

# How Might Models of Innovation Inform the Management of Knowledge?

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**Abstract.** Small to medium sized enterprises (SMEs) tend to have the lowest take up of patents as a means of securing financial benefits for an organisation's codified knowledge [1]. This characteristic has led me to undertake research into knowledge management with the focus on such organisations. More specifically, I am currently concerned with developing an understanding of how models of innovation might offer new insight to theories currently centred in the area of knowledge management. This paper is a vehicle for expressing my findings related to the interplay between models of innovation and knowledge management in the literature to date and will provide some of the underpinnings for the rest of my PhD study.

## 1. Introduction

The paper is structured in the following way – firstly, I will define what I understand by innovation and knowledge, drawing from selected current thinking on these processes. I will then go on to introduce a handful of innovation and models of knowledge management. The penultimate section will identify commonalities between the two categories of models and surface potential synergy between them. The paper will close with a summary of future research plans.

The following definitions of innovation and knowledge will lay the foundations for examining the models of innovation and knowledge management. Miller and Morris describe innovation as “the process of transforming an invention into something commercially useful and valuable” [2]. Rogers has also described this as “an idea, practice or object that is perceived as new” [3]. Harkema and Browaeys [4] acknowledge the work of Nonaka and Takeuchi [5], defining innovation as “structural and mental knowledge processes”. Knowledge has been considered to encompass a “fluid mix of framed experience, values, contextual information and insight” [6], ‘what a knower knows’ [7] and even putting information and people's competence to work together [8].

## 2. Models of Innovation

It is relatively easy to identify an acknowledgement within writers in the field of innovation of the importance of knowledge [2, 3, 4], but to what extent this literature overlaps with knowledge management models and writing is less clearly delineated. Traditionally, the approach to modelling the innovation process has been linear [9]. This is underpinned by the conception that pure science progresses in a straight line to applied science through to its development in an industrial setting. The reason that the linear approach has held sway is related to the expectation that investment in research and development will provide organisations with a competitive advantage [10]. However

Yildizoglu [10] recognises that investment carries a strong underlying risk of uncertainty. Critics of the linear approach argue that it is essentially reductionist, thereby failing to recognise what is occurring in the wider environment and seeing knowledge move in this same linear way. From reading of the current literature, two aspects have arisen in response to this traditional approach. Firstly, criticism of this approach, has led other writers to try to develop alternative models [9, 11]. Secondly, there has been an attempt to develop the traditional model, itself, through the use of feedback loops.

### *2.1 Fourth Generation Innovation Model*

Developing new models related to understanding the innovation process, Miller and Morris [2] are concerned with companies looking afresh at the process of innovation. They describe what they term, third generation research and development as incorporating the use of feedback mechanisms. Their conception of a fourth generation model acknowledges an appreciation of knowledge as part of the process of creating new products and processes. They, as with many writers in the field of knowledge management, acknowledge the debt that the field owes Polanyi [12]. They consider that what is explicit is the informational aspect of knowledge, whereas that part of knowledge that is concerned with experience is akin to tacit knowledge [2].

They see a correlation between the tacit / codified split and the process of innovation. As their work is concerned with developing the capacity of an organisation to innovate, they say that “Success at creating new dominant designs depends to a significant degree on discovering new tacit knowledge, and then transforming it into an explicit form so that an innovation team can discuss it, refine it and apply it in their work” [2].

Von Hippel [13] alludes to the idea that the higher the degree of expertise required to create new products correlates with the level of expertise latent at a particular organisation’s site. The term he uses to describe this is “sticky information”. In this way it is evident that the innovation process is concerned with development of a product and successive evaluation and refinement by users in the creation of the product.

### *2.2 “Complex Adaptive System” Model*

From Harkema and Browaeys’ [4] definition of innovation, they assert that there are two characteristics that determine whether a process is innovative. They state that these are – the ability to produce new ideas and from this, the ability to transform these into something they describe as ‘successful’. They conceive that the definition of innovation is linked with the idea of invention and might actually be interchangeable with it. Within an historical context this has been closely associated with industrial manufacturing. However, as the industrial revolution has been superceded with, what has been termed the ‘knowledge revolution’; there has been a similar shift in understanding of how this impacts on a traditional definition of innovation. With this change, they argue, innovation is now “a process wherein knowledge is absorbed, assimilated, shared and used with the aim to create new knowledge” [4]. In this they see an explicit linkage with the work of Nonaka and Takeuchi [5]. They recognise that this shift in emphasis will affect how innovation models are developed. They think that traditional models of innovation are grounded in traditional economic theory. By taking in to account the complexity of knowledge, they perceive the idea of innovation or, as they perceive it, knowledge creation, to be itself a complex system.

### *2.3 “Churn” Model*

A different approach is suggested by Rogers and Bozeman [9] that they term 'churn' to emphasise that during the innovation process, knowledge is used and transformed at various stages. They suggest that linear models suffer from unrealistic assumptions in part due to their sequential approach to innovation. As part of their model they identify the need for a new definition of knowledge. Using their model, Rogers and Bozeman are attempting to show how knowledge fits in to the overall process of innovation. They highlight the conception that knowledge is transformed during the various stages of innovation which they describe as a "use and transformation theory" [9]. In some respects this may simply be a further iteration of the view posited by Morris and Millar [2].

#### *2.4 Summary*

All the approaches to modelling theories of innovation appear to recognise a central aspect that innovation involves an activity that yields economic value at an economic cost. Those writers who are interested in understanding the innovation process understand the underlying economic importance to organisations of developing a successful model of the innovation process that might be utilised in practice.

### **3. Knowledge Management Models**

There is a lengthy tradition in the study of European philosophy, stretching back to Plato and Socrates that attempts to examine what constitutes knowledge, its characteristics and boundaries. In the present climate, organisations appear equally concerned with understanding aspects of knowledge and their relevance to enhancing the work of a particular organisation. Literature in the field of knowledge management has proliferated in recent years as organisations attempt to address the shift from a production based economy to "the practice of harnessing and exploiting intellectual capital to gain competitive advantage" [14]. Nowhere is the need to manage knowledge more evident than in the research and development process of organisations, where, a key component of a successful organisation is the ability to develop new products. Traditionally patent grants have been used as a measure of organisational success or economic health. Amongst writers of innovation the economic value of research and development has been acknowledged as has been mentioned, supra [10]. However, there appears to be no corollary among writers in knowledge management.

#### *3.1 Knowledge Spiral Model*

Nonaka and Takeuchi [5] take their work from the start point of trying to separate out tacit and codified knowledge. They are specifically concerned with 'knowledge conversion', which might be considered as having a relevance to theories about knowledge in relation to innovation. Their work stems in large part from the forerunner in the field of knowledge management, Michael Polanyi [12]. He was concerned with examining aspects of tacit knowledge and how it affected the work of scientists. Tsoukas [15] attempts to formulate a conception of both Polanyi and Nonaka and Takeuchi's work, perceiving the distinguishing feature of Polanyi's work that he attempts to show a common structure that underlies all types of knowledge. In relation to tacit knowledge, he observes that three elements need to exist for tacit knowledge [15]. He sees distinctions between Polanyi and Nonaka and Takeuchi because he thinks that the latter perceives tacit knowledge and simply knowledge that has not yet been articulated. Essentially Tsoukas does not develop his own model but rather supports Polanyi's view that it is not possible to make explicit that

which is tacit. Both Polanyi [12] and Nonaka and Takeuchi [5] are implicitly referenced in Johnstone's [16] work, where knowledge is said to be a 'state of mind' that involves three things identified as 'the conceptual dimension, epistemic dimension and informational dimension'. It is stated that the first two dimensions are within the individual, the last, most closely associated with the idea that knowledge can be managed as it refers to the content of knowledge that can be considered to be accurate or factually correct.

### *3.2 Cycle Model*

Blumentritt and Johnston's work [17] is an attempt to draw together key thinking in the area of knowledge management to enable a distinction to be drawn between information and knowledge, and provide a framework encapsulating the various strands of thinking about knowledge into an overarching structure.

They believe that there are three strands to the approach the literature has taken in relation to knowledge management. The one that concerns this paper is how knowledge itself is managed. They believe that the literature has been concerned with capitalising on knowledge creation, acquisition and flow. Their work emanates from the perspective that little attention has been given to the characteristics of knowledge itself, or what makes it special and therefore have an economic value. They acknowledge the legacy of philosophical thinking in epistemology, which they say identifies three distinct types of knowledge – "of things and objects, how to do things and of statements or propositions" [17]. They go on to identify various other writers who have attempted to categorise knowledge – Lundvall, Collins, Millar, Blackler and Fleck. From these categorisations, they have developed their own framework to categorise knowledge. Within this framework there is an increasing level of difficulty associated with transforming knowledge in to information. They develop their framework further by challenging the contention that information systems may be used interchangeably with knowledge management systems. Instead, they posit that knowledge can only exist within the mind of the individual. By creating a clear distinction between knowledge and information they attempt to develop a model which shows the links between knowledge and information.

One of the models that they have developed bears great similarity to Nonaka and Takeuchi's Knowledge Spiral [5], showing it within the context of the transformation of knowledge into information and back through the cycle to knowledge. Blumentritt and Johnston's [17] cycle is intended to enable identification by users to identify where suitable mechanisms can be introduced to manage information and knowledge.

### *3.3 Summary*

The approaches to knowledge management rely heavily on the initial work of Polanyi and Nonaka and Takeuchi. A central feature of knowledge management theory is to distinguish between codified and tacit knowledge and formulate a model to show how they transform from tacit to codified and vice versa. Unlike innovation theorists, writers concerned with understanding knowledge management do not exhibit the same understanding of the economic importance to organisations of developing a successful model that might be utilised in practice.

## **4. Links**

Looking at some current models relating to innovation and knowledge management it is possible to see that there are links between writers in both fields.

Writers in innovation have traditionally developed a linear model to attempt to understand what takes place during the process of innovation. The essential characteristic of the linear model is the view that innovation proceeds along a straight line. Current literature in innovation now seems to recognise the inadequacies of the linear approach. Instead, particularly in the work of Rogers and Bozeman [9], innovation theory is seen as cyclical in the use, transformation and re-use of knowledge. Akin to the knowledge spiral of Nonaka and Takeuchi [5], Millar and Morris emphasise a 4<sup>th</sup> generation approach to innovation which itself advocates a knowledge creation spiral. Their description of knowledge is that it “is created and used only by individuals and communities of people, and has no tangible expression beyond what people bring to it” [2]. Harkema and Browaeys [4] support to the idea that innovation models need to develop to deal with the complexity of understanding knowledge in the innovation process a view also espoused by Rogers and Bozeman [9] in their ‘churn’ model.

Writers in knowledge management have favoured a more linear approach also, seeing knowledge in terms of reducing it to its informational attributes, e.g. database creation, knowledge banks. The exception to this can be seen in the work of Nonaka and Takeuchi [5]. They have developed a transformational understanding to knowledge management creating a theory of a ‘knowledge spiral’. Nonaka and Takeuchi’s theory is closer to the current innovation theorists’ views of knowledge in the innovation process.

Another aspect of the innovation process is to successively refine a product or service to enhance an organisation’s economic wealth. Writers in innovation refer to successive iterations of creating something new that is also economically viable. It is for that reason that Yildizoglu [10] highlights the tension between financial investment in organisational research and development and the inherent risk associated with this type of financial investment. Barth refers to “harnessing and exploiting intellectual capital to gain competitive advantage” [14]. However, actually measuring the investment in managing knowledge balanced with its return is not so easily identified. Part of the difficulty with models of knowledge management is the differing conceptions of what constitutes knowledge. The lack of a more unified view of what constitutes knowledge leads to confusion about what measurements might be used to assess the economic worth of managing knowledge.

By identifying similarities and distinctions between writers in innovation and knowledge management theory, the latter theories appear to exhibit characteristics which would suggest they are still in their infancy in terms of understanding the management of knowledge.

## **5. Possible Future Research Directions**

Having considered some models of innovation and knowledge management, there are some commonalities that do exist. However there are further questions that arise from examining the links and distinctions that do exist.

Questions that might be posed are to what extent the models of innovation mirror those of knowledge management in trying to understand the cyclical nature of transforming information in to knowledge and vice versa. Does Nonaka & Takeuchi’s work implicitly acknowledge the ‘churn’ model and what differentiates them? Is this an example of co-evolving tacit and codified knowledge? Does this offer a way of approaching knowledge management?

What significance do these theories have for SMEs, as most of the current research in knowledge management appears to focus on large organisations? Do SMEs display unique characteristics, particularly given the economic considerations of innovation and the

potential lack of knowledge management research focused in the area? Have models of innovation addressed this explicitly? Is there research specifically related to SMEs from the innovation literature that might offer insight to theories of knowledge management?

As the current literature has used patent output as a measure of the innovativeness of SMEs, it could be asked whether this is the right method of measurement? Would a clearer picture emerge from developing quantifiable measures regarding innovation and its interrelations with knowledge management?

Having offered definitions of innovation and knowledge management, considered some current models in both spheres and identified links existing between these two areas, a number of potential avenues for further research have been highlighted.

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