



Knowledge and quality management: An R&D perspective

Dilani Jayawarna^{a,*}, Robin Holt^{b,1}

^a MMU Business School, Aytoun Street, Manchester M1 3GH, UK

^b The University of Liverpool Management School, Chatham Street, Liverpool L69 7ZH, UK

ARTICLE INFO

Keywords:

Research and development (R&D)
Quality management
Knowledge management
Exploration
Exploitation

ABSTRACT

The nature of knowledge management in a research and development (R&D) environment and the implications for the use of quality systems are examined. We suggest knowledge inquiry in an R&D context is localised, provisional, mediated and pragmatic. Using case study analysis of seven technology-based UK R&D organisations we investigate their experiences and how use of quality systems promotes and/or discourages the exploration and exploitation of R&D knowledge. We argue that the knowledge-intensive nature of R&D activity, coupled to the endlessly re-constructed nature of the knowledge, precludes the use of generic frameworks or best-practice guidelines. We conclude that the use of quality systems in R&D environments are most effective when they provide an organisational background or frame within which individuals are encouraged to undertake inquiries that are integrated with the firm's strategic concerns without these concerns being at all fixed. Such systems are least effective when they externally impose procedures as unmoveable and immutable "blueprints".

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1. Introduction

The rise of the "network" or "information" economies (Castells, 2000; Nonaka et al., 2001; Roos et al., 1997; Volberda, 1998) signified by terms such as "intensive", "innovative" and "flexible" suggest that firm performance is increasingly predicated on the efficient and effective use of knowledge (Grant, 1996). Acting knowledgeably, rather than repetitively, is becoming critical because not only does it prompt learning from experience and provide insight into possible commercial futures, it is hard to imitate and can be strategically distinctive (Kogut and Zander, 1992). The knowledge management task can blend a depth and richness of experience (exposing people to new ways of doing things and enhancing problem-solving capabilities such as experimentation) with a sufficient procedural clarity and control to exploit such knowledge. It is this blend of exploration and exploitation that Hage (1999) calls looking to the consequences as well as causes of innovation. So managing knowledgeable activity requires the ability to create strategically useful insight and skills as well as providing the means by which these can be made organisationally available through articulation, codification, transfer and transformation (Argote et al., 2003). This involves managers devising and establishing routines that help stimulate and diffuse innovation throughout the firm's structures and

communities, whilst remaining focused on what actions are helpful, in which circumstances, and in what ways the generation and evaluation of innovation contributes to performance (Feldman and Rafaeli, 2002; Knudsen and Levinthal, 2007). The ever-present risk is that this balance between exploration and exploitation becomes skewed to the latter as routines encourage settled activities and rigidities (Lemon and Sahota, 2004; Zollo and Winter, 2002). Established knowledge becomes a source of comforting certainty that reduces exposure to potential future opportunities (Garud et al., 2008).

In casting knowledge management as a practice oscillating between creativity and control (Lessem, 2001), researchers require a richer awareness of how innovation arises from continually negotiated and socially embedded patterns of organisational activity within and between firms. These activities can consist of specific knowledge claims, background norms, material objects and technologies, organisational procedures, collective habits and the wider institutional context. Resource-based views of the firm typically emphasise knowledge as a skill or asset with the managerial role being the recognition, absorption and exploitation of these skills and assets using organisational routines. We suggest that equally important for knowledge managers is an awareness of how innovation arises from the creative agency of those being organised (Pitelis, 2007; Tsoukas, 1996). For example, Skovvang et al.'s (2003) study of Danish firms suggested that a critical aspect of successful knowledge management was the idea that different assumptions about the nature of knowledge requires different management approaches. From this perspective, the use of organisational routines is often counter-productive if managers are insensitive to the localised behavioural

* Corresponding author. Tel.: +44 161 247 6076.

E-mail addresses: d.jayawarna@mmu.ac.uk (D. Jayawarna), r.holt@liverpool.ac.uk (R. Holt).

¹ Tel.: +44 151 795 3714.

as well as structural conditions in which they are applied (Berends et al., 2003). This means routines, where they are used, can be adapted, so that organisational habit becomes a contested terrain (Engeström and Blackler, 2005). Moreover, management cannot presume itself working on something “at a distance”, the knowledge being “recognized”, “encouraged” and “exploited” remains intimate to their own activities as well as to those for whom innovation is an explicit responsibility.

In this paper we examine the exploration and exploitation of knowledge within research and development (R&D) and new product development (NPD) activities in a number of large firms. It is these organisational activities which occupy a continually negotiated threshold between creativity and control and exploration and exploitation. Specifically, we studied the use of quality systems in R&D contexts. Whilst not overtly a knowledge management tool, there is substantial overlap in that quality systems articulate and codify a firm’s activities and skills. In Zollo and Winter’s (2002) terms, this articulation and codification converts accumulated experience into knowledge by making explicit learning that otherwise would remain mute, ad hoc and hence strategically unavailable. Here knowledge is understood as a mode of understanding and co-ordinating innovative insights and strategically appropriate behaviours (Lorenz, 2001). The R&D context is particularly germane because it is an exploratory activity to which the structured and repetitive nature of quality systems appears somewhat antithetical. Yet, R&D activity involves investigating what might be known in order to transform it in strategically beneficial ways. So whatever the quality of imaginative exploration, the resulting insight needs to be embedded into wider organisational routines in order to deliver sustainable competitiveness (Bossink et al., 1992; Lyons et al., 2008). It is in integrating insight, procedure and performance that quality systems are deemed potentially most effective.

Evidence of the effectiveness of quality systems within R&D comes from a variety of sources. Miller (1995) conducted a quality study in R&D units of 45 large international firms and concluded that “not only is the quality movement applicable to R&D but it brings a new mindset to the task of effectively managing R&D” (Miller, 1995, p. 51). This new mindset has delivered benefits to a number of firms. For example, Eastman Kodak’s Research Organisation showed a continuous upward growth with research output and competitive advantage from innovation showing marked improvements through institutionalising Total Quality Management (TQM) practices (Munir and Philips, 2005). AT&T reported that within a two-year period of quality system implementation the product development cycle for their software was reduced by 50% with an associated ten-fold decrease in faults found by customers (Endres, 1997). Survey results of several leading US R&D organisations also claim a positive response to using quality systems in R&D environments. This suggests that a majority of firms have “not only maintained but actually accelerated implementation of quality processes” in order to effect further improvements (Davidson and Pruden, 1996, p. 52). More recently, using case study evidence from a number of R&D organisations operating in the UK, Jayawarna and Pearson (2002, 2003) commented on the benefits for R&D organisations in combining formal quality standards with improvement initiatives at the project, process and strategic levels. Based on empirical data from 194 Australian R&D Organisations, Prajogo and Sohal (2006) showed the benefits of integrating Total Quality Management and Innovation Management systems. TQM practices are highly effective in building various capabilities within R&D and these capabilities go beyond supporting product quality to include process innovation and learning (Prajogo and Hong, 2008).

Notwithstanding the reported improvements, there is little empirical evidence for the contribution quality systems make to

activities that reproduce and transform R&D knowledge. Moreover, where evidence does exist, as in the cases above, it veers towards an association of growth patterns and R&D investment levels, rather than any qualitative analysis of the potentially creative R&D activities themselves (Patino, 1997). Moreover, there is much in the way of contrary evidence suggesting that R&D and related service functions are the last activities within an organisation to be touched by quality concerns (Berson and Linton, 2006). As these authors go on to say, even where quality systems are used there is often discrepancy from those measures used in manufacturing or sales. May and Pearson (1993) noted that while some characteristics of R&D make it a natural arena for quality systems application, others mean that it requires careful tailoring and customising. We argue that gaining a richer and more critical understanding of the use of quality systems within a knowledge-intensive environment requires a more critical awareness of the character of the knowledge being reproduced and transformed (Lyons et al., 2008; Yang, 2008). Using case study analyses of seven technology-based R&D organisations in the UK, this paper therefore aims to: (1) explore the experience and use of quality systems within R&D organisations and (2) understand how these systems promote and/or discourage knowledge exploration and exploitation.

The paper is structured as follows. It begins with a review of literature associated with knowledge and R&D activities. The methods adopted in this research are then discussed and this is followed by presentation of the data. The analysis of these data is then presented with reference to a four-fold typology of knowledge. We finish the paper with a discussion of the findings, implications for stakeholders and direction for future research.

2. Conceptualising knowledge and quality systems in R&D activities

2.1. The nature of R&D management

A number of writers on R&D management (Nobelius, 2004; Rogers, 1996; Rothwell, 1992) have discussed its development in generational terms. From these accounts it is clear that organisation of the R&D function has undergone many changes and has broadened its boundaries to adapt to the changes in organisational structure and environment (Howells, 2008; Jones, 2000). Within the quality literature, Miller (1995), for example, illustrates the evolution of R&D activity by means of a four level “ladder” whose “rungs” rise from scientific aloofness through a process of gradual organisational integration to full strategic influence via the adoption of quality systems. Similarly, Francis (1992) identifies a set of R&D tenets isomorphic to those of quality concerns. Both studies show that the consistent distance between quality management and R&D management is narrowing as a result of overlapping interests. Nobelius (2004) has gone further to predict the next R&D generation will interact with the business environment and gain competitive advantage through integrated systems and sharing of “best quality practices”.

The implication is that R&D can benefit from applying quality systems to its operations insofar as these systems assist in the exploration for and exploitation of strategically relevant knowledge. Yet differences between R&D activity and other organisational activities need to be acknowledged. Tenner (1991), for example, argues that non-manufacturing processes such as R&D differ from their manufacturing counterparts in three ways: the direct involvement of customer in the delivery of services; intangible outputs; and non-repetitive processes. These practice-specific elements of R&D mean any quality system has to be managed differently than those applied to manufacturing

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