Management of creativity and design within the firm

DTI ‘Think Piece’

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In this report we explore the potential for, and experience of, using creativity and design as a *strategic* resource within the business. Specifically we propose to answer the following questions:

- How can creativity and design be used as a strategic resource within the business?
- What evidence exists that using creativity and design be used as a strategic resource within the business has a positive impact on organisational performance?
- What are the barriers to using creativity and design as a strategic resource within the business?

1. Working definitions

One of the problems with this area is the different ways in which people interpret terms like design, creativity and innovation. It is important to recognise, when considering terms like 'design' and 'innovation' that they can be used both as noun and verb. For example, the dictionary definition of 'design' is both

> *'… to contrive, to formulate, to project … to draw, to plan, to sketch out ... to purpose, to intend, to devote or apply to a particular purpose'*

and

> *'… a plan, a scheme, … an arrangement of forms and colours…. Thought and intention as revealed in the correlation of parts or adaptation of means to an end.'*
> (*New Elizabethan Dictionary* 1960)

Our focus throughout this report is on the verb, the activity – and particularly on how the process might be organised and managed to strategic advantage. Our understanding and use of the terms can be set out as follows.

Design in our view is *the purposive application of creativity to all the activities necessary to bring ideas into use either as product (service) or process innovations.* (Bruce and Bessant 2001) This may involve a number of aspects, all of which are covered by the broad term design and which include:

- Design for aesthetic appeal – styling, image, fashion status – for example, the iPod
- Design for function – for example, aircraft engines, Dyson cleaners
- Design for manufacturability – creatively thinking about how the product can be effectively and efficiently made
- Design for sustainability – for example, for re-use, recyclability, etc.
- Design for reliability and quality in use

Importantly these and others all represent ways of contributing competitive advantage to the enterprise – in other words, design is more than simply styling or image. Typical definitions of design indicate a process of bringing together an understanding

of three key elements in doing this - user needs (latent and expressed), form (styling, etc.) and function.

We ought also to stress at the outset that design is not always about creating something totally new, never seen before. Even wheels can be re-invented to good effect and most innovation involves finding new and better variations on existing themes. For example, in the case of electric light bulbs, the original Edison design remained almost unchanged in concept, but incremental product and process improvement over the sixteen years from 1880 to 1896 led to a fall in price of around 80%. Even established items like the bicycle are continuing to evolve, nearly 150 years after their invention (Bright 1949; Walsh, Roy et al. 1992). Breakthrough innovation itself may have more to do with recombining existing ideas than inventing things which are radically new – and in this process of 'technology brokering' design plays a central role (Hargadon 2003).

'Creativity' is helpfully defined in our view by William Coyne, Vice President of 3M, as *'the thinking of novel and appropriate ideas'*. (Coyne 1996) Importantly this is not the province of specialists or gifted individuals but a common human capability. Where there is a difference is in the preferred creative *style* (Kirton 1989) – some people are more comfortable taking radical leaps whereas others prefer to deploy their creativity in more incremental, problem-solving fashion.

Our definition of 'innovation' corresponds to the DTI's - *the successful application of new ideas* - recognising that this may involve a broad spectrum including innovation in what the enterprise offers the world (product or service innovation), the ways it creates and delivers those offerings (process innovation), the market contexts into which it delivers those offerings (position innovation) and the underlying business models in use ('paradigm' innovation) (Francis and Bessant 2005).

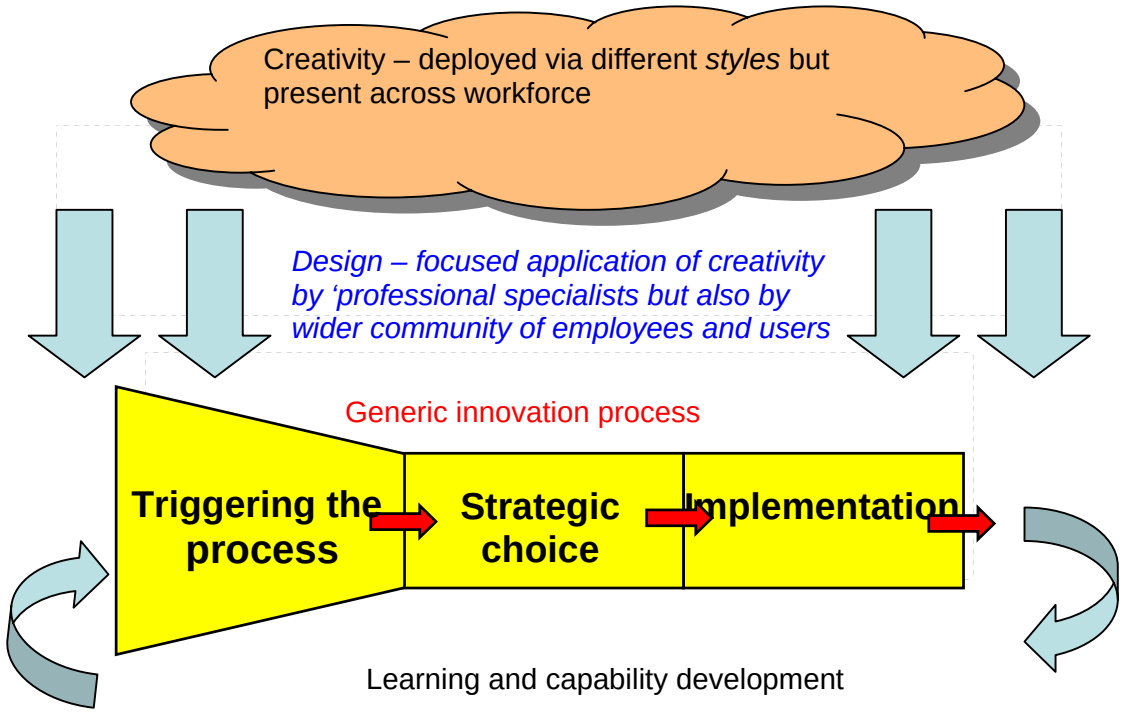

Figure 1: Design and creativity in the generic innovation process

Figure 1 presents an overview of the roles played by design and creativity in the generic innovation process. For now we crudely characterise this as a process involving triggering, strategic choice and implementation phases, but we will detail and elaborate on this model in section 5.2.

2. Creativity, design and innovation – impacts on competitiveness

There is extensive evidence to support the view that purposive use of creativity and design to enable innovation has an impact on performance. Table 1 offers a summary of studies which look at the issue from different levels – firm, sector, national – and although there are some concerns about methodology the overwhelming conclusion is that design and innovation does make a difference. This is not a new insight; an influential report published in 1979 by the then UK National Economic Development Office under the chairmanship of Sir Kenneth Corfield concluded that:

> *'The difference between the apparently more successful companies and countries and those less so is not in the quantity of work performed, but rather in the quality. Not in the volume of final output, but in the value added to basic raw materials. This value is determined more by the quality of design and the way it is made to meet customers requirements, than by other factors.'* (Corfield 1979)

Importantly the benefits seem to be sustainable in terms of growth. A pioneering study in the 1980s demonstrated how firms were able to obtain competitive advantage initially through radical design and innovation, but that they were able to sustain this over the following ten to fifteen years through a series of systematic modifications and incremental improvements building on and exploiting their core knowledge base. Successful firms were those which improved their products in response to user needs and continuously revised and updated their designs to take advantage of emerging new technologies and competing products (Georghiou, Metcalfe et al. 1986)

Another study of furniture heating and electronics firms told a similar story: the six firms which did best in overall design terms … had significantly higher profit margins and return on capital than the remaining UK firms sampled. Other research (for example (Dosi, Freeman et al. 1988) has shown that there is a correlation between top performing companies and their commitment to design and that design investment leads to growth and success. A study looking at 42 companies over a decade found that fast-growing firms:

> *'employed a higher proportion of Research, Design and Development (RD&D) staff, more often used external expertise for product development; introduced more products more frequently; and were more likely to employ modern product development practices, than the slow-growing or declining firms.' (Roy and Potter 1997)*

Transformation of consumers' associations with Japanese products, from relatively low quality expectations to the association with world class quality standards, was made by careful attention to manufacturing management and driven by some

revolutionary thinking about the organisation and management of the factory. But, as Clark and Fujimoto and others point out, the revolution was not confined to the production side of manufacturing (Clark and Fujimoto 1990). The design process was also the subject of major rethinking, with considerable efforts placed in the field of integrated high involvement. The result was not only products designed for quality and reliability and for ease of manufacture, but also products whose design captured the attention and the chequebooks of customers. Sony's pioneering designs in transistor radios and later in the Walkman and a wide range of other audio products finds its latest expression in the slim-line VAIO design for lightweight laptops and similar stories can be told of Canon and its copiers, for example.

Italian experience has been extensively reviewed by Verganti and colleagues in a project involving 17 research teams and 74 case studies across a wide range of industries.(Verganti 2005) This highlighted the importance of close integration between users and producers and suggested that competitive success in fields like furniture owes less to individual flair than to a well-managed design *process.*

There have been many studies of design and firm-level performance; however the methods and findings have varied from study to study. The table below summarises some of the major studies. More details of these are given in Appendix A.

Table 1: Major studies of design and firm-level performance

Study	***Summary of Empirical Findings***
Langrish, Gibbons, Evans, & Jevons, 1972	Focusing on 84 UK firms (Queen's Awards winners), the study classifies technological innovations into 4 areas: chemical, mechanical engineering, electrical & craft-based. It also investigated the size of change in technology in a scale 5 point scale.
Ughanwa, 1988	A survey of 138 UK firms (Queen's Award winners) indicates that effective management of design is a powerful factor in maintaining & sustaining competitiveness in manufactured products, but that design is ill-managed in British firms.
Robinson, 1990	Archival research on 144 US firms finds that relative product advantage is the most important product innovation characteristic, and that, surprisingly, incompatibility with customer's current way of doing things does not have a meaningful market share impact.
Roy, 1990	Interviews in 100 firms across seven countries suggest that successful firms are combining & integrating new capabilities with existing strengths in traditional engineering design. Design management practices associated with financially success are: multiple sources of design ideas; attention to the design brief; and viewing design as an investment justifying the best professionals the firm can afford.
Bharadwaji, & Menon, 1993	Archival data on 81 US firms suggest that service quality does not have a direct effect on a service provider's financial or market results, but does lower a firm's strategic or business risk. This study shows that it is the firm's reputation and perceptions of service image that ultimately drive performance.
Roy & Riedel, 1997	Statistical survey of 44 UK product development projects suggests little difference in the roles of design between the commercially most

Study	*Summary of Empirical Findings*
	successful products and the less successful. However, in the successful projects more attention had been paid to genuine improvements in product performance, features and quality than in the loss-making projects, which tended to focus on styling or costs.
Roy, Potter, & Riedel, (1999)	Study of 42 UK firms finding statistically significant relationships between business success & various measures of long-term investment in design & innovation. The study also finds that markets where the firms operate moderate this relationship.
Gemser & Leenders, 2001	Study of 147 Dutch firms finding that integrating industrial design in new product development projects has a significant and positive influence on company performance, particularly when investment in industrial design is relatively new to the industry. Design innovation has significant positive performance effects in both mature and emerging industries.
Design Council, 2002	This survey of 1000 firms focuses on the importance & role of design; design practices; and design influences. It suggests that one of the greatest barriers to increased use of design, innovation and creativity in firms' work is a perceived lack of relevance. Yet, four out of ten firms have developed or introduced new products or services over the last 3 years. 74% of firms rely on their customers as the main source of ideas to improve or change their businesses; goods & services.
Mozota, 2002	A survey of 33 European SMEs demonstrated that design creates a competitive advantage. It identified and validated the three levels of design management: operational, functional, & strategic and classified the variables that are pertinent to discriminate design management strategy; dividing managers into two categories depending on whether they agree that design is a useful process in the management of innovation.
Tether & Hipp, 2002	A survey of 2900 German service firms, suggests they derive competitiveness from focusing on quality & flexibility in meeting different users' needs, rather than on price. Willingness to adapt (or even create) services for specific users is shown by the high proportion of income earned from customized and bespoke services.
Whyte, Salter, Gann, & Davies, 2003	Case studies of six Millennium Product winners suggest that successful firms are combining & integrating new capabilities with existing strengths in traditional engineering design, developing a holistic approach to design by complementing core design activities with complementary ones. These include branding; marketing; interactive websites; customer & employee feedback; integration of design & sales; customization of products; team-based working; & managing external collaborations.
Teknikforetagen & SVID. 2004 (Swedish Study)	A study of 1308 managers in Sweden revealed that demands on design have increased & that what is important is how design is used. Companies were mapped into the 4-step design ladder (design maturity model) based on their attitudes towards design. The steps are non-design, design as styling, design as process, & design as innovation. Companies with the greatest design maturity (design as innovation) were found to enjoy very strong growth.

Study	*Summary of Empirical Findings*
Tether, 2005	A survey of 1304 European firms found that service firms do innovate. Whilst it found no distinctively different, or unique, ‘‘services pattern of innovation’’, services tend to have an orientation to innovation that differs from that of manufacturers. In particular, many service firms have an organisational change orientation to their innovation activities whereas this appears to be relatively uncommon amongst manufacturers.

2.1: Differences in the exploitation of this potential – by sector, by firm size, etc

Although there is clear evidence of the contribution and therefore potential for design to affect competitiveness there appears to be widespread variation across sectors in terms of its application. Of particular significance is the relative lack of systematic application of design management in services, although there is growing evidence of the contribution which it could make (Hollins and Hollins, 1999). Examples include the Heathrow Express (introduced in 1999 and now used by almost 20,000 people each day) and the pub chain Wetherspoons. Currently the fastest-growing company in the UK and the ninth fastest in Europe by job creation (according to a report by research organisation GrowthPlus), Wetherspoon has achieved this spectacular growth through set procedures for designing and developing the services in each new pub. It also has quality standards that are checked and maintained through a group of 800 'mystery shoppers'.

3. Demand-side issues

Interest in design has grown as a result of global competition and the growing importance of non-price factors in determining firm-level competitiveness. In particular there has been a significant increase in demand for customisation against increasingly segmented markets. Arguably there has been a significant shift since the mid-20th century as emphasis moved from supply struggling to catch up with demand to a position where basic needs had been met, there was full employment and customers were becoming more discerning. They no longer wanted undifferentiated goods - in Henry Ford's words, "a Model T Ford in any colour as long as it was black". They no longer wanted poor quality goods, with low product lives and high recall rates. But, perhaps most importantly, they no longer wanted the same goods - **consumers increasingly began to see themselves as individuals** or as members of distinct, and increasingly, of small consuming groups.

The challenges posed by markets which are both increasingly segmented and increasingly volatile has meant that in manufacturing the emphasis has shifted in terms of what are considered ‘order qualifying’ (the things a manufacturer has to offer simply to stay in the game) and ‘order winning factors’(Hill 1993). Table 2 gives an illustration, based on the annual ‘Manufacturing Futures’ survey of strategic concerns of global manufacturers which highlights the continuing shift towards non-price factors. It also stresses the demise of the ‘trade-off’ – demand is now for

manufacturers to offer a bundle of non-price features without compromising on price competitiveness.

Table 2: Shifting patterns of order-winning and order qualifying factors

Time period	Order-qualifying critical success factors	Order-winning critical success factors
Pre 1970	Availability	Price
1970s	Availability, price	Quality
1980s	Availability, price, quality	Differentiation
1990s	Availability, price, quality, differentiation	Time to market with new products
2000	Availability, price, quality, differentiation, time to market with new products	Price , customisation

What international markets have shown is that when new **"disruptive" technologies** are involved, the firms who were the best and most effective producers with the old technology and who understood their markets best, are least able to capitalise on the new market opportunity. In their respective industries, disruptive innovation has been caused by technologies such as mechanical excavators, mini steel mills and low cost airlines, which swept away the competitive advantage of incumbents. Christensen (2000) uses the example of hard disk drives, showing how each new generation of drives caused disruptive innovation within the industry. This is because they have become really good at listening to the needs of their existing customer base. However, the markets of the future are made up of new and different customers. Typically, in the early stages of development, these new "disruptive technologies" offer products that are cheaper and perform less well than the existing technologies, and the existing customers, and producers, thus spurn them.

This poses the challenge to producers to develop the capability to influence their markets. In this case, it is not so much a matter of "hearing" the market, but rather of "**shaping**" **the market**, and this may require the firm to develop the capability to educate its users. Conventional media-based advertising is one way of educating customers, but there is a range of marketing tools that can be deployed to achieve these ends, including through the use of the World Wide Web (e-business).

3.1: The rise of mass customisation

Spring and Dalrymple (2000:442) argue that, “In industrial markets…customisation is nothing new, and has always been significant”. Although this is true, two key issues emerge. The first is that the degree to which customisation is required within

industrial markets is now greater than before (Ford 1990); the second is that similar requirements are now evident within many consumer markets also (Pine *et al* 1993).
Mass customization has been seen in different ways. For example, Gilmore and Pine (1997) mention "four faces of customisation": collaborative (designers working closely with customers); adaptive (where standard products are changed by customers during use); cosmetic (where packaging of standard products is unique for each customer), and transparent (where products are modified to specific individual needs). By contrast, Lampel and Mintzberg (1996) discuss a continuum of various mass customization strategies including different configurations of processes (from standard to customized), product (from commodities to unique) and the nature of the customer transaction process (from generic to personalised).

In essence, *mass customisation* describes the ability to both produce and distribute what are perceived to be customized goods and services within a high-volume, or mass market (Davis, 1987). However, a large part of the volume is achieved through the aggregate variety produced around a single product or similar products. Undoubtedly, *mass customisation* has links to "flexible production" and "flexible specialization" (Piore and Sabel 1984) and the inability of American competitors to achieve this was highlighted in a major MIT Report (Dertouzos *et al.* 1989). This report demonstrated that many US firms' manufacturing capabilities lagged behind their Japanese competitors for a number of reasons. These included outdated strategies with a continued emphasis on mass production; short time planning horizons; severe technological weaknesses; insufficient development of human resource capabilities; and poor co-operation with related partners – specifically, customers and suppliers. The report went further by predicting that, in the immediate future, it would be a necessary requirement for firms to transform from mass production to manufacturing capabilities which could, simultaneously, provide high quality, customised products and competitive costs – low cost having been a key, driving force behind mass production, particularly in the early days of Taylorism.

However, the development of *mass customisation* is more than mere 'fine tuning' of existing operations capabilities whereby high-volume, line, production is simply adjusted to lower volume, higher variety batch processes. It involves instead, major step changes, which may demand radical configurations and redesigns of the complete operations structure within the firm's plants. As Feitzinger and Lee point out,
" *Instead of taking a piecemeal approach, companies must rethink and integrate the designs of their products, the processes used to make and deliver those products, and the configuration of the entire supply network. By adopting such a comprehensive approach, companies can operate at maximum efficiency and quickly meet customers' orders, with a minimum amount of inventory"*.

3.2: Trends towards more active user involvement in design

Although users have always been seen as an important element in the design process there is growing evidence that they are taking a more active role. Work by von Hippel has consistently highlighted the importance of the 'user active- paradigm (Von Hippel 1988; Herstatt and von Hippel 1992)and the role of 'lead users' in shaping and evolving dominant designs but with the advent of enabling technologies in simulation, visualisation , prototyping and IT has come an increasing level of user activity. In his most recent work von Hippel draws attention to movements like open source software

where users tolerate a high level of bugs in exchange for early involvement in shaping the final emergent product (Von Hippel 2005). Significantly this is a trend which is more open to service innovation than product since the technological barriers to user shaped design are lower.

4. Enabling design and innovation

In this section we review the range of inputs available to the design process, particularly the skills associated with creativity and design and the increasing range of technologies and techniques which can support the overall innovation process.

4.1: Design skills

The UK has a rich heritage of design as a discipline, and an infrastructure for training relevant skills. Professional designers specialise in particular areas, such as industrial or product design, textiles, fashion, graphics, multi-media, or interiors. All aim to combine aesthetic considerations (*form*) with *function* (technology, cost, etc.) and customer needs. They are commercially oriented and work with their clients to define a brief and product concepts, drawings and plans that enable a product, or graphic, or website to be constructed. Designers have skills and knowledge that is valuable to business. In particular, visual imagination is a crucial aspect of design because it enables mental pictures to be constructed of what has never been experienced. Drawing, model making and visual sensitivity enables alternative forms, details and ideas to be explored, discussed and considered before time and capital is invested in making the design.

The distinctive skills of professional designers have been highlighted by a study commissioned by the Design Council (1999). This report stresses their strategic and tacit skills, such as creative thinking, decision-making, risk taking and user focus. A good designer has the ability to integrate, interpret and conceptualise solutions and this is of value to the business. Designers are under constant pressure to develop new skills and re-train in new technology, and they can harness technology and 'couple' this with user needs to create novel products and/or services. There is a need for designers to be taught to develop business skills to help their effective integration with the business community. Indeed, the ability to assess the market, design the right product for the consumer and then position it for success requires business research and awareness. As designers take up more managerial responsibilities in the role of design/project managers, a business outlook is important. Often, designers are member of a multi-disciplinary project team and so have to be able to communicate with a range of other disciplines.

4.2: Involving others in the design process

Although specialist training equips design professionals with a particular skill set relevant to the task, it is clear that effective design at the firm level will involve a much broader range of people and inputs. If we remember our definition of design as

purposive creativity applied across the entire innovation process, then a number of other contributions can be made to help understand user needs and link these with inputs on development of form and function. In the following section we look in more detail at the concept of 'integrated design' and suggest that an important issue surrounds the development of organizations in which cross-functional inputs and perspectives can feed the design and innovation process.

And moving beyond the boundaries of the organization there is increasing recognition of the role users can play as sources of ideas and insights (Thomke 2002; Von Hippel 2005)

4.3: The nature of creative skills and how they are (or could be) used

In this connection it will be useful to explore the concept of 'creative skills' and the extent to which all employees in a business possess these and could deploy them in support of the innovation process. Stereotypes of 'creative' individuals tend to focus on a few characters, often slightly marginal and radical in their attitudes and behaviours. But evidence is that the capacity to think creatively is common to all people – the major differences lie in the preferred style of expressing it (Kirton 1989). A useful definition of creativity is 'the generation of novel ideas' though such novelty may simply arise from looking at things in a different way. Part of the challenge is not to look too soon for relevance; whilst organisations are concerned that creative activity should lead to some useful output they must be careful not to block it by evaluating ideas too soon or too rigorously.

A more significant challenge is recognising the context in which different creative behaviours are required – sustained incremental, short-term radical breakthrough thinking, etc. – and setting up the organizational conditions within which people feel motivated and enabled to deploy them (Bessant 2003).

Considerable evidence now exists to support the view that sustained high involvement innovation based on 'incremental creativity' can be organised and managed to contribute competitive advantage (Bessant 2003). This includes:

- Studies of learning and capability development within organisations
- Surveys and multi-organisation studies
- Detailed studies of specific high involvement innovation programmes
- Case studies of experiences from around the world

Measuring creativity is difficult because it can refer both to the behaviour and the output of people involved. Studies of *output* have particularly concentrated on the high frequency/low impact area – for example the work of quality circles, problem solving groups and other employee involvement mechanisms. A number of studies provide extensive discussion of these including (Robinson 1991; Schroeder and Robinson 1993; Boer, Berger et al. 1999; Bessant 2003). Fewer measures exist for low frequency/high impact creativity (such as the creation of a completely new product or service) – but proxies might include the number of new products launched over the past 3 years, patents or copyrights, etc.

In terms of measurement of creative behaviour there have been a variety of attempts

to ‘audit’ the process and the conditions for enabling and supporting it – see, for example, (Bessant and Rickards 1980; Ekvall 1991; Rickards 1997; Amabile 1998). Work on a ‘capability model’ for high involvement innovation developed out of a Eureka project in the 1990s has led to a widely used reference framework for exploring the extent of development of the high frequency/low impact creative behaviours.(Bessant 2003) In particular this model distinguishes between low level development as opposed to more structured (and sustainable) approaches and the use of tools like policy deployment to contribute demonstrable strategic impact over time on key productivity dimensions such as quality, time and operating cost. (Akao 1991; Bessant and Francis 1999)

4.4: Specialist design agencies

An important growth area in recent years has been the specialist design consultancy which takes on much of the management of the innovation process, from initial concept through to prototype and beyond. Organizations such as the design and innovation consultancies IDEO and WIPRO Technologies have become major global players covering an increasingly wide market and developing considerable in-house experience and expertise around generic design and innovation issues.(Kelley, Littman et al. 2001) This is not simply sub-contracting key professional expertise but a growth of what might be termed an outsourcing capability, covering an increasingly large portion of the design and innovation process. In the case of firms like WIPRO much of the consumer electronics industry is now based on outsourced design linked to contract manufacture in low-cost locations. (Business Week, 2005). There are legitimate concerns that with increasing use of outsourcing, design firms will suffer from a ‘hollowing out’ losing key skills and capabilities. As they outsource activities to other companies they lose associated knowledge, which is crucial for high-end innovative design work. Conversely, where there is a large concentration of manufacturing and routine design activity, it becomes easier to locate high-end activities. There may also be a risk that the concentration of activity in such centres acts as a magnet to attract key UK skilled personnel who have a high degree of potential career mobility.

4.5: Design-enabling technologies

New technologies, such as advanced simulation and prototyping tools, are central to emerging models of innovation. They are becoming widely used across a range of industries, including pharmaceuticals; film animation and games; engineering and construction. In design processes, these tools are used both for the co-ordination within the professional project team and supply chain; and for soliciting input, and presenting design to end-users, clients, managers, funding institutions and planners (Whyte 2002) Their use can be illustrated by considering the combination of advanced computer-aided design tools with lean methods and processes to co-ordinate the design and construction of major projects such as Heathrow Terminal 5.

The use of such tools is making the innovation process more accurate and efficient (Dodgson, Gann et al. 2005), allowing more scope for ‘play’ (Schrage 2000). A number of authors have highlighted how this occurs. Computer simulation, argues

Thomke (1998; 2001), enables developers to speed up and simultaneously reduce the cost of design iterations; increasing the frequency of problem-solving cycles while reducing the total time and money spent on research and development. The advent of families of novel design technologies, argues Debackere (2003) makes concurrency at the technical and functional levels a reality.

In a new model of the innovation process, Information and Communications Technologies (ICT) are seen as *enabling* innovation; Operations and Manufacturing Technologies (OMT) as *implementing* innovation; and Innovation Technologies (IvT) as *creating* innovation. They encompass search tools, modelling and simulation, visualization/virtual reality and rapid prototyping (Dodgson, Gann et al. 2005) as shown in Figure 2. Together they lead to intensification in the innovation process.

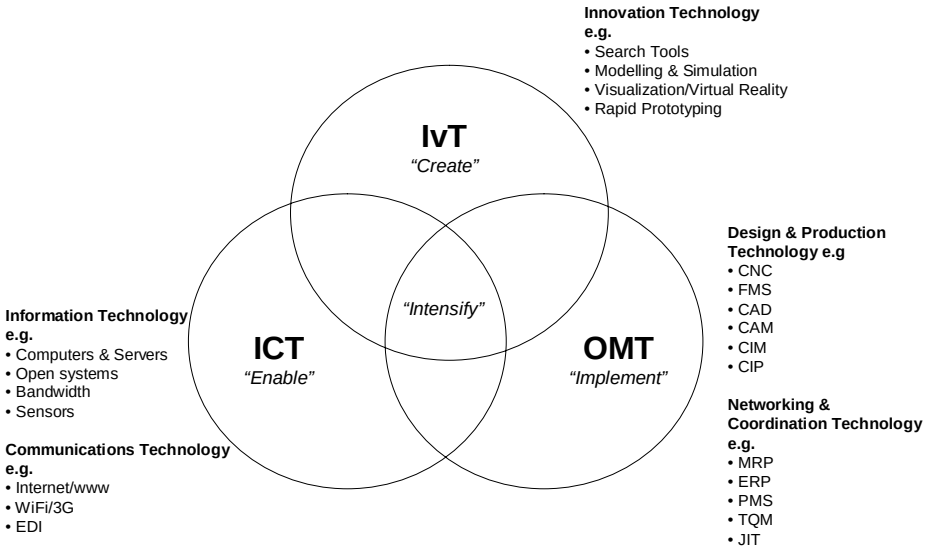

Figure 2: Innovation Technologies and Related Tools (Source: Dodgson, Gann and Salter 2005)[1]

Practitioners account for the benefit of these technologies in terms of both their current benefits and a set of predicted future outcomes and states. Such realised and potential advantages can be illustrated by considering the simulation techniques used in computer-generated crash tests for automobile designers. These provide infrastructure for R&D in the automotive industry and are seen to provide significant advantages for the automaker, reducing development times and cost by avoiding need for the slow production of prototypes for safety testing at early stages in the design process and the expense of crashing them; and improving safety as the quality of data

[1] Wireless Fidelity (WIFI), Third Generation (3G), Electronic Data Interchange (EDI), Computer Numerical Control (CNC), Flexible Manufacturing Systems (FMS), Computer Aided Design (CAD), Computer Aided Manufacture (CAM), Common Information Model (CIM), Convergence and Implementation Plan (CIP), Manufacturing Resource Planning (MRP), Enterprise Resource Planning (ERP), Performance Measurement System (PMS), Total Quality Management (TQM), Just in Time (JIT).

from the simulation is better than that derived from physical prototypes (Dodgson, Gann et al. 2005).

In design, there is often a mismatch between tools and practices (Henderson 1999), so acquisition, deployment and management of new digital tools present a challenge to firms. Previous work on visualization/virtual reality found that the size and complexity of the project and the extent to which components of the design are reused affect the types of tools firms could use (Whyte 2002). However as these technologies mature and begin to approach key diffusion crossover points – as CAD packages such as AutoCAD did in the 1990s – we now have innovation technologies coming down in price, going up in potential and converging around the design facility of the future.

In parallel with the development of such innovation technologies has been a growth in the range and availability of methodologies aimed at supporting creativity – examples include various creativity techniques, empathic design methods and cognitive mapping. (Rickards 1997; Cook 1999; Leonard and Swap 1999)

5. Design management issues

In this section we look at some of the key management issues around exploiting the full potential of creativity and design to enhance the innovation process and contribute competitive advantage. In particular we concentrate on the nature of design as a core business process which needs integrated management – and the problems which often militate against this happening.

5.1: Recognition (or otherwise) of the strategic potential of design

Design can contribute in many ways but in essence it is about linking user needs with form and function to create something attractive and adoptable as an innovation:

- Design for aesthetic appeal – styling, image, fashion status – for example, the iPod
- Design for function – for example, aircraft engines, Dyson cleaners
- Design for manufacturability – creatively thinking about how the product can be effectively and efficiently made
- Design for sustainability – for example, for re-use, recyclability, etc.
- Design for reliability and quality in use

As we saw earlier, it is possible to exploit this potential across a wide range of manufacturing and service applications – but there is still considerable reticence about taking advantage of such opportunities. One problem is the perception that design needs to have dramatic and stylish impact – as in the iPod. Evidence suggests that sustained incremental improvement can also have major impacts on both product and process design and consequent performance factors (Tidd, Bessant et al. 2005).

Table 3 indicates some of the available ‘innovation space’ for both radical and incremental innovation.(Francis and Bessant 2005)

Table 3: 'Innovation space' for incremental and radical innovation

Design in product	Process	Position	'Paradigm'
Incremental – continuing evolution of Bic ballpoint pen, bicycles, etc	Continuous improvement in steelmaking, rayon production,	Repositioning to open up market segments – e.g. Lucozade repositioned through design – telling a new story to a new audience whilst retailing the old one.	Reframing the ways in which a category of product or service is perceived – e.g. low cost airlines (design for price)
Radical change is emergence of completely new product or even category	Radical is completely new process design – e.g. float glass vs. grind and polish	Radical is opening up a completely new market	Bang and Olafsen reframing hifi as designer furniture, Artemide reconceptualising light and lamps, etc.

A particular problem arises in the area of services. Whilst there is considerable potential for design in services there is often a failure of perception, seeing the concept as being irrelevant to service activity or expecting the models used in product innovation to be transferable. The importance of the development of service products is only just being appreciated in the service sector. *'Many service companies do not even realise that they are involved in design when they consider new service products. They do not have the ethos that industry has, so it must be remembered that those in the service sector, in many cases being unfamiliar with the whole concept of developing new services in a structured manner, need extra and specific guidance.'* (Hollings and Hollins 1999)

5.2: Design management as an integrated process

There is strong evidence that obtaining the benefits of design depends on managing the process in a structured and systematic fashion. This is not to say that there is no scope for free thinking 'out of the box' but rather that the divergent aspects of creativity need to be balanced with the convergent. This is particularly relevant in all but the smallest organizations where informal processes can survive; certainly the ability to build sustained competitive advantage through design will depend on being able to repeatedly create new ideas and bring them through to becoming successful innovations.

In essence there are three broad phases of activity:

- A planning phase – initial idea picked up/ generated and developed, analysis of potential technical and market issues, feasibility assessment, and preparation of a design brief.
- A development phase – detailed market and technical specification, concept design, prototype development and testing, detailed design and production engineering.
- A production and sales phase – production and marketing planning, tooling, test manufacturing, trial marketing, full-scale production, market launch, follow up.

Although this has a manufacturing orientation the basic principles apply equally to services (Hollins and Hollins 1999).

Multiple approaches to modelling the process have been suggested and there is even a British Standard (7000) which offers a normative set of guidelines. The model is not meant to depict a linear process – ideas will move back and forth through iterative stages of development – but rather a route map to help organise around. There will also be considerable variation amongst projects – in terms of timescale, complexity, etc. Typical key stages in the process are:

- ***Stimulus/trigger*** *– something which kicks starts the process. This could be a new idea emerging from technical possibilities, an expressed need for something new, or a strategically planned extension to an existing offering.*
- ***Concept development*** *– entails the appraisal of the idea in terms of viability for the company, based on its strengths and capabilities, and marketplace demands. Feasibility in terms of production capability, quality and costs need to be considered too.*
- ***Project planning*** *– if the company decides to explore the idea further, then a product plan should be put into place to clarify objectives, allocate resources, establish timescales and budgets. This may include the preparation of a formal 'design brief' if design specialists are to be involved*
- ***Sourcing design skills*** *– may be an in-house team; or a combination of external and in-house designers; or, be solely outsourced.*
- ***Concept design*** *– creation of an outline of the design idea, one which can be shared with others and explored, such as sketches, simple models, or back of the envelope notes, as well as a more formal design brief elaboration of the outline into a clear, focused concept, which can be shared and considered in strategic terms*
- ***Concept development*** *– elaboration of the concept, collecting missing and incomplete information and exploring key strategic questions, for example by initial market or technical research*
- ***Prototype and testing*** *– production of mock-up, model or some other preliminary version of the final design which can be explored, tested, evaluated and used to promote discussion and development*
- ***Detailed design*** *– conversion of agreed design into detailed specifications for production prototypes and trials.*
- ***Market development*** *– extended problem finding and solving on market side, such as nature of demand or changes to original concept*

- ***Technical development*** *– extended problem finding and solving around technical aspects, such as feasibility, de-bugging, and design for ease of manufacture*
- ***Launch*** *– product launch usually signifies the end of the design phase. In textiles the design phase typically takes two to four weeks of the total product development process, which is about nine months. The use of web based technology to communicate between different designers in the fashion business is being introduced to try extending the design process and freeze this as close as possible to the customer.*
- ***Evaluation*** *– this entails analysis of the process and the project outcome. The design management process should be reviewed to ascertain whether the design has achieved the goals, it is delivered on time and budget, and its success (e.g. sales figures, customer feedback, etc).*
- ***Support and extension*** *–once launched much can be learned in the technical domain by close links with users and access to their feedback on the product or service. At the same time customer retention and the development of relationships depends on providing a degree of after-sales support – more relevant in complex or expensive products.*
- ***Re-innovation*** *– an important though often neglected stage which sees the lessons of experience in both design and post launch use as the inputs to a further round of innovation. (Rothwell, 1984: 621).*

A key principle in successful design management is to try and manage the risk – and the value of a process model is that if provides milestones along the journey where these risks can be assessed. Robert Cooper, one of the foremost writers on product innovation, introduced the concept of 'stage-gates' at these milestones – essentially points at which strategic assessment can be made and where progress – passing through the gate – only takes place when key technical and market questions can be answered (Cooper 1994:271).

The issue is not one of implementing a standard set of stage gates – as with models of the process, the number and position of these will vary with the kind of business – but rather it is one of managing the inevitable uncertainty in the process. It moves design from being a gamble to a managed set of risks.

One of the problems in managing design is that there are many individuals within organisations or acting as consultants to organisations who are loosely labelled 'designers' or 'design professionals'. This reflects their training in particular skills associated with design – but it sets up the problem that other members in organisations see the task of design as belonging to this group of specialists and not relevant to them. In other words design becomes 'someone else's problem'. This is a dangerous trap to fall into – not because of any limitations in the skills on the part of design specialists but because – as we have already begun to see – design is an organisation-wide task which needs to be managed in an integrated and high involvement fashion.

We might usefully draw the link with the theme of quality. For many years this was also something which was seen as the province of quality professionals and specialists – and therefore something which the rest of the organisation did not have to bother about. The results were mediocre at best, with firms running 'acceptable' defect

levels measured in percentages – parts per 100. It was something of a shock to find Japanese manufacturers able to make major inroads into Western markets on the back of a quality capability which measured defects in terms of parts per million and which did not charge high prices for this. What lay behind it, as we now know, was a philosophy of total quality management – essentially a process of re-integrating everyone in the organisation into the core process of building in and assuring quality (Brown 2000:832).

Our view is, following Cooper, that effective management of design needs an integrated approach, which links the specific contribution of design specialists with those of others throughout the organisation (Cooper 2005). Similarly the danger in a stage model of the process is that it implies separation of involvement. When a particular stage is finished those involved can throw the design over the wall to be picked up (hopefully) by the next group, and so on. A helpful metaphor here is that of the relay race, in which runners hand on the baton after finishing their leg of the race. The risks here include two of particular relevance to our concern with design. If one runner is slow then the whole performance is held back, and if the handover is badly handled, then again the efforts of everyone may be wasted.

But if design is about a process over time requiring different perspectives it makes sense to organise it in a much more integrated fashion. Instead of sequentially involving people, there is a case for bringing the whole set of perspectives together at the outset and building a shared and clear concept around which everyone can contribute. Concurrent working involves the shared working of all these different sets of people together, at the same time, and it can play an important role in the organisation and management of the design process. Early involvement of this kind can demonstrably reduce the incidence of problems at a later stage (for example in designing for easy manufacturing) and it can also help head off what can otherwise be tricky problems which occur at interfaces and at handover between phases.

5.3: Success factors in managing the design process

There is no guaranteed recipe for success in design, but there is consistency about the kinds of factors that make a difference to the management of the process, as shown in the summary of success factors for design management below (Bessant and Francis 1997; Bruce and Bessant 2001; Cooper 2003).

- Top management commitment
- Clear concept definition
- Voice of the customer – dedication to the market and customer inputs throughout the project
- product advantage – differentiated unique benefits, superior customer value
- Well-planned and adequately resourced launch
- Early detection of problems – leads to less rework
- Tough decision points and stage gate model with close monitoring at each stage
- Overlapping/parallel working. Concurrent or simultaneous engineering to aid faster development, whilst retaining cross-functional involvement
- Choice of structure – matrix, line, project – to suit conditions and task

- Cross-functional team working, involvement of different perspectives, use of team-building approaches to ensure effective team working and develop capabilities in flexible problem-solving
- Advanced support tools, such as CAD, rapid prototyping, computer-supported co-operative work aids (for example Lotus Notes) to assist with quality and speed of development
- Learning and continuous improvement. Carrying forward lessons learned, via post-project audits, etc. Continuous learning improvement culture

Concern for organising innovation as a shared activity has been around for a long time – and as a result we can benefit from the many attempts to do it well. As we might expect there isn't a single 'best' way of doing it – not least because all groups are to some extent unique and differ from each other in terms of the personalities involved, the context in which they find themselves, the tasks which they are trying to undertake, etc. But there are a number of consistent themes which provide us with a 'blueprint' from which to try and configure innovative organisations.

Table 4 summarises these and gives some indication of the research which describes in more detail the ways in which they operate.

Table 4: Creating an innovative culture

Factor	Influence on innovative behaviour	Underpinning research
Motivation	People are driven to make their mark on the world and also motivated by the degree to which they feel able to do so They are also highly motivated by recognition of their contribution from both peers and superiors. Need for achievement, need for recognition, etc.	(Maslow 1963) (McClelland 1965; Csikszentmihalyi 1988; Amabile 1998; Sternberg 1999)
Availability of 'slack' resources	People need time and space to explore and create They need resources to experiment with and to fail	(Claxton 2001) (Gundling 2000)
Leadership	People need role models who exemplify key values – innovators and rule breakers as heroes Leaders who provide resources and motivation and who are consistent – 'do as I do not just as I say'	(Senge 1990; Bess 1995; Goleman 1998; Cooper 2000)

	Expression of commitment at strategic level – this is important	
Direction	Innovation as strategically targeted not just 'moving the deckchairs' Measurement and improvement motivated from within Buy in and ownership of challenge	(Dodgson 1989; Johnson and Scholes 1993; Francis 1994; Robert 1995; Mintzberg, Lampel et al. 1998; Hamel 2000)
Self development	Learning to learn and acquiring and using key skills in context and process	(Wickens 1987; McGill and Warner Weil 1989; Pedler, Boydell et al. 1991)
Enabling tools and resources	Systematic approaches to problem finding and solving Creativity training	(de Bono 1993; Rickards 1997; Cook 1999)
Communication and information exchange	Networking across boundaries Invisible college Knowledge-based organisation	(Allen 1977; Wenger 1999)
Knowledge management	Capture and codification Tacit to explicit Display and dissemination	(Nonaka 1991; Tidd 1997; Teece 1998; Krogh, Ichijo et al. 2000; Swan 2003)
Cross-boundary working	Linking different knowledge sets Unexpected knowledge inputs and stimuli Different perspectives and complementary resources Cross functional working and EI	(Clark and Fujimoto 1992; Blackler 1995; Dyer and Nobeoka 2000; Sapsed, Bessant et al. 2002; Swan 2003)
Appropriate structures	Structures to facilitate interchange and flexibility Project, matrix, line and other choices – need to develop skills in matching tasks to configuration	(Mintzberg 1979; Clark and Fujimoto 1992; Nohria and Eccles 1992; Clark 1993)
Team working	Teambuilding and theory	(Belbin 1984; Bixby 1987;

Learning	Embedding a cycle of systematic problem finding and solving Ensuring challenging reflection on experience Building and extending a theory base – understanding and having mental models to guide action Encouraging experiment Sharing and communication of learning with others	Thamhain and Wilemon 1987; Francis and Young 1988; Hackman 1990; Kharbanda and Stallworthy 1990; Katzenbach and Smith 1992; Holti, Neumann et al. 1995; Tranfield and al. 1998; Conway and Forrester 1999; Tranfield, Smith et al. 2000) (Kolb 1984; Senge 1990; Garvin 1993; Leonard-Barton 1995)

6. Problem issues and policy implications

This work identifies a number of issues which have policy implications. These include the:

- Challenge of recognising the potential of design – there is currently a preoccupation with mass markets, price focus, etc.

In section 2, we collate evidence that creativity, design and innovation impact on competitiveness, and yet there is a current inability to recognise this due to pre-occupation with mass-markets and price. Developing awareness of the potential of design and mobilising commitment to more design-linked strategy has been a long-standing policy target for DTI and the Design Council. Arguably this pressure needs to be maintained with emphasis on extending channels and also on devolving the delivery of the message to regional and local levels –e.g. by further engaging Regional Development Authorities, Business Links, etc.

- Challenge of managing innovation as an integrated *business* process and to organise to repeat the trick.

In section 5, we look at design as an integrated business process. However there is currently an inability to manage innovation in this way. This has particular

implications for the way design is brought into the business management curriculum at undergraduate and post-graduate levels.

- Challenge of sourcing and managing professional design skills – e.g. some organisations choose to outsource the lot and abdicate responsibility rather than deal with integration issue.

In section 4, the question of sourcing and managing professional design skills comes up, for example with regard to the potential loss of skills due to outsourcing. The abdication of responsibility for integrated design has implications for developing not only awareness of design but also mechanisms for signposting to sources of design and innovation management skills. There are a number of questions: Is this a shortage of skills and/or shortage of connection to them? Does the 'market' work or is there a role for 'Design Counsellors? If so, for whom, and what is it? There may also be scope for encouraging use of such resources through some kind of subsidised consultancy or advisory scheme along the lines of the Manufacturing Advisory Service.

- Challenge of understanding and engaging users – passive, design-push innovation *vs* high user involvement.

Section 3 looks at the demand –side issues facing policy makers, with consumers increasingly beginning to see themselves as individuals. There has been an inability to understand and engage users. Here the issue is one of learning and promoting lessons around user involvement such as open-source software. There is a need to move from passive, design-push approaches to innovation to high user involvement.

- Challenge of understanding, accessing and using the emerging innovation toolkit to its full potential.

In section 4 we introduce the emerging innovation toolkit, which is leading to intensification in the innovation process. The issues here are both around awareness and also access and it may be that some form of subsidised access to key tools such as rapid prototyping could be made available to smaller firms - along the lines of earlier policy to promote the use of computer-aided design.

- Challenge of appropriating learning from design – risk of outsourcing and losing connection to knowledge accumulation.

In section 5 we discuss the exploitation of creativity and design to enhance the innovation process and contribute to competitive advantage. This inability to learn from design leads to a failure to use it as a strategic resource within the business. There is an additional concern here that with increasing use of design outsourcing, firms will suffer from a 'hollowing out', further losing key skills and capabilities.

- Opportunities for growth of a new service sector based on outsourcing design – and how to accelerate this?

Section 4 highlights the growth of professional design consultancies. If there is a shift to outsourcing design then the UK has a significant opportunity to foster and develop the supply side for such services, given the strong commitment to design education. Policy needs to identify measures which could be taken to enhance the development of this.

- Risk in outsourcing design – the converse of the above is that the growth of the outsourcing sector will take place offshore.

However, as also discussed in section 4, there is now global competition for design skills. There is some evidence that this is happing with the growth of specialist design houses such as WIPRO Technology with their rapid accumulation of knowledge around designs for products like mobile phones. There is also a risk that the concentration of activity in such centres acts as a magnet to attract key UK skilled personnel who have a high degree of potential career mobility.

These challenges, shortages, opportunities and risks need to be addressed to harness the potential for using creativity and design as a strategic resource within business and are hence important areas for policy.

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Appendix A: Evidence Table

Study	Research Questions	Research Design	Key Concepts/ Variables	Summary of Empirical Findings
Langrish, Gibbons, Evans, & Jevons, 1972	What are the kinds of technological innovations? What are the factors enabling technological innovation? What are the factors inhibiting technological innovation? What are the paths to innovation (innovation models)? What are the sources of ideas for innovation?	**Research Method:** Case study **Industry:** Multiple **Country:** UK **Sample:** 84 Technological innovations from 66 firms who received the Queen's Award in 1966 & 1967 for technological innovation or technological innovation & export achievement. **Unit of Analysis:** Technological innovation **Data Structure:** Cross-sectional **Data Analytic:** Descriptive statistics	Technological innovations; Enablers of innovation; Inhibitors of innovations; Models of innovations; Sources of ideas	The study classified technological innovations into 4 areas: chemical, mechanical engineering, electrical & craft-based. It also investigated the size of change in technology in a scale 5 point scale. Only 11 innovations scored '5' or '4'. **Factors enabling innovation:** 1- Top person: the presence of an outstanding person in a position of authority who made a special contribution to innovation. 2- Other person: some other type of outstanding individual who possessed some unique area of knowledge. 3- Clear identification of need. 4- The transition of the potential usefulness of a technology. 5- Good co-operation. 6- Availability of resources. 7- Help from government sources **Factors enabling innovation:** 1- Some other technology not sufficiently developed. 2- No market or need. 3- Potential not recognized by management. 4- Resistance to new ideas. 5- Shortage of resources or manpower or capital. 6- Poor co-operation or communication. **Innovation models:** The study classified the innovation models into 2 categories: discover push & need pull. Each category was divided into 2 subdivisions. The resulting classification is as follows. 1- DS – The science discovers, technology applies model [0 innovations fitted this description] 2- DT – The technological discovery model [5] 3- NC – The customer need model [18] 4- NX – The management by objective model [18] **Sources of ideas:** Out of the 158 ideas generated for 51 innovations, 102 were external & 56 were internal.
Ughanwa, 1988	Do British firms manage design effectively? How design in British firms could be improved?	**Research Method:** Survey **Industry:** Multiple **Country:** UK **Sample:** 138 Queen's Award winners of which 94 (79%) usable responses were received **Unit of Analysis:** Firm **Data Structure:** Cross-sectional	Design management; Best practice in design management; Queen's Award winners' experience	The results indicate that the effective management of design is a powerful factor in maintaining & sustaining competitiveness in manufactured products. The evidence suggests that design is ill-managed in British firms. About 140 techniques of managing design were suggested by 64% (60 out of 94) of the sample. These techniques were grouped into 30 as follows. 1- Better definition of design; 2- Top management involvement & commitment; 3- Effective cooperation & coordination,; 4- Employ the best people; 5- Motivation; 6- Continuous design evaluation & review; 7- Effective communication; 8- Clear identification & understanding of the market/customer; 9- Closer interaction with customer/user; 10- Create overall design awareness; 11- Adopt multi-disciplinary team approach; 12- Effective use of project management; 13- Overall departmental involvement; 14- Design with ease of manufacture & marketing in mind; 15-

Study	Research Questions	Research Design	Key Concepts/ Variables	Summary of Empirical Findings
		Data Analytic: Qualitative analysis		Introduce new technology; 16- Adequate education & training; 17- Input sufficient resources; 18-No 'nonsense' objectives; 19- Bridging the gap between design & other functions; 20- Encourage in-house design; 21- Change of attitude; 22- High quality leadership; 23- Honour the marketing concept; 24- Collaborative arrangements; 25- Create cost awareness; Do not be discouraged by failure – try again!; 27- Government support; Introduce problem-tackling/management very early in the design; 29- Avoid compartmentalization of design team; & 30- Learn how Britain's most successful foreign competitors manage design & apply the lessons.
Robinson, 1990	What is the impact of product innovation characteristics on start-up market share?	**Research Method:** Archival **Industry:** Manufacturing (industrial & consumer goods) **Country:** USA **Sample:** 144 **Unit of Analysis:** Firm **Data Structure:** Panel data (4 years) **Data Analytic:** Regression analysis: Generalized Least Squares (GLS)	Relative product advantage; Product innovation characteristics; Market share; Start-up business;	The study found that relative product advantage is the most important product innovation characteristic. A major product advantage increases market share by roughly 5 points in years 1 & 2 and by roughly 14 points in years 3 & 4. When the relative product advantage is held constant, a new & proprietary technology reduces market share by roughly four share points. So market shares typically arise only when the new & proprietary technology results in product advantage. Surprisingly, the study shows that incompatibility with customer's current way of doing things does not have a meaningful market share impact.
Roy, 1990	What is the impact of design on company performance? Why do many firms give design relatively low status & priority, while others make the achievement of good design one of their corporate goals?	**Research Method:** Field Study (interviews) **Industry:** Engineering based industries, design-based industries, & technology-based industries. **Country:** UK, Japan, Canda, Sweden, Denmark, Holland, West Germany **Sample:** Over than 100 firms. Some of the firms won design awards. **Unit of Analysis:** Firm **Data Structure:** Longitudinal (7-years) **Data Analytic:** Qualitative analysis; Descriptive statistics.	Role of design activities; Capability migration; Core Firm performance; sources of design ideas; design brief; Employment of designers	Successful firms are combining & integrating new capabilities with existing strengths in traditional engineering design. The study revealed that the most financially successful firms were those who had clear business objectives and strategy for achieving them that balanced their own particular strengths – in design, marketing, or manufacturing – with the requirements of their customers. The study identified 3 design management practices that were associated with financially successful firm. **1- Sources of design ideas:** Marketing & customer information were gathered from many different sources New & updated products were usually a result of group decision. An evolutionary product development approach was followed were competitors' product was used as a starting point. **2- Design brief:** Management of successful firms paid a special attention to draw a comprehensive brief at the start of any major development project. **3- Employment of designers:** Successful firms generally employed a higher proportion of their staff in research, design, development than the average of their industry. Firms which employed in-house industrial/product designers also performed significantly better financially than those which did not. However the key factor was not whether designers were in-house,

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				consultants or both, but that design was viewed by management as an investment justifying the best professionals the firm could afford.
Bharadwaj i, & Menon, 1993	What are the key determinants of superior financial & competitive performance in service industries?	**Research Method:** Archival **Industry:** Services (industrial & consumer) **Country:** USA **Sample:** 81 business units from the PMIS (Profit Impact of Market strategy) database **Unit of Analysis:** Business unit **Data Structure:** Cross-sectional (4-year averages) **Data Analytic:** Regression analysis	Degree of vertical integration; Service quality; Image; Degree of shared customers; Advertising level; Promotional levels; Sales force levels; Price; Product line breadth; Product customization; Order of entry; Market share; Number of competitors; Financial performance; Competitive performance.	Interestingly, service quality did not have a direct effect on a service provider's financial or market results, but it did lower a firm's strategic or business risk. A firm's reputation and service image not only increases market share but also lowers business risk. Therefore, it appears that while managerial perceptions of service quality may impact on actual service quality, this study shows that it is the firm's reputation and perceptions of service image that ultimately drive performance. Synergy of business operations and marketing activities increases market share, improves financial performance, and lowers business risks. High market shares appear to be double-edged swords according to the results of this study. On one hand, high shares improve the financial position of a firm, but, they also increase its risk levels. In contrast to conventional wisdom, customizing services actually increases market share. Sales promotions appear to have a positive effect on a firm's risk levels. In contrast, advertising has a negative effect on profitability but it has a positive effect on relative market share and it also lowers a firm's risk level. Forward integration increases market share and has a significant and positive impact on financial performance. On the other hand, backward integration strategies do not seem to affect a firm's market or financial performance per se.
Roy & Riedel, 1997	What is the contribution of design and innovation to product competitiveness in different markets?	**Research Method:** Survey (postal & interviews) **Industry:** Multiple **Country:** UK **Sample:** 44 projects (32 commercially successful and 12 loss-making projects) chosen from Commercial Impacts of Design (CID) database containing over than 220 projects in British SMEs; non-probability sample **Unit of Analysis:** Product (Product development project)	Product design; Product innovation; Design/Innovation polar profile map; Incremental/ Radical innovation	There is little difference in the roles of design between the commercially most successful products and the less successful. Also, there is no significant difference in the frequency of innovation (radical or incremental) between them. There is difference in the roles of design between the commercially successful projects and the loss-making projects. In the successful projects more attention had been paid to genuine improvements in product performance, features and quality than in the loss-making projects, which tended to focus on styling or costs. There were clearly different patterns in the design and innovation roles for different types of commercially successful projects. Some project emphasized more dimensions than others. Commercially successful product development projects and the more technically complex projects involved a broad, multidimensional approach to design than loss-making projects.

Study	Research Questions	Research Design	Key Concepts/ Variables	Summary of Empirical Findings
		Data Structure: Cross-sectional **Data Analytic:** Descriptive statistics		
Roy, Potter, & Riedel, (1999)	What is the moderating effect of market on the relationship between long-term investment in product design and innovation & business success?	**Research Method:** Survey **Industry:** Multiple **Country:** UK **Sample:** 42 firms that were part of the Commercial Impacts of Design (CID) project **Unit of Analysis:** Firm **Data Structure:** Longitudinal **Data Analytic:** Descriptive statistics, Chi-Square	Research, Design, & Development (RD&D); Long-term benefits; Investment in design & development	The study found statistically significant relationships between business success & various measures of long-term investment in design & innovation. The study also found that the markets were the firms operated moderated this relationship. More specifically, firms which have grown rapidly in turnover over the past 5-years operated in growing markets, while the declining firms generally operated in static or declining markets. Furthermore, The study found that fast-growing firms employed a higher proportion of RD&D staff, used more external expertise for product development, & introduced more products than slow –growing or declining firms. The study also indicated that in the growing firms the attitudes of the managers were positive toward investing in product design & innovation. By contrast the declining firms predominately had a limited & narrow understanding of design & innovation & their relevance to the firm.
Gemser & Leenders, 2001	How and when integrating industrial design in the product development process can enhance a company's competitive position?	**Research Method:** Survey **Industry:** Manufacturing: Home furniture & precision instruments **Country:** Netherlands **Sample:** 147 **Unit of Analysis:** Firm **Data Structure:** Cross-sectional **Data Analytic:** Regression analysis	Industrial design intensity; Industrial design innovation strategy; Organizational performance	The study found that the extent to which firms integrate industrial design in new product development projects has a significant and positive influence on company performance, in particular when the strategy of investing in industrial design is relatively new for the industry involved. There was no systematic pattern indicating that design innovation is more important in industries where the use of design is mature (furniture) than in industries where the use of design is emerging (instruments). Instead, the study found that design innovation has significant positive performance effects in both types of industries.
Design Council, 2002	What are the perceptions of the importance & role of design? What are the approaches to design? What are the influences on design?	**Research Method:** Survey **Industry:** Multiple **Country:** UK **Sample:** 1000; probability sample **Unit of Analysis:** Firm **Data Structure:** Cross-sectional **Data Analytic:** Descriptive statistics	Design role & importance; Approaches to design; Design practices; Design influences.	<u>The importance & role of design:</u> Although firms do not rank design, innovation and creativity individually as the top key ingredients of business success, they are rated as important factors in the overall mix. Firms define design in different ways but on balance the majority see it as relating to "how products look". Firms regard design as being included in a wide range of business functions & activities, but firms end to take differing approaches to managing design projects. Whether narrowly defined or more broadly defined to include innovation & creativity, design is regarded as integral or significant to the operations of more than one third of firms. Firms gain most from using design in terms of improving communications with their customers, improving their image, and improving the quality of their goods and services. The greatest barriers to increased use of design, innovation and creativity in firms' work

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				are a perceived lack of relevance and, to a lesser extent, costs or lack of finance & other resources (e.g. skills and time). Four out of ten firms have developed or introduced new products or services over the last 3 years. <u>Design practices:</u> 16% of firms have a design department or employ designers 16% of firms believe that they could benefit from external support on design & innovation covering a wide range of issues and needs. Firms would be most likely to approach private design consultants for support on design issues. <u>Design influences:</u> Three-quarters (74%) of firms rely on their customers as the main source of ideas to improve or change their businesses and/or goods and services. A significant majority of firms carry out research mainly to assess their competitors, markets and customer satisfaction. Firms tend to rate that the UK's ability to generate and nurture new ideas is more positive than negative.
Mozota, 2002	How design relates to strategy & innovation policy in SMEs?	**Research Method:** Survey **Industry:** Multiple **Country:** Europe **Sample:** 33 European SMEs who applied for European Design Prize **Unit of Analysis:** Firm **Data Structure:** Cross-sectional **Data Analytic:** Descriptive statistics; Factor Analysis; Cluster analysis; t-Test	Design management; Value chain; Competitive advantage	The research demonstrated that design creates a competitive advantage. It validated the three levels of design management: operational, functional, & strategic. It classified the variables that are pertinent to discriminate design management strategy. The most interesting result, apart from the typology, is that managers can be divided into two categories whether or not they agree that design is a useful process in the management of innovation. Using factor analysis, the study revealed 21 characteristics variables of design management that were grouped into 3 clusters. Cluster 1 is constituted by the variables describing the impact of design on market. Cluster 2 is constituted by the variables that describe the impact of design on the support activities of the firm's value chain. Cluster 3 is constituted by the variables that describe design as a factor to change the company's vision. The study developed a typology of design management based on how firms characterize & differentiate their leadership. The typology consists of 4 classes. Class 1 firms perceive design as a managerial competence that creates value by its action on the support activities of the chain. Class 2 firms perceive design as a resource competence that creates value by its action on understanding the system value chain & on external coordination. Class 3 firms perceive design as an economic competence that creates value by its action on the primary activities of the value chain. Class 4 firms are indecisive on the role of design.

Study	Research Questions	Research Design	Key Concepts/ Variables	Summary of Empirical Findings
Tether & Hipp, 2002	What are the patterns of innovation & sources of competitiveness amongst service firms? How these patterns differ between service firms, & particularly how technically based & knowledge intensive firms differ from services more generally?	**Research Method:** Survey **Industry:** Service (Multiple industries) **Country:** Germany **Sample:** 2900 firms **Unit of Analysis:** Firm **Data Structure:** Cross-sectional **Data Analytic:** Descriptive statistics	Knowledge intensive business services (KIBS); Service innovation; Patterns of service innovations	Service firms tended to derive their competitiveness from focusing on quality & flexibility in meeting different users' needs, rather than on price. The willingness to adapt services (or even create services) for specific user's needs is shown by the high proportion of income the firms earned from customized and bespoke services. The patterns of investment also showed interesting differences, with the technical & knowledge intensive firms tending to invest less (per employee) in new machinery & equipment than services in general. However, these services tended to spend more on ICT (per employee) than services in general. Most of the service firms claimed to have innovated, in terms of having introduced new service 'products', changed methods to produce services, and/or changed organizational arrangements and there was little difference between the proportion of innovators amongst the four types of firms examined. However, amongst the innovators the KIBS firms tended to spend more (per employee) on innovation-related activities, indicating a greater commitment to innovation. External firms & organizations were frequently recognized as important sources of information for innovation and were to a lesser extent engaged in formal collaborative arrangements for innovation. KIBS firms were more likely to identify external sources of information as important and were also more likely to engage in co-operative arrangements for innovation.
Whyte, Salter, Gann, & Davies, 2003	How small manufacturing firms use design to compete in international markets?	**Research Method:** Case Study **Industry:** Manufacturing **Country:** UK **Sample:** 6 small manufacturing firms who are Millennium Product winners **Unit of Analysis:** Firm **Data Structure:** Cross-sectional **Data Analytic:** Qualitative analysis	Role of design activities; Capability migration; Core design activities; Complementary design activities.	Successful firms are combining & integrating new capabilities with existing strengths in traditional engineering design. They are developing a holistic approach to design by complementing the core design activities with complementary design activities. They are engaged in the process of capability migration, shifting their capabilities into new areas. Some of the new complementary design activities are: branding; marketing; interactive websites; customer & employee feedback; integration of design & sales; customization of products; team-based working; & managing external collaborations.

Study	Research Questions	Research Design	Key Concepts/ Variables	Summary of Empirical Findings
Teknikfore tagen & SVID. 2004 (Swedish Study)	What is state of design in Swedish companies?	**Research Method:** Survey **Industry:** Multiple **Country:** Sweden **Sample:** 1308 managers from companies with 20 or more employees. **Unit of Analysis:** Firm **Data Structure:** Cross-sectional **Data Analytic:** Descriptive statistics	Design ladder; Design maturity model	The study revealed that demands on design have increased & that what is important is how design is used rather than if. Companies were mapped into the 4-step design ladder (design maturity model) based on their attitudes towards design. The steps are non-design, design as styling, design as process, & design as innovation. The study found that companies with the greatest design maturity (design as innovation) enjoy very strong growth.
Tether, 2005	Do service firms innovate? Do service firms innovate differently from manufacturing firms?	**Research Method:** Survey **Industry:** Multiple **Country:** Europe **Sample:** 3,014 European firms (Innobarometer 2002 database) **Unit of Analysis:** Firm **Data Structure:** Cross-sectional **Data Analytic:** Logistic regression	Service innovation	The answer to the first question is yes. The answer to the second question is both “yes” & “no”. The answer is yes in the sense that the evidence shows services tend to have an orientation to innovation that differs from that of manufacturers. In particular, many service firms have an organisational change orientation to their innovation activities whereas this appears to be relatively uncommon amongst manufacturers. But the answer is also ‘‘no’’ in the sense that there is no distinctively different, or unique, ‘‘services pattern of innovation’’.

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URN 05/1784