The Innovation Dimension: Designing in a Broader Context

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Context

The term "innovation" has become increasingly prominent in debates in government policy through the establishment of the new UK government department, Department for Innovation, Universities, and Skills (DIUS) and through reports such as "Innovation Nation."[1] National funding bodies, such as research councils and the Leverhulme Trust, are emphasizing innovation through the "digital economy" and a corresponding prioritization in the design establishment through the activities and publications of the Design Council.

These converging activities have highlighted the complex, overlapping, inconsistent, and incompletely understood relationship of innovation as used in design and innovation in the broader literature of innovation studies. Concentrating on the UK, this paper provides an indicative review of these fields and aims to achieve three goals: 1) describe the wider academic field of innovation and relate this to a design perspective, 2) examine the connections, tensions, and synergies that emerge as these fields converge, and 3) propose active areas for contributions between fields.

Many disciplines are active in innovation research, including management studies, economics, entrepreneurship, psychology, sociology, and, starting to emerge in broader innovation studies, design. The velocity of research, especially in the area of design and innovation, is increasing, driven by the developing needs of the digital or knowledge economy. Specifically, the UK government has committed to spending £3.5bn on innovation through the Technology Strategy Board (TSB).

These initiatives were shaped in the UK by a series of policy papers, including: *Competing in the Global Economy—The Innovation Challenge*,[2] *Creativity, Design, and Business Performance*,[3] *Innovation in the UK: Indicators and Insights*,[4] *The Cox Review of Creativity in Business: Building on the UK's Strengths*,[5] *The Race to the Top: A Review of Government's Science and Innovation Policies*,[6] *Innovation Nation*,[7] and *Creative Britain: New Talents for the New Economy*.[8]

In a European context an engagement with innovation is seen in an ongoing manner through the activities of Euro-Innova,[9] the EU's innovation portal. This portal sponsors an ongoing series of activities, from conferences to innovation panels, that look at sector-specific innovation issues ranging from textiles to space to gazelles (fast-growing small and medium enterprises (SMEs)). There has

1 John Denham, *Innovation Nation* (London: Department for Innovation, Universities, and Skills, 2008).

2 DTI Economics Paper No. 7: *Competing in the Global Economy—The Innovation Challenge* (London: Department of Trade and Industry, 2003).

3 DTI Economics Paper No.15: *Creativity, Design, and Business Performance* (London: Department of Trade and Industry, 2005).

4 DTI Occasional Paper No. 6: *Innovation in the UK: Indicators and Insights.* (London: Department of Trade and Industry, 2006).

5 Sir George Cox, *Cox Review of Creativity in Business: Building on the UK's Strengths.* (London: HM Treasury, 2005).

6 Lord Sainsbury, *The Race to the Top: A Review of Government's Science and Innovation Policies* (London: Department of Trade and Industry, 2007).

7 See note 1.

8 *Creative Britain: New Talents for the New Economy* (London: DCMS/BERR/DIUS, 2008).

9 Innova, European Innovation Portal. http://www.europe-innova.org/index.jsp.

also been a long-standing commitment to investigating innovation through the Community Innovation Survey (CIS), a Europe-wide survey to measure and analyze innovation activity in companies. This survey has been completed every four years since 1993, with the last CIS including responses from more than 140,000 companies.

Beyond Europe there is broader international interest in innovation, seen in the activities of the OECD (Organisation for Economic Co-operation and Development). This group of thirty industrialized nations has developed a widely accepted and implemented international standard for the measure and analysis of innovation, known as the Oslo Manual.[10] This standard allows for the direct comparison of national innovation surveys, and the EU has facilitated this comparison through the ongoing funding of projects, from the 1990s onward, that analyze CIS data.[11]

To date there has been relatively little direct discussion of innovation in design, although this is changing partly because it is stimulated by government funding and policy that concentrate on innovation. There has been a degree of surprise and skepticism in design journalism that innovation has come to such prominence, questioning any substantive difference between innovation and design. (See Poynor's, "Down with Innovation."[12]) George Cox takes the view that "*design is what links creativity and innovation*,"[13] although throughout his report innovation and design are usually used together (design innovation) in a way that compresses this distinction. There is evidence to support the assertion that the creative sector is more innovative than other firms. The UK National Innovation Survey of 2005 shows that in a measure of key innovation indicators, the creative industries are twelve percent more likely to demonstrate these indicators than other firms.[14] However, this statistic also demonstrates that innovation is by no means dominated by the creative industries.

Although it is possible to read reports such as *Innovation Nation*[15] from a design perspective and to see design as explicitly core to the development of competitiveness through innovation in the UK, looking a little closer the picture is more complex. *Innovation Nation* describes the key skills for innovation to be developing: science and technology, management, and creativity, as well as softer skills "*for things such as open-innovation*," but the white paper recognizes the creative industries as a component of a subsidiary "hidden innovation," placing design outside the mainstream of innovation activity. In academic studies of innovation, design is often not represented at all. For example, the 650-page *Oxford Handbook of Innovation*[16] does not include any references to design, and in a recent review of the top 50 innovation journals, no design journals were represented.[17]

This evidence is presented here not to dislocate innovation from design. As James Utterback argues, product design is more of

10 Oslo Manual, *Guidelines for Collecting and Interpreting Innovation Data* (Paris: OECD, 2005). www.oecdbookshop.org/oecd/display.asp?lang=en&sfl=DI&stl=5LGPBVQFQ4G5 (accessed 1/1/2010.)

11 Keith Smith "Measuring Innovation," in *The Oxford Handbook of Innovation,* ed. J. Fagerberg, D. Mowery, and R. Nelson (Oxford: Oxford University Press, 2005), 148–177.

12 Rick Poynor, "Down with Innovation: Today's Business Buzzwords Reflect a Bad Attitude About Design," *The International Design Magazine* 55:3 (May 2008), 41.

13 See note 5.

14 See note 4.

15 See note 1.

16 Jan Fagerberg, David Mowery, and Richard Nelson, eds. *The Oxford Handbook of Innovation* (Oxford: Oxford University Press, 2005).

17 Jonathan Linton and Narongsak Thongpapanl, "PERSPECTIVE: Ranking the Technology Innovation Management Journals," *Journal of Product Innovation Management* 21:2 (March 2004), 123–139.

18 James Utterback et al., *Design-Inspired Innovation* (London: World Scientific Publishing Co., 2007).

a force in innovation now than 20 years ago.[18] This higher profile for design in innovation studies is reflected in the latest amendments to the Oslo Manual, adding the marketing category to make it easier for design activity to be counted as an indicator of innovation. What is clear is that the relationship between design and innovation is not straightforward or well established.

Innovation Studies

While innovation is a very active area of study now, there is a body of research going back to at least Joseph Schumpiter's *Theory of Economic Development* in 1934,[19] and of course the practice of innovation itself is as old as human activity. Similarly, even the claim of the topicality of innovation is not new. As Downs and Mohr stated in 1976, "*Innovation has emerged over the last decade as possibly the most fashionable of social science areas*."[20]

There is a substantial academic tradition of innovation study in the UK, some of the foundations of which were established by Science and Technology Policy Research University (SPRU) of Sussex. Established in 1966, SPRU undertook one of the key early empirical studies of innovation in the UK. Using a team of 300 experts in panels, they analyzed and cataloged every significant innovation in the UK from 1945 to 1983, resulting in a database of 4,300 innovations.[21] Manchester Institute of Innovation Research (MIIR) at Manchester University is one of the largest academic centers dedicated to innovation in the UK, with more than fifty academics looking at all areas of innovation. This has developed into a field of study collectively known as Innovation Studies.

Also noteworthy is the Open University's Design Innovation Group, formed in 1979 as an early example of innovation explicitly linked to design, although this group's focus is currently directed toward sustainable design rather than innovation.

The Oslo Manual defines innovation as "the implementation of a new or significantly improved product (good or service) or process, a new marketing method, or a new organization in business practices, workplace, organization, or external relations."[22] This definition has recently been modified with the removal of the word "technological," broadening the scope of the definition and acknowledging that innovation is not restricted to technology development and exchange.

The Oslo Manual is a guide for the collection (and measurement) of innovation; generating this guide is recognized to be very difficult, not least because there are a select number of aspects of innovation that can be measured.[23] This is achieved at the EU level through the Community Innovation Survey (CIS) and nationally through the innovation surveys (in the UK, see *Innovation in the UK: Indicators and Insights*).[24] In these surveys hard empirical data are developed around innovation activity. Because of the acknowledged limitations of measuring innovation, innovation studies tend to be

19 Joseph Schumpeter, *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle* (Cambridge, MA: Harvard University Press, 1934).

20 G. W. Downs and L. B. Mohr, "Conceptual Issues in the Study of Innovation," *Administrative Science Quarterly* 21:4 (December 1976), 700–714.

21 See note 11.

22 See note 10.

23 See note 11.

24 See note 4.

skewed toward innovation's empirically accessible aspects. For example, the value of the time and resources put into innovation are measured, rather than the aspects of innovation that are closer to creativity, inspiration, and invention—all areas that resonate strongly with design and are crucial to successful innovation.

A number of different approaches have been used to categorize innovation activity. Schumpeter saw innovation as consisting of one of five types of activity: the creation of new products, new methods of production, new sources of supply, the exploitation of new markets, and, finally, new ways to organize business.[25] The legacy of this approach is evident in the Oslo Manual definitions of innovation, which establishes four categories:

1 Product innovation: the introduction of products and services that are new or significantly improved
2 Process innovation: the implementation of significantly improved production or delivery of methods
3 Marketing innovation: the implementation of a new marketing method
4 Organizational innovation: the implementation of new organizational methods in a firm's business practices.[26]

Rather than looking at the sectors of innovation activity, Kline and Rosenberg proposed that the degree of uncertainty for success is a useful metric for looking at innovation processes.[27] This proposal resonates with the widely used approach of looking at the degree of innovation as a means of describing and analyzing activities across sectors. Drawing on Schumpeter's work, this approach is useful because the more "energetic" the innovation, the more likely it is to cross boundaries, making the Oslo categories difficult to separate in practice. The degree of innovation is sometimes presented as a spectrum spanning from the lower degrees of innovation (through terms such as incremental, marginal,[28] or evolutionary[29]) to higher degrees of innovation (through terms such as: radical,[30] disruptive,[31] or architectural[32]).

The danger here is that there appears to be a smooth continuum or range of innovation, or that a greater jump in innovation is necessarily "better." There is a wide consensus that all innovation activity is multidimensional—that different types of activity and thinking need to come together to enable innovation to occur successfully.[33] This dimensionality contributes to arguments that incremental-type innovation is fundamentally a different class of activity than radical-type innovation, rather than a matter of degree.[34]

Experience (and the research identified in the preceding paragraphs) shows that in its initial stages radical innovation is not well refined or developed and as a result is often very inefficient or even nonfunctional. Only through the quite different

25 See notes 16 and 19.
26 See note 22.
27 S. J. Kline and N. Rosenberg, "An Overview of Innovation," in *The Positive Sum Strategy: Harnessing Technology for Economic Growth*, eds. F. Landau and N. Rosenberg (Washington, DC: National Academy Press, 1986), 275–305.
28 See note 16.
29 See note 27.
30 Chris Freeman and Luc Soete, *The Economics of Industrial Innovation* (London: Routledge, 1997).
31 Clayton Christensen, *The Innovator's Dilemma* (Boston, MA: Harvard Business School Press, 1997).
32 William J. Abernathy and Kim B. Clark. "Innovation: Mapping the Winds of Creative Destruction," *Research Policy* 14:1 (February 1985), 3–22.
33 For example, see: S. J. Kline, and N. Rosenberg, "An Overview of Innovation," in *The Positive Sum Strategy: Harnessing Technology for Economic Growth.* (Washington, DC: National Academy Press, 1986); Rosanna Garcia and Roger Calantone, "A Critical Look at Technological Innovation Typology and Innovativeness Terminology: A Literature Review," *Journal of Product Innovation Management* 19:2 (March 2002), 110–132; Hubert Gatignon, Michael L. Tushman, Wendy Smith, and Phillip Anderson, "A Structural Approach to Assessing Innovation: Construct Development of Innovation Locus, Type, and Characteristics," *Management Science* 48:9 (September 2002), 1103–1122; and Occasional Paper No. 6,"Innovation in the UK: Indicators and Insights," (London: Department of Trade and Industry, 2006).
34 Giovanni Dosi, "Technological Paradigms and Technological Trajectories: A Suggested Interpretation of the Determinants and Directions of Technical Change," *Research Policy* 11:3 (June 1982), 147–162; Pia Hurmelinna-Laukkanen, Liisa-Maija Sainio, and Tiina Jauhiainen, "Appropriability Regime for Radical and Incremental Innovations," *R&D Management* 38:3 (June 2008), 278–289.

process of incremental innovation do new services, products, and processes become effective, often many years after the initial radical breakthrough.

Within these frameworks (whether based on sector or degree of innovation), there are many different approaches to innovation research. These approaches include:

Schumpeterian, concentrating on the market and the identification of waves of creative destruction

Economic, concentrating on asset creation and the incentives for and effects of innovation

Organizational behavior and organizational structures

Sociological views on issues such as the diffusion of technology[35]

Managerial, looking at innovation in terms of practices leading to competitive success

Psychological,[36] concentrating on creativity and how people's vision is restricted to one or another set of opportunities

Marketing, concentrating on consumer behavior and the marketing mix.[37]

All of these areas (and more) have substantial bodies of knowledge addressing innovation, which makes the development of a coherent picture of innovation research problematic. This complexity has resulted in turbulence throughout the field, especially because, as noted by the key innovation scholar Keith Pavvit, "A growing number of 'innovation studies' shows little allegiance to any particular discipline, and widely disparate theories and methods coexist in relevant journals and handbooks."[38]

While universal perspectives are rare in the study of innovation, one area of commonality is that a sophisticated understanding of innovation requires going beyond simple collaboration to an engagement with a systemic or networked view of innovation processes.[39] Related to this view are the ideas of communities of practice[40] and networks of innovation[41] as groups or networks involved in complimentary activities and active in the circulation of ideas.

In addition to resonating with service design approaches, thinking in terms of networks raises some important issues, including knowledge transfer between "nodes" in the network (whether people, departments, or institutions). Nodes have different states of knowledge—different capabilities in terms of developing, adopting, and exploiting innovation. Thus, the spread (or diffusion) of innovations becomes an important issue.[42] Research indicates that a mix of strong ties (productive, reliable, and long established) and weak ties (speculative, unpredictable, facilitating serendipity) are most likely to offer maximum innovative potential.[43]

One of the most well-known examples of where problems occur in the innovative process is where a high degree of innovation

35 Everett Rogers, *Diffusion of Innovations,* 5th ed. (London: Free Press, 1995).

36 Vinod Goel, *Sketches of Thought* (Cambridge, MA: MIT Press, 1995).

37 William Perreault, E. Jerome McCarthy, and M G H Companies, *Basic Marketing: A Global-Managerial Approach* (London: McGraw-Hill, 2005).

38 Keith Pavitt, "Innovation Processes" in *The Oxford Handbook of Innovation,* eds. J. Fagerberg, D. C. Mowery, and R. Nelson (Oxford: Oxford University Press, 2005), 86–115.

39 For example, see Fagerberg, "Innovation: A Guide to the Literature" in *The Oxford Handbook of Innovation* (New York: Oxford University Press, 2005); Ming-Huei Chen, Yuan-Chieh Chang, and Shih-Chang Hung, "Social Capital and Creativity in R&D Project Teams," *R&D Management* 38:1 (December 2005), 21–34; Pavitt, "Innovation Processes" in *The Oxford Handbook of Innovation*, 86–115; Walter Powel and Stine Grodal, "Networks of Innovators" in *The Oxford Handbook of Innovation,* 56–85.

40 Etienne Wenger, *Communities of Practice: Learning, Meaning, and Identity* (UK: Cambridge University Press, 1999).

41 John Brown and Paul Duguid, "Knowledge and Organization: A Social-Practice Perspective," *Organization Science* 12:2 (March 2001), 198–213.

42 Everett Rogers, *Diffusion of Innovations* 5th Edition. (London: Free Press, 1995)

43 Walter Powell and Stine Gordal, "Networks of Innovators," *The Oxford Handbook of Innovation,* 56–85.

44 Wesley Cohen and Daniel Levinthal, "Absorptive Capacity: A New Perspective on Learning and Innovation," in *Strategic Learning in a Knowledge Economy: Individual, Collective and Organizational Learning Process* (Woburn: Butterworth-Heinmann, 2000), 39–68.

is not matched by a corresponding ability to exploit the results of this innovation, termed a company's absorptive capacity.[44] To illustrate, consider Parc Xerox in the 1980s. This research laboratory was a hot house for innovation in ICT and digital media, almost simultaneously developing the basis for the personal computer, computer mouse, and graphical user interface. These (and several other) significant innovations were taken out of the company and exploited either by other firms (e.g., Apple) or in new companies set up for the purpose because Xerox (then a photocopier company) was not in a position to recognize the value of the ideas emerging and to exploit these developments effectively. This was a costly limitation: research shows that the market valuation of these spin-out innovations became worth twice the market valuation of the whole of Xerox.[45]

As the potential for innovation to leak or spin out of companies became better understood, knowledge transfer issues and issues related to managing tacit knowledge became much more important.[46] Open innovation developed as an area of study focused on extending the value of the network and on the ease of diffusion as a facilitator. The field was pioneered by Henry Chesbrough at Berkeley through the popularist *Open Innovation: The New Imperative for Creating and Profiting from Technology*,[47] as well as the more academic, edited volume, *Open Innovation: A New Paradigm for Understanding Industrial Innovation*.[48] This term is entering into popular use and is recognized in design circles through articles such as "Anyone Can Have a Good Idea" in the *Design Council Magazine*.[49]

Open innovation is often mistakenly seen as being the same as open source software production, but fundamentally open innovation is a business model that allows for profitable and sustainable business practices that use the sharing of ideas and information to maximize innovative potential. The underlying principle of free work for common good, which is at the core of open source development, is absent from open innovation. Thus, open innovation is presented as a new paradigm by Chesbrough[50] in the explicitly Khunian sense; however, this has yet to be conclusively evidenced.

Allied to open innovation is an analysis and recognition of innovation in which users, rather than innovation professionals (i.e., scientists, R&D, product engineers, and so on) take the lead. *Democratizing Innovation* by Eric von Hippel[51] is a widely cited analysis of this movement, although there is a rich literature going back to Richard Allen's exploration of "collective invention" in eighteenth century heavy industries, such as blast furnace creation and steam-powered water pumps.[52] This literature recognizes that innovation professionals tend to produce incremental innovation at a relatively slow pace, while certain groups of advanced users (identified as "lead-users" by von Hippel) often produce more

45 H. Chesbrough, "Graceful Exits and Missed Opportunities: Xerox's Management of its Technology Spin-Off Organizations," *Business History Review* 76: 4 (Winter 2002), 803–837. http://www.proquest.com/ (accessed 8/29/2008).

46 Richard Nelson and Sidney Winter, *An Evolutionary Theory of Economic Change* (Cambridge, MA: Harvard University Press, 1982).

47 H. Chesbrough, *Open Innovation: The New Imperative for Creating and Profiting from Technology* (Boston: Harvard Business School Press, 2003).

48 H. Chesbrough and A. K. Crowther, "Beyond High Tech: Early Adopters of Open Innovation in Other Industries," *R&D Management* 36:3 (June 2006), 229–236.

49 M. Mendoza, "Anyone Have a Good Idea?" *Design Council*, July 2008 (Issue 4), 36–41.

50 See note 48 and Thomas Kuhn, *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1970).

51 Eric von Hippel, *Democratizing Innovation* (Cambridge, MA: MIT Press, 2005).

52 Robert C. Allen, "Collective Invention," *Journal of Economic Behavior & Organization* 4:1 (March 1983), 1–24.

radical solutions, more quickly—solutions that address market needs more effectively than would be possible otherwise.

There are well-documented examples of this phenomenon in categories as broad as sporting equipment,[53] microchip design,[54] and medical equipment.[55] Charles Leadbeater calls these users "Pro-Ams" and sees a groundswell of mass innovation changing not just innovation and creative practices but economics and culture as well.[56] This area of thinking represents one of the important interfaces between academic innovation research and design studies as design also grapples with the notion that innovation (and creativity) are not necessarily the USP (unique selling proposition) of the designer.

Design and Innovation

While the definitions of innovation in innovation studies have a high degree of commonality, the way innovation is used in design is more varied and contentious. This lack of consensus is partly because of the emerging use of innovation in the design literature, but more significantly it represents a predilection of design to engage with aspects of innovation that are not easily quantifiable, are not part of national innovation surveys or the CIS, and so, despite the best of intentions, can be underrepresented in innovation studies.[57] One aspect of this difference in emphasis in "design innovation" is a closer relationship between thinking about invention and innovation. This is highlighted in Wylant's paper, "Design Thinking and the Experience of Innovation."[58] Here, Wylant argues that innovation is an *abstract* process for conceptual problem solving, using Downs and Mohr's definition of innovation as "the adoption of means or ends that are new to the adopting unit"[59] to support this assertion.

This view of innovation as conceptual/creative practice (and so the province of designers) is evident in *The Art of Innovation* and *The Ten Faces of Innovation*.[60] Drawing on the experience of the design consultancy, IDEO, innovation here is not defined or explicitly addressed but instead is used as an umbrella description for creative practices, such as brainstorming, "unfocus groups," and ethnographic approaches.

The separation of innovation from practical implementation is in tension with contemporary definitions of innovation used outside design. These include definitions in the *Oxford English Dictionary*, as well as definitions used across the general body of innovation literature; for example see Fagerberg's *Innovation: A Guide to the Literature*.[61] In innovation studies some definitions go further than just requiring practical implementation. For Lam, innovation occurs when a "new or better product or promotion proven successful is consumed or used"[62] which makes successful consumption a condition of innovation. The literature is clear that innovation is distinct from invention in that "invention is the first occurrence of an idea for a new product or service while innovation is the first attempt to carry it out in practice."[63] While the blurring of invention

53 Nikolaus Franke and Frank Piller, "Key Research Issues in User Interaction with User Toolkits in a Mass Customisation System," *International Journal of Technology Management* 26:5 (June 2003), 578–599.

54 See note 51.

55 Christian Lüthje, "Characteristics of Innovating Users in a Consumer Goods Field: An Empirical Study of Sport-Related Product Consumers," *Technovation* 24:9 (February 2004), 683–695.

56 Charles Leadbeater, *We-Think: The Power of Mass Creativity* (London: Profile, 2007).

57 See note 11.

58 Barry Wylant, "Design Thinking and the Experience of Innovation," *Design Issues* 24:2 (Spring 2008), 3–14.

59 George Downs and Lawrence Mohr, "Conceptual Issues in the Study of Innovation," *Administrative Science Quarterly* 21:4 (December 1976), 700–714.

60 Tom Kelley and J. Littman, *The Art of Innovation: Success Through Innovation the IDEO Way* (London: HarperCollinsBusiness, 2004); Kelley and Littman, *The Ten Faces of Innovation: Ideo's Strategies for Beating the Devil's Advocate & Driving Creativity Throughout Your Organization* (London: Profile Business, 2008).

61 See note 16.

62 A. Lam, "Organizational Innovation" in *The Oxford Handbook of Innovation*, 115–147; also Pavitt, "Sectoral Patterns of Technical Change: Towards a Taxonomy and a Theory," *Research Policy* 13:6 (December 1984), 343–373.

63 Fagerberg, "Innovation: A Guide to the Literature," *The Oxford Handbook of Innovation,* 1–27.

and innovation is anomalous when working between design and other areas of innovation research, it also points to an area of fertile research potential: much of innovation studies concentrates on the effects of innovation rather than on the act of innovation directly. As Fagerberg comments, "we know much less about how and why innovation occurs than what it leads to."[64]

The desire to cross between disciplines (common in design thinking) offers innovation a useful tool when considering the problems of path dependency. Path dependency occurs when circumstances preclude the adoption of innovations because the necessary physical, logistical, or conceptual changes present too great a barrier. This path dependency becomes an issue particularly when systems of innovation become interrelated or heavily specialized, when infrastructure costs are very high, or even when working practices are long established and when people are resistant to change.

As firms become less self-sufficient, either through open innovation processes or conventional organizational development, the firm is increasingly seen as part of a system or community, and path dependency becomes more likely.[65] This is recognized by the Oslo Manual with the inclusion of new sections that look at innovation management and networking and also with the specific introduction of a measure for organizational innovation. Path dependency is increasingly being seen as a limiting factor for innovating companies; as Leonard-Barton says, "Yesterday's core competencies are today's core rigidities."[66]

In essence the rigidity described by Leonard-Barton is why "innovation occurs at the boundaries between mindsets, not within the provincial territory of one knowledge base,"[67] innovation tends to happen at the boundaries where path dependency is less established and restrictive. *Innovation Nation* recognizes that the ability to jump between assumptions, practices, paradigms, or established practices is essential for continuing, non-incremental innovation. Reliance on routine and on established patterns of working forms an important component of path dependency. Design theorists such as Lawson,[68] backed by cognitive psychologists such as Goel,[69] argue that design thinking is distinctly different from other sorts of thinking and that designers, through the use of drawing as a cognitive tool, are uniquely placed to avoid conceptual path dependency. In Lawson's terms, designers have a significantly greater perceptual span because of their use of visualization techniques, contrasting the degree of innovation seen in architecture (which has a greater perceptual span through drawing) and in blacksmithing (which has a smaller perceptual span through direct construction). More directly one could use Barnes Wallace's description of his approach—"I knew nothing except how to think, how to grapple with a problem and then go on grappling with a problem until you had solved it"[70]—thus adopting problem solving as the only core skill and as a method of helping to avoid path dependency. The tension here is that successful

64 Ibid.

65 Pavitt, "Innovation Processes," in *The Oxford Handbook of Innovation,* 86–114.

66 Dorothy Leonard-Barton, *Wellsprings of Knowledge: Building and Sustaining the Sources of Innovation* (Boston: Harvard Business School Press, 1995).

67 See note 43.

68 Bryan Lawson, *What Designers Know*, (London: *Architectural Press,* 2004).

69 Vinod Goel, *Sketches of Thought* (Cambridge, MA: MIT Press,1995).

70 Bryan Lawson, *How Designers Think: The Design Process Demystified* (London: Architectural Press, 1997).

innovation requires this openness to be adopted, not just by the lone inventor, but by manufacturers, financers, marketers, technologists, and the myriad of other contributors to successful innovation, and that they work in harmony with each other.

There are other dimensions of interface between innovation and design worthy of note, including that in Rick Poynor's polemic article, "Down with Innovation: Today's Business Buzzwords Reflect a Bad Attitude About Design."[71] This article attacks innovation as a term developed by business to take design away from designers. Poynor's position highlights the tensions in the design profession generally about the standing (and even durability) of the design profession, the (self-) perception of the designer as the pre-eminent creative wellspring in industry, and the relationship of design to wider society.

Design and innovation also interact through aesthetics and semantics. Utterback et al., in "Design-Inspired Innovation," offer the most direct example of this interaction when they say, "Are we perhaps closing the circle, coming back to simple, straightforward beauty as an overarching principle [of innovation] for products and services, and demoting technology as something hidden in and relegated to their deeper recesses?"[72] They go on to propose a "radical innovation of meaning."[73] These sentiments are also present in Poynor[74] and Wylant.[75] The proposition of a return to simplicity and beauty (in Poynor's case, to being suitable to be displayed in a museum in the future) is difficult to relate to wider movements in design research.

Research Needs

The clear picture here, with regard both to innovation and to innovation and design, is that there *is* no clear picture and that the relationships involved are emerging and chaotic, and although the bodies of knowledge are highly overlapping, there is limited dialogue. To address this situation, some key areas deserve concentrated research attention. The most important of these are:

- The role of design thinking and an exploration of the appropriateness and effectiveness of using design thinking approaches in other disciplines, particularly with the aim of collaborating across disciplines to avoid unnecessarily limiting path dependencies.
- The importance of semantics and aesthetics to design innovation and wider innovation practices. To an extent, this is reflected in the new category of marketing innovation in the Oslo Manual, allowing new modes of or approaches to communication to be recognized as being innovative.
- The relationships between the two differing positions on design—the one in which a concentration on semantics sees design in terms of decoration, versus the one (paralleled in wider innovation thinking) that sees design with

71 See note 12.

72 See note 18.

73 See note 18.

74 See note 12.

75 See note 58.

76 For example, see Richard Buchanan, "Design Research and the New Learning," *Design Issues* 17:4 (Autumn 2001), 3–23; Wolfgang Jonas, "A Scenario for Design," *Design Issues* 17:2 (Spring 2001), 64–80; Ezio Manzini and François Jégou, *Sustainable Everyday: Scenarios of Urban Life* (Milan: Edizioni Ambiente 2002); and John Thackara, *In the Bubble: Designing in a Complex World* (Cambridge, MA: MIT Press, 2005).

a more systematic, networked understanding, personified by service design.[76] This fluid area of investigation urgently requires more research into the relationships between these two positions.

The changing role of the "innovation professional," (and, within this category, of design) in light of the emergence of open innovation and, especially, of democratized innovation practices and the developing role of the citizen innovator. Within this shifting economic and creative landscape, design as a discipline has to adapt and, as part of this adaptation, accept that design is not the "gatekeeper" of innovation. Rather, it is one component in a larger network of innovation. Similarly, innovation researchers must come to recognize the position of design in innovation networks (something that is seldom acknowledged), as well as the ways in which the multidisciplinary approaches routinely used in design thinking have applications across broad areas of innovation research and practice.