Transformative Design Thinking: A human-centred model for innovation

Julian Paul Malins

The Robert Gordon University Aberdeen

j.malins@rgu.ac.uk

Abstract

In recent years there have been a number of Innovation Centres established in the UK and associated funding calls to support the development of new ones, however there is no common theoretical framework, which underpins the methodology for their operation. Innovation Centres range from Business Parks clustering businesses from similar sectors, through to University Knowledge Exchange projects involving multidisciplinary teams of individuals working with companies from a particular sector or across all sectors, perhaps focused on cultural change. This paper describes a number of models for Innovation Centres some of which are based on principles derived from design thinking (Brown 2009) and others that are more focused on technology push (Martin 1994). Key government policies and subsequent public investment are relying on a number of assumptions that underpin the theoretical frameworks on which these Innovation Centres are based. Developing reliable methods based on a strong theoretical framework that questions existing assumptions has implications for ensuring that these investments are not wasted. This paper examines the use of user-centred design versus the more serendipitous process of invention and concludes that a process based on critical reflective reframing of problems through observational methods involving the identification of key stakeholders, may lead to sustainable transformational innovation. The paper concludes by proposing a theoretical framework and methods for supporting the establishment of a successful Innovation Centre, applying methodology designed to bring about transformational innovation.

KEYWORDS: Innovation Centres, transformational design, human-centred design, user-centred design, reflective reframing

Introduction

In response to the on going global economic recession, Governments have been showing increasing interest in supporting companies to value creativity and to focus on design and innovation. Reports have been commissioned, which has resulted in funding being allocated for Innovation Centres with the aim of stimulating growth and economic recovery (Cox 2005; Dyson 2010). In the UK, The Technology Strategy Board have funded a number of sector specific Technology Centres for example the new Technology and Innovation Centre (TIC) at the University of Strathclyde focusing on Renewable Energy. In addition the Scottish Government are in the process of funding the establishment of several more new Innovation Centres. Scottish examples are based on proposals initiated by University research groups working in collaboration with commercial partners. This represents a considerable investment (£10M in 2012 and a further £20M in 2013 and 2014) however there are a number of assumptions that underlie these initiatives, which are important to question. The first assumption is that clustering around a particular sector for example Energy, Food & Drink or the Creative Industries, will lead to innovation as opposed to Innovation Centres that are not sector specific but are deliberately cross- sectoral. It could be argued that the bringing together of expertise across disciplines is more likely to lead to new pathways to innovation, for example applying micro-electronics to Life Sciences or sensor technologies to Food & Drink, or combining expertise from the Creative Industries with the Sciences. Another implicit assumption relates to the idea that the Centre should be industry demand led. This assumes that the industry partners will know where future demand is going to come from, where in practice, very few industries are sufficiently future-focused to anticipate society's future needs. In addition, most businesses will naturally focus on what they feel comfortable producing and will be unwilling to explore completely new avenues, indeed this may be unwise depending on how the company is positioned. Ian Davies, (2010) in his online presentation for NESTA (National Endowment for Science, Technology & the Arts). points out some of the drawbacks of companies focusing on different forms of innovation at the cost of basic efficiency.

In response to the various sources of funding, a number of initiatives have been established to support innovation development. These initiatives include one-off workshops facilitated by business support organisations, through to large-scale investment in new research and development facilities. However often it is unclear how specific innovations might emerge as a result of these interventions.

This paper examines what theoretical framework might be used to underpin innovation initiatives to ensure that transformative innovation results from the interventions. The British Standard, 'Design Management Systems –Part 1: Guide to managing innovation', might be referred to for general innovation advice by companies, but fails to address where new innovations originate and

doesn't address how an Innovation Centre might interact with other organizations. There is no common agreed model as to how an Innovation Centre should work. Indeed, there is no clear theoretical pathway that will ultimately result in novel applications and new products and services being developed as a result of the establishment of an Innovation Centre. Undoubtedly they have been effective in some cases, but there seems to be a lack of research into which methodologies are most likely to result in successful transformative innovations. The paper initially describes the various models for Innovation Centres, it then looks in more detail at theoretical models for innovation concluding by suggesting how Innovation Centres might be organised to be more effective mechanisms for bringing about new products and services based on transformational innovation.

Innovation Centre Models

All Innovation Centres have to be underpinned by a theoretical framework that determines the methodology for their operation. How will they achieve their goal for developing new products, services or new ways of doing things? These underlying strategies are sometimes made explicit (eg stated on Innovation Centres websites) and sometimes implicit (eg open to interpretation), nonetheless, they are present. Centres may refer to design methods, unique visual methods or design thinking, but rarely disclose the underlying methodological approach. Reference is often made to adopting a 'creative approach' without specifying how this is manifest. Clients of these Centres are expected to trust that they are being offered a more creative, tried and tested set of methods that are guaranteed to lead to innovation. Successful case studies are quoted on websites as evidence of qualification for this work but these are not of a critical nature and only emphasise positive outcomes usually accompanied by glowing testimonials. The paper examines the underlying theoretical frameworks that have been adopted by various models of Innovation Centres with the aim of questioning some of the existing assumptions that they may be based on, and putting forward a model based on a human-centred and problem-focused approach to innovation. Hassi & Lassko (2011) in their paper at the EAD 09 Conference provided a review of definitions of design thinking, providing key features relating to practices, cognitive approaches and mind-sets.

A number of design led Innovation Centres have adopted a design thinking approach to support companies with innovation development. In practice this specific approach varies but there are some key elements which are found in a number of initiatives, such as The Centre for Design & Innovation in Aberdeen (c4di), (http://www.c4di.org.uk); The UK Design Council Designing Demand Programme (http://www.designcouncil.org.uk), and The Centre for Design Innovation in Ireland (http://www.designinnovation.ie/how.html). These initiatives often involve the appointment of a design associate who works closely with a company helping to identify specific projects that can then be developed with the aid of further experts brought in as required. Essentially the innovation that is being promoted is design, to change the culture within the

organizations to make it more likely, that new innovations or developments will occur. The advantage with this approach is that it can have a systemic effect on the organization, which can lead to significant improvements over time, for example empowering individuals within the organization and making the organization less risk-adverse and more outwardly facing. The disadvantage is that it is very difficult to isolate the effect of this type of design intervention. It may lead to significant change over time but it may not be directly attributable to the original design-led intervention. Companies are often reluctant to provide detailed figures relating to turnover, investment, and employee numbers, but even if they do provide this information, it is almost impossible to establish a causal link between design intervention and performance improvement. Funding bodies set performance targets such as number of companies worked with, number of days assisted, number of patents produced etc, however none of these indictors are particularly reliable ways of assessing the real impact of an intervention. For example causing a company to re-examine its organisational structure and the way in which it supports innovation could have far reaching long-term implications. Simon Sinek (2009) emphasises the importance of companies reframing their mission in terms of why they are in business rather than what they produce, appealing to customers' emotions rather than reason alone. A design intervention applying this approach with an SME could result in a major cultural shift, changing its whole approach to new product development and subsequent marketing. This result may not be manifest immediately or linked directly to the original design-led support. The effectiveness of projects that focus on the development of new products based on finding uses for new technologies are much easier to evaluate than projects that focus on cultural change. An example of an Innovation Centre which focuses on technology development with the emphasis on finding uses for new technologies and material, is the P3i project led by Professor Raymond Oliver of Northumbria University, which aims to design products, services and experiences that enhance future ways of living through the interaction of biology, electronics and polymers. http://www.northumbria.ac.uk/sd/academic/scd/research/casestudies/raymondoliverproject. This type of project brings together a multidisciplinary team of experts working outwith the normal hierarchical constraints of the host organisation, however the disadvantage may be the lack of a specific goal, for example, addressing a specific human need, so one resulting approach from this type of innovation model, is the development of virtual products which suggest possible applications for the technology.

A more common Innovation Centre model consists of a subsidized Business Park, for example Innovation Centres Scotland Ltd http://www.innovationcentre.org/ which provides incubation space for new businesses. This latter model has the advantage of trying to exploit strategies relevant to a particular sector for example energy or microelectronics, however these businesses may be in a state of competition with each other without necessarily being focused on an agreed goal. Apart from providing business facilities, this type of innovation centre/park rarely has any mechanisms to support collaboration or innovation, which may be a result of the cross-fertilisation of ideas between companies. The assumption is that the clustering of companies

from the same sector will inevitably lead to opportunities for innovation but in practice there is little evidence to support this assumption.

Forms of Innovation

A further common assumption influencing policy, relates to the nature of creativity. A frequently used model is of the 'Funnel' in which lots of creative ideas inevitably leads to concentrated innovations. Obeng (2006) referring to the Funnel metaphor, points out the flaws in this particular model. The assumption is that innovation by definition is a creative process therefore putting a lot of creative people together must lead to innovation. Unfortunately this is not necessarily the case. The flaw in this argument arises from a misunderstanding of the nature of creativity. However, if creativity is regarded as a basic human trait that can be encouraged or inhibited depending on the environment in which it is taking place, then it is only necessary to ensure the right conditions are present for it to flourish, regardless of whether the individuals are labelled as 'creative' (Kelley & Littman 2009). As part of the theoretical framework for successful innovation, initiatives must include organizational structures that encourage a creative response. This means embedding this framework into the company's structure and vision. Scott Berkun (2007) in his book 'The Myths of Innovation' gives the example of the 3M company who learned that "innovation comes from the bottom of the organization, where exploration happens……they developed a culture that supports mavericks and experimenters", by allowing employees time to work on individual projects.

Transformational innovation refers to a step-change or game-changing development. Burns et al (2006) in their UK Design Council Red Paper, offer a more complete definition of the term. Transformational innovation begins with problem identification that is often based on direct observation or consultation. A recent paper by Norman & Verganti (2012), explored the potential of user-centred design (USD) expressing the view that it can only lead to incremental innovation whilst radical innovation depends on a technology push.

There is compelling logic around the view that USD by its nature can only lead to incremental development. Whilst generally agreeing with this view this paper proposes a development of this approach, which would be to consider the role of observation, ethnographic methods and empathic design as a form of problem identification along with 'reflective reframing'. A key element in the cognitive approach they propose is "rephrasing the problem, going beyond what is obvious to see what lies behind the problem/challenge". This is a critical step in the innovation process and this is why it could be argued that independent innovation facilitators are useful as they may be less encumbered by preconceptions and therefore are better placed to reframe the problem or challenge. One useful reframing method is The Ideal Final Result (IFR) originally put forward by Genrich Altschuller (1946) as a key element in his problem solving technique TRIZ (Rantanan & Domb 2008.) IFR calls for the description of the best possible solution for the problem/situation regardless of the resources or constraints of the original problem. Laws of

physics or basic costs are ignored allowing for the reframing of the situation. The role of the innovation facilitator or the designer is to question the existing assumptions that often lie behind the way in which the original problem has been framed. The designer has to be able to acknowledge the human factors, in particular the users' emotional responses that make the difference between a successful and unsuccessful solution. Once the problem has been clearly identified the designer's role is to reframe the problem trying to avoid existing assumptions. At this point appropriate technologies can be sought to provide a solution.

Another helpful approach for supporting reflective reframing is based on the concept of 'serious play' developed by Roos and Victor[1] for the LEGO Company in the mid 1990s. The main aim is to encourage the free flow of ideas by creating situations that eliminate existing hierarchies within a team, using game or play metaphors to free up individuals' imaginations. Part of the process involves the use of lo-fidelity prototypes to express ideas and explore concepts as part of the ideation process. In addition the use of visual methods, which includes anything from stick-men illustrations to virtual reality simulations, provides techniques for overcoming communication barriers across specialisms.

Another reframing approach that has proved to be extremely effective as a source of innovation is the use of biomimetics, which relies on examples derived from nature, which has had the benefit of an evolutionary timescale. In her TED presentation, Janine Benyus of the Biomimicry Institute provides some excellent examples of new products being developed as a result of naturally occurring solutions, http://www.asknature.org./article/view/videos. She takes the opportunity to promote the Ask Nature website which can be used as an open-source resource for looking for natural solutions to problems www.asknature.org.

Applying the transformational innovation approach

In order to demonstrate how a transformational innovation model might work we can consider the problem of designing survival suits for the offshore industry. Survival suits provide personal protection to workers being transported by helicopter to offshore installations in the North Sea. In the event of a ditching, the survival suits provide protection from a range of threats, culminating in extending the wearer's survival time in adverse environmental conditions, particularly when immersed. Preferably, the suits have to be worn fully sealed to provide the best protection. In anticipating cold-water immersion, elevated levels of thermal insulation can be uncomfortable to wear in warm conditions. Helicopter passengers are offered a range of standard sizes that are not bespoke, so may not be an ideal fit. This clothing already incorporates a large number of advanced technologies in the form of advanced textiles materials and is manufactured to avoid unnecessary seams. To innovate this product it is necessary to observe how the product

[1] Serious Play is a service offered by a LEGO Serious Play Certified Partner. Its aim is to foster creative thinking through team building, using LEGO. Participants work through scenarios using bricks. It was created in the mid-1990s as a way to enable managers to describe, create and challenge their views of their business.

is actually used in practice and to consult those users who not only use the product most often but those who are responsible for cleaning and maintaining it, considering the entire product lifecycle. It is the human factors that lead to circumventing of the safety elements. We might adopt the IFR approach in reframing this problem. This would require us to imagine the ideal final result in which the new protective clothing maintains a comfortable body temperature at all times regardless of external temperatures; can stand any degree of thermal shock; is easily maintained; and is a perfect fit regardless of body shapes. Reframing this design challenge might begin by restating the problem in terms of how to provide a system capable of maintaining a comfortable body temperature regardless of all external environmental conditions.

The next step is to use ideation methods and look for new materials to extend the number of ideas that could provide the solution to this problem, for example the use of dry water[2] for providing an inner cooling system or a chemical ration heater based on a magnesium based compound which provides instant heat when in contact with salt water[3]. This could conceivably be developed within an outer layer that challenges the existing assumption that the suit is a single garment. Alternatively we can take a systems approach combining discrete functional elements. Inevitably there will be a trade-off between function/complexity and ease of servicing.

In this example the problem is reframed based on human factors, which highlight the limitations of the existing design. A reframing of the problem using the IFR technique followed by ideation methods may lead to the incorporation of new materials drawn from alternative domains.

In recent years, communities of users experimenting and sharing ideas as a result of social networking, has resulted in providing opportunities for innovations. Applying this principal to the survival suit example above, other interested groups, surfers, sailors and divers for example, provide large communities of users who are a rich resource for the development and testing of new solutions. Having a resource that includes many different types of materials and technologies used as part of a lo-fidelity prototyping kit, is an additional resource for any Innovation Centre, however an over-emphasis on the development of new technology at the core of an Innovation Centre runs the risk of developing inappropriate or over-engineered solutions to design challenges. As a reminder of this potential technology trap it is useful to recall the fable about NASA's search for a pen that would write upside down for use in space and after millions of pounds spent, the pencil was discovered. Had the problem been critically reframed in terms of 'writing implement' a cheaper solution might have been found. Although this never actually happened, it is a useful reminder of how important it is to frame the problem correctly before embarking on an innovation process.

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[2] Dry water, also known as "powdered water", is a solidified form of water, where a sandy silica coating surrounds water droplets. Dry water actually consists of 95 percent liquid water, but the silica coating prevents the water droplets from combining and turning back into a liquid. The result is a white powder that looks very similar to powdered sugar.

[3] Iron and magnesium metals, when suspended in an electrolyte (such as salt water), form a galvanic cell -- a "battery" that can generate electricity. For an example of how to build such a battery see http://www.miniscience.com/link/Airbattery.htm

There is a lot of technology that is currently being developed around the world that has yet to find an application. This includes whole new categories of smart materials for example, piezoelectric materials, shape memory alloys, temperature responsive polymers and self-healing materials. A range of solutions can be developed that may include nano-scale electronics through to advanced materials or solutions derived from natural systems. In effect there is no shortage of technologies available for innovation once the human need has been correctly identified.

Introducing key stakeholders to assist with the co-design of solutions can support radical change. This goes beyond user-centred design, which may only be concerned with existing end users but engages at the earliest opportunity with key stakeholders. These stakeholders may include 'expert users', for example this might include manufacturers, key retailers and extreme users in the form of early adopters or enthusiasts or those who had a negative experience related to the product or service. Understanding the human factors that influence the way a product is used, can be helped by adopting an empathic design approach (Malins & McDonagh, 2008). Once a new solution is implemented, USD then provides for ongoing incremental development. Figure 1 shows a diagrammatic representation of the transformational innovation process.

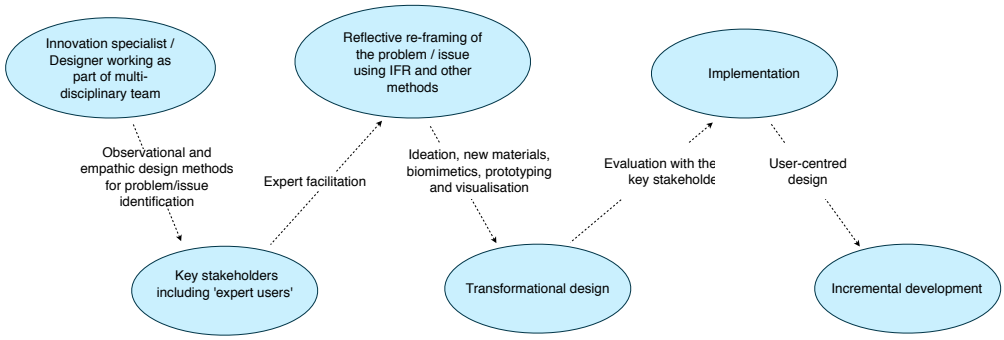

Figure 1 –Diagrammatic representation of a transformational innovation process

Conclusions

For an Innovation Centre to be effective it needs to be able to draw on a multidisciplinary team of individuals with complimentary skills and knowledge. It should focus on the identification of specific human needs as opposed to any particular technology or sector. It would begin by using techniques to critically reframe existing problems combining lo-fidelity prototyping and visualisation methods to engage at an early stage with stakeholders including end-users. It would be driven by human factors rather than by a need to exploit any particular technology. Its organisational structure would be independent of the usual hierarchical constraints commonly found in Universities and large corporations and it would encourage risk and experimentation. It would be evaluated based on measures that reflect changes in organisational culture as well as new products and services developed. Currently there is a range of models for what constitutes

an Innovation Centre, some focused very much on the development and application of technology whilst others could be more accurately described as Business Parks. There are others that apply human-centred design methods focused on bringing about cultural shifts within organisations. Despite the different models that exist it is hard to discover the underlying theoretical frameworks on which these Innovation Centres are based. There is a lack of verifiable evidence that points to a single effective methodology. What evidence exists, is in the form of Case Studies that tend only to be based on positive outcomes and are generally used for marketing purposes. Approaches range from user-centred design, or alternatively, rely on accident or chance, based on experimentation, or what Norman and Verganti refer to as 'tinkering'. An alternative model, that lies somewhere between these two approaches, which relies on a critical reframing of the problem using appropriate methods to gain new perspectives, may offer a more effective pathway to innovation. Transformational innovation that puts human needs before technology development provides the basis of a core philosophy on which to base the work of Innovation Centres of the future.

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