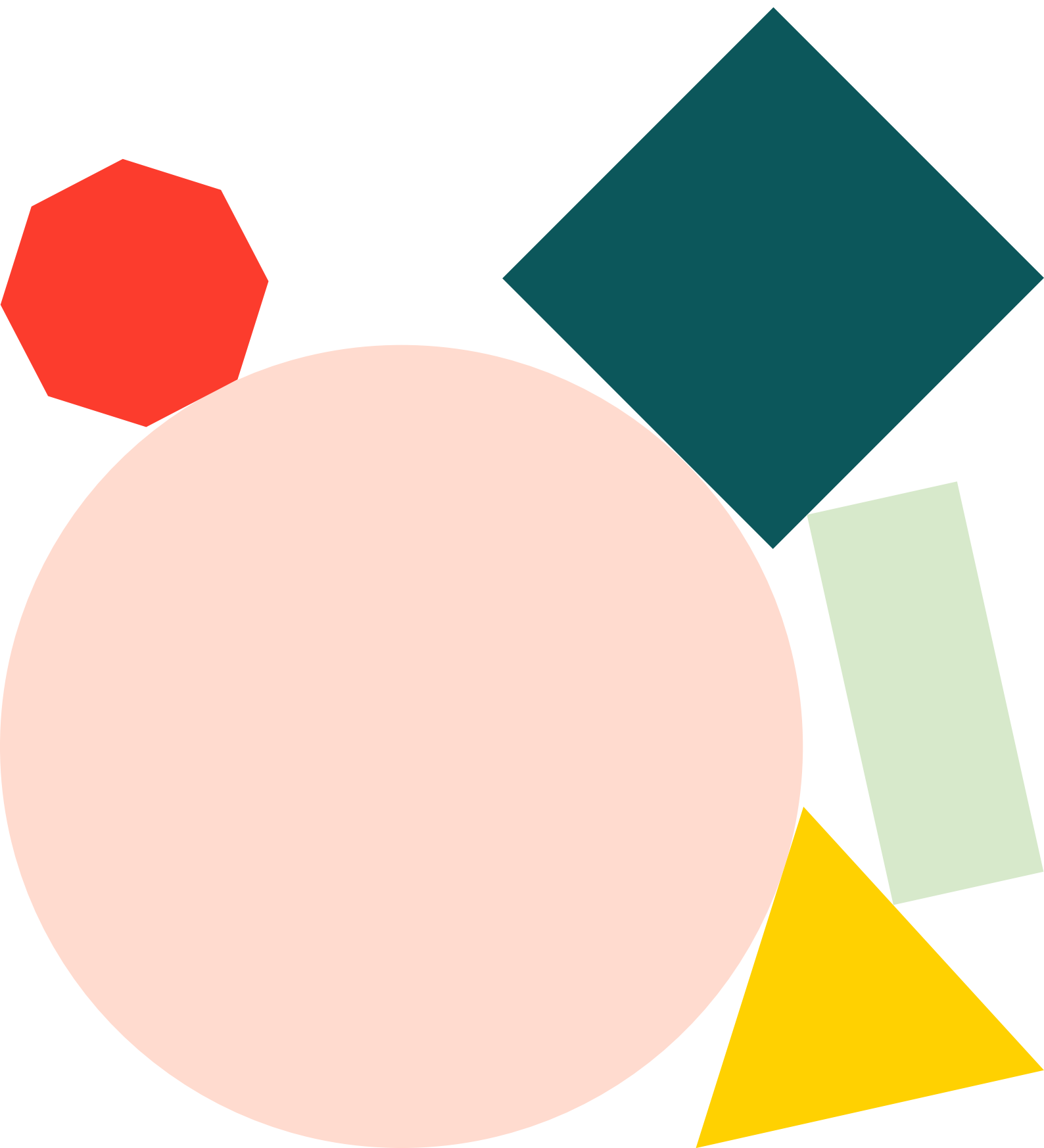
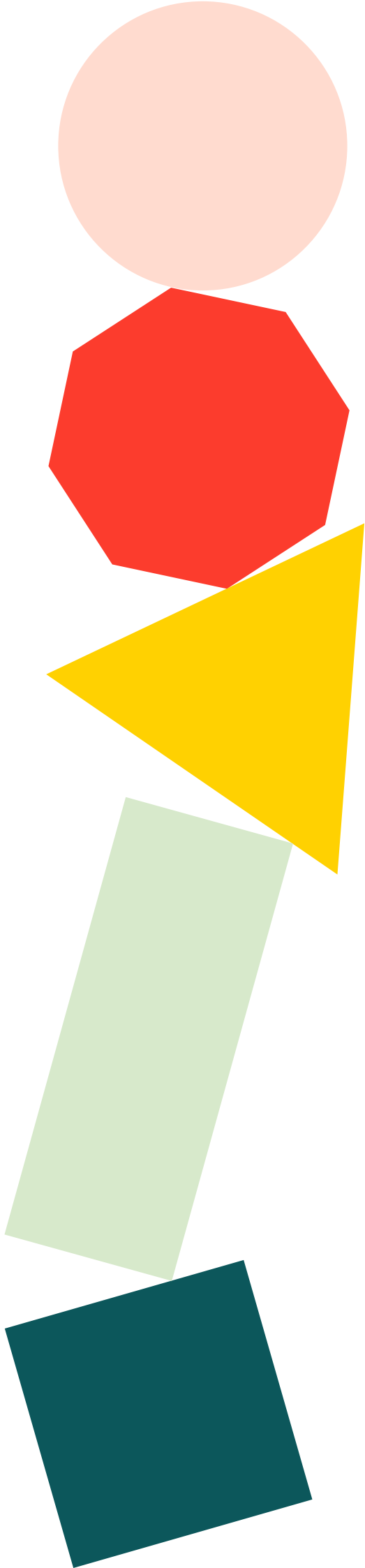

**Understanding design-intensive innovation:
a literature review**





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Design-intensive innovation in focus: an introduction

How does design contribute to innovation? Does the use of design increase or determine the likelihood of innovation happening? If so, can the role of design in innovation be measured?

Designers, academics, government and industry have been considering these questions for decades, and while a great deal has been written on the interaction between design and innovation, there remains ambiguity and confusion about the role of design in innovation. This is evident in the use of multiple terms used to describe the phenomena, such as ‘design-led innovation’, ‘design-driven innovation’ and ‘design innovation’.

For design to realise its full potential, there is a need to consolidate the existing evidence base to build consensus as to what design’s role is and isn’t with regards to innovation. This literature review was undertaken by RF Associates, and forms part of a major research project being led by Design Council. This review is designed to explore the literature around the key issues for the project, and provide a sound basis for a codified definition of design’s role in innovation which can be used as the foundation for further analysis.

The literature review is in two parts: Part 1 considers what design theory has to say on the issue; while Part 2 looks at it from the other side, reviewing literature which takes the economics of innovation as its starting point.

As a frame of reference for this review, we have taken the Cox Review of Creativity in Business (DTI 2005a) as our starting point. This review considered how best to enhance UK business productivity by exploiting the country’s world-leading creative capabilities, and offered a linked set of definitions to position design as the essential interface between creativity and innovation:

- ‘**Creativity**’ is the generation of new ideas.
- ‘**Innovation**’ is the successful exploitation of new ideas. It is the process that carries them through to new products, new services, new ways of running the business or even new ways of doing business.
- ‘**Design**’ is what links creativity and innovation. It shapes ideas to become practical and attractive propositions for users or customers. Design may be described as creativity deployed to a specific end”.

Much of the literature published since the Cox Review has demonstrated that the role of design is not just about aesthetics or engineering. In its broader sense design, or the family of design activities, should be considered both as a process and an outcome which have a distinctive and often determining role in innovation. The literature argues that design makes the difference between routine and radical innovation, or between low and high benefits to suppliers and customers of goods and services. This includes the established contribution that design plays in physical product design, as well as its role in service innovation.

We have also reviewed what the literature has to say about the extent to which the role of design in innovation can be measured. We’ve looked at the available data sets that provide direct or indirect indicators and reviewed the various ways that writers have tried to quantify design’s role.

Design-intensive innovation in focus: an introduction

Terms used in this review

Our approach to understanding and researching design's role in innovation is also reflected in the terms used in this review. Many terms are currently used to describe the process, and frequently qualified using suffixes to describe how design plays a role in innovation (e.g. by leading it or driving it). When making explicit reference to theories, we mirror the language of the theory and theorist.

However, when referring to design's role in innovation more generally, we use the term 'design-intensive innovation'. We have settled on this term following the literature review and extensive consultation with 200+ experts around the world, which highlighted ambiguity around terms such as 'design-led' (as it could refer to design being instigated at the beginning and/or being the major factor during the innovation). Instead, we refer to the intensity with which design is applied during the innovation process, which opens the possibility of design being introduced at any stage of the innovation process.

The theory of design and innovation

Conversations about design often fluctuate between design as a resource for innovation and design as a form of innovation. This tension was also apparent in our review of design theory literature. This is in part due to the number and variety of possible definitions of design, though there have been numerous attempts to develop unifying models or to broaden the definition of design as an innovation relevant discipline.

This chapter summarises these important schools of thought, and reflects on commonalities between them. In doing so it considers if and how these core concepts could be developed into approaches to measure the role of design in innovation.

1.1. Science of the Artificial

In his well-known contribution to a theoretical model for design, *The Science of the Artificial*, Herbert Simon wrote: “design is the transformation of existing conditions into preferred ones” (Simon 1996:111). He’s also on record as saying: “Everyone designs who devises courses of action aimed at changing existing situations into preferred ones.” (Simon, 1996)

Simon coined the term “bounded rationality” to argue that designers don’t have perfect knowledge, which means their designs are based on limited information. Simon developed his “science of the artificial” theory of problem solving to tackle this imperfect knowledge, arguing that design deals with the man-made not with natural things. In this model, design and creativity are forms of problem solving.

1.2. Design Thinking

A major body of theory and literature that developed during the 1980s and 90s goes under the banner of “design thinking”. This is an attempt to move the concept of design away from its traditional links to making visual artefacts to a type of mental model, which is potentially applicable everywhere and to all social, economic and business problems. Importantly, design thinking is a tool available to all, not only professional designers.

An important contribution is Buchanan’s paper *Wicked Problems in Design Thinking* (Buchanan, 1992), which suggests that design is an almost universal discipline of thought that can break down barriers between over specialised fields of knowledge to increase human wellbeing. Buchanan wrote “design continues to expand in its meanings and connections, revealing unexpected dimensions in practice as well as understanding” (Buchanan, 1992: 5), arguing it should therefore be seen as “a new liberal art of technological culture”.

The key principles of design thinking have been developed into an approach to managing and integrating design into business innovation strategy. The resulting framework of thought and business practices, have been publicised by Tim Brown of IDEO. He cites Thomas Edison – who famously led the development of an electricity distribution network to exploit the potential of the light bulb – as an early design thinker:

“Edison’s approach was an early example of what is now called “design thinking” – a methodology that imbues the full spectrum of innovation activities with a human-centred design ethos”. (Brown 2008).

In Brown’s account, design thinking drives innovation by observing what people want – by understanding their preferences businesses can differentiate and better meet the needs of the markets. In this model, design thinking is characterised as a system of ‘spaces’ rather than a series of linear steps. Each project has three fundamental spaces to pass through:

- **Inspiration** - the circumstances or issues to be addressed in the design thinking process
- **Ideation** - the process of idea genesis and testing
- **Implementation** - setting out the path to market or change in the organisation

Brown suggests that projects do not move in a linear way from one stage to the next, but instead that they will move back and forth between spaces, particularly ideation and implementation. (Brown 2008: 4).

The theory of design and innovation

1.2.1. Measurement

It's most common for design thinking to be measured using case studies. These are likely to be case specific, providing qualitative analysis of the structure and organisation of the business, and the designers and other disciplines involved. The scope for quantitative analysis by gathering data using a common set of terms and definitions is limited.

1.3. Design Driven Innovation

Design thinking and some related developments in design theory, such as interface design in software development, have emphasised the importance of the user or human centric aspects. Design in this context is about direct contact with the final user, and design based innovation should be driven by evidence of demand and deep understanding of user needs, often based on applied ethnographic research. This focus on the user aims to challenge the limiting perception of "design as style".

However, this strong user focus can also be limiting. On grounds of bounded rationality, users cannot specify radical change because they're not informed about all possibilities. For example, Henry Ford famously said that if he had asked his potential customers to specify their needs they would have asked for a faster horse. One reaction against too great a focus on the user is the "design driven innovation" model used by design intensive firms ¹, developed by Roberto Verganti and colleagues (Verganti 2008, 2009, 2016).

For these authors many of the definitions of design in the literature are too broad to usefully demarcate a design function. They argue that practitioners - including innovation economists and statisticians - end up at the lowest common denominator, i.e. design as "aesthetics and style". The new theory is based instead on the concept that "design is making sense of things" (Krippendorf, 1989) so that the core of design is about meaning, and uses a specific design language to deliver the meaning. The key concept is that novel design based innovation works largely at the symbolic level, rather than the technical or functional levels,

which are seen as the domain of more traditional, technologically driven innovation.

The theory is largely concerned with the management of design and is in some respects allied to Open Innovation ². Business that have adopted this approach consult external interpreters and add information from sources other than the users when reconfiguring the user experience. Design driven innovations are inherently novel or radical – they change perceptions and habits rather than accommodating to them. Design driven innovation based businesses have "superior capability to propose innovations that radically redefine what a product means for a customer". (Verganti 2008). Several leading Italian firms that have adopted this approach make proposals to consumers, they don't follow the market. For example, Alessi designed corkscrews shaped like dancing women and parrots, and Bang & Olufsen and Apple offer different meanings to existing functional products rather than just focussing on their appearance.

As a management model, design driven innovation emphasises a networked research process, with many players with common or over-lapping interests – referred to as the "design discourse". This is a mirror image of networked research in science and technology, such as open innovation. The Italian firms who are known for the model are leaders in production culture, and source specific designs and designers worldwide.

John Chisholm of Lancaster University provides a useful summary ³ of the key themes of this school of thought - "Design-driven innovation is an approach to innovation based on the observation that people do not just purchase products, or services, they buy 'meaning' – where users' needs are not only satisfied by form and function, but also through experience (meaning)". These changes in 'meaning' are potentially socially and economically important, as their diffusion, or take up in the market, can result in changes to entire socio-cultural models of consumer behaviour.

¹ The model draws on a number of examples of internationally successful Italian examples such as Alessi, Artemide, and Kartell.

² For a fuller discussion of Open Innovation see p25.

³ John Chisholm, (2016), What is design-driven innovation? <http://www.designforeurope.eu/what-design-driven-innovation>

The theory of design and innovation

The theory of radical design driven innovation explicitly parallels radical technology driven innovation, particularly the idea of a “design push”, offering users new possibilities that they would not have been able to specify or conceive themselves. “Design driven innovation is not an answer to, but a dialogue with and a modification of the market” (Verganti 2008).

The idea of design changing the meaning of goods and services has also been put in the context of an overall business strategy. Battistella et al. (2012) for example suggest that firms should have a “meaning strategy” by adapting the design driven innovation concept to the total strategy or business model of the organisation. From this perspective, design innovation operates in the space of semantics, or meaning - the aesthetic, symbolic and emotional messages embodied in a good or service.

In a similar vein, Norman & Verganti (2014) stress the importance of design in achieving radical innovation by altering the meaning⁴ of goods and services for users. They give an example of the international market for watches, where the introduction of digital technology moved market leadership from Swiss to Japanese producers, through a change in meaning from jewellery to a tool. Leadership then switched back to Switzerland as Swatch provided another new meaning for a watch as fashion accessory, making it attractive to own multiple watches for different looks/ occasions. They argue that technology led radical innovation has been thoroughly researched, but radical change in meaning as a mode of innovation is not yet well understood. “Radical innovation driven by meaning change can also be design-driven through a better understanding of potential patterns of meanings”. (Norman & Verganti 2014: 19).

1.3.1. Measurement

Like design thinking, design driven innovation is commonly measured by case studies. There is some potential to quantify some elements of the theory by developing business surveys aimed at a firm’s approach to design as a high or low importance element in their innovation strategy. In this way, there seems some overlap with the famous Danish Design Ladder.

1.3.2. Innovation by Design

In another variant of “design push”, Mutlu and Er (2003) identify a working concept as ‘Innovations by design’, where radically new products or services are developed with design effort, rather than with new techniques. However, the importance of this theory may be open to doubt because any innovation dominated by design usually involves other complementary assets and resources.

1.3.3. Design-led Innovation

A recent contribution by Bucolo and Matthews (2011) uses the terminology of Design-led Innovation to discuss a process of value creation for both firms and their customers. Design here is regarded as the combination of form and function. Like innovation itself, design can be thought of as both a process and an outcome. For them “design-led Innovation is a process of creating a sustainable competitive advantage, by radically changing the customer value proposition”. They argue that radical new options are not contained within the purview of current users, and design-led innovation can stimulate previously unknown, or latent customer demand.

⁴ They cite a concept of design by John Heskett: “Design: The deliberate and reasoned shaping and making of our environment in ways that satisfy our needs and give meaning to our lives”.

The theory of design and innovation

1.4. Concept-Knowledge Theory

Another line of development from Simon's work is the Concept-Knowledge (C-K) model of Hatchuel and colleagues (Hatchuel 2001; Hatchuel & Weil 2003). They argue that problem solving itself should be seen as a form of design, not the other way around. Instead of Simon's "bounded rationality" a better model for design theory is "expandable rationality". The approach is particularly complex, and draws on concepts from set theory and offers "proofs" of its propositions.

A central idea of Simon's C-K model is that economic agents take the path of least resistance, rather than optimising, and achieving their goal is the most important factor in the decision-making process. This led him to pursue a design theory that could be a branch of computing, with imagination providing options and connections that could be systematically worked through to find a "satisficing" (path of least resistance) conclusion. Design and creativity are similar to other decision processes, subject to the constraints of bounded rationality.

This framework for looking at the role of design in economic activity may be perceived as concerning the inter-face and interaction between creativity or new ideas (concept) and pre-existing or more logical (scientific) understanding (knowledge). In an interesting variant, the concept space can include more radical (crazy) thoughts, which can evolve into practicability through the C-K based process of innovation development. While the authors largely come from an engineering background and express the model in that context, it may well have more general applicability.

A definition of design (Hatchuel et al 2003 5) is offered as "assuming a space of concepts (C) and a space of knowledge (K), we define design as the process by which a concept generates other concepts or is transformed into knowledge, i.e. propositions in K".

So, design involves the iterative adaptation of concepts to existing knowledge and the reverse. We might sum this up by saying that pure creativity, for example painting from imagination, is not design, but instead that creativity (concept) interacting with existing knowledge, to form a new but practicable idea or artefact is what constitutes design.

Design can offer unexpected concepts for goods and services, and therefore goes beyond the bounds of the knowledge previously accepted as relevant. An example is the difference between the meaning of "a good movie" to go to see, which is a bounded, countable set of options, versus "a good party" which is infinitely expandable since new concepts can be added. A business innovation might be to support the choice of a good movie through a website that lists cinemas and what they are showing in a geographical area, together with information on each movie including cast, director, published reviews, etc. By contrast, a business offering to arrange "good parties" can add previously unknown types of party, potentially employing artists, designers and other creatives to work closely with the customer to achieve this.

By expanding the range of options available to suppliers and users, design-intensive innovation can promote economic growth more effectively than innovation that seeks to meet known demands more efficiently.

The theory of design and innovation

1.4.1. Measurement

This theory is about the nature of design and its potential for achieving radical change. So, one approach would be a case study to measure how firms that achieve radical (novel) innovation use design as the defining element of that process. This sort of research into business organisation and strategic engagement with "design push" radical innovation would be enlightening but does not lend itself to quantification in the sense of statistical countability and generalisation from statistical patterns. It would also be challenging to frame the right question to get the right data.

1.5. Design Practice

Reacting against design thinking, Lucy Kimbell (2009) pointed out that the proposed shift from the visual traditions of design towards a generic cognitive stance risks losing track of what constitutes design - the practice, in her view, of making various sorts of visual artefact to embody and communicate the designer's contribution. Instead she proposes a 'back to basics' approach centred on the activities inherently involved in designing:

- Design as practice - the process that necessarily involves the creation of artefacts such as drawings, models, and prototypes, and might be regarded as the domain of the professional designer due to the skills, training and experience needed.
- Design in practice - design outcomes resulting from the actions of professional designers, associated professionals, customers and other relevant groups - a democratising of innovation acknowledging that the finished "design" needs to be implemented alongside many other inputs.

The theory of design and innovation

1.6. Service Design and Innovation

Although service design firms are included in official surveys of innovation activities and outcomes, mainstream discussion of innovation - especially policy discourse - continues to focus on production activities and innovation in goods. Similarly, theoretical discussions of design have tended to be largely concerned with the design of physical artefacts, including writing on design innovation. However, a recently emerging field of academic teaching and research, and a small but growing element of the design consultancy industry, has embraced the subject of service design. This section summarises some of the contributions that are helpful in defining and measuring design innovation.

Much of the literature is concerned with defining, and even justifying, the idea of service design (Mager 2009; Junginger & Sangiorgi 2009). This stream in the literature draws heavily on the practices and methods of service designers to differentiate the field from “traditional” design (Holmlid 2009).

Birgit Mager, who heads the Service Design Department at the Cologne Schools of Design, offers the following definition:

“Service Design addresses the functionality and form of services from the perspective of the user. It aims to ensure that service interfaces are useful, usable, and desirable from the client’s point of view, and effective, efficient, and distinctive from the supplier’s point of view” (Mager 2009).

This useful construct tries to cover both the user centricity of much of the conceptual framework developed by specialists in the field, but also maintains the importance of the service supplier’s perspective, including the need for a distinctive offering, which is one aspect of innovation.

Others have emphasised the practical, even craft like, nature of service design and maintained the link with the designer’s role: “Service design ultimately

depends on the designer’s sensibility and uses a range of tools from different disciplines to achieve a range of objectives”. (Saco & Goncalves 2008: 12).

The need for a distinct practice of service design in part comes from the increasing recognition from at least the early 1990s, that the vast majority of final outputs in the modern economy are classified as “services”. Therefore, there is a need to understand, measure and encourage innovation in services. Design is a part of innovation in production so why not in services? As part of the desire to find an intellectual identity, researchers have tried to find a history of ideas to underpin service design, and a set of connections to current or recent movements of thought in design and its uses. Design Council has been part of that history:

“Service design owes quite a bit of its origin to both American and British design consultancies, notably IDEO, and public institutions in England and Germany, such as the UK Design Council in London and KISD in Cologne”. (Saco & Goncalves 2008: 12).

Another perspective is that service design has evolved from interaction or interface design, the development in software writing that prioritised the User Interface (UI) and usability research so that programming the content and functions of the software was driven by these needs. Service design took up the user centricity theme, through making “service encounters” the core of its identity (Sangiorgi 2009: 415).

Two streams of literature have attempted to bring theoretical rigour to service design – these are considered below.

The theory of design and innovation

1.6.1. Service Science

This is an idea very much associated with IBM – with seminal papers written by IBM researchers aiming to promote a systematic study of services, impelled originally by IBM's own need to understand and optimise its own services business. Subsequent developments suggest that a more comprehensive framework, to be used to promote economic ends such as productivity, is an imperative for modern economies (Spohrer & Maglio 2008). The authors suggest a definition of service as clients and providers working together to effect a transformation.

Shelley Evanson and colleagues see a future with service design at the centre of every organisation's innovation, where service design is an integral part of service science. Service design they argue is complementary to development, management and marketing of services, which makes it different from "conventional" applications of design in that strategy is developed as part of a service development process, not a pre-condition. Service design is not solely about "designing processes" but covers user orientation, contextualisation and design as a strategic instrument. In order to become part of the core of service science, a specific language of service design would need to be developed (Evanson et al 2010), i.e. a Linnaeus is needed to provide systematic foundations for the discipline.⁵

1.6.2. Service Dominant Logic and Service Innovation

"Service dominant logic" (SDL) is a marketing theory-based vision of services and service innovation, which is different from "traditional" product innovation. The term SDL was coined in Vargo and Lusch's seminal paper (2004) which contrasts the proposed vision of services and their marketing with the claimed "goods dominant logic" of mainstream marketing and innovation literatures. The model has been extensively developed by the originators into 10 Fundamental Propositions (Vargo and Lusch, 2008).

⁵ Although in our era a standards committee is more apposite.

The theory of design and innovation

	Foundational Premise	Explanation & Comment
FP1	Service is the fundamental basis of exchange	The application of operant resources (knowledge and skills) or “service,” as defined in S-D logic, is the basis for all exchange. Service is exchanged for service.
FP2	Indirect exchange masks the fundamental basis of exchange	Because service is provided through complex combinations of goods, money, and institutions, the service basis of exchange is not always apparent.
FP3	Goods are a distribution mechanism for service provision	Goods (both durable and non-durable) derive their value through use – the service they provide.
FP4	Operant resources are the fundamental source of competitive advantage	The comparative ability to cause desired change drives competition.
FP5	All economies are service economies	Service (singular) is only now becoming more apparent with increased specialisation and outsourcing.
FP6	The customer is always a co-creator of value	Implies value creation is interactional.
FP7	The enterprise cannot deliver value, but only offer value propositions	Enterprises can offer their applied resources for value creation and collaboratively (interactively) create value following acceptance of value propositions, but cannot create and/ or deliver value independently.
FP8	A service-centred view is inherently customer oriented and relational	Because service is defined in terms of customer-determined benefit and co-created, it is inherently customer oriented and relational.
FP9	All social and economic actors are resource integrators	Implies the context of value creation is networks of networks (resource integrators).
FP10	Value is always uniquely and phenomenologically determined by the beneficiary	Value is idiosyncratic, experiential, contextual, and meaning laden.

The theory of design and innovation

In subsequent work, the authors have consolidated the list into premises 1, 6, 9 and 10, which can be summarised as “Service is the basis of value and is always co-created by the customer through their acceptance or rejection of supplier propositions. Consumption as well as production is the integration of networked resources”.

A more recent paper (Edman 2009) compares the central ideas of service design with the fundamental propositions of service dominant logic (SDL) and finds them to be broadly complementary but also with some significant discrepancies - one model does not collapse into the other. SDL basically proposes that everything is a service and that value is always co-created. One implication for the service organisation is that a wider range of people and business functions should be aware of the customer. In this context, the customer-focused designer - who can address “wicked problems” (Buchanan 1992) - can be a major contributor. Here we see links to another major source of ideas and intellectual grounding for service design, in the literature on Design Thinking.

Another effort at drawing the connections between SDL and service design (Cautela et al 2009) uses SDL as the basis for a set of service categories that it is argued can inform the practice of service design. The paper aims to develop services categories with a service logic and provide models of innovation subject to these service categories and to suggest roles of service design. They read SDL as a new model of value generation, in which services are the main point of reference. (Cautela et al 2009: 4,320). The contribution to the theory of service design lies in the categories or “service offer clusterings”:

- a. interaction based (sole transaction)
- b. relationship focused (multiple transactions)
- c. network centered (transactions by different actors) (Cautela et al 2009: 4,321)

According to this logic, the roles of service design can be summarised in terms that could be the basis for a working concept of design in services innovation:

- a. Interface design – this includes service-scapes, symbols and semiotics. Innovation occurs through translation into symbols of, for example, new technologies and how to use them.
- b. Services channel, rules and culture. Support learning- and knowledge transfer – for example through new user competencies.
- c. Entire system architecture design.

1.7. Components of Service Design

A broadly common theme in service design research literature is the enumeration and explication of the range of tools and processes adopted in the day-to-day practice of service designers, including some adapted from other disciplines. The use of these is seen to be characteristic of specialised service design consultancies.

These include techniques used in Interaction Design, such as storyboarding, flowcharting, scenario creation, dramatization and role-play (Sangiorgi 2009 416). Others include “servicescapes” and the “customer journey” (Holmlid 2007).

A persistent theme in service design literature is that it puts the user or consumer of services at the heart of design, in contrast to an artefact centred approach which arguably characterises traditional design practice. Service design takes an outside-in, human centred perspective (Holmlid 2007).

The element of co-creation is a central theme of the literature and practitioners’ comments, either by the designer and the client (service provider) or between one or both of these and the final consumer of the service. (Saco & Goncalves 2008).

The theory of design and innovation

Co-design or co-creation of the service experience has also been highlighted in the service design literature. Service design is a process of planning and organising all the elements of a service, including the interfaces, to optimise the customer experience, with co-design between designers and clients and between both and representative customers playing a significant role. The benefits of co-design are argued to occur:

1. through improving the creative process and organisation of the service project;
2. for the service's customers by a better match between offer and needs;
3. in the supplier through creativity, awareness of customers and internal cooperation on innovation (Steen et al, 2011).

A foundational concept is the customer journey, and how the service is structured to make that experience most satisfactory, which the designer and service supplier need to understand from the user perspective. The journey can be conceived literally as the encounters a user has in spatial interactions, when taking up experiential services such as transport, or visiting sports venues (Voss and Zomerdijk 2007). Similarly, documenting the customer journey in experiential services is another way of arriving at the "service blueprint" (Evanson et al 2010). Many of the tools and methods that have been highlighted in the service design literature - for example design as choreography - represent departures from the traditional practices of designers making visual artefacts. But a closer parallel, with long established engineering design practice, can be seen in the idea of "blueprinting" the structure of the service offering - showing how the back office and front office (customer interface) components fit together for the management of the service and for the experience of the customer (Shostack 1987, 1993).

In a recent paper Maffei and colleagues (2010) also point to the dominance of "services" in the modern economy, which includes both services firms and services activities in other sectors. They argue that

interactivity with the customer and organising their experiences are central to service design. Further, they perceive the need for convergence between the economics of innovation and design to derive a theoretical framework for services innovation, especially the user driven dimensions of the latter.

"These considerations lead us to imagine the necessity of a new form of convergence between economics and design; a new interpretative framework is required to depict and explore a new theory of service innovation that merges the contemporary innovation theory (more focused on the process/product dichotomy) with the contributions and models of the user-design driven approach" (Maffei et al 2010). The model is focussed on service design as a mode of innovation, and on the user interface as the core of service design. Service design is argued to be potentially transformative for innovation and productivity in services - a view similar to the proponents of Services Science.

1.8. Social Innovation

Although not addressed by mainstream innovation economics or design theory literature, there is a growing number of publications focused on design's contribution to social innovation, which uses much the same conceptual framework as design innovation. This section draws on a conference paper (Manzini 2014) by a leading writer on the subject. While the ends and actors in social innovation may be different, the design innovation means are on the same lines as employed in the market or public sector spheres. He posits design for social innovation as design techniques to initiate or encourage innovation for social goals. This can encompass design initiatives "characterised by a clear design approach and by the use of specific design devices (e.g. prototypes, mock-ups, design games, models, and sketches)". He proposes that social innovation can be radical or instrumental, and be top-down or bottom-up.

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Top-down radical social innovations have much in common with design driven market innovations, where the design process makes radical propositions that the social group concerned can adopt and adapt. As Manzini puts it “We can summarise what Democratic Psychiatry (opening up psychiatric hospitals) and Slow Food (markets and festivals devoted to high quality fresh ingredients and traditional preparation) accomplished in their design strategy by describing three interdependent actions: (1) recognising a real problem and, most importantly, the social resources that might be able to solve it (people, communities, and their capabilities); (2) proposing organisational and economic structures that activate these resources, helping them to organise themselves, to last over time, and to replicate them-selves in different contexts; and (3) building (and communicating) an overall vision to connect a myriad of local activities and to orient them coherently” (Manzini 2014).

Bottom-up social innovations are more akin to “user innovation” (Von Hippel 2005) where the change is genuinely initiated and implemented by a social group not by commercial suppliers. Examples include community gardens on derelict land in New York City and communal sourcing of fresh organic food in rural areas in China.

“These cases of bottom-up social innovation thus appear to be design-led processes. However, they are design-led processes with a particular characteristic: The “designers” are very diverse social actors who, consciously or not, apply both skills and ways of thinking that in all respects are to be considered design activities” (Von Hippel 2005).

The roles of designers in these social innovation practices can be summarised as:

Designing with communities - participating as peers with other actors involved in creative community building, to collaborate in service co-design

Designing for communities – identify the strengths and weaknesses of specific typologies of collaborative services, and intervening to make them more favourable, developing solutions to increase their accessibility and effectiveness

The economics of design and innovation

This section draws on approaches to the role of design that can be found in the economics of innovation literature.

2.1. The Chain Link Model

Several years ago, Kline and Rosenberg (1986) argued against the linear model that science or R&D based invention leads to innovation followed by diffusion. Instead, they suggested that a design is a more central pivot for the innovation process.

“Contrary to much common wisdom, the initiating step in most innovations is not research, but rather a design. Such initiating designs are usually either inventions or analytic design. The term “analytic design” is used to denote a study of new combinations of existing products and components, rearrangements of processes, and designs of new equipment within the existing state of the art” (Kline and Rosenberg 1986: 302).

While the authors may be considering engineering design more than creative design, the underlying principle can apply to innovation in general, including in service provision. Kline and Rosenberg develop these insights into a model of innovation that incorporates feedbacks and cross relationships between design, research and markets, that they term the “chain-linked model”. This approach was incorporated as the main theoretical framework in the second revision of the Oslo Manual.⁶ So, in respect of design-intensive innovation, the third revision of the Oslo Manual in 2005 seems to be somewhat retrograde. And in practice, though, most innovation surveys⁷ guided by the Oslo Manual have not gathered data explicitly on design as an innovation category or investment. Indeed, analysis and policy often retain the influence of the linear model, despite innovation economist’s best efforts over the years to kill it off.

2.2. Economics of Services Innovation

In the field of innovation economics, a trend roughly contemporary with the emergence of service design, there has been growing interest and literature on innovation in services. The point is often made that innovation studies have been founded, either explicitly or more implicitly, on a “goods dominant logic” (Vargo & Lusch 2004, 2006) with approaches that have the production and distribution of physical goods at their heart providing the framework for theory and empirical research. Some types of service can be readily accommodated in this framework - for example the supply of computer software or the wholesale distribution of goods, and Bessant and Davies (2005) argue for similarities with innovation in manufacturing and services. Other areas of the economy, such as retailing of supplying package holidays for example, need more service oriented innovation theories and models.

A seminal contribution to the economics of innovation literature offered an angle on service innovation as a sort of mirror image of innovation in manufacturing. The key difference for service innovation is how the new technology affects the sector (Barrass, 1986). The essential element is a “reverse product cycle” innovation process that takes place in user industries such as services, once the new technology has been adopted. This cycle starts with process improvements to increase the efficiency of delivery of existing services, followed by process innovations for higher service quality, ultimately leading to product innovation in new types of services. Although design does not feature in this approach (in common with most of the innovation economics literature) it seems intuitively that recent ideas of service design could find a natural, cross disciplinary home in the second and third of these stages of service innovation.

⁶ The Oslo Manual is compiled by the OECD, providing “guidelines for the collection and use of data on innovation activities in industry”. More information can be found here: <http://www.oecd.org/sti/inno/oslomanualguidelinesforcollectingandinterpretinginnovationdata3rdedition.htm>

⁷ With some exceptions, such as in Denmark and in the UK.

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Other writers have delved into the fundamental reasons for the lack of a distinctive economics of services innovation (Gallouj, 2002; Gallouj & Windrum, 2009). This is seen to lie in a long tradition, dating back to Adam Smith, of perceiving services as inherently unproductive and by implication non-innovative. “Production has etymological connotations of progress and leadership” whereas “to serve” implies lower status. These ideas have a strong hold and even in the predominantly services based developed western economies, there are numerous policy initiatives, for manufacturing strategies to create employment opportunities. In parallel, policy is informed by innovation measurement frameworks which are substantially based on indicators such as R&D and patenting that are heavily biased towards manufacturing industry, so that most services sectors appear to have lower degrees of innovativeness than manufacturing. However, even using these indicators, some services sectors have exhibited high innovation, which affects other sectors. What are usually termed “knowledge-intensive business services” (KIBS) have significant impacts on their clients’ innovation processes (including in manufacturing industry). These service providers assist at various stages in the innovation process. Some commentators have seen the emergence of a “consultant-assisted” model of innovation (Gallouj, 2002). Again, although design is not explicitly mentioned in this literature, designers, including service designers, fit comfortably into the KIBS category.

2.3. Economic functions of design in innovation

One line of development for new concepts of design innovation follows from a study commissioned by the UK Department for Business, Innovation and Skills⁸ (Swann 2010) which offers a set of functional categories that mediate between the wide variety of definitions and the unattainable desire for a monolithic concept. This study is particularly useful in providing possible approaches to a framework for applications of design in innovation. Starting from the recognition that design is multi-faceted, Swann suggests aspects of design which are relevant to innovation.

Design is multi-faceted, leading to many definitions being used, but its nature is well expressed in the following definition - “Design is a vision Design is a process Design is a result”.

The five specific facets of design are summarised by Swann as follows.

A. A link from creativity to innovation

Design can be expressed as “a structured creative process”, a way in which creativity can be harnessed for good and not lead to chaos. This is congruent with the literature that conceives design as a resource based on skills, teamwork and combining specialist knowledge with market understanding.

B. From chaos to order

Good design imposes order and simplicity on a chaotic world. Swann quotes the Victorian art critic John Ruskin, who contended “and thus you see design, properly so called, is human intention, consulting human capacity. Out of the infinite heap of things around us in the world, it chooses a certain number which it can thoroughly grasp, and presents this group to the spectator in the form best calculated to enable him to grasp it also, and to grasp it with delight”.

In Swann’s approach there is also congruence with the Kline-Rosenberg model - the central design governs the multiplicity of options for product and service content.

C. A source of competitive distinction

This facet is congruent with the increasing importance in the modern world of non-technological innovation, and with a view of product and service innovation that emphasises how the characteristics of value to users can be augmented and varied to offer new configurations. Swann summarises this in several ways:

⁸ In 2016 the department was renamed the Department for Business, Energy and Industrial Strategy.

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- “Design adds the extra dimension to any product”
- “What will make a product stand out is the quality of the way it matches the purpose, skills and personality of the user, of the visual communication which goes with it, of the environment in which it is sold, and of the image of its maker. All of these are created by design”.
- “Corporate purpose is made visible through design”

D. Planning and problem solving

Design can be seen as a plan. Swann summarises by highlighting that “Design, from the Latin *designare*, ‘to mark out’, is the process of developing plans or schemes of action ... (design) indicates primarily an interrelation of parts intended to produce a coherent and effective whole”.

E. A technique for creative problem solving

“Design’s true value lies in the proven methods used (often behind the scenes) to develop solutions. Design is creative problem solving”.

This has some congruence with Design Thinking and aspects of service design theory, since the design of a service is often apparent only in the experiencing of the service.

2.4. Design and the Knowledge Economy

Design is very knowledge intensive, and can be deployed in a co-ordinating or supportive role with other approaches to effect both practical and new solutions. This section develops a framework of the roles and impacts of design in the knowledge economy and the associated types and effects of innovation.

Complementarities in innovation

Innovation in organisations is generally a multi-faceted activity using assets, capabilities, knowledge, skills and linkages to external resources in complementary combinations. In an analysis of data from the UK Innovation Survey, Bruce Tether (2006) reported that:

“Firms that invest in combinations of R&D, marketing and design are more likely to innovate, particularly at a high level...firms that spend on combinations of R&D, design and other innovation related activities tend to spend more on each activity than firms that spend on only one or two innovation related activities design is an important complementary asset for innovation, particular for high level innovation”.

That is, design is one important activity for innovation, working together with other assets and capabilities. So, the idea of design-led innovation cannot be conceived as design acting as the sole initiating factor, but rather one that adds value to the process of innovation and to its outcomes. Further, the relatively low share of businesses using design as a strategic innovation resource suggests that there is scope for enhancing the scale and value of innovation in the UK by raising the take up of strategic design. Design leadership in innovation should be interpreted in this sense of adding value through expanded options.

Investing in design can also lead innovation through its effects on complementary investment in other innovation inputs. Again, using data from the UK Innovation Survey, Peter Swann analysed the probability of firms engaging in an innovation activity if it already engages in another innovation activity. The table below shows the asymmetric conditional probabilities for each pair of innovation activities from the survey.

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Table 2: The conditional probabilities of innovation activities (Swann 2010)

		Probability of this category of investment for innovation						
		Intra-mural R&D	Extra-mural R&D	Capex and Software	External knowledge	Training	Design	Marketing
Conditional on this category of investment	Intra-mural R&D	100%	31%	73%	28%	68%	39%	51%
	Extra-mural R&D	82%	100%	82%	45%	73%	49%	60%
	Capex and Software	45%	19%	100%	25%	67%	28%	39%
	External knowledge	59%	36%	85%	100%	81%	43%	57%
	Training	49%	20%	77%	27%	100%	30%	45%
	Design	71%	33%	81%	37%	76%	100%	63%
	Marketing	60%	27%	74%	31%	74%	42%	100%

Implications

Here there are a large number of one-way only complementarities. So, 71 % of those with specific design activity also have intra-mural R&D, 81% have expenditure on Capex, 76% on training (for innovation) and 63% on marketing. But the probabilities of a design function conditional on other inputs are low. That is, commitment to design appears to be an enabler of other innovation investments, but the inverse relationship is less apparent.

Knowledge Integration

Design in business can be conceived as capability to access and utilise knowledge from inside and outside the enterprise in order to develop and implement new goods and services. In their 2003 paper Bertola & Teixeira articulate this vision of design as a “knowledge agent” that is “capable of flexibly adapting to specific contextual factors and contributing to the development of product and business innovation in any given situation”.

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Designers in this vision, bring multiple forms of understanding for example of user behaviour, the properties, affordances and functions of products; tacit knowledge through participation in user activities; understanding of their own organisation and its potential; how to manage design projects and how to conceptualise and model possibilities to communicate to colleagues and potential customers. They can also act as integrators of internal and external knowledge such as technologies not owned by their own organisation. The designer's knowledge agent functions vary between large multi-national corporations and smaller, more local firms. In global firms the design capability can codify into tangible goods and services "...the ideas and abstract concepts defined and negotiated by many different areas of expertise". In more local firms - where innovation is more likely to take the form of amending mature products - design acts as a "knowledge broker" capturing user and local network knowledge and adjusting internal structures to achieve incremental innovation.

Commercialising Science

Following the conception of design as a knowledge agent, it is feasible to consider that design and designers could play a role in the process of knowledge transfer between the research base and potential users in business, public services and even social innovation. Some modest scale support programmes run by Design Council included designers working with Technology Transfer Offices of Universities to ease the path to commercialisation of research results. An evaluation of the programmes reported that:

"Designers help integrate an understanding of user needs at stages in the development including prototyping, development funding applications and concept generation. They facilitate clearer and easier communication between the differentiators throughout the commercialisation process" (Design Council 2015: 16)

2.5. Design and Open Innovation

Another perspective on design as a knowledge agent comes from the literature on Open Innovation. The central concept is that firms choose to work with external partners, who can offer new or different ideas, capabilities and technologies to the innovators developments. This is often contrasted with a closed innovation model, led by in-house R&D and by secrecy and unwillingness to share with external bodies. Close study of the forms of openness revealed by the UK innovation survey indicates that the existence of a design department in a business greatly facilitates the effectiveness of a range of open innovation strategies, as the appropriate design discipline is important in co-ordinating and integrating a diversity of external and intra-mural inputs to achieve successful innovation. A study of how design capability is important in the effective deployment of an "Open Innovation" strategy in many industries, is set out in a report by Virginia Acha (2005). The main conclusions are that design capacity enables effective open innovation strategies because of the important role of interfaces between partners in task partitioning – combinatorial specialisation.

Overall, the paper supports two basic hypotheses on "open innovation":

- **Hypothesis 1:** 'Open' innovators need more developed design capabilities to manage innovation across organisational boundaries.
- **Hypothesis 2:** Open patterns of innovation will vary by sector, reflecting differences in market conditions, opportunity (technological and organisational) and organisational structures for innovation.

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2.6. Innovation Systems

The complex of knowledge flows between economic agents - such as firms, institutions, governments and universities - are summarised in innovation system models that show and quantify the linkages. These models are mostly for the national economy, but can also be developed for sub-national units or individual industries. Their purpose is to show the interdependencies between agents and to highlight where impediments to the easy flow of knowledge might limit the effectiveness of the national innovation effort and lead to lower levels of innovation and hence productivity and growth. These impediments are usually thought of as “systems failure” by analogy with the more common idea of “market failure”.

An aspect relevant to design in innovation is ‘Capability and Learning Failure’ (Swann 2010: 16) where organisations can be locked into a low rate of innovation and low engagement with external knowledge due to lack of important resources. The role of design as a knowledge integrator or broker summarised above might suggest that a wider spread across the economy of design resources dedicated to innovation could enhance openness to and use of external knowledge, including understanding of actual and potential user behaviour and how to translate knowledge into new and better goods, services and processes. It is notable that extensive surveys of business approaches to innovation (UK Innovation Survey, the Intangible Assets survey 2012) find that only around 20% of firms report investing in design for innovation or employment of specialised design skills. The national totals for expenditure on design for innovation that emerges from these surveys is in the range of £1 - 2bn. There is potential therefore for improvement in the uptake and use of design as a strategic innovation resource.

Conclusions and next steps

The literature about design and its role in innovation is extensive. There is a long tradition of theory exploring how design stimulates and enhances innovation, complemented by a growing body of evidence on its economic impact. This literature review has formed an essential step towards Design Council's ambition for better measuring design's role in innovation, as well providing what we hope will be a useful review for other readers.

We believe there are several common concepts across the literature reviewed above which can inform the desire for a codified definition of design intensive innovation and thus inform further, improved economic measurement. These are:

- Design relies on the ability to create and imagine, to solve problems, to combine knowledge of the existing world with possible versions of future products and services.
- Design is multifaceted – applying design to the innovation process improves the benefits for both the user and the supplier.
- Design enables innovation to be both user and human centric, through designers' understanding of human behaviour in the use of goods and the customer journey involved in the use of services.
- Design approaches are considered to operate in a distinct fashion, involving convergent and divergent thinking, and iterative and visual approaches. These can include for instance participatory techniques and enable rapid prototyping and development.
- The active use of design is associated with a higher tendency for delivering novel innovations and creating new possibilities for goods and services in the market.
- Design is complementary to other innovation inputs and strategies. Design capabilities strengthen organisations and enhance the capability of the national innovation system level to absorb and use knowledge.

These core concepts informed our consultation with 200+ international experts, which further informed a codified definition of design intensive innovation. This work has subsequently informed our research into the role of design skills in productivity and innovation, as well as measuring design's contribution to the economy.

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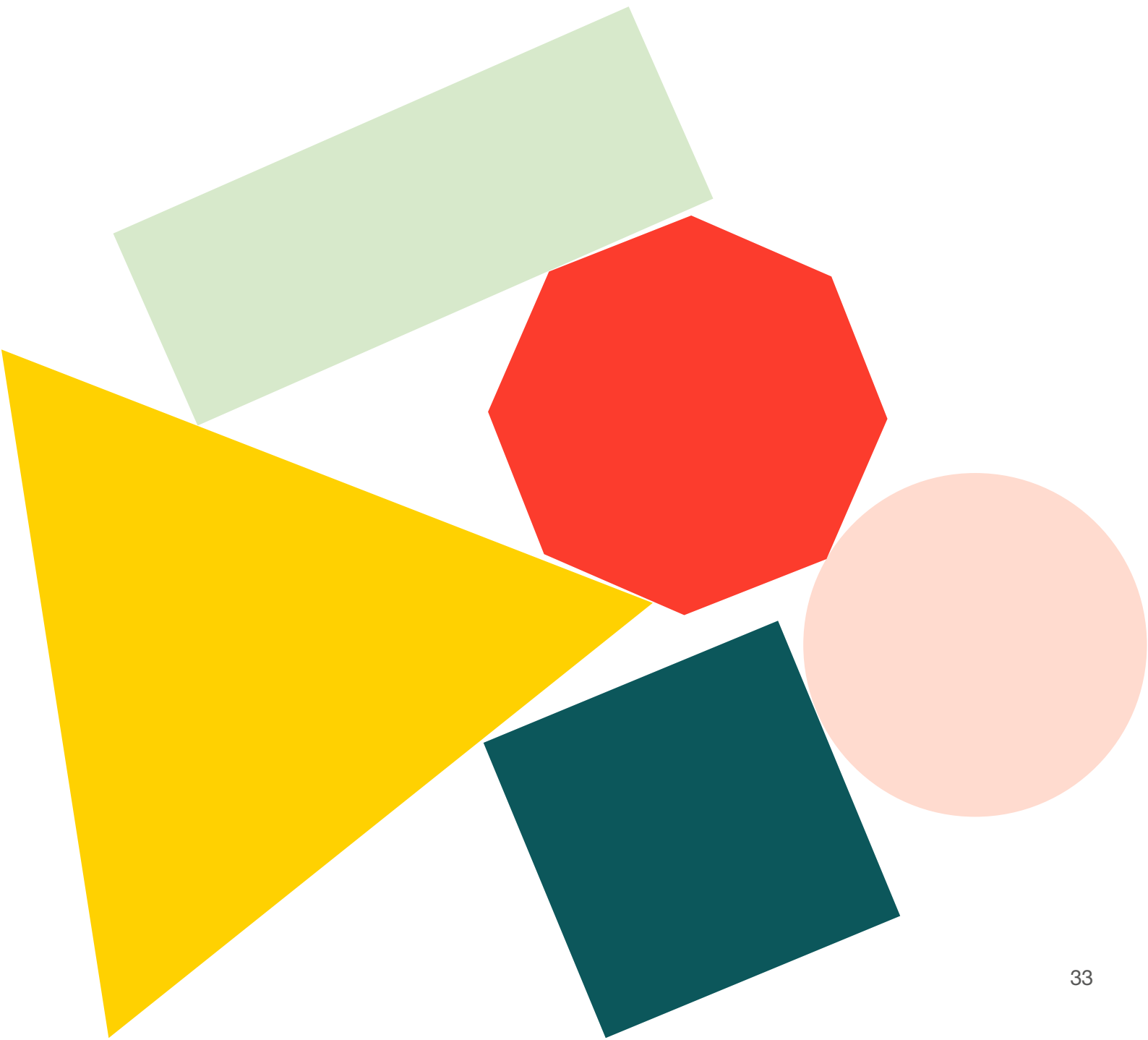
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We are an independent charity and the government's advisor on design. Our vision is a world where the role and value of design is recognised as a fundamental creator of value, enabling happier, healthier and safer lives for all. Through the power of design, we make better places, better products, better processes and better performance.

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