Beyond design for manufacture: Design Innovation Framework for Manufacturing Companies in the UK

Dr Jea Hoo Na, Dr Youngok Choi, and Professor David Harrison

One of the main uses of design is the design of manufactured products. However, other uses of design are evident in many successful businesses which use design across the company in various forms to enhance innovativeness and increase competitiveness in the global market. This paper provides a comprehensive overview of potential design-driven benefits and key design innovation goals, using a framework with which manufacturing companies and/or supporting organisations can identify, to prioritise and work towards systematically improving innovativeness.

Introduction

The meaning of design in a business context has expanded over the year: no longer simply about enhancing aesthetics and functionalities, design has become an important strategic factor in making business successful (Neumeier, 2008, DC, 2012). With this expansion, design is now regarded as a process, seen more as a strategic business tool for increasing competitiveness by providing a holistic in-depth understanding of the market (trend identification), users (empathic research) and future directions (forecasting) which together can influence creative opportunity identification and problem-solving (Mozota, 2002, Martin, 2009, Banks, 2013). Among the extensive uses of design, this research identified three key areas of design: (i) designing – the action of creating products/services, (ii) design strategy – the management of design with strategic intent), and (iii) corporate-level design thinking - the philosophy and method of design applied to managing a business holistically. This change in the design paradigm has been noticed by successful businesses including Dyson, Apple, Herman Miller, Jaguar Land Rover and Burberry (DC, 2011, Rae, 2013, DC, 2014) which have used design as an enabler for enhanced and sustained innovation for their companies (Tether, 2009, Verganti, 2009, DC, 2015). Despite the advantages of holistic use of design, many manufacturing companies still have a limited use and view of design, primarily as 'technical' design (Cox, 2005, Livesey and Moultrie, 2009). This is also closely linked to manufacturing companies' narrow view of innovation which emphasises 'technological/product' aspects while marginalising 'hidden' innovation such as organisational innovation, which can be a pivotal disadvantage to achieving sustained global competitiveness by remaining 'locked-in' to existing technologies and business models (NESTA, 2008).

Underutilisation of innovation can be improved through design innovation, which this research defines as "a creative process with the outcome of enabling increased

technological, product/service, process and organisational innovativeness in a company by using the full spectrum of design, including designing, design strategy, and corporate-level design thinking." A framework can provide a diagrammatic representation of a theory or concept, to explain the relations and the phenomenon (Robson, 2011), and "providing a formal framework for design reasoning has become a vital issue, which goes well beyond academic circles as industrialists are also voicing their concerns" (Le Masson et al., 2010:63). Developing a framework which provides a comprehensive overview of the wider spectrum of design and its influences on different types of innovation is therefore timely and important.

Many frameworks address the role of design (Mozota, 2006, Gemser et al., 2011) and the role of innovation for a company (Boer and During, 2000, Keeley et al., 2013, Murimbika and Urban, 2014). However, there is little research on how different areas of design influence equally diverse areas of innovation. This paper therefore outlines a design innovation framework which provides a comprehensive overview of design innovation for UK manufacturing companies and supporting organisations, to enable them to identify and improve areas in which to embrace the advantages of design innovation specific for the company's specific circumstances and environments.

Methodology

The framework was created by conducting an extensive literature review and a series of in-depth interviews with twenty-two manufacturing and design innovation experts, and a further ten interviews with prospective users of the framework, in order to address both theoretical and practical perspectives. The manufacturing practitioners includes managing directors (n=6) and senior managers (n=5) of companies with at least 10 years (but most with 25 or more years) of experience in cultivating innovation in manufacturing companies which are regarded as 'innovative' because of their continuing successful external collaborations and/or winning recognised innovation awards, including the innovation category of the Queen's Award for Enterprise. The design innovation experts are directors of multi-award winning design innovation consultancies (n=5), heads of design and design advisors (n=3) of one of the UK's most influential design support and promotion organisations, and heads of innovation development and lead technology/design advisors (n=3) of the UK government's largest innovation support organisation. The evaluation interviews were conducted with prospective users of the design innovation framework including directors (n=4) of innovative manufacturing companies, heads of innovation/design (n=3) and directors of design innovation consultancies (n=3), with at least 25 years of experience in delivering innovation through design for manufacturing companies in the UK. The data included 711 years of combined experience of the experts, captured in over 36 hours of audio conversations. A

system of coding methods was used to converge all the data effectively and reliably: ‘open coding’ was followed by ‘axial coding’, and finally ‘selective coding’, to identify the design innovation action, effect and benefits which form the design innovation characteristics, and eventually the design innovation framework. For the final evaluation interviews, content analysis was used to validate the concept and identify further improvements to the design innovation framework.

Design-driven benefits: potential contributions of design to innovation

The final stage of analysis identified design innovation characteristics. The research indicates that design practitioners’ and design thinkers’ most influential capabilities are empathy and holistic thinking, through which their creativity is manifested in identifying, understanding and problem-solving in various areas of business. These design capabilities therefore influence all areas of innovation including improving processes, defining company goals and vision, creating better business models, and creating innovation culture within the business. The effects of design innovation include both the tangible (e.g. increased production efficiency) and the intangible (e.g. increased employee engagement) outcomes of the actions. Combining these effects creates impact on manufacturing companies. In this research, the impacts are referred to as ‘design-driven benefits’: (i) problem/opportunity identification, (ii) extensive collaboration, (iii) work culture/environment improvement, (iv) efficient process development, (v) clear communication, and (vi) innovative product/service development.

Problem/Opportunity identification

Design innovation influences a company to identify problems and/or opportunities for developing products/services. Some elements of design innovation enable the company to identify problems/opportunities in production processes by encouraging internal collaboration and other elements in business management by using design-led tools to analyse business operations. As design is generally regarded as a problem-solving process, identifying problems is a key asset of design in increasing innovation in companies, as explained by many other literatures (Cooper and Press, 1995, DTI, 2005, DC, 2008, Brown, 2009, Mootee, 2013). Problems and opportunities can be identified in many ways in business. Some use a systematic approach: a Quality Assurance (QA) department, or by running Total Quality Management (TQM) programmes to ensure potential problems are identified, as explained by most manufacturing practitioners. While such approaches are both detailed and holistic in nature, most design innovation experts emphasised that design professionals’ skill-sets of creativity and thinking “outside the box” can also provide a perspective which brings new meaning to products/services, and ensure that creativity is transferred in generating new ideas to improve product/service innovation and organisational innovation.

Extensive collaboration

Collaboration is undoubtedly important for improving innovativeness by helping the company understand users' and/or clients' preferences, and to extract and use knowledge and experience both inside and outside the company (von Stamm, 2008, Gouillart, 2014). The research found that collaboration can be much more broadly used in manufacturing companies through design innovation. Most interviewees explained that design innovation encourages creative idea generation through various collaborations, by planning, recruiting (stakeholders), mediating, and analysing for collaboration, helping the company to provide an appropriate physical space for effective collaboration to generate creative ideas. These ideas for developing a product/service, process or strategic business decisions are used to both maximise market success and optimise the business environment. It was noticed, however, that caution is required when undertaking collaboration, where misunderstanding values and objectives and a poorly managed process can drain resources, becoming unproductive and failing to bring insights to the company. Thus careful planning and execution - understanding the stakeholders with appropriate top-level management support and investment - are needed for extensive collaboration, to yield the desired outcome of generating creative ideas.

Improving the work culture/environment

Design innovation and manufacturing experts and many literatures (Kelly, 2006, Meyer and Marion, 2010, Topalian, 2013, BCG, 2014) concur that people are the primary source of creativity and innovation. The design innovation experts especially emphasised that companies need an appropriate culture and environment to encourage creative idea generation. Design innovation focuses on this particular aspect of encouraging creative ideas by providing physical spaces, an increased sense of ownership which enables increased participation by clearly communicating the vision and values through internal branding, and managing internal collaboration by using design-led tools, often in a workshop environment. For example, as part of an internal branding exercise, one design innovation expert explained design's prominent role in conveying the right brand message to employees by using visual communications with cues of the company's vision and values. By understanding the users' (employees') needs for a more creative workspace, the expert's agency provided a flexible working-space where creativity is encouraged, including break-out areas designed specifically as spaces for employees to meet and interact, creating spaces conducive to collaboration.

Efficient process development

Efficient process - vital for the growth of manufacturing companies - is often seen in lean manufacturing (Katayama and Bennett, 1999, Narasimhana et al., 2006, Wilson, 2010) and just-in-time (JIT) theories (Shah and Ward, 2003). The design innovation influence on the process closely follows those theories' principles of optimisation and efficiency, acting as a medium to identify areas which can be improved through holistic and empathic investigation into the production process. One design innovation expert described a project to design medical laboratory equipment which eventually included a production process improvement. Including design in the process of creative problem-solving, the manufacturing company achieved an increase in production efficiency by shortening the lead time. The potential benefit of design in efficient process development also uses collaborations to combine external and internal ideas from both experts and non-experts (from other departments) to help identify further areas for optimisation, mainly for production but also for the business operation. Developing efficient processes can optimise the business environment, especially in manufacturing companies where production is a vital part of process innovation. The research therefore also recommends using design innovation in conjunction with manufacturing-oriented process management principles such as lean manufacturing, to further enhance the efficiency of the process.

Clear communication

Design innovation influences can enhance clear communication both technically and strategically. It includes identifying the target audience, choosing appropriate means to communicate effectively, designing communication materials, and helping the company identify appropriate and representative messages (vision, values, quality, etc.,) to its audiences. This is closely linked with company branding (Mozota, 2003) where the audience can be both internal (employees) and external (users/customers and prospective users/customers). However, the research uses the term 'communication' rather than 'branding' because branding, like design, has various areas (which require further in-depth study) which can lead to confusion among manufacturing companies, as several design innovation experts mentioned. The research found that internal communication is essential for enhancing company employee loyalty and ownership, resulting in greater commitment in developing and producing/delivering quality products/services. External communications are also crucial to successful commercialisation, to improve brand value and loyalty. The research therefore recommends the consideration of the design innovation characteristics identified to influence clear communication, to maximise manufacturing companies' internal and external branding.

Innovative product/service development

A manufacturing company's ultimate goal is to produce commercially successful products/services. All design innovation experts and some manufacturing practitioners explained that developing innovative products/services involves design at every level of business. Design is most likely to be found in this area in manufacturing companies because it includes technical design and many conventional 'designing' elements, including aesthetics and graphics/websites. However, the research also found that other design innovation characteristics - including collaboration, investment, the business model and user and market understanding - directly influence 'innovative product/service development'. Manufacturing companies are therefore recommended to consider using design innovation more broadly to increase product/service and process innovation, in turn increasing the chance of successful commercialisation.

Design Innovation Framework

Design innovation's key goals were synthesised with a selective coding process. They represent the three primary benefits for manufacturing companies: (i) clear idea generation, (ii) optimising the business environment, and (iii) successful commercialisation. The research identified the main source of creative idea generation as 'extensive collaboration' and 'problem/opportunity identification'. Design-driven benefits encourage and spark creative idea generation by using co-creation methods to enable collaboration across the whole company (interdepartmental and cross-positional) and with customers and external organisations to maximise cross-pollination. Its empathic research into the users and a holistic approach to market and technology research together help create/optimise sales channels, resulting in a new/improved business model. Although creative idea generation is used across different functions of manufacturing companies, its main contribution is improving product/service and organisational innovations. In optimising the business environment, design innovation enables effective use of resources, including materials (reduced waste, maximised material utilisation), processes (modular systems for product ranges), time (reduced product development and production lead time), productivity (a better work environment), knowledge (the transfer of tacit knowledge), and investment (where it is most needed) to optimise business performance. Optimisation stems from design innovation benefits found in 'work culture/environment improvement' and 'efficient process development'. Improving these areas through design innovation also contributes to improving process and organisational innovations.

Design innovation characteristics are determined by the nature of design innovation actions and their effects. Although the effects almost always help the company achieve successful commercialisation of products/services, the immediate influences of design innovation are mainly from 'clear communication' and 'innovative product/service development'. These

benefits lead to successful commercialisation by creating aesthetically and functionally desirable high-quality products/services which are intuitive to use and easily manufactured. Their values and unique qualities are effectively communicated through graphics on the products and packages, and promoted using appropriate channels for target customers. The process of creating successful commercialisation therefore also entails improvements in product/service and process innovation.

The design innovation framework provides a descriptive diagram of design innovation benefits in relation to three key goals and contributions to various areas of innovation (Figure 1). The three goals of design innovation are at the centre of the framework, with overlapping areas showing where contributions to innovation occur most strongly. Six design-driven benefits are placed on the outside of the three key goals with arrows towards the three key goals showing the main benefits. It is important to note here that the arrows do not represent exclusive benefits, but show the most likely categorisation of the benefits of design innovation derived from the qualitative analysis. ‘Users/clients’ and ‘branding’ also played an essential part in formulating the six design innovation benefits, where all the benefits described in the framework bear some elements of user/client understanding and collaboration, and internal and external branding. These terms are thus not used as a separate design innovation benefit in the framework.

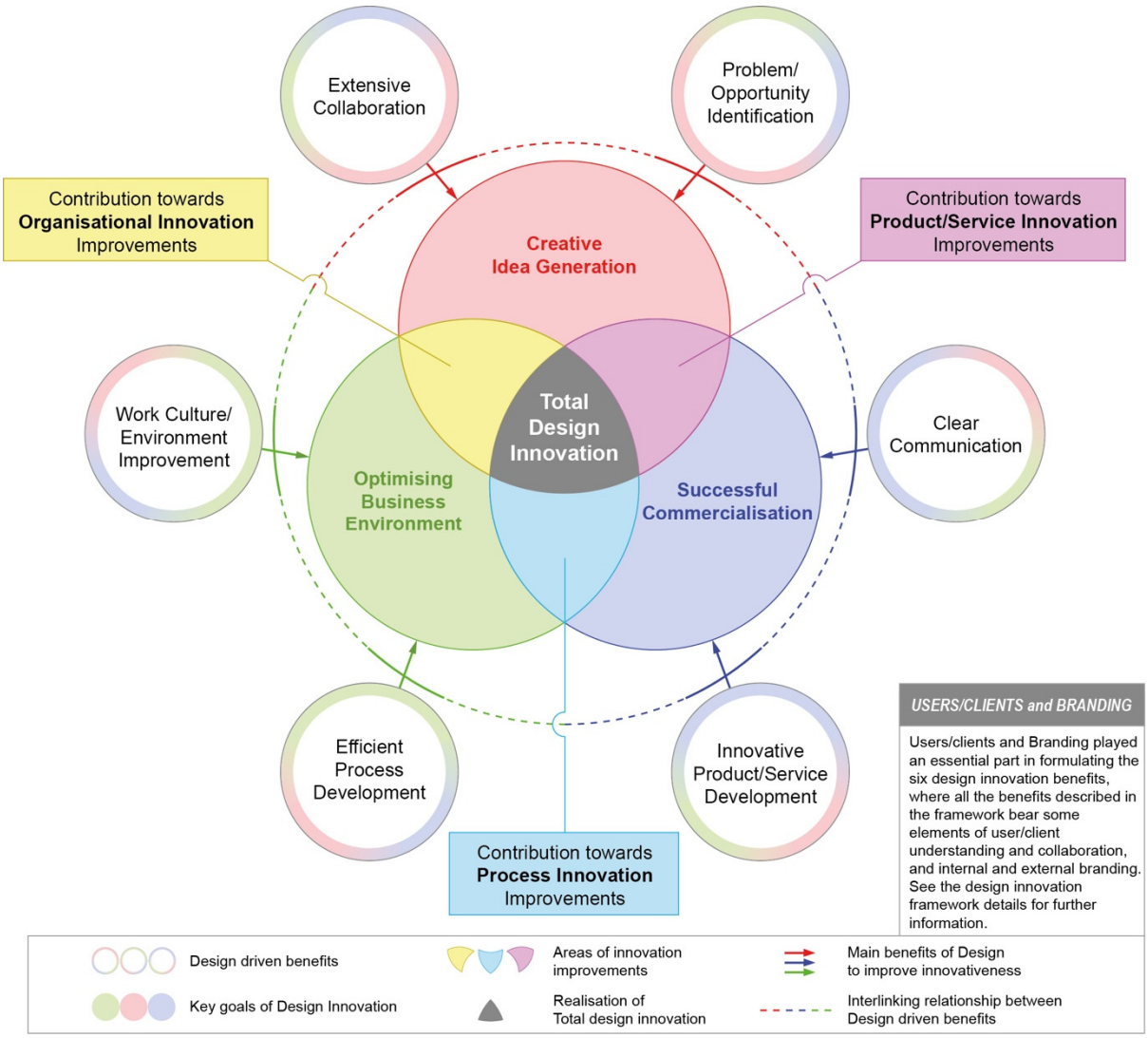

Figure 1. Design innovation framework for manufacturing companies in the UK

Design innovation's contribution to product/service, process and organisational innovation is shown in the intersection of three main goals, as already mentioned, towards improving innovativeness. In the centre, the intersection which is the common denominator of all design innovation - 'Total design innovation' - represents the space where all benefits and subsequent characteristics of design innovation are practised similar to that of 'Total design' (Pugh, 1996) in the broader sense, and 'Total innovation' (NESTA, 2008). It is rare to find manufacturing companies practising total design innovation because of its comprehensiveness, and some companies may not require certain elements of the design innovation characteristics because of the nature of their business. However, it is recommended that manufacturing companies aim to achieve total design innovation, because the process itself enhances product/service, process and organisational innovation.

Conclusion

This research investigated the dynamic relationships of design and innovation in UK manufacturing companies, which often fail to utilise extensive areas of design (including

designing, design strategy and corporate-level design thinking) to increase equally diverse areas of innovation (including product/service, process and organisational innovation). The design innovation framework provides a comprehensive overview of design innovation benefits: (i) extensive collaboration, (ii) problem/opportunity identification, (iii) work culture/environment improvement, (iv) efficient process development, (v) clear communication, and (vi) innovative product/service development. Using the framework – which was endorsed by prospective users during the evaluation process - manufacturing companies or supporting organisations can identify, prioritise and work toward systematically improving different areas of innovation appropriate to their unique environment or circumstances. This research would be particularly useful for top-level managers and design/innovation managers of manufacturing companies when creating an innovation strategy for the company to better utilise design innovation to enhance creative idea generation, optimise business environment and successful commercialisation.

This study primarily focused on providing a comprehensive overview of design innovation considering the relevant issues in the manufacturing industry. Therefore, this research would benefit from further studies of individual characteristics of design innovation and interlinking relationships between the characteristics, and into other industries (e.g. service, financial, tourism etc.), which will enable to create a more generalised design innovation framework. Finally, further research is recommended into the strategic implementation process of the design innovation framework to increase its practical contribution.

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