Munsch¹¹⁰ elaborates further on designers’ capacity to produce and manage valuable information in the innovation process, highlighting how external designers are considered by many companies as valuable drivers of innovation due to the information and knowledge they bring from the outside. Some globally-recognized market leaders – Alessi, Bang & Olufsen, Herman Miller, and Kartell, for example – work with external designers, and they are often recognized as highly innovative.¹¹¹ Francesco Zurlo and Cahirio Cautela present external designers as “privileged interlocutors” and as “innovation-carriers and expert manipulators of the signs and ‘text’ in the design process.”¹¹²

Whatever terms we use to define a designer, a creative designer, or an innovative designer is evidence of a much larger and complex discussion on the relationship between creativity and design¹¹³ and creativity and innovation.¹¹⁴ For example George Cox states that “creativity is the generation of new ideas. . . . Innovation is the successful exploitation of new ideas. . . . Design is what links creativity and innovation.”¹¹⁵ However, as it is not within the remit of this paper to delve into the

92 Walsh, "Design, Innovation and the Boundaries of the Firm."

93 Ibid., 514; Christopher Freeman, "Design and British Economic Performance" (lecture, Science Policy Research Unit, Sussex University, 1983).

94 Jane Millar, Adrian Demaid, and Paul Quintas, "Trans-Organizational Innovation: A Framework for Research," *Technology Analysis & Strategic Management* 9, no. 4 (1997): 399–418, DOI: <https://doi.org/10.1080/09537329708524294>.

complexities of that discussion, we acknowledge that the contributions designers can make to innovation is a topic whose scope is far wider than the few insights we offer here. The relationship between creativity, design, and innovation is a topic that merits a literature review of its own.

Factors Impacting the Relationship between Design and Innovation

In addition to the roles design can play in innovation and the contributions designers make to innovation processes and outcomes, there were some studies in our review that touched on the character of the design/innovation relationship. There are, it seems, internal and external factors that can affect the relationship between design and innovation. We note that the number of papers identifying these factors was very small.

Internal Mediating Factors

A small group of authors assert that integrating design practices across an entire organization enables innovation, especially when this integration manifests itself in organizational culture.¹¹⁶ However, Alessandro Deserti and Francesca Rizzo critique the way design thinking has been adopted by businesses as a managerial approach. They say, "to become effective in enterprise, design must become part of the culture, and companies must develop their unique design culture by integrating design through bottom-up processes that require negotiation and alignment and are continually performed in the never-ending activity of innovation."¹¹⁷ A Design Council¹¹⁸ report concludes that the value design can create for innovation is strongly affected by the top management commitment. Similarly, Orietta Marsili and Ammon Salter note that "support for the development of design capabilities can have important implications for an innovation system in general."¹¹⁹

It seems that, to an extent, the quality of the design/innovation relationship is a function of how well design activity meshes with other internal company activities. According to Lisbeth Holm and Ulla Johansson,¹²⁰ innovation processes and outcomes depend on relationships being established between design and engineering or design and marketing, for example. Several authors discuss the link between design and marketing and its implications for innovation¹²¹ – successful collaboration between these two sectors yields user insights that enrich the innovation process.¹²² Marsili and Salter¹²³ suggest that coupling investments in R&D and design is a way to stimulate innovation.

Another group of authors notice that the interfacing of technical and non-technical aspects can impact the overall relationship between design and innovation. Satish Nambisan and Mohanbir Sawhney¹²⁴ discuss how modularization can be strategically used to integrate or prevent integration among the actors involved in the innovation process. Christopher Voss and Juliana Hsuan see modularization as a variable affecting the service design and innovation process.¹²⁵ More generally, Jones¹²⁶ suggests that differences in perception about the relationship between design and innovation might stem from the differing technical backgrounds of designers and engineers. Another explanation is associated with the divergent paths industrial design and engineering design took many years ago¹²⁷ and the responsibilities ascribed to each in the innovation process.

From a non-technical standpoint, personal and institutional values may affect the perception about the relationship between design and innovation as well.¹²⁸ Jones¹²⁹ suggests that designers, and the design process, can be constrained or stimulated by values that favor stability over change or vice versa. Finally, an orga-

95 Anna Whicher and Gavin Cawood, *SEE Platform Policy Booklet 5: European Design Systems and Innovation Policy* (Cardiff: Design Wales, 2012), 7.

96 Nomen and BDC, *€ Design—Measuring Design Value*, 17.

97 von Stamm, "The Role of Design in Innovation"; Ward and Dekker, "Managing Design in SMEs."

98 M. Economidou, "Dimensions of Designer's Creativity: The Development of a Selection Process" (PhD dissertation, University of Salford, 2005).

99 von Stamm, "The Role of Design in Innovation," 321.

100 Weiss, "Developing Tangible Strategies."

101 Ward et al., "Embedding Innovation."

102 Anonymous, "Design as Interface."

103 Design Council, *Design Delivers for Business: A Summary of Evidence from the Design Council's Design Leadership Programme* (London: Design Council, 2013), available at <https://www.designcouncil.org.uk/resources/report/design-delivers-business>; Design Council, *Eleven Lessons: Managing Design in Eleven Global Brands A Study of the Design Process* (London: Design Council, 2007), available at <https://www.designcouncil.org.uk/resources/report/11-lessons-managing-design-global-brands>.

104 Anna Essén and Britt Östlund, "Laggards as Innovators? Old Users as Designers of New Services & Service Systems,"

nization's internal culture, and its attitude to learning and change,¹³⁰ can affect the contributions design can make to innovation – especially its approach to risk.

External Mediating Factors

We found many anecdotal discussions about the external conditions affecting innovation during our review. However, only a handful of articles treated the mediating effects that external conditions had on the design/innovation relationship in a substantive way.

Hobday and his colleagues¹³¹ report that, despite being strongly related, innovation policy and design policy have grown separately. One reason for this is that in the first and second generations of innovation policy development, design was mentioned marginally (as a styling activity) and granted a limited scope. Another reason is that innovation policy research has a longer history than design policy research. However, in a later study by the same group of researchers, this disconnect is changing – later generations of innovation policies (fourth and fifth) position design as “a core technical task and a contributor to business differentiation

International Journal of Design 5, no. 3 (2011): 89–98, available at <http://ijdesign.org/index.php/IJDesign/article/view/915>.

105 von Stamm, “Innovation—What's Design Got to Do with It?”

106 Mortati and Villari, “Bridging Languages,” 73.

107 Alexander Peine and Andrea M. Herrmann, “The Sources of Use Knowledge: Towards Integrating the Dynamics of Technology Use and Design in the Articulation of Societal Challenges,” *Technological Forecasting and Social Change* 79, no. 8 (2012): 1496, DOI: <https://doi.org/10.1016/j.techfore.2012.04.014>.

108 Verganti, “Design, Meanings, and Radical Innovation.”

109 Paola Bertola and José Carlos Teixeira, “Design as a Knowledge Agent: How Design as a Knowledge Process Is Embedded into Organizations to Foster Innovation,” *Design Studies* 24, no. 2 (2003): 181–94, DOI: [https://doi.org/10.1016/S0142-694X\(02\)00036-4](https://doi.org/10.1016/S0142-694X(02)00036-4).

110 Kenneth Munsch, “Outsourcing Design and Innovation,” *Research-Technology Management* 47, no. 1 (2004): 27–30, DOI: <https://doi.org/10.1080/08956308.2004.11671605>.

111 Philip Kotler and G. Alexander Rath, “Design: A Powerful but Neglected Strategic Tool,” in *The Handbook of Design Management*, ed. Rachel Cooper, Sabine Junginger, and Thomas Lockwood (London: Bloomsbury Academic, 2013), 87–95; Roberto Verganti, *Design-Driven Innovation: Changing the Rules of Competition by Radically Innovating What Things Mean* (Cambridge, MA: Harvard Business Press, 2009).

112 Francesco Zurlo and Cabirio Cautela, “Design Strategies in Different Narrative Frames,” *Design Issues* 30, no. 1 (2014): 34, DOI: https://doi.org/10.1162/DESI_a_00246.

113 Bryan Lawson, *How Designers Think: The Design Process Demystified*, 4th ed. (Oxford: Elsevier, 2006).

114 Michael West and James L. Farr, eds., *Innovation and Creativity at Work: Psychological and Organi-*

and strategy.”¹³² This is a positive change that might transform how innovation and design policies are related to each other. Nonetheless, Hobday and his colleagues maintains elsewhere that this transformation in innovation policy is not necessarily reflected in design policy.¹³³

Borja de Mozota asserts that a company's location affects its perception of design's contribution to innovation management. She says, “The perception of the impact of design on the management of innovation is different according to the company's geographical zone. In Northern Europe, design is seen as a know-how that transforms processes. In Southern Europe, on the other hand, design is seen as a useful tool to set up project innovation with multidisciplinary teams.”¹³⁴ The implication here is that because the interpretation of what design varies from one region to another, those variances will, in turn, affect how it is and how its impact is

Finally, political and socioeconomic developments across the globe are impacting the role design plays in innovation processes. For example, the concern for sustainability that has grown over the last several decades has affected processes across the board at many organizations. According to Michael Hopkins,¹³⁵ the pressure that companies face to make products that respect environmental concerns can result in more efficient designs. Redesigning products to use fewer, more sustainable materials is one way to influence the development of important innovations. In the words of Steve Eppinger, in an interview given to Hopkins in 2010, “The way to think of environmental sustainability when it comes to design and product innovation is by framing it as a It's about that we use in the products and the materials that are used to run the processes that make the products.”¹³⁶ This is just one example of how emerging behaviors or new paradigms – sustainability, social responsibility, and climate change, to name but a few – exert pressure on the relationship between design and innovation from outside the organization.

Discussion and Conclusions

The aim of this review has been to explore the last thirty years of design literature dealing specifically with the study of the role – or roles – design activity plays in innovation processes. This revealed three issues.

- A major obstacle in this task is a lack of clarity and precision with regard to

- the definitions of design and innovation in the papers.
- Many positive insights on the value design offers to innovation were brief mentions unsupported by substantive analysis.
- Many of the articles that refer to the relationship between design and innovation do so by using short examples, case studies, or personal anecdotes – again, few included detailed analysis, especially of quantitative data.

This leads to normalizing assumptions related to the design/innovation relationship, when indeed the link between them may be exceptional. In very interesting case studies, such as those presented by the Design Council,¹³⁷ organizational feedback tends to be very positive – and presumably biased toward design, given the Design Council's role as advocate. Nevertheless, even the Design Council provides little in the way of informative or evaluative detail. A fair conclusion, therefore, is that the role of design in innovation and its contributions to the innovation process presented in the design literature to date relies on experiential episodes, specific examples, case studies, opinions, and anecdotes. Although this makes these findings unique and interesting, the nature of the information published in the literature presents some issues in terms of reliability. The evidence in the design

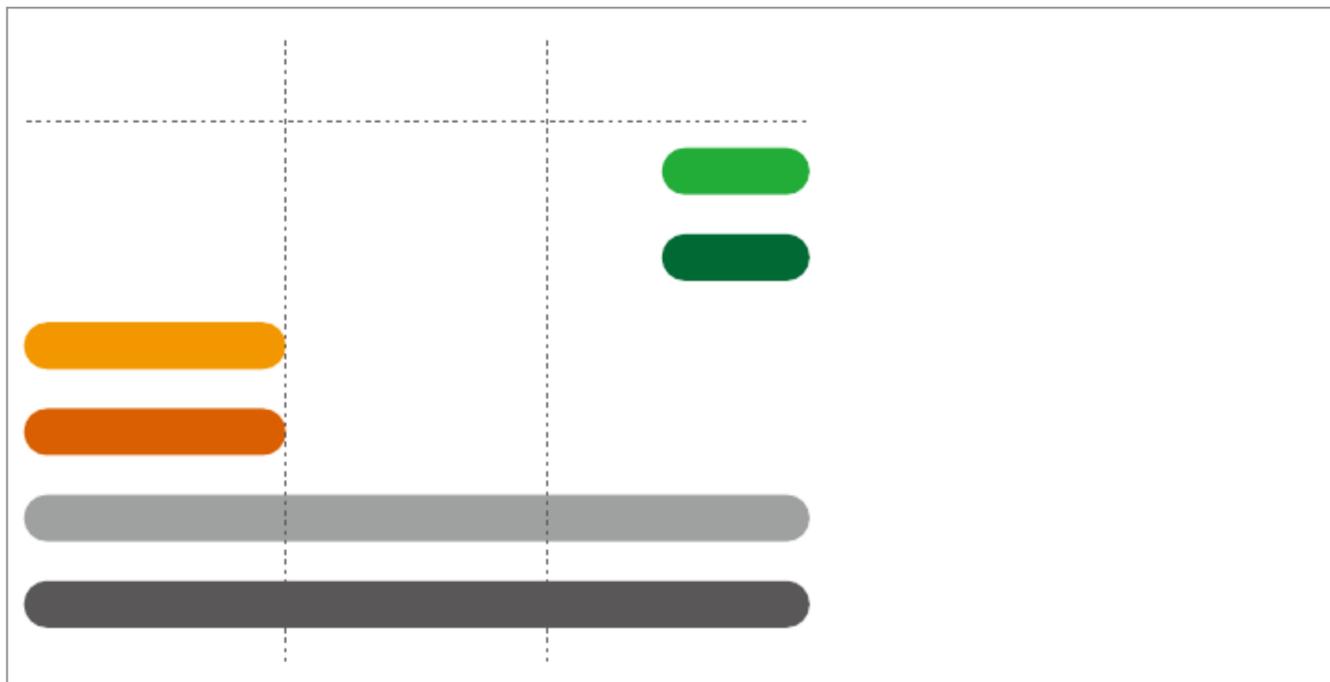


Figure 2 Roles of design in the innovation process. Copyright © 2018 Ricardo J. Hernández, Rachel Cooper, Bruce Tether, and Emma Murphy.

literature of the contributions design can make to innovation is still unclear.

In spite of the lack of clarity and evidence, an important result of this review has been that we now understand the narrative that has emerged over the past thirty years. Hearsay and experiential discourse is often part of that narrative – many of the studies we analyzed used case studies and qualitative data collection methods. It is impossible, with the data available, to produce a formal model of our literature review, which was never our intended purpose. We have been able to map out the prevailing narrative and cluster the most prevalent characteristics of the design/innovation relationship. These clusters do not constitute a formal taxonomy; instead, they represent an effort to describe – with some kind of order – what we found. Indeed, this attempt to identify and formalize from the literature the roles design can play in innovation helped us to better understand not only design is used in the innovation process but it is most commonly used during this process in relation to the different roles we identified (Figure 2).

We acknowledge that the information we present in the previous sections of this review contains assumptions and grey areas that require further investigation. We argue that "Design as a creative, generative thinking process," "Design (as) research," and "Design as differentiator" are valuable labels, but we do propose that

Manufacturing," *Technology Analysis & Strategic Management* 18, no. 5 (2006): 531, DOI: <https://doi.org/10.1080/09537320601019628>.

120 Lisbeth Svengren Holm and Ulla Johansson, "Marketing and Design: Rivals or Partners?," *Design Management Review* 16, no. 2 (2005): 36–41, DOI: <https://doi.org/10.1111/j.1948-7169.2005.tb00191.x>.

121 Bruce Wood, "Design as First Aid: The Wallace Cameron Company," *Design Management Review* 15, no. 3 (2004): 40–44, DOI: <https://doi.org/10.1111/j.1948-7169.2004.tb00170.x>; Walton, "Identifying the Creative Frontiers," 6; Marsili and Salter, "The Dark Matter of Innovation."

more explicit and precise language is needed to specify the role, or roles of design in innovation. We suggest three lines of future research to explore the roles design activity plays in innovation.

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overlapping roles are unlikely to entirely disappear, by developing a more consistent labelling of activities it should be easier to differentiate one type of design from another, and clarify the characteristics of different applications of design to the innovation process.

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play in innovation; we must also establish a clear connection between those roles and its specific benefits or contributions to the innovation process. Beyond this, it is essential that we benchmark any connection against an organization's Key Performance Indicators (KPIs). These studies will need researchers to identify and develop a set of dedicated measurement tools.

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integrate quantitative and qualitative measures not only of economic value,

122 Wood, "Design as First Aid." 123 Marsili and Salter, "The Dark Matter of Innovation."

124 Satish Nambisan and Mohanbir Sawhney, "Orchestration Processes in Network-Centric Innovation: Evidence from the Field," *Academy of Management Perspectives* 25, no. 3 (2011): 40–57, DOI: <https://doi.org/10.5465/amp.25.3.zoi40>.

It is not enough to define the roles de
125 Christopher A. Voss and Juliana Hsuan, "Service Architecture and Modularity," *Decision Sciences* 40, no. 3 (2009): 541–69, DOI: <https://doi.org/10.1111/j.1540-5915.2009.00241.x>.

126 Peter H. Jones, "When Successful Products Prevent Strategic Innovation," *Design Management Journal (Former Series)* 13, no. 2 (2002):

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30–37, DOI: <https://doi.org/10.1111/j.1948-7169.2002.tb00306.x>.

127 Walsh, "Design, Innovation and the Boundaries of the Firm."

128 Jones, "Successful Products."

129 Peter H. Jones, "Embedded Values in Process and Practice: Interactions between Disciplinary Practices and Formal Innovation Processes," *Academic Review* 2, no. 1 (2002): 20–36.

130 Powell, "Fear of Failure," 5.

131 Hobday et al., "An Innovation Perspective on Design, Part 2."

132 Hobday et al., "Policies for Design and Policies for Innovation," 276.

133 Hobday et al., "An Innovation Perspective on Design, Part 2."

134 Borja de Mozota, "Design and Competitive Edge," 96.

135 Michael S. Hopkins, "How Sustainability Fuels Design Innovation," *MIT Sloan Management Review* 52, no. 1 (2010): 75–84, available at <https://sloanreview.mit.edu/article/how-sustainability-fuels-design-innovation/>.

136 Ibid., 76.

137 Design Council, *Leading Business by Design*.

138 Anna Whicher, Gisele Rau-

but also social and environmental impact.¹³⁸ The contributions design can make to innovation should be measured along a wider spectrum aligned with current socio-economic paradigms – not only against revenue projections and benchmarks. Most of the research we report on in this review is qualitative, leaving a large gap in quantitative evidence that will significantly enrich the narratives, opinions, and experiences currently presented in the design literature.

Despite these gaps in the design studies literature, a thread has emerged: the unique element afforded to innovation by design activity is that design language – communication based on visual tools, design development techniques, and research methods, for example – has effectively become the language of innovation. Design practices, design visualizations, and design methods – not to mention the push toward integrating design thinking – often form the common ground upon which conversations can be built in the complex context of innovation process. Design language, indeed, the language of innovation.

Finally, we recognize that the framework for this review presents two core limitations. The first is related to the scope of our review. Our intention was to establish how the relationship between design and innovation has been portrayed in the design literature over the last thirty years. However, this objective leaves out other domains of literature where this relationship is of interest and consequence. The disciplines of engineering, management, and business have their own literature studying and explaining the design/innovation connection. Without taking these contributions into account, the answer we seek about that connection will be always incomplete.

The second limitation regards the terms we used to frame our search of the literature. We limited ourselves to terms that we had identified as central – and without strong bias – during our research for the "Design Values" project. We do recognize that other terms would also be valid, and that the net ought to be cast much more widely in the future.

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Design, the Language of Innovation

271

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