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Innovating by Design? How Design Practice Shapes Furniture Innovation

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Abstract

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It is widely acknowledged that a substantial shift in the nature of competition in recent decades has compelled manufacturers in advanced industrial economies to embrace a competitive strategy based on design (Lash and Urry 1994; Scott 2000). Literature on the geography of innovation implies that there is a two-fold industrial knowledge base in complex, design-led manufacturing: symbolic knowledge (crucial to the design component) and synthetic knowledge (crucial to the industrial manufacturing component) (Asheim and Gertler 2005; Gertler 2008). Yet knowledge creation and innovation for each is said to rest on divergent labour practices and modes of work organization because symbolic knowledge is facilitated by open labour markets and the rapid movement of workers between firms and projects (Grabher 2002), whereas synthetic knowledge rests on more long-term employment arrangements and consensus-based working relations (Asheim and Gertler 2005). If this is the case, then what are the labour dynamics and optimal employment structures that underpin innovation for this particular production model, which is increasingly prevalent in today's knowledge economy?

This paper seeks to provide a framework for understanding the organization of design work and the integration of this expertise into a product and related production process. To address the overarching question, this research draws on a case study of the Canadian contract (or office) furniture manufacturing sector, in which design practice is shown to be a core competency among firms, and which has demonstrated resilience and vibrancy in the midst of widespread economic downturn throughout the Canadian manufacturing landscape of late. The empirical analysis entails an online survey questionnaire to the full population of firms in the industry (N=220), designed to collect information about design and shopfloor practices, and resulted in a final response rate of 46%. In addition, 60 in-depth interviews were conducted

with senior managers, production workers and designers from a subset of leading firms. Here I aimed for a more in-depth understanding of the division of design labour and its relation to production activities, and firms' motivations for opting for a particular employment model.

Results show that firms employ either long-term practices conducive to the synthetic knowledge model of innovation (i.e. the presence of an in-house design team), short-term practices more consistent with the symbolic knowledge model (i.e. the hiring of design talent on a temporary basis), or a combination of both employment models, in order to capitalize on design inputs into product development. Findings indicate that on the one hand, the in-house team enables designers to maintain a close association and interplay with other key actors (i.e. those in engineering or manufacturing), which is fundamental to the process of incremental product enhancement. On the other hand, the employment of temporary project designers enables a firm to bring in fresh new ideas and outside perspectives. These inputs are of critical importance to firms' ability to introduce new - often radically innovative - products to the marketplace. A firm's decision to bring both in-house and external design functions together serves to leverage a two-fold competitive advantage.

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It is widely acknowledged that profound changes have taken place in the landscape of traditional manufacturing in the economies of advanced industrialized countries in recent decades. The demise of mature manufacturing in these economies has been foretold by scholars and policymakers alike, many of whom have argued that the present knowledge economy is centered less on the physical processing of goods and more on knowledge processes, and that low-tech production activities can be undertaken more efficiently and economically in low wage contexts.

Yet empirical work on the furniture industries of Europe, the UK and Canada reveals that high-wage, high-cost nations *can* effectively compete in a global manufacturing economy by demanding economic restructuring towards a less price- and more quality- and design-oriented competitive niche. In other words, shifting product ranges towards more diversified, customized demands of high quality markets can insulate production from the pressures of price competition (Best 1989; Rusten 1997; Maskell 1998; Maskell et al. 1998; Lorenzen 1998; Leslie and Reimer 2006). Implicit in this work is the notion that if manufacturing in mature industries has a future in high-wage economies, it is likely to depend on firms' success in renewing both their products and their production processes. The adoption of new designs that enhance product quality and value-added, further reinforced by the implementation of employment practices that leverage the capacity of the labour force, are likely to be fundamental elements of a more resilient corporate strategy.

Much research in geography has investigated the labour market dynamics that underpin growth in the cultural industries, whose primary input is said to be 'creativity' (Scott 2000, 2001, 2004, 2006; Grabher 2002; Florida 2002; Christopherson 2002; Power and Scott 2004; Vinodrai 2006; Currid 2007). In a related vein, several bodies of work

focus on the dynamics of innovation in more traditional, low-tech manufacturing sectors such as furniture production and the garment industry (Scott 1996; Maskell 1998; Maskell et al. 1998; Lorenzen 1998; Rantisi 2002, 2004; Leslie and Reimer 2006). However there has been limited discussion of the nature of employment relations and work practices that support innovation in a distinctly *hybrid* industrial activity that combines elements of both creativity and industrial production processes. The purpose of this paper is to begin addressing this gap. It investigates the intersection of the complex and often divergent labour practices and modes of work organization that underpin innovation in a high-quality, design-led manufacturing niche, which is increasingly prevalent in the contemporary knowledge economy. In doing so, I bring together several fields of theory and literature in economic geography, innovation and the cultural industries, and I draw on a case study of the Canadian 'contract' (or office) furniture manufacturing sector, which has undergone dramatic growth following North American trade liberalization in the late 1980s.

Literature Review

Long-term, structural changes in the terms of competition have had a substantial impact on producers throughout most industrialized countries in recent decades (Piore and Sabel 1984; Amin and Thrift 1992; Lash and Urry 1994; Stoper 1997; Cooke and Morgan 1998; Scott 2000; Florida 2002; Power and Scott 2004). As scholars have argued since the mid-1980s, the nature of contemporary capitalism is generally acknowledged to have undergone something of a transformation, as mass markets previously served by a limited range of standardized products have been carved up into smaller, qualitatively distinct niches. In pursuing these smaller, more fragmented and quickly changing niche markets, firms are pressured to compete on the basis of quality, distinctiveness and innovativeness, or suffer extinction. In adapting to this new competitive environment, manufacturers have been compelled to adopt radically new sets of practices and forms of work organization, and to embrace a competitive strategy based on quality, value and design.

This resonates with a large body of literature in geography and the social sciences that highlights the key role that creativity and culture play in the contemporary economy, and points to the growing importance of symbolic and aesthetic inputs into the production

of goods and services (Lash and Urry 1994; Zukin 1995; Landry 2000; Scott 2000; Florida 2002; Grabher 2002; Christopherson 2002; Currid 2007). Lash and Urry (1994) discuss the increasing design-intensity across all facets of the economy, and suggest that the production of physical goods which are imbued with a high degree of creative and semiotic content have certain intangible qualities that serve as the basis for their economic success. In other words, the design element comprises an increasing component of the value of goods, providing the decisive competitive advantage. In a related vein, Scott (2000) argues that those sectors that can most creatively and consistently exploit the symbolic aspects inscribed in their products will 'define the frontier of modern capitalism.'

Thus there has been a growing recognition of the increased emphasis on creativity and design in the manufacturing of goods. Yet as has been discussed, our knowledge of the labour market conditions that underpin design-led manufacturing is more limited. To begin addressing this gap, I propose a framework that conceptualizes the core differences in the nature of work organization, production and labour processes across the economy. The emerging 'knowledge bases' literature provides such a framework. This approach seeks to bring together an understanding of key differences in the innovating processes for firms and industries by identifying the different 'knowledge bases' that underpin the activities most central to each sector's competitiveness. Upon these knowledge bases, scholars develop a comparative conceptual framework for understanding differences in the logics of innovation across sectors, including the diversity of skills and competences required of workers, the different modes of work organization, and optimal workplace structures for the development of new products and processes (Asheim and Gertler 2005; Asheim and Coenen 2005; Asheim, Coenen, and Vang 2007; Gertler 2008; Moodysson, Coenen, and Asheim 2008) . The lead proponents of this view acknowledge that knowledge involved in innovation is increasingly complex and multidimensional. However they nonetheless imply that there is a two-fold industrial knowledge base in complex, design-led manufacturing – synthetic and symbolic – yet each having divergent labour input requirements.

Inherent in this view is that synthetic knowledge (crucial to the industrial manufacturing component of this production model) largely involves the novel

application or combination of existing knowledge in context-dependent scenarios or engineering-related problem solving (Asheim and Coenen 2005). While some of the knowledge involved is based on partially codified knowledge, synthetic knowledge tends to have a larger tacit component by nature, which means that important parts can't be removed from their human and social contexts. This is because often, this kind of knowledge cannot be transformed into codes understandable to others - often one cannot even describe for oneself how to do things (Lundvall and Johnson 1994). It depends on 'know-how' which draws on experience gained at work through applied testing and on-the-job learning in the creation and diffusion of knowledge (Gertler 2008; Lundvall and Johnson 1994). As well, given the importance of frequent producer-user interaction an face-to-face communication, synthetic knowledge tends to be more sensitive to distance, is often created within firm boundaries, and involves incremental developments . Moreover, the synthetic knowledge model of innovation rests on the capacity of an organization to build a wealth of skill and problem-solving capability among its workforce through many years of training and learning-by-doing. Of fundamental importance is the ability of workers to develop a high level of expertise through consensus-based working relations that are cultivated over the long-term.

However, this description contradicts the growing literature on project ecologies which contends that symbolic knowledge (crucial to the design component) is facilitated by short-term employment structures, open labour markets, and the rapid movement of skilled workers between firms and projects (Grabher 2002; Christopherson 2002) . Highly skilled, creative workers are said to play a vital role as mobile agents of knowledge transfer in the symbolic knowledge model of innovation, bringing ideas and practices with them from firm to firm (Florida 2002; Saxenian 1994, 1999). Mobility is driven not only by the nature of employment structures that underpin the creative process itself, but is also fostered by a strong incentive for workers to continually learn in order to remain productively employed and to consistently upgrade their skills. The ability for individuals to move from one opportunity and organization to another is also a means by which workers seek to minimize risk and tenuous employment relationships that are inherent in many creative industries (Ekinsmyth 1999) . Social capital and personal networks provide the basic social infrastructure, in other words, 'know-who' is a key

component of success (Grabher 2002). Social relations and mutual loyalties between creative professionals transcend organizational boundaries for the duration of the project, driving collaborative practices, innovation, and competitive advantage. Creative work such as design is said to embody a diversity of specialized technical and artistic skills that are needed to accomplish complex tasks, and therefore defies conventional employment arrangements and modes of work organization (Grabher 2002). Such flexible working conditions are fundamental to the very nature of competition within creative (and also high-tech) industries in an era of intensified global competition and the drive for rapid change, continual innovation and product development ahead of competitors (Benner 2002).

This literature review has thus far highlighted the increasing prevalence of a design-led manufacturing model in high wage nations in the present period of economic activity, which combines both the synthetic and symbolic knowledge models of innovation. It then raised the issue that the nature of employment structures and work practices that underpin each are said to be divergent: on the one hand requiring long-term, high-skilled and consensus-based working relations, and on the other hand dependent upon short-term, flexible employment arrangements. To investigate the above paradox, this research draws on a case study of the Canadian contract furniture manufacturing sector to ask the following questions: What employment structures and work practices do manufacturing firms adopt in order to incorporate design capability? What are the optimal labour dynamics and modes of work organization that underpin innovation for this particular production paradigm? To what extent do incompatible labour practices limit or shape the manner in which synthetic or symbolic knowledge is created and diffused? How do different sets of work practices foster divergent patterns of innovation and competitive advantage?

Results from the case study show that firms employ either long-term practices conducive to the synthetic knowledge model of innovation (in the form of an in-house design team), short-term practices more consistent with the symbolic knowledge model (primarily in the form of temporary outside design consultants), or a combination of both employment models, in order to capitalize on design inputs into product development. Findings reveal that on the one hand, the in-house team enables designers to maintain a

close association and interplay with other key actors (i.e. those in engineering or manufacturing), which is fundamental to the process of mass customization and incremental product enhancement. On the other hand, the employment of temporary project designers enables a firm to bring in fresh new ideas and outside perspectives. These inputs are of critical importance to firms' ability to introduce new – often radically innovative – products to the marketplace.

Case Study and Methods

The empirical analysis in this paper has been designed to address the above research questions directly. It focuses on the production characteristics and design practices of Canadian contract furniture manufacturing firms located in three geographic regions in Canada: Ontario, Quebec and the western provinces, which together represent nearly 98% of the Canadian industry (Statistics Canada 2008). This sector provides a compelling case study due to its strong growth since the 1990s, at which time firms operated in a context of a strong US economy, a weak Canadian dollar, and intensified economic openness on continental and global scales. Despite heightened competition from low-cost manufacturers in China as well as high-cost, design-oriented producers in the US and Europe, these favorable economic conditions enhanced opportunities for Canadian firms to expand sales into US markets, and globally.

In the midst of widespread, long-term economic downturn throughout the Canadian manufacturing landscape, the Canadian furniture industry has demonstrated resilience and vibrancy. It is emblematic of key dimensions of economic change in the Canadian manufacturing industry since the advent of the Free Trade Agreement with the US in 1989, and later the North American Free Trade Agreement (NAFTA). Traditionally dominated by small scale, craft-based factories catering to regional markets, furniture was expected to be more vulnerable than most sectors in responding to the influence of trade liberalization. Not surprisingly, it underwent a major shake-out between 1989 and 1991 that led to a decrease in the number of establishments by nearly one half and a reduction in employment by just under 30% (Pau et al. 1998). Faced with the realities of new domestic markets and competitive pressures, firms had no choice but to become more efficient, or risk extinction. They chose the former option, embracing

new practices and forms of organization, and shifting towards higher value-added, more technologically sophisticated and flexible operations. By the mid-1990s, the industry had undergone a renewal as firms upgraded the quality, responsiveness and timeliness of production, enabling them to achieve tremendous success in export markets (Gotlieb 2002). Between 1980 and 2001, global exports increased by 10.5% each year on average (compared to an 8.8% increase for all manufactured exports) and between 1993 and 2002 it was the fastest growing manufacturing industry in Canada (Industry Canada 2007). Moreover, from 1999 to 2005, the total value of exports climbed from $54 to $94 billion USD and presently Canada is the 5th largest exporter of this product to the world. It ships 53% of its production goods beyond its borders, primarily to the US, and has enjoyed an impressive trade surplus with the US which peaked at $5.8 billion in 2002 and was $4.0 billion in 2006 (Industry Canada 2008).

These trends have been particularly pronounced in the contract furniture segment of the market which has undergone exceptionally high growth, especially throughout the 1990s and up to 2006. Statistics reveal that while the share of household furniture experienced significant decline during the period 1988-97, from 45 to 26%, the 'office' and 'other' sectors rose from 54 to 64% (Pau et al. 1998). Data on the Canada/US trade balance further illustrates the divergent trajectories of these two primary furniture subsectors and shows that by 1997, contract furniture had a significantly higher surplus as compared to the household manufacturing segment, at more than three times the value (US$722 versus US$229 million).The contract segment also showed considerable growth during the subsequent period 1997 to 2006, with manufacturing revenues increasing from $3 to $4.6 billion, and manufacturing value-added growing from $1.6 to $2.4 billion (Industry Canada 2010).

Within the broader Canadian furniture industry, this research focuses on the contract segment which encompasses the production of office (rather than household) furniture (as per the North American Industrial Classification System coding category NAICS 3372). The empirical analysis presented here involves a mixed-methods research approach and is drawn from two modes of inquiry: 1 – a bilingual (English and French) online survey questionnaire to the full population of firms, and 2 – a series of in-depth,

semi-structured interviews with senior managers and designers from a subset of leading firms.

The survey was administered between January and September 2010 and targeted senior managers, in particular plant, production or human resources managers or firm founders, as these individuals were deemed most closely involved with and knowledgeable about the survey content. The initial sample was drawn from an industry list of NAICS 3372 made publicly available online at Industry Canada, which was cross-referenced with Scott's Industrial Directory of Canadian Manufacturers. The sample was stratified by firm size, excluding firms with less than five employees, and the initial list yielded a total of 302 firms. However further research uncovered that a number of firms had gone out of business or were not relevant, thus the list was further refined to a final industry sample of 220 firms. Respondents were initially contacted and sent the survey via email, and then followed-up several weeks later by phone if they had not yet completed the questionnaire. With 101 usable returns, the final response rate was 46%. The survey instrument was designed to solicit information about firm characteristics and design practices in this sector, in particular firm history, ownership, and production characteristics such as degree of customization, flexibility of operations, use of technology and design-intensity. In addition, information was collected on design-specific practices such as the percentage of annual expenditure on design, and the use of in-house versus outsourced design services.

It was recognized that a survey alone would be limited in the extent to which it could collect information of a more qualitative nature related to the nature of employment structures and practices among the design and product development labour force. As a result, plant visits and personal interviews with individuals from the leading firms in the industry were conducted from November 2009 to July 2010 to allow for a more detailed probing and insight into these questions. This sample of leading firms (as defined by performance, innovativeness and the level of quality- and design-intensity) was informed by a number of sources including a review of government statistics, market research reports, trade journals, participation at trade shows as well as preliminary results from both the survey and key informant interviews. In total, 55 interviews were conducted with individuals representing 21 firms.

In what follows, I begin by providing a summary of overall survey findings. This entails an assessment of some of the key characteristics of respondent firms in the industry, the design-intensity of manufacturing operations, and the unique nature of production characterized by a process of mass customization, or what I have termed 'high quality volume production'. Then I analyze design practices based on results from the interviews, according to two specific dimensions: 1 - long-term practices (in the form of the permanent, in-house design team), and 2 - short-term practices (in particular the hiring of freelance or external design consultants on a temporary, project basis). I address both dimensions and the findings from my study.

Analysis of Findings

Characteristics of Survey Respondents

Results from the survey show that most of the companies (87%) are single-plant, relatively small operations (Table 1). While the mean firm size in terms of employment is 92, there is a considerable range (5-2000) and the majority of firms cluster within the 5-50 employee range. The small-scale, entrepreneurial nature of the industry is evident in the survey sample, as 98% of respondent firms are privately held and 66% are family-owned and operated. Given that innovation in the contract furniture sector is a relatively recent phenomenon that came into effect primarily following the North American Free Trade Agreement in 1989, the average age of firms is quite high, at just under thirty-two years. Although 97% of companies are Canadian-owned, a considerable 42% of firm founders were born outside Canada, and a total of 29% of founders were also educated or trained outside the country (some of whom overlap with those originating outside Canada).

Two indicators reveal the presence of a highly skilled manufacturing labour force in the case study. The first is a measure of worker occupation which suggests that 69% of workers in the industry hold positions that require a substantial level of expertise. The second is an indicator of educational attainment and reveals that 34% of workers are considered skilled, as defined by the proportion of individuals who hold a university degree and/or college or technical institute diploma. The fact that on average, just over one third of the workforce is skilled upon entry into the organization, yet over two thirds

hold high-skill positions, indicates that a significant amount of training and development occurs in the workplace following recruitment.

Production Characteristics: 'High Quality Volume Production'

To get a sense of the presence of design activity among firms in the industry, survey respondents were asked three initial questions: the first two concerned the characteristics of their respective production models, and the third related to the importance of design to their competitive strategy. Individuals were asked to rate their production model on a one- to seven- point Likert scale based upon the following dimensions: between 1 (low quality) and 7 (high quality), and between 1 (generic) and 7 (design driven) (Table 2). Results indicate that firms are competing in the high end of the market, with a score of 6.4 out of a possible 7 for high quality, and 6.0 for design-intensity. This resonates with the 78% of firms who rate 'quality of design' as 'Highly Important' to competitive success (Table 3), and reveals the strong presence of design among manufacturing firms in the case study.

Not only can products and services be considered highly design-intensive, but data shows that the design process is being carried out primarily in the manufacturing firm itself. As many as 75% of respondent firms reported that they 'carry out design activities,' and these firms spend on average up to 14% of their annual expenditures on design-related functions (Table 3). Moreover, 85% of the design is shown to be done in-house, rather than being outsourced to another firm. This data further underscores the high degree of emphasis on quality and design-intensity in this case study, as well as a strong orientation towards in-house practices, suggesting that design is a core competency of furniture manufacturing firms.

The next three survey questions examined the key characteristics of a firm's production model that are said to underpin a high-quality, design-oriented competitive strategy. The first question asked survey respondents to rate the importance of the degree of customization on a one- to seven-point Likert scale, between 1 (high volume production for mass markets) and 7(small batch production for niche markets) (Table 2). Results show a mean rating of 5.7, which indicates a very high degree of product customization among firms, and supports previous data which point to a strong emphasis

on design and quality. In a similar format, the second question asked about the importance of flexibility of operations, between 1(infrequent changes to product line) and 7(highly flexible and adaptive to markets), and data shows a mean rating of 6.0 which depicts an even higher emphasis on flexibility. The importance of these production features and their relation to a high quality, design-led model was discussed at length in the interviews as well. For example, one senior manager from a large firm considers both factors to be key strengths in the organization, a means to respond to market demands and a crucial aspect of everyday business. She provides an example:

> We have 14,000 shapes and sizes for our table line, in our 300-page price list. Then we do 30% custom on top of that each year… In our everyday business, we might do a floor of tables for a building in New York and for an order of 10 tables, 5 might be standard, the other 5 in all different sizes.

A similar situation is described by the Vice President of Manufacturing of another large company who reflects on the firm's recent trajectory of growth, "One of our key strengths was our ability to do whatever the customer wanted. And that was what really drove our growth." He goes on to explain that "Everything's made to order. So right away that tells you that you have to have incredible flexibility. You need an extremely flexible workforce that's multi-skilled and you need equipment and technology that's flexible."

The very topic of a firm's propensity to enhance productivity through the use of people and/or machinery constituted the focus for the third survey question in this series. In the same one- to seven-point Likert scale, firms were asked to rate their relative reliance on labour versus technology in boosting productivity: between 1 (productivity achieved through more intensive use of labor) and 7 (productivity achieved through adopting higher levels of automation) (Table 2). The mean score of 4.5 shows a somewhat higher focus on technology, machinery and automation over labour. One senior manager from a large firm supports these survey findings by discussing the significant advantage of technology and machinery in boosting performance:

> With labor-intensive operations, you can't change the product design as easily, you've got to spend money on new tools and you can't respond to the market demands as quickly. You have to buy a new machine. And the fact that we can just 'Bang, done! Out comes a new part!' is huge! So it costs less and is way faster. And the quality and consistency is better. So when you've got the technology in place, it does it reliably and consistently and you can increase your capacity and flexibility.

> So we've invested significantly. The amount of capital investment in these facilities has been huge. And that's probably the only reason why we're still alive here.

Yet the following statement by the President of a mid-sized organization underscores the importance of skills on the factory floor instead:

> In terms of knowledge on the production floor, all of our staff have to know all the products we make in the plant because we run them all through (regularly), we have so many different options and are running them through essentially the same process… which is very difficult because there are all kinds of variables that are there that impact the production flow and process. (And) there's a lot of knowledge that's needed by most of our people to understand the many different products that we make. That's something we've developed internally by training our people.

These comments seem more consistent with previous survey data that point to the high level of skill among manufacturing workers, suggesting that skilled labour may play a more central role in achieving a design-led model than the survey question about productivity reveals.

In fact, evidence shows that in the case study, labour and capital serve as complementary components of the high performance workplace. A substantial body of research has shown that the implementation of advanced manufacturing technologies will be most successful when such technologies are also accompanied by changes in the broader organization of work and supported by extensive and regular training (Wever 1995). Findings from this case study reveal the pervasive influence of these principles and practices. Results also point to the multifaceted nature of production on the part of high performance firms, and a distinct manufacturing paradigm in this industry that is both complex and in some ways contradictory – one that may be termed 'high quality volume production.' As the name implies, such a model places equal emphasis upon the ability to produce for high volume/mass markets, on the one hand, as well as customized niche markets, on the other. High quality volume production requires a combination of a highly skilled and flexible labour force coupled with advanced machinery, technology and automation on the shopfloor, and the need for firms to mediate continuously between the two to meet market demand.

Design Practice

(I) Long -Term Employment Structures: The Internal Design Team

The knowledge base conceptual framework highlighted the complex knowledge base of design-intensive manufacturing and raised questions as to the optimal employment structure and work organization that drives creativity and innovation in this sector. This theory provoked a series of questions in the interview guides focusing around the nature of employment structures among the design labour force, a firm's motivation to choose a particular employment model, and the advantages (or disadvantages) of each.

Research shows that the practice of employing a permanent in-house design team as a means by which to incorporate design capability into the firm is prominent and widespread in the case study, with three quarters of firms in the interview sample adopting this method. Of this group, one third have in-house designers as their exclusive practice, whereas the remaining balance of firms adopt an in-house team in addition to other sources, namely hiring temporary project designers.

Evidence finds that the long-term structure that is characteristic of the in-house team is conducive to design-led production and the synthetic knowledge model of innovation in two ways. First, such a model enables an organization to maintain close proximity between, and interplay with, design and other product development functions within the firm, namely engineering and manufacturing. The President of a mid-sized organization discusses the importance of this employment structure to the research and development process, "The proximity between design and manufacturing always creates a natural think tank on how to improve the product. Plus, you have people on the shopfloor who have ideas about product improvements and enhancements." This supports several key ideas in the knowledge base and innovation literatures pertaining to the interactive nature of the learning process for this type of industrial activity, and the importance of face-to-face interaction in supporting synthetic knowledge creation and diffusion. Moreover, it underscores the notion that consensus-based working relations, on-the-job problem solving, and interactive learning-by-doing, are crucial elements in the innovation process for this type of industrial activity.

Second, long-term employment relations in the workplace support the gradual, incremental learning and skill development process that is critical to advanced

manufacturing. The Vice President of Marketing for a mid-sized firm provides insight into the incremental nature of the learning process, as well as the interdependence of the respective areas of product development expertise - design, engineering and manufacturing - on one another:

> Over time, those that are in-house gain the expertise of what works in our system and what the limitations and capabilities are of the manufacturing process are. Design has a very strong relationship with both engineering and manufacturing. The attachment is very close. Whenever they create a design, they have to base it on the engineering criteria and create a prototype for manufacturing to see if it's doable. This is all a part of the design criteria.

The Vice President of Manufacturing for another mid-sized firm provides a similar analysis:

> It's a lot easier when on a permanent basis, (design) people are inside the organization because they already know that a certain proposed change might be a silly idea because of the limits of the manufacturing processes, or the raw material, or the subcontractors, and so on. There are a lot of occasions where you say this is a neat thing to look at but we know it's not feasible. So you gain that very strong awareness between the product design and the ability of a product to have success in the marketplace and then your ability to manufacture it on a consistent basis.

These complementary perspectives point to the importance of long-term employment structures, such as the in-house design team, in facilitating the interactive, incremental learning process central to synthetic knowledge creation and diffusion, and a high quality, design-led manufacturing model.

Data also shows that the long-term structure would seem to underpin an important aspect of design innovation in the industry that is suited to the process of incremental product enhancement. Speaking on behalf of his team of in-house designers, the Director of Design Innovation for a large company implies that the product development process is more about 'evolution' than 'revolution,' and that there are multiple scales of incremental innovation. He remarks:

> It's about overseeing a large portfolio of product, and understanding where you are changing that group of products in ways that respond to new ways of working or trends that you're seeing in the workplace. So we try to maintain the stuff we have, we also try to come up with changes, addendums, improvements, to all the existing stuff, as well as trying to come up with ideas of: what's next?

In other words, there are varying degrees of incremental innovation, entailing both the modification of existing products and processes, as well as the introduction of new products to the marketplace. The introduction of new product ideas does not necessarily constitute a radical innovation and the obsolescence of former products, suggesting that our understanding of the term 'incremental' is perhaps more multifaceted than the prevailing innovation literature contends.

Finally, findings from the case study reveal that an in-house design team has a fundamentally different design focus from project designers who engage on a very short-term basis. Research shows that the permanent employee needs to be more pragmatic and commercially viable than her freelance designer counterpart, who by contrast often plays a greater role in producing signature pieces that may garner a firm accolades in the design community. "I can't remain successful strictly as an acclaimed designer," says the in-house designer for a mid-sized firm, "That's not how it works. I have to be commercially successful. I've got to make sure that the gears keep turning and that the critical mass of sales are there." The Design Director for another mid-sized company contends that "The work has been pragmatic in the sense that I have to understand my market and I need to be able to provide industrial design that keeps the factory busy." In a similar vein, the Vice President of Design for a large firm remarks that "I'm driven by examining the business as a whole and recognizing our weaknesses and making sure we're filling in where we need to fill in. So it's not always strictly creative." These various remarks suggest that long-term structures support the commercial viability of a product line more so than its design integrity - in other words, the 'volume' aspect of high quality volume production, or the 'mass' in mass customization. In this way, this work practice supports a process of innovation that can be understood as more pragmatic and risk-averse than other innovation models.

(II) Short-Term Employment Structures: Temporary, Project Designers

The previous section discussed the practice of employing an in-house design team as one of the primary means by which furniture manufacturing firms incorporate design expertise, and how stable employment relations are conducive to the synthetic knowledge model of innovation, incremental developments, and ensuring the commercial viability of

a product line. Synthetic knowledge was identified as one of the core industrial knowledge bases for design-led manufacturing activity and mass customization. However research from the case study also reveals that while this type of long-term practice may be suited to the input requirements of the industrial manufacturing aspect, it stops short of effectively supporting symbolic knowledge creation and diffusion, and leveraging the creativity of the workforce. The President of a mid-sized firm discusses these limitations, "The way our team sees things is based on their own experiences and abilities. And it's sometimes the case with an internal design team that you can get a bit of an inward focus because they're not out there every day." In other words, "Sometimes you can't see the trees for the forest," explains the Vice President of Design and Innovation for another mid-sized manufacturing firm, "and you need to get fresh blood." By 'fresh blood', the interviewee is referring to the common practice in the industry of engaging external industrial design consultants on a temporary, project basis, as 75% of firms in the interview sample do. Of this group, one third employ outside designers as their exclusive design practice, with two thirds adopting this method as complementary to the internal team.

In what follows, I discuss the labour dynamics that contribute to the strong market knowledge embodied by outside designers, the role of the outside expert in radical innovation processes, and the intangible creative input that constitutes the foundation of the symbolic knowledge of innovation. I then discuss the manufacturing firm's preferred model of working with a group of renowned designers who are often geographically distant to the operation, and the inherent challenges of distance to the synthetic knowledge model of innovation.

(i) Labour Market Mobility: Acquiring Design Knowledge

The literature review on project ecologies pointed to the importance of labour market mobility in fostering creativity and innovation in the cultural industries. Research from the case study supports this core idea and finds that industrial designers in the industry engage in this very practice of moving - often fluidly - between projects, companies, sectors, and sometimes places. They do so as a means by which to learn, advance in their careers, stay abreast of market knowledge, and mitigate the risk of potential

unemployment. It is often the case that the creative input conveyed to an organization by a temporary project designer constitutes the basis on which a firm differentiates its products and achieves competitive advantage in the marketplace.

Examples from the case study underscore how career path shapes market knowledge, design expertise and creativity that an industrial designer will in turn bring to the manufacturing firm. One individual who started his own design consultancy with a partner worked in a freelance capacity for as many as nine manufacturing companies in a three year period, often times balancing up to four projects at a time. He says:

> So we did a lot of work with Allseating. I guess at the same time I had an independent consulting business. We did other furniture work outside the contract sector. And we did some work for Teknion - a series of wood side chairs. And then we started working in other industries as well. And we continued to do other work for Umbra.

Not only are designers in the case study working on multiple and concurrent industrial design projects for a variety of organizations, but the following quote by another design consultant suggests that experience in different product sectors is an important dynamic that enhances their ability to be creative. Formerly a transportation designer, he brings a unique approach to a public seating solution for an airport:

> For me it is important for an object to have a dynamic to it, because I find that a lot of furniture tends to be more static. We were looking at the seats and seeing they were kind of shaped like an airplane wing, and that became the genesis of the product idea. However we could, we should try to make something aeronautical about it. When looking at transportation objects, they look like they're moving even when they're still. I've gone the other way too - I've had concepts for cars that were inspired by knock-down furniture.

The experience of the next individual perhaps best illustrates how labour market (hyper) mobility enables a designer to broaden her skills base, acquire valuable experience, and work with key people. Her career trajectory is defined not only by experience with different projects teams and firms, but like the former individual, she has crossed sectors, and has also 'shuffled' between places. She discusses her varied background:

> I graduated from the University of Manitoba and started at a well-established firm in Toronto that focused on corporate office. Then I wanted to gain experience in retail, hospitality and hotel so I pursued and was successful in working with a large Toronto firm. Then the economy went sideways and the firm reduced itself by about 80% so I had the chance to go to Ottawa with a firm that I had met through work in my first job. Another firm I was content with approached me so I

> went back to Toronto. I did quite a bit of shuffling between Ottawa and Toronto. And then I met someone and moved to Calgary and I've been with this firm ever since.

She describes these moves as 'calculated', always focused on developing, learning from different people or gaining experience in a variety of project types. Her background, as well as those of her design contemporaries previously discussed, illustrates the way in which mobility and career trajectory can foster the development of vast market knowledge and creativity that a designer will ultimately bring to the manufacturing firm.

As a manufacturer, the benefit of being able to tap into this expertise was discussed at length by senior managers. The Design Director for one mid-sized firm reports that "Outside designers bring new fresh ideas into the company - they are less influenced by the day to day needs." The President and Founder of another organization of similar size contends that "Bringing in outside designers allows us to get a different and broader perspective because they bring an influx of new ideas to the table." In a similar vein, the Vice President of Design and Innovation for a large company says that "I usually tap into outside consultants for fresh thinking and to look at things objectively." Likewise, the President of another large firm suggests that the main reason and benefit of bringing in designers is because "their world view of the market place and products is different from what our teams is going to be." He goes on to explain:

> If you're a product designer that's in the marketplace designing products for a lot of different companies, if you're out there every day in the middle of what's happening in the marketplace, that's a very different focus than an industrial designer who's here every day. It's hard to replace being out there.

This type of exposure to a broad array of practices, and the ability to work with a variety of people across multiple firms, sectors and places, has a tangible impact on the nature of the design influence an individual can make. It is often the case that outside experts play a significant role in shaping highly credited design solutions that may constitute a radical departure for a company. One designer discusses the 'game-changing' nature of product design that comes from outside consultants:

> If a company wants some game-changing, super creative design, like a product that they launch and go 'wow - where did that come from?', they will hire an outside designer who comes in with a different point of view. Sometimes you want those Eureka things, those designs that come out of nowhere that are so amazing. That that's why you use outside designers.

Such a comment implies that project designers who have acquired broad knowledge of product sectors and market trends can play a fundamental role in a firm's ability to introduce new - often radically innovative - products to the market.

The magnitude of design influence that is conveyed by the outside expert can best be described by drawing on an analogy illustrated by the President and Founder of one of the leading contract furniture companies in the industry. In articulating the essence of what it is that the outside designer contributes, he also captures the precise contours of the division of labour between engineering, design and manufacturing:

> Once we have a product concept, we can create it beautifully with tooling and engineering and all the things necessary to bring a product to the production line. But there is a gap between the concept that's been defined and the starting point of developing the product - and that's the *idea*. So if you take the need to create the product, there's this gap, and it's the creative spark that the designers provide that take us from down here to up here (gestures). We take it this far, they jump us over, and we take it the rest of the way.

Albeit intangible, that 'creative spark' constitutes the difference between, on the one hand, commodity, and on the other hand, globally competitive good that draws accolades in the international design community, positioning a manufacturer as leader in the field of contemporary design.

(ii) <u>The Nature of Engagement: Associating With a Group of Design 'Stars'</u>

The previous section highlighted the benefits of engaging with industrial designers who are not inside the organization, and for the temporary duration of the product development process. These short-term practices are shown to underpin the symbolic knowledge model of innovation, radical product development, and the introduction of signature products that bring design credibility to the manufacturing firm. Research shows that firms typically work with not one, but several outside designers, and they are compelled to do so due to the cyclical nature of the creative process and because such a strategy broadens a firm's marketability. The President of a mid-sized manufacturer explains that his firm tends to work with a small group of designers who understand them, and with whom they share a similar design perspective and style:

> There is a style to it. By having several designers move in and out of the 'zone' - I'll call it the zone... because sometimes they're hot, or

> they're in a groove or... like writers, you have writer's block. So some designers are really prolific at moments in time, others need a little bit of a break, or maybe you're getting a sameness, so you need to push the envelope by going to someone else.

In other words, working with a number of individuals enables a company to maximize its creative engagement with outside designers and diminish the risk of encountering periods of 'creative block'. In a related comment, the Design Director for a large company suggests that a firm's association with a group of renowned designers, rather than just one or two, is a fundamental aspect of its branding strategy. He says:

> Most companies want to have a group of designers, and to sell themselves that way. If you go to the Knoll website, there's a whole area there that talks about all the designers who have influenced the company since day one. Herman Miller is another example of that. It's valuable to bring that to the table.

Thus working with a group of design 'stars' has the potential to bring not only significant design influence to the manufacturing firm, but also international credibility in the field of industrial design.

(iii) The Geography of Design and Constraints of Distance

However these highly acclaimed individuals are more often than not located in geographically distant markets such as the US and Europe. Yet as has been discussed, the product development process and synthetic knowledge creation and diffusion are dependent upon an iterative, interactive process in which face-to-face contact among members of design, engineering and manufacturing is of paramount importance. "I don't know how companies do without face-to-face," says the Vice President of Design and Innovation for a mid-sized firm, "It's a fundamental requirement - you have to have it. In the design and development stage, it's about the interaction of ideas." This of course begs the question as to how firms who engage in this practice of employing outside designers overcome the effects of distance?

Evidence suggests that in addition to facilitating periodic visits by the designer to the manufacturing site, firms employ the typical tools of long distance communication, including email, conference calls, webinars and videoconferencing. The President of a large firm discusses how the advent of new technology such as rapid prototyping has facilitated the development process when designers are not on site:

> One of the greatest things in the last ten years has been rapid prototyping. This enables me to model this up and pro-engineer it to a 3D model. It helps me design - I can shape it and carve it and it gives me the accuracy I can never get on the drafting board or anywhere else. I can check to see whether the design idea is good or not, and if it's no good, I simply throw it out. I can share it with anybody, anywhere, as long as they have access to the technology.

This technique in particular has enabled firms to minimize the detrimental effects of distance between outside designers and their counterparts in the manufacturing firm during the critical design and development stage.

However despite such efforts, research indicates that the attempt to incorporate outside designers into an organization's practices is often fraught with difficulties, not only as a result of geography. The President of World Markets for a large firm discusses the challenges of integrating an external individual into the company's concurrent design process:

> It's very stressful, especially for designers. It's a go-fast process, and it's very disciplined. Because designers like to 'blue-sky think' and toss things around all day and try alternatives. But the gates are disciplined in order to meet the timelines... The outside designers don't work to that concurrent process. And that in itself causes delays and issues.

The Vice President of Manufacturing for a mid-sized company remarks on the inherent problems of working with individuals who are not always in on the 'day-to-day':

> There's a bit of a disconnect because it's hard when you're evolving a product. There are often trade-offs between what the designer wants and what you can do. So it's always better to have the decision maker right there in the ebb and flow of the process. Because it's kind of hard they way we do it now, when they're not always there. They're not in on the day-to-day decisions, which creates a disconnect.

These comments reveal that the practice of working with designers who are not a part of the organization, oftentimes located at vast distances from the manufacturing operation, while potentially enhancing the design sophistication of a product line, can considerably constrain the product design and development process. It exemplifies how the practice of drawing on outside talent in order to maximize a firm's design capability (and thus the symbolic knowledge model of innovation), has the detrimental effect of undermining the development process (and synthetic knowledge creation and diffusion).

Conclusions and Implications for Theory

This paper began by making a number of observations. A shift in the nature of contemporary capitalism in recent decades has brought about widespread changes affecting manufacturers in advanced industrialized economies, whereby producers are pressured to compete on the basis of quality, value and design - or risk extinction. Literature on the geography of innovation, in particular the knowledge-base conceptual framework, implies that there is a two-fold industrial knowledge base in complex, design-led manufacturing: synthetic knowledge (crucial to the industrial manufacturing component), and symbolic knowledge (crucial to the design component). Yet knowledge creation and innovation for each is said to rest on divergent labour practices and modes of work organization because synthetic knowledge is supported by long-term employment arrangements and consensus-based working relations, whereas symbolic knowledge is facilitated by open labour markets and the rapid movement of workers between firms and projects.

This research draws on a case study of the Canadian contract furniture manufacturing sector, which demonstrates a high degree of quality and design-intensity, to investigate the above paradox. In particular, this research asks: What employment structures and practices do manufacturing firms adopt in order to incorporate design capability? What are the optimal labour dynamics and modes of work organization that underpin innovation for this particular production paradigm? To what extent do incompatible labour practices limit or shape the manner in which synthetic and symbolic knowledge is created and diffused? How do different sets of work practices foster divergent patterns of innovation and competitive advantage?

The analysis presented here indicates that stable employment relations in the form of an internal design team foster a work organization that facilitates an interactive innovation process and incremental developments conducive to the synthetic knowledge model of innovation. Moreover, these practices promote the commercial viability of a product line, one of the essential features of mass customization, or 'high quality volume production' that is central to a complex, advanced manufacturing model. Research from the case study also finds that long-term practices encourage workforce skill development necessary to achieve high levels of quality control as well as engineering and

manufacturing excellence. However, this mode of work organization may be limited in the extent to which it enables a manufacturing firm to produce exceptionally innovative design, in other words, to support symbolic knowledge creation and diffusion. In particular, the practice of employing an internal team as a means by which to incorporate design expertise into the firm may in fact constrain an organization's ability to advance the design sophistication, and harness the creative potential, of its workforce.

By contrast, short-term structures, for example the hiring of design consultants on a temporary, project basis, enable a manufacturer to tap into the highly developed market knowledge and creativity of design experts, who are often engaged in concurrent work for multiple organizations. Evidence from the case study indicates that this form of work organization promotes the design of signature products that garner credibility in the design community, and supports radical development that is conducive to the symbolic knowledge model of innovation. However because external designers are by nature outside the manufacturing operation, often located in markets at vast distances from the firm, this practice may limit the interactive, iterative nature of the product development process. Therefore while these short-term structures serve to maximize a firm's design capability, at the same time such arrangements may undermine its ability to produce and diffuse synthetic knowledge.

A firm’s decision to bring both in-house and external design functions together, as 50% of the firms in the interview sample have done, leverages a two-fold competitive advantage, and is consistent with both the synthetic and symbolic knowledge models of innovation. On the one hand, the internal design team plays a crucial role in working with engineers and manufacturing staff to continuously improve a firm’s catalogue of existing products. On the other hand, the steady influx of ideas from project designers facilitates a firm’s ability to introduce new, often radically innovative and highly acclaimed, products to the marketplace. These different employment structures seek to capitalize on design inputs into the product development process.

Tables

Table 1: Characteristics of survey respondents

Percentage distribution of firms by region	60% Ontario 22% Western Canada 18% Quebec
Mean size of firm (employment), range	92, 5-2000
Mean age of firm (years)	31.1
Skilled employment as percentage of total employment (occupation)	69
Skilled employment as percentage of total employment (education)	34
Percentage of firms Canadian-owned	97
Percentage of firms privately held	98
Percentage of family firms	66
Percentage of firm founders born outside Canada	42
Percentage of firm founders educated or trained outside Canada	29

Source: Author's survey of Canadian contract furniture sector, 2010

Table 2: Mean score to describe production characteristics based upon the following scales:

1 (low quality) and 7 (high quality)	6.4
1 (generic) and 7 (deign driven)	6.0
1 (high volume production for mass markets) and 7 (small batch production for niche markets)	5.7
1 (infrequent changes to product line) and 7 (highly flexible, adaptive to markets)	6.0
1 (productivity achieved through more intensive use of labor) and 7 (productivity achieved through adopting higher levels of automation)	4.4

Source: Author's survey of Canadian contract furniture sector, 2010

Table 3: Use of Design

Percentage of firms rating Quality of Design as 'Highly Important' to firm success	78
Percentage of firms who carry out design activities	75
Of those firms who carry out design activities, percentage of overall firm expenditure on design (2009)	14
Of those firms who carry out design activities, percentage of expenditures that are for IN-HOUSE (rather than OUTSOURCED) design services	85

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