Menage a trois! Innovation, digital and knowledge transfer

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Published version

URUCHURTU, Elizabeth, ROAST, Chris and MASWERA, Tonderai (2018). Menage a trois! Innovation, digital and knowledge transfer. In: Proceedings of the 13th European Conference on Innovation and Entrepreneurship. Academic Conferences and Publishing International, 823-830.

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Menage a Trois! Innovation, Digital and Knowledge Transfer

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Abstract: Knowledge transfer is often seen as a mechanism to support innovation of this sort, and in this paper, we describe work aimed at developing an understanding of such collaborations. Within this setting we believe that the adoption of digital technologies can lead companies on a path that can take them into new and challenging territories. Our work focuses upon support for digital innovation for Small to Medium Enterprises (SMEs) aiming to identify alternatives/strategies for establishing effective knowledge transfer based innovation. We analysed existing digital innovation models and instruments in order to develop an understanding of the factors valued in characterising digital innovation. Our findings show that although existing approaches have a useful role in digital innovation, they are however inappropriate for SMEs, who have probably not been involved in such a transformation. In addition, this paper reports on the early instrument developed to identify potential for digital innovation based on collaborative knowledge transfer between SMEs and universities. This study provides a better understanding of the makeup and effectiveness of some of the existing digital innovation models and frameworks.

Keywords: Knowledge Transfer, Digital Technology, Knowledge Exchange, Innovation.

1. Introduction

The aim to innovate is commonly proposed as a good means of supporting commercial growth within industry as well as presenting opportunities (Arbell et al., 2016). It normally offers the prospect of moving beyond incremental changes to business models and processes improvements; enabling steep changes through developing new products and services, and also revisions to tried and tested models of operation and distribution. This research is based upon the assumption that there are a number of characteristics of digital technology that make its general role in innovation and commercial growth interesting while also often being poorly understood.

> "… computing devices are no longer isolated but connected by increasingly ubiquitous communication networks. Mobile devices and pervasive applications link their users to networked applications and to other people almost permanently. The nascent 'Internet of things' and digital/material 'hybrid' objects are beginning to link what we have to come to think of as distinct 'virtual' reality to the reality of everyday material objects." (Walker et al., 2012)

Digital-based innovation is dominant in many aspects of business transformations and developments. This ranges from operational innovation of realising and developing in-house digital capability, through to the innovative application of novel technology within a specific sector, or market. However, there are two main drivers: technological feasibility and market readiness. These often enable operational transformations resulting from: smaller, faster, more secure, more accessible (geographically and temporally), intelligent and/or automated products and services. While enabling operational improvements at the point of implementation, their potential to be disruptive within a market is high and often the innovation is in terms of business models and processes.

Despite these opportunities, there are significant challenges about how to make the best of digital innovations within business, including technological, financial, organisational and regulatory (Ramilo et al., 2014). As Berkhout and Duin (2004) put it: merely investing in product development does not suffice in a competitive digital industry.

Our research and assessment is driven by two perspectives concerning governmental and strategic support for company innovation:

- *Third party innovators* – This refers to the role adopted often by agencies and consultants, by explicitly bringing innovation to a company. Although this can appear naïve, it has the benefit of being a way of

managing, monitoring and resourcing interventions aimed at supporting innovation. Hence, it is especially relevant to governmental programmes aimed at driving innovation. It should be noted that in terms of management of innovation, value comes from collaborations (such as joint-ventures), as opposed to the transactional perspective offered by third party innovators (BSi, 2008). The third party we focus upon, in this paper, is that of University expertise (sometimes termed a "knowledge provider"). Unlike consultants and professional agencies, Universities provide a level of access to expert knowledge and insight, and thus have an interest in ensuring that their own knowledge and research expertise are employed. Hence, they are not simply facilitators but also actively transfer or apply knowledge.

- *SMEs and Innovation* – SME's are of specific interest for a number of reasons based on their strategic economic relevance (Higón, 2011). Broadly speaking they are opportunistic and flexible and while often valuing innovation they are commonly not in a position de-risk an innovation process (Auzzir et al., 2018; Beck & Demirgruc-Kunt, 2006; Garcia-Perez-de-Lema et al., 2017; Liang et al., 2017; Ramilo et al., 2014). Specifically, in our experience for digital innovative products and services "speed to market" is often prioritised by SMEs in the digital sector.

Given this setting, the problem we wish to address is from the perspective of a "third party innovator" aimed at serving and supporting SMEs:

How can companies be helped to identify opportunities for innovation with digital technologies?

There are many facets to this problem beyond specific technologies. All companies will be at different stages of creating, developing and deploying innovations, hence the current "innovation maturity" of a company needs to be understood. More specifically, innovation may be enabled or inhibited by organisational and operational factors. Naturally, linking these in the business context will normally be motivating or justifying innovation. For a third party to effectively engage and contribute, clearly these facets are all relevant.

In order to gain a deeper understanding of this problem, we have focused upon developing an instrument to assist with scoping and assessing the potential for collaborative innovation. Since our institution is actively engaged as a third party innovator for SMEs, the instrument should be useful in itself. However, its design, development and refinement will provide key insights in to the problem of helping identify quality innovation opportunities.

In this paper, we discuss different innovation models and related instruments for understanding and managing innovation. This has fed into the creation of an initial version of our instrument, which has then been critically reviewed in collaboration with knowledge transfer professionals. We conclude the paper by summarising on our early findings and plans regarding the development of the instrument.

1.1 Knowledge transfer in the context of Higher Education in the UK

Interdisciplinary work and the exchange of knowledge between participants is central to innovation (Wehn & Montalvo, 2018; Lin & Wei, 2018). Within the context of higher education, perspectives are shaped by academic disciplines and objectives. In the broadest sense, it can range from research dissemination to public and professional courses (continuing professional development - CPD), through to an academic-based contribution to business and industry, and commercialisation of intellectual property. In the UK, there have been numerous governmental reviews of how an academic knowledge base could best interact with industry needs (see Wilson 2012, Witty 2013, Dowling 2015). In the context of this work, we focus upon the value of academic collaboration with industry that has relevance for one or both parties:

- There is a strategic and sometimes financial value for academia to realise the benefits of applying their knowledge and expertise in a commercial setting. The classical view being that of arrow projects (Witty 2013), where a discovery or insight forms the core basis for a future product, patent or service. The same value is recognised through the concept of research impact - a core element of UK research excellence framework (Stern 2016, REF 2017).
- There is a pedagogic value to knowledge transfer activity for academia in that it strengthens academic awareness of contemporary practice in industry that can underpin, inform and direct pedagogic objectives and practice. Strong academia-firm interactions have positive impact on innovativeness of SMEs (Jones & Corral de Zubielqui, 2017).

- There is an industrial value to being able to access expertise and knowledge in specific domains. Academic awareness of state of the art practice has the potential to contribute to product and process improvement and growth.

While this is not an exhaustive list of opportunities, it characterises some key cases. It is important to note that the different perspectives do not necessarily align. For example, the academic desire to publish research findings is at odds with an industrial desire to gain commercial advantage from the same insights.

1.2 Concepts of Digital Innovation

Digital innovation has over the years presented companies with a competitive edge in many respects. Numerous examples exist in e-commerce and, less directly, social media. It is hard to characterise such innovations, though we can pick some common features:

- The dissolution of traditional boundaries regarding: location, distance, scale and timeframes.
- The improved automation of processes (i.e. dissolution of boundaries of skills, ability and agency)
- Access to more data (quantity and quality) and the potential for greater transparency and/or insight.

Smart products which are data driven have been emerging to complement the traditional physical products both in homes and industry (Schwab, 2015). Digital innovation impacts also upon organisations' products and services that have been digitised – such as media production and publishing (for example, see Roast, et al., 2011).

These points concur with Nylen & Holmstrom (2014) who highlight that research in digital innovation has not progressed as much as innovation research in other fields, mainly because managers lack knowledge about digital technology and its potential. Hence, there is the potential that digital innovation opportunities need to be managed differently. Two significant challenges presented by digital innovation:

- The pace of digital innovation processes is judged to be different to that of traditional innovation. This is predominantly attributable to the fact that production processes differ and that the quality and integrity of digital products is largely inaccessible and only indirectly understood. This encourages a prioritisation of speed-to-market within digital technology companies and also means they need to keep technically up to date to maintain their competitive advantage.
- Once available, a digital innovation's impact is not easily managed. Digital is present in, and core to, so many processes that innovations have the potential to skew the very business assumptions and context on which the initial concept was based. The wide reach and accessibility of digital technology underpins this disruptive influence, and cascaded innovations. The reach of digital innovation is such that it impinges on many non-digital details (see UBER Rulings - Chapman, 2017).

While these factors are not new in innovation, we'd claim their relevance and velocity is distinctive in the domain of digital innovation.

2. Review of frameworks for understanding Business Innovation with Digital technology

In our research we analysed existing digital innovation frameworks, identifying those that were diagnostic in nature and explicitly relevant to digital innovation (Barbieri & Teixeira Álvares, 2016; Berkhout and Duin, 2004; Binz and Trufer, 2017; Carayannis et al., 2018; Chanaron, 2016; Chen et al, 2018; Gkypali et al., 2018; İzadi et al. 2013; Nylen and Holmstrom, 2014; Scaringella and Silviana, 2018;).

Berkhout and Duin (2004), BSi (2007), and Nylen and Holmstrom (2014) each present a different perspective: technology-cyclic, innovation management, and components of digital innovation. These different frameworks were critically reviewed by the authors and then insights and observations compared. The resulting assessments are summarised below, for each we identify their core features relevant to formulating a comprehensive approach to understanding digital innovation.

2.1 Cyclic Innovation model

The cyclic innovation model (Berkhout and Duin, 2004) is motivated by the fast-paced technological and market developments in the telecommunications industry and how they have continually influenced the way companies innovate. However, with the advent of technological convergence across many business sectors it can be argued that its scope is not limited to telecommunications. The cyclic view is contrasted with the traditional linear model, where innovation is represented by a pipeline of sequential processes that starts at pure scientific research and ends with commercial applications. The cyclic account captures refinements that

take into consideration the feedback from the market, and three other domains, linking changes in science, business, and technology. This gives four interacting "cycles of change" (Figure 1), intending to reflect the complex, contemporary cross-boundary innovation processes.

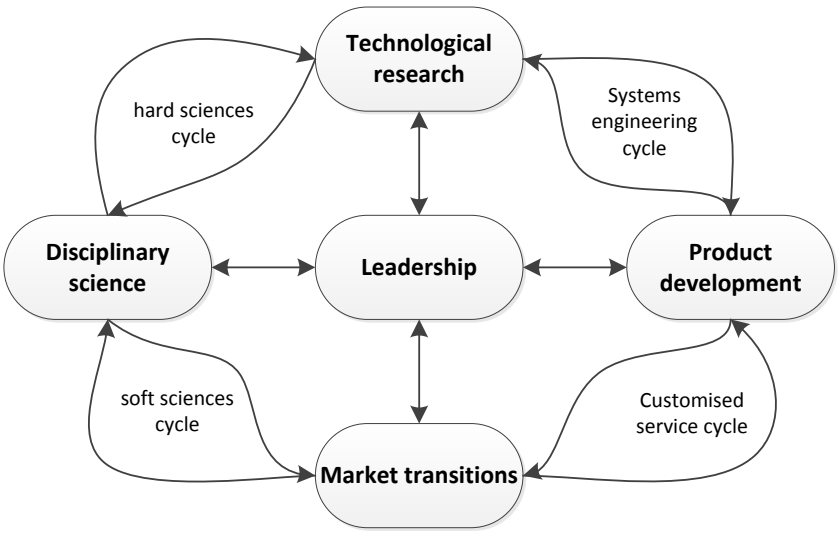

Figure 1. The Cyclic Innovation Model (Berkhout & Duin, 2004).

The model was used to analyse the introduction of a mobile data service into the Dutch telecommunication market. Berkhout and Duin (2004) discuss the complex nature of this specific venture, where a number of stakeholders contributed to the design and implementation of the service. In their analysis, they ascertain that the *Science and Technology* domain had not played any significant role in the new digital service - i.e. new science and technology components were not required to develop the new data service. While the *Market* domain played a vital role in that much attention was needed to understand the emerging business requirements and market potential during the early stages of the project. Subsequently, the understanding of the market allowed the establishment of a number of *Product* requirements (both functional and non-functional). In turn, those requirements specified the technological capabilities of the partners required in the project - i.e. software development, mobile device specs and telecommunications infrastructure.

In this example, innovation happened through the "Customised service cycle" and the "Systems engineering cycle" iteratively. Which illustrates that different innovation processes, will comprise different domain and different cycles of the model. The other cycles in the model clearly reflect viable innovation processes. However, timescales and velocity of each vary and thus shape the manner in which they may interact.

Although this model has not been used extensively, it is of value in that it is inclusive in the sense of recognising innovation drivers from a variety of stakeholders. The validity of this perspective can be found in many digital examples. From a digital focus, *Science and Technology* largely predicates innovations that are closely allied to *Market* transitions through customer engagement (and customer/market creation). Examples, such as UBER and many others illustrate this point - the technological infrastructure used has not purposefully driven the innovation. That said, the model also entertains a "reverse" flow from product concept to technological and scientific research. Some digital examples where product need has driven technological advances might be evident in Internet of Thing (IoT) development and cyber security.

In terms of our research aims, the model substantiates the view that innovation engages many facets of value that are not purely led by technology, or themselves digital. As we have observed above, the model also supports the point that digital results in innovations can gain their value in many "non-digital" contexts (principally business and market contexts). One question it does pose is whether any of the four domain and cycles represent necessary activities.

This model presents an interesting challenge for University based innovation under the auspices of KT, since it suggests that innovation in digital technology is not driving innovation within digitised markets - contrary to

the notion of arrow projects. A more positive point is that the model indicates that innovation may benefit multidisciplinary knowledge transfer that Universities could easily support.

2.2 BS 7000-1:2008 Design Management Systems. Guide to managing innovation

BS 7000-1:2008 Design management systems (BSi, 2008), sits in contrast to the process view of the cyclic model, its primary perspective is organisational and focusing upon strategy, managerial structures, features and mechanisms that support innovation. Also, unlike more rigorous notions of a 'standard', it takes the form of guidance and recommendations for supporting innovation that are to be used selectively and adaptively to suit the needs of an organisation. Despite this, the dominant philosophy is that innovation should not be approached half-heartedly. It is not necessarily an individually-driven activity or linked to specific projects or programmes of work, it is something that needs to be practiced as an organisation - an overall philosophy that will reap benefits that will not be immediately measurable or causally related to specific initiatives.

The benefits of managing innovation effectively are those common to knowledge management in general, it supports a better understanding across an organisation, sharing of experience and reduces the risk of innovation 'drying-up'. This managerial perspective means that innovating within a company is not in itself innovative; it also resists the third party innovator model -especially where the innovator has no formal interest in a project.

The framework positions itself mainly in terms of innovation as a means of identifying and meeting customer needs or drawing in new customers in a competitive market. Hence, there is a strong customer focus/drive behind innovation. This emphasis on the domains of *Product* and *Market* means that, while *Science and Technology* are clearly relevant, an innovation without *Product* and *Market* relevance is unlikely to be supported.

As a rather management heavy perspective the standard is not ideal for small enterprises, and enterprises with light management. However, the tools and techniques provided have a greater potential value. Many of the innovation techniques collated are techniques widely adopted in many digital SMEs, especially those working in the B2C context. In addition, the standard offers a number of checklists and diagnostics for assessing innovation within a company, and these are likely to be of relevance within SMEs. This offers pointers towards evidence of innovation maturity within an enterprise with long term relevance, since the practice encouraged that are likely to enable sustained and successful innovation.

2.3 Managing Digital Innovation

Nylen and Holmstrom (2014) devised a framework not only to encourage innovation in organisations but also to help them keep track of their digital innovation ventures. The framework is a product of research examining the innovation processes and the challenges and demands of new technologies. In order to be able to properly manage uncertainties brought about by innovation driven by digital technologies three dimensions were identified: the digital *products/service*; the digital *environment* and characteristics of the *organisation*. Within these, five areas were proposed as being of importance to managing digital innovation:

- User experience (in Product/Service) - The focus of products should not just focus on usability but also on engagement and aesthetics as users are affected and influenced by what the product looks like. It was argued the focus on aesthetic properties by Apple has led to its dominance in the PC market. Within the innovation management processes, the relevance of the users voice and values is also recognised though not prioritise as here.
- Value proposition (in Product/Service) - Organisations need to clearly define the value proposition of the new product or service. The framework evaluates value proposition by assessing customer segmentation. The framework analyses the target market in an effort to ensure that the product is accessible to everyone. The information from the analysis of customers will be used to determine how to customise the product for each customer segment. Value proposition also assesses the revenue from the digital product or service which goes to distribution networks.
- Digital evolution scanning (in Environment) - As digital technology evolves, firms need to continuously look at how they can take advantage of the new technologies to improve goods and services. This is done by gathering information about new and upcoming digital technologies. Firms also need to explore emerging

distribution channels and how users react to them. This relates closely to one of the innovation tactics "horizon scanning" endorsed in the BSi document.

- Skills (in Organisation) - The rapid pace at which the digital innovation process occurs needs to be matched by the skills available within a firm. The framework evaluates this process by looking at ways in which learning is supported and promoted. The learning will have to be continuous to ensure a better understanding of the unique properties of the digital technologies. Companies are encouraged to take note of staff who come up with unprompted initiatives and then put them in roles that will enable them to experiment further with these technologies. Again, this aligns closely to some of the best practices encourage by the BSi document.
- Improvisation (in Organisation) - Traditional ways of designing and developing new products and services will not work because of the pervasive nature of digital technologies. This framework promotes innovation through improvisation. It is recommended that staff be given time and space to explore emerging technologies in an effort to promote creativity and ability to innovate.

Nylen and Holmstrom (2014) devised a diagnostic tool based on these key areas. The tool is "oriented" in the sense that it each element contributes directly to a score of digital innovation readiness. The tool is also not a standalone in that it is proposed as being basis for workshops and discussions about how to support digital innovation - starting with the lowest scoring areas of the framework.

This approach has been developed for the purposes of internal review of innovation practice within companies developing digital media. While our focus is on KT and SMEs in a wider range of industries, the dimensions proposed and their components can be repurposed on a wider context.

3. Developing an Instrument

Bringing together our findings and observations we have developed a pilot diagnostic instrument. This combines ideas from the three frameworks with the aim of helping to address our initial question. Specific attributes of the pilot instrument are: conciseness (for enabling engagement); generality (to cover the diversity of innovation contexts involving digital technology); digital relevance.

The instrument comprises a series of statements aiming at ascertaining a company's business strategy, and their approach to innovation and product/service development and value proposition. Also, company's understanding of their: market, segments and customer expectations; attitude to digital horizon scanning; and approach to the development of knowledge and skills among staff.

To date, the pilot instrument has been collaboratively assessed by nine KT professionals, ranging from 2 to 25+ years of experience in KT and Innovation roles. The full analysis of feedback and refinement of the pilot instrument is currently being conducted. However, on the whole, feedback has been positive with most critical elements concerning operational specifics regarding how it would be used in practice. Other points raised concern: the difficulties of keeping a digital focus (when an innovation may not involve an intrinsically digital advance); the extent to which companies have clear goals; and the importance of managing company expectations of KT, among others.

4. Conclusion and Future work

Our analysis shows that existing innovation frameworks have got a useful role to play in understanding innovation. However the distinctive nature of digital innovation is not easily identified, thus these frameworks may not be suited to companies with limited resources, light management structures, and no specific or explicit innovation goal. The three models reviewed represent different perspectives upon innovation, ranging from managerial to digital solutions. Nylen and Holmstrom (2014) is the closest to the diagnostic instrument we believe will enable to assist companies identify potential for innovation. However, in general, evidence backing their validity is limited.

Our original research interest is: How can companies be helped to identify opportunities for innovation with digital technologies? The three areas of interest shaping our work are: the distinctiveness of digitally based innovation; the role of knowledge transfer principally via third party innovators, and supporting SMEs. Only

the first of these is addressed by the previous work of Nylen and Holmstrom (2014), while the second is discouraged by the British Standards Institution (2007).

Following a review, features of the models and frameworks analysed have been used to develop our own pilot instrument for address our original question. The next stage of this project is additional to the formative validation work, prior to applying the instrument within digital innovation opportunities coming from a "live" innovation programme for supporting SMEs.

The differentiation of digital and other technologies in innovation partly reflects the fact that digital is still novel in many respects. As such the authors are conscious that there are on-going legislative and regulatory changes that do, and will, impact upon digital services and their use of data (Government UK, 2017). Hence, while digital can view as presenting extensive new opportunities, it is worth noting that some innovations may be constrained.

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