Abstract

The aim of this paper is to contribute to understanding the nature of specialist and generalist human capital by exploring the ways in knowledge workers view their experience of working in specialist and generalist roles in pharmaceutical firms in Ireland and the UK. The findings are based on interviews with 55 knowledge workers employed in a range of scientific, technical and managerial positions in four Irish and two UK firms located in the pharmaceutical sector. Interviews were also conducted with nine human resource/training and development managers within these six firms.

The findings suggest that the categorisation of human capital as either specialist or generalist is too rigid and does not take account of the fact that individuals may themselves choose to shape their careers by investing in a range of education, training and development opportunities that will enable them to move between specialist and generalist roles. The paper unpacks the concepts of specialist and generalist human capital from an employee perspective and challenges the sharp distinction that is made between specialist and generalist human capital.

Keywords: human capital**;** specialist; generalist; knowledge workers; learning; pharmaceutical sector.

Paper type- Research paper

Introduction

Organisational learning has become an important topic of research as firms seek to leverage its benefits in their ongoing quest for competitive advantage. In this regard, the notion of “ambidextrous learning” or “the balancing of the processes of exploitation and exploration” has become particularly important (Kang & Snell, 2009, p. 71; Raisch & Birkinshaw, 2008). In a recent article, Kang and Snell (2009) present a framework that considers how firms might achieve ambidextrous learning through the management of human resources. As their framework is theoretically positioned, it is as yet untested.

This paper reports on the findings of research that provides insights into how one element in Kang & Snell's (2009) intellectual capital architecture – human capital – is utilised in the pharmaceutical sector in Ireland and the UK. In this sector, the balancing of the processes of exploration, concerned with "search, variation, experimentation and discovery", and exploitation, encompassing activities such as "refinement, efficiency, selection, and implementation" (March, 1991, p. 102), is particularly crucial given the sector's commitment to both the development of new drugs and the full utilisation of existing drugs. The pharmaceutical sector also employs many highly educated and skilled knowledge workers, frequently educated to doctoral level, who represent an extensive human capital investment. How the return on this investment might best be achieved is an issue of ongoing concern to the sector (Rothaermel & Hess, 2007).

In the context of organisational learning, Kang & Snell (2009, pp.68-69) encapsulate this investment dilemma in stating: "a central issue that firms face is the value of specialist versus generalist human capital". Specialist capital is seen as embodying "domain-specific knowledge within a narrow range of parameters" and is "linked to exploitative learning"; generalist human capital, in contrast, is "more broadly positioned in multiple knowledge domains" and is "more predisposed to exploratory learning". In their model, Kang & Snell describe the different types of HR practices that support the development of these two forms of human capital.

While a case for the distinction between specialist and generalist human capital might be argued at an organisational level, little is known about how such a distinction might impact on those at the receiving end of such a strategy. In this paper we therefore ask the question: how do knowledge workers view their experience of working in specialist and generalist roles? In answering this question, the paper draws on interviews with 55 knowledge workers who were employed in a variety of scientific and engineering related positions within six firms located in the pharmaceutical sectors in Ireland and the UK, together with insights provided by nine HR and training/development managers. The paper's contribution lies in its unpacking of the notions of specialist and generalist human capital from an employee perspective. In so doing, the paper begins the process of exploring the human capital element within Kang & Snell's (2009) model and of elucidating the importance of generalist and specialist human capital in organisational learning. At the same time, the findings respond to the call to "restore employees' experience of work to the heart of HRM research and practice" (Boselie, Dietz & Boon, 2005, p. 82).

Specialist and Generalist Human Capital

While there are many factors that affect the ability of firms to learn, human capital, defined as "the knowledge, skills, abilities and experiences of individuals" (Kang & Snell, 2009, p. 68), has been identified as a crucial underpinning to organisational learning (Argyris & Schon, 1978; Crossan, Lane & White,1999; Swart & Kinnie, 2010). Kang & Snell further argue that "the implications of human capital on learning are fairly straightforward in that, in individuals, diverse knowledge of multiple domains versus deep knowledge in a specific domain has different effects on their future knowledge search behaviours or mind-sets as well as the diversity of current knowledge available" (p. 68). The domain-specific knowledge embodied within specialist human capital has been shown to be effective for acquiring and assimilating new, in-depth knowledge within a narrow range of parameters (Brown & Duguid, 1991). Thus, incremental innovation is related to the possession by employees of specialized in–depth knowledge and skills (Kang & Snell, 2009; Subramaniam & Youndt, 2004). At the same time, this type of human capital may not possess the willingness or the ability to exchange and combine new knowledge beyond its specialised areas (Bunderson & Sutcliffe, 2002; Dougherty, 1992; Kang, Morris & Snell, 2007).

In contrast to specialist human capital, generalist human capital is seen as less entrenched in a particular functional perspective. In decision making processes, generalists are seen as possessing the capacity for varied interpretations of problems and situations (Bunderson & Sutcliffe, 2002). In addition, generalists are seen as providing firms with the greater adaptability required for organisational learning (Wright & Snell, 1998) and as an important mechanism for discovering new opportunities that depart from existing knowledge stocks (Shane, 2000). Thus, generalist human capital not only provides the variety of knowledge immediately available for alternative tasks, but also the potential adaptability to discover, comprehend, combine, and apply new knowledge in the future (Shane, 2000; Taylor & Greve, 2006). Overall, in drawing on the work of a variety of writers (e.g. Brown & Duguid, 1991; Bunderson & Sutcliffe, 2002; Dougherty, 1992; Iansiti, 1993; Shane, 2000), Kang & Snell (2009, p.69) conclude that “specialist human capital is *ceteris paribus* less likely to focus on exploration and more likely to focus on exploitation”, while “generalist human capital tends to be more predisposed to exploratory learning”.

The differentiation between specialist and generalist human capital has implications for the types of human resource (HR) practices that might be adopted. Kang & Snell (2009, p. 79) suggest that firms that focus on developing generalists will focus on future skills requirements and use what they term “skill-based development” that will include “broad and multidimensional job designs and job rotations” as well as “recruitment/selection based on potential”. In contrast, they suggest that firms that focus on developing specialists are likely to use “job or function-based development that involves intensive training that improves existing job-related skills, as well as narrow job designs, focused career development, and recruitment/selection based on the fit between persons and jobs” (ibid, p.79). However, while Kang & Snell (2009) emphasise the importance of ‘fit’ in their analysis, the need for ‘flexibility’ has also been identified as of crucial importance (Wright & Snell, 1998). In addition, little is known about the ways in which such HR practices might impact on those at the receiving end, particularly in the light of recent research that calls for an employee-centred perspective to be adopted in understanding the impact of human resource management practices on employees themselves (Boselie et al., 2005; Conway & Monks, 2009; Kinnie, Hutchinson, Purcell, Rayton and Swart, 2005). The next section moves to considering the ways in which knowledge workers might view such strategies as these workers are regarded as crucial to both the exploitative and exploratory types of learning that are needed within the pharmaceutical sector.

Knowledge Workers

While a wide variety of knowledge workers may be employed within the pharmaceutical sector, two types are of interest to this paper: scientists and engineers. Both categories of employees fit the definition of knowledge workers suggested by Swart (2007, p. 452) as “employees who apply their valuable knowledge and skills (developed through experience) to complex, novel and abstract problems in environments that provide rich collective knowledge and relational resources”. This definition, while focusing on the expertise that is at the heart of knowledge work, also captures the intricacies of the relationship between knowledge workers and their employing organisations. On the one hand it has been suggested that knowledge workers are more or less independent operators, responsible for their own self-development and much more committed to their occupation rather than their employing organisation (Reed, 1996). However, more recently it has been argued that, given the combination of theoretical and contextual knowledge that is important for knowledge creation, knowledge workers are dependent on their organisations for access to a variety of resources and that there are limits to knowledge workers’ autonomy (Alvesson, 2000; Tam, Korczynski & Frenkel 2002). Thus, while the opportunities to develop the generalist skills that are of relevance in broader labour markets may be of crucial importance to knowledge workers (Gardner, 2005), at the same time the organisation has a key role to play in managing the employee’s career (Baruch, 2006) and their aspirations and expectations (Tam et al., 2002).

Swart (2007, p. 463) applies the notion of “knowledge trading” to understanding the symbiotic processes involved in managing knowledge workers. She suggests that knowledge workers are dependent on the organisation for access to other skilled employees who can complement their skills, as well as the resources and technologies of the organisation. The organisation, on the other hand, is reliant for its competitive advantage on the knowledge and skills of its human capital. However, in order to reduce the tensions that such "knowledge-trading" might create, Swart suggests that knowledge-based organisations will need to "strike a balance in their skill development agenda between organisation-specific and transferable skills" (ibid, p. 464). In the case of knowledge workers such as scientists and engineers, such "knowledge trading" might be particularly important. Finegold & Frenkel (2006, p. 5) argue that the management of scientists will require a careful blending of the provision for individuals of the operational autonomy required to organise work and solve problems, with the provision of adequate resources and the coordination of the interdependencies that exist with other units. The various ways that organisations have tried to manage these tensions are noted by Lam in studies of research and development (R&D) scientists (2005) and engineers (1994). These include the provision of parallel managerial and technical career tracks to enable the balancing of professional and managerial commitments and "hybrid" career options that consist of "cross-functional, project-to-project and mixed technical and managerial roles" (Bailyn, 1991, p.3). Lam's (2005) research on R&D scientists in five pharmaceutical firms noted the new pressures on scientists in network firms where they are expected to be both "corporate and professional scientists", (p.256) roles that caused them considerable anxieties. Additional pressures, referred to by Lam as the "specialization-flexibility dilemma" (ibid, p. 259) emerged from the emphasis on project-based work arrangements in which many R&D scientists found it difficult to maintain their core expertise.

In summary, the delineation between specialist and generalist roles may be particularly complex in environments that employ knowledge workers such as scientists and engineers. This complexity was explored in the present study by examining the ways in which such roles are experienced by scientists and engineers working in the pharmaceutical sector in Ireland and the UK.

The Research

The research is part of a study of knowledge intensive firms (KIFs) in the pharmaceutical and ICT sectors that is being undertaken as a collaborative project between research teams based at Dublin City University in Ireland and Kingston University in the UK. The study examines the impact of industrial policy, labour market regulation and firm strategies and practices on skills and broader employee outcomes in KIFs in these two countries and includes both industry and firm level surveys and interviews. This paper reports on the interviews in the pharmaceutical sectors in which a qualitative approach was used to collect and analyse data (Miles & Huberman, 1994; Streb, 2009).

The Pharmaceutical Sector

The Irish and UK pharmaceutical sectors differ substantially from one another in a number of respects. While the pharmaceutical sector in Ireland is crucially important to the economy, there is no indigenous industry and its growth and development is mainly the result of Government policy that aims to attract multinational corporations to invest in Ireland. Although highly skilled staff are employed in the Irish pharmaceutical sector, they are not necessarily working in dedicated R&D units but are often part of other functions, notably production, technical support and quality control (Van Egeraat, 2010). In contrast, the UK has a long established indigenous pharmaceutical sector and has a strong R&D base (BIS, 2010). It therefore offers substantial opportunities for graduates to engage in the more cutting edge elements of R&D activity.

Data Collection

Data collection took place between January and August 2009 in six pharmaceutical firms. Table 1 provides a profile of the organisations and shows their location, number of employees, age and core activities.

Insert Table 1 about here

The data was collected through 64 semi-structured in-depth interviews that lasted between 45 and 60 minutes and were digitally recorded and transcribed. Table 2 shows the breakdown of interviews in each of the firms.

Insert Table 2 about here

Interviews first of all took place with 55 individuals who were working in a range of scientific, technical and managerial positions. A purposive sampling strategy (Denzin & Lincoln, 2000) was used to request a sample of knowledge workers, defined as individuals educated to at least primary degree level, from across a range of experience levels (entry level to senior management) within the firms. These interviews used 25 questions to explore the areas of education, training and development; job design; knowledge sharing and transfer; experience of management practices; and career satisfaction and progression. Second, interviews were held with nine staff from HR or training/development areas and focused on the design of HR practices and the ways in which employees were managed, particularly the way in which education, training and development systems were designed and operated. The aim in interviewing HR specialists was to ensure that employer and employee perceptions of HR practices were cross-checked in order to triangulate the data.

Data Analysis

The collection and analysis of data were closely related and carried out in constant alternation. The data coding and analysis phase was underpinned by three analytic techniques used in the grounded theory approach to qualitative text interpretation and consisted of open coding, axial coding, and selective coding (Strauss & Corbin, 1994; Glaser, 1998). During the coding process the data was first separated into two groups according to whether it reflected statements by knowledge workers or HR professionals. Then, for each group, each of the interview transcripts was examined by two independent researchers and each researcher analysed single passages of texts and phrases. Here both researchers found that the strict delineation between specialist and generalist human capital (Kang & Snell, 2009) failed to reflect the diversity of knowledge, skills, abilities and experiences possessed by employees in the sample. Rather, our examination of the interactions between the components of human capital (knowledge, skills, abilities and experience) led us to derive four categories of specialist-generalist human capital which are outlined in Table 3: Bench Scientist, Technical Specialist, Technical Generalist and Expert Generalist.

Insert Table 3 about here

The Findings

Specialist Positions

We identified two types of specialist roles. The first type is labelled "bench scientist" and describes individuals who were working in highly specialised areas within laboratories. While all possessed at least a primary degree in chemistry or engineering-related disciplines, many held Masters or PhD degrees. The second type is labelled "technical specialist" and encompasses individuals who held similar types of educational qualifications to the bench scientists but who had undertaken additional technical training that had extended their area of expertise.

Bench scientists.

These individuals had remained working within the specialist areas within which they had originally completed their doctorates. They were also utilising the skills and training that they had received as part of their doctoral training:

> I have a PhD in Organic Chemistry. A chemistry PhD is a purely laboratory exercise … It is purely hands on and you know it is giving you the bench skills that you need

> to work as a chemist. This is what I feel most comfortable working at and I would prefer to stay here (Process Chemist, Pharma1)

Since completing their education, the bench scientists' training had been focused for the most part on increasing their specialist knowledge in the use of a new technique or instrument. This training was in many cases very structured and of short duration and was very much oriented towards the regulatory environment of the pharmaceutical sector:

> We're very structured in how we do our training, particularly in our department in the lab and each role has a description of all the training that you need to have…each task has a particular number code associated with it, so when we bring a new person in they start at zero and they are told that they have 253 things to train in before they can start doing any real work (Process Development Director, Pharma2)

As a result, the bench specialists tended to have in-depth knowledge of highly specialised areas and they utilised these skills to solve problems that arose in a particular aspect of the manufacturing process. This specialisation resulted in efficiencies but also problems for both the individual and the organisation. First, it caused difficulties because individuals, as they became more specialised, were less able to share this knowledge with others. This was particularly problematic for firms that were still using paper systems for data storage as, when a piece of research was conducted as "it was not visible to or easily accessible by others" (Associate Research Fellow, Pharma6). Second, this knowledge base was frequently not recognised formally by others in the organisation:

> I'm here 7 years which is quite a long time and people often ring and ask "how did you do this?"…so it is about calling on knowledge and finding something that you have worked on in the past but organisational management don't recognise this knowledge I feel (Process Chemist, Pharma1)

In addition, if individuals either became sick or left, the time taken for others to acquire the level of specialist knowledge was very extensive and therefore left a gap in the organisation's overall knowledge repository. The focus on specialisation was also problematic at an individual level as it created a barrier to long-term progression within the organisation. Many of those interviewed recognised that they would need to engage in management training and development if they were to further their careers, even if this switch to a managerial role was not something that they desired. One respondent illustrated this sense of resignation with the career change that was required: "I would like to be a scientist. See, I don't like to manage people but there aren't as many opportunities to stay in a purely scientific role" (R&D Analyst, Pharma4). As a result, some individuals struggled when placed in a more managerial role:

> You know I have a situation at the moment where we had somebody team leading. He struggled with it. It really is…and yet he is an excellent technically minded individual. He wants to get stuck into the detail of a project and get it there. And you know we need to recognise those types of skills (Senior Manufacturing Technology Director, Pharma3)

Finally, the focus on knowledge acquisition that was at the heart of the specialist training ignored the development of the overall competency of individuals and the range of skills and abilities that they might need to develop more fully.

Technical specialists.

"Technical specialists" were also working in specialised scientific roles and may have begun their career as a bench scientist but they had extended their areas of expertise so that they were now working outside the "comfort zone" afforded by their original education and training. This group of individuals differed from the bench scientists in that they were not confined to the laboratory and worked across different parts of an organisation. At the same time they remained technical experts who were brought in to advise on technical problems. They did not engage in the management of boundary spanning organisational projects but did provide advice on such projects. They therefore provided in-depth knowledge for very specific problems. This knowledge had been acquired in a variety of ways such as company-provided training or through exposure to external conferences and seminars, as well as self-directed learning on the job. In particular, the notion of self-managed learning came through strongly in this group of specialists:

> The organisation does provide training and we are encouraged to attend conferences of relevance and I enjoy keeping my skills fresh…I spend hours on line and finding answers to problems…you have to take control of your career development…if there is a course you want to go on and can justify it management are very supportive (Principal Scientist, Pharma5)

The technical specialist roles in the Irish firms provided fewer career opportunities than those in their UK counterparts. The R&D base within the UK firms provided the potential for progression through technical career ladders but these were not found within the Irish firms. Through the technical career ladders, scientists had the opportunity to “climb to the top of the science ladder and focus on using scientific skills without having line management responsibility” (Chief Scientist, Pharma5). An example of this was provided by a Principal Scientist who commented, “I think that I’m seen as more of a technical expert and I like scientific challenges…and I’m constantly stretched from that point of view in this role (Principal Scientist, Pharma6). At the same time, the technical career ladder had limitations as it was not part of the mainstream career development system: “even when technical positions are put on the same level as managerial positions within the organisation. The former often lacks the same prestige, salary and status” (Director of Pharmaceutical Sciences, Pharma6).

The specialist roles and the issues that these raised for individuals in terms of career development were confirmed by the interviews with the HR and training/development staff. In particular, these interviews called attention to the regulatory and quality control conditions within the pharmaceutical industry that underpin much of the training and development. As the HR manager in Pharma1 pointed out, the training was undertaken: “so when the FDA [Food and Drug Administration] or the IMB [Irish Medical Board] arrive here on site we can show them the training records that everything is trained according to the best possible standards so that our production quality is as best as possible can be”.

Generalists

Two types of generalist roles were identified in the study: “technical generalist” and “expert generalist”. Individuals who were classified as “generalists” were on the same type of career trajectory in that both individuals and their organisations were engaged in adding substantial elements of education, training and development to their early career level qualifications. However, it is worth differentiating between these two types as not all individuals were likely to reach the position of “expert generalist” as these were senior level positions for which few vacancies were available. In addition, while both types of generalists were exposed to management training, in the case of the technical generalists this was most likely to focus on project management skills, whereas the expert generalists had been exposed to a variety of management development experiences.

Technical generalists.

Individuals who were working in “technical generalist” roles had acquired additional specialist educational qualifications during the course of their careers. All sorts of degrees had been undertaken: individuals with degrees in chemistry had undertaken postgraduate degrees in engineering or manufacturing technology; a graduate in engineering had undertaken a degree in veterinary medicine. The need for this additional in-depth knowledge was embedded in the nature of the processes that are undertaken within the pharmaceutical industry, as one respondent explained:

> I have a PhD in organic chemistry. When I came into this company, it was totally production based and it became more of a day to day production role and less technical and in fact you went into a role that required engineering knowledge rather than chemistry knowledge. I was in a more technical role and I went off and got my self a new skill set. I went back to university and did more of an engineering discipline because a lot of the issues you have are, like chemistry is one aspect of it, but a lot of the time it is the controls that you place on the chemistry (Process Safety Manager, Pharma1)

The addition of a new discipline to their skills portfolio enabled these individuals to employ a shared language across a range of disciplines, thus enhancing the flow of knowledge across boundaries. Technical generalists were generally involved in project management roles that required the use of the cross-disciplinary understanding that their additional educational qualifications had engendered, together with project management skills and abilities. The complexity of these roles was illustrated by one respondent:

> I started off as a graduate physical chemist and I worked for a couple of years in material science for an electronics company and then I came here. I undertook a master in dispersion science and have a certificate in manufacturing technology processes…these are areas of physical chemistry and engineering that my current job role requires knowledge of (Senior Scientist, Pharma5)

Once they took on these project manager roles, the technical generalists' roles moved away from solving discipline specific problems to a much wider range of cross-disciplinary activities:

> We meet once a month to discuss any kind of problems that have arisen in the past month. So then with everybody around the one table or a phone line or whatever, it just means that, you know, we can discuss solutions with the input of the regulatory people and the research and development people and QA and supply chains. My role is to act as a chairperson I suppose in a sense and bring these people together on a common note (Project Team Leader, Pharma1)

The ability to take on these new roles was enabled through the training opportunities that had been provided by the organisation. For technical generalists this in the main consisted of access to management training such as project management or “train the trainer” courses. At the same time, while the additional expertise acquired through their education and training enabled the technical generalists to take on cross-disciplinary project management roles, this also created certain tensions for some of the respondents as the increasingly generalist nature of their roles moved them more and more away from their original area of specialist expertise. In some cases, in the UK context, research scientists compensated for this by engaging in collaborations with industry and academia that enabled them to keep up-to-date with their scientific field:

> In terms of academic interaction I am a visiting senior lecturer at [X University] and I do lots of lectures. The company is very supportive of things going to the external environment and I spend time on my research and attending conferences to keep up to date with the science industry (Process Supervisor, Pharma6)

Expert generalists.

The expert generalists are differentiated from the technical generalists in two ways: their level of seniority within the organisation and its concomitant range of diverse responsibilities, and their engagement in extensive management development that was concentrated on their overall competency as an individual rather than the job-focused training that was embedded in the technical generalist role. Opportunities for training and development were offered to this group of employees through the performance management system, and management development programmes then provided them with the necessary skills to undertake the management of large numbers of staff. The management development programmes were either delivered in-house, often as an organisation-wide event located at the parent company headquarters in the case of MNCs, or through in-house or company-sponsored external programmes such as an MBA. The reason for the provision of management training related to the managerial responsibilities characteristic of the roles held by these individuals:

> I suppose … you know in terms of as an initial job where you're lab based; you are only personally responsible for yourself. So, you went from that point where you were responsible for yourself to a point where you were looking after the lab. So it meant you had to deal with all the rest of the people in the lab and then you looked after a process which meant you had to deal with lab personnel, engineers and operators. And I suppose then when you're a plant manager you know it's totally man [sic] management (Process Development Director, Pharma 2)

This group of knowledge workers were not always involved in managing staff directly, although as part of their developmental process they would have had these responsibilities. In some cases they acted as “boundary spanners” who harnessed expertise from different parts of the organisation. Their deep understanding of different discipline areas, and their ability to communicate effectively with each of the discipline specialists, ensured that they could resolve complex technical problems that did not necessarily sit neatly in one discipline area:

> You build up knowledge over time and it comes from being involved across the firm and its processes. I manage 73 individuals who come from engineering and chemistry backgrounds. You need to learn how to bring these very diverse groups of people together and get them to feed off each other's knowledge (Senior Manufacturing Technology Director, Pharma3).

The differences in the expert generalists were also acknowledged by other staff who had spotted the diversity entailed in the career path to senior management:

> When you look at the senior management team they have a diverse skill set. So the head of quality can't be head of quality unless he has production experience. The managing director comes from a quality assurance (QA) background and you know he is bringing a quality mindset to the place. But he has an engineering background. Well not an engineer but sorry a biologist so he is microbiological expert let's say. The head of purchasing would have had 15 years as a quality background but he is an engineer in his original trade. So they bring a lot of experience and a lot of diverse areas into their roles so that they are not just focusing on their little area (Project Manager, Pharma1).

These individuals were also involved in learning from outside the organisation and drew on their extensive networks to gain knowledge and solve problems. The interviews with HR and training and development staff revealed a variety of ways in which generalist roles were developed. First, the potential for such roles might be spotted through the graduate recruitment programme and opportunities offered for access to education, training and development programmes. Second, through the succession planning and performance management processes, individuals might be targeted for promotion. The HR manager in Pharma3 explained his company's approach:

> We put a huge amount of time into our talent management system which operates closely with our strategic workforce planning team who have a great insight into the long term view around the critical skills of the organisation and they have an in-depth insight in terms of our key internal talent as well (HR Manager, Pharma3).

Discussion

The paper asked the question: how do knowledge workers in the pharmaceutical sector view their experience of working in specialist and generalist roles? In posing this question, we endeavoured to begin the process of unpacking the distinction between specialist and generalist human capital that is embedded in Kang & Snell's (2009) framework, as well as adding to an understanding of knowledge workers' experience of work. The findings support Kang & Snell's (2009, p. 68) contention that specialists "typically have knowledge that is deeper, localized, embedded and invested within particular knowledge domains" while generalists "tend to be multi-skilled with a more versatile repertoire of capabilities that can be used across alternative situations". At the same time, Kang & Snell (2009, p. 68) suggest that: "the implications of human capital on learning are fairly straightforward in that, in individuals, diverse knowledge of multiple domains versus deep knowledge in a specific domain has different effects on their future knowledge search behaviours as well as the diversity of current knowledge available". However, the distinction made by Kang & Snell in regard to deep or diverse learning, in differentiating between specialists and generalists, does not match neatly with the career experiences of the individuals who were interviewed in our study. The impact on the individuals in these different types of roles is considered separately below.

The Specialists

In considering the utilisation of specialist human capital, the group that have been categorised as "bench scientists" seemed to be the most restricted in their skill development and to have the fewest career opportunities within the organisation, particularly in the Irish firms. For example, some of those interviewed in Ireland had remained within their original specialist areas for considerable lengths of time and had engaged in more or less the same type of work. One scientist had been employed in the same type of role for 32 years; another for 18 years. In both cases, there had been little opportunity to rotate into positions outside these areas, although a small amount of rotation might occur within a particular department. These findings raise issues in relation to the extent to which some organisations were fully utilising the skills and abilities of these employees and whether a strategy based on specialist skills as exemplified in the bench scientist represents a good return on investment by the individual. While some bench scientists seemed happy with their positions, for others there was a sense of routine and lack of challenge attached to the ways in which they viewed their jobs and a lack of opportunity to utilise fully their knowledge, skills and abilities. The findings confirm prior research that has identified the dependency that some knowledge workers may have on their organisations for resources and the limits to their autonomy (Tam et al., 2002).

The "technical specialists", in contrast, appeared to have found the balance in their careers between specialist roles and ongoing skill development. Here individuals had made the decision to remain within a technical role and to pursue a technical career path. This process was assisted in the UK pharmaceutical industry by the existence of technical career ladders that enabled scientists to deepen their technical expertise and engage in exploitative learning (March, 1991; Kang & Snell, 2009). However, as prior research in the UK has also shown (Lam, 2005), this technical career ladder could also prove limiting in its provision of opportunities and career status.

The Generalists

We found that all the generalists interviewed had started their careers as specialists. It was not the case that they had been recruited by the organisation as generalists. Rather, they had all entered the organisations as specialists in areas such as chemistry or engineering. It was through their own investment, and that of the firm, in education, training and development that, over time, they developed a wider set of skills. In addition, the skills that they had acquired could not necessarily be described as generalist. These individuals had invested in the acquisition of additional specialist skills, for example through completing a Bachelor or Masters degree in a discipline area that was different to their original area of specialisation. Thus, we interviewed individuals who were specialists in two disciplines, for example chemistry and engineering or chemistry and computing.

There was evidence that the generalists we interviewed were engaged in the type of exchange across knowledge boundaries that has also been associated with the notion of generalist behaviour (Bunderson & Sutcliffe, 2002; Kang & Snell, 2009). This emerged through their involvement in and management of cross disciplinary project teams. Their generalist skills were embedded in the project management or broader management training and development programmes they had undertaken as these gave them the people and project management capabilities required for working across the “alternative situations” identified by Kang & Snell (2009, p. 68). For example, generalists in the study possess interpersonal knowledge and skills for working closely with other team members and use management knowledge and skills to plan, control and lead the project teams. The combination of generalist and specialist knowledge and skills that these individuals possess is characteristic of “hybrid careers combining project and scientific elements” (Bailyn, 1991, p. 3). For these individuals it was the different sets of specialist knowledge that they held that enabled them to engage in and engender diverse knowledge and contribute to exploratory learning. This worked on two levels. First, they themselves were able to solve complex technical problems that spanned different knowledge domains, for example a chemical problem involving an engineering solution. Second, they were able to communicate effectively across project teams that comprised individuals who were chemists and engineers because they spoke the language of both discipline areas. However, several of those in the technical generalist roles expressed discontent with their work roles. This is resonant of the “specialisation-flexibility dilemma” (Lam, 2005, p.15) where a personal desire to engage in scientific discovery was hindered by the organisational need to drive the project teams.

Limitations to the Research

There are several limitations to the research. First, the research was conducted in only six firms, all based in the pharmaceutical sector which has very specific regulatory and working conditions. Second, the interviewees were not chosen by the researchers. Instead, we were reliant on the organisations to provide us with the types of knowledge workers that we had requested. Indeed, in making our request for highly qualified individuals, in line with the remit of our research agenda, we are conscious that we were already biasing the types of individuals whom we interviewed. Third, we interviewed an average of ten knowledge workers in each organisation and they do not therefore comprise a representative sample of employees, despite their shared educational backgrounds. Finally, in our analysis we concentrated solely on human capital and we are conscious that Kang and Snell’s framework indicates that human capital cannot be considered in isolation but alongside the social and organisational capital that also comprise intellectual capital.

The Implications for Research

In exploring how knowledge workers viewed their experience of working in specialist and generalist roles, the findings start the process of unpacking the human capital element within Kang & Snell’s (2009) model and of elucidating the importance of generalist and specialist human capital for organisational learning. While Kang and Snell’s (2009) framework presents a sharp distinction between specialist and generalist human capital, our findings suggest that this demarcation is too rigid as it does not take into account the ways in which individuals themselves may choose to shape their working lives and careers. The knowledge workers whom we encountered in our interviews were all highly educated individuals. While some, through a combination of family circumstances, personal choice, or lack of opportunity, had remained working in the specialist positions into which they had been originally recruited, others had taken the initiative in moulding their own careers. They had seized opportunities that they had identified and had taken advantage of secondments or additional training. They had also invested time and energy in degree courses taken at night or through distance learning and completed very much in their own rather than company time. They had also spotted that senior management positions required a degree of versatility that was not going to be attained by reliance on their original skill set. Thus, in unpacking the specialist and generalist positions as experienced and moulded by knowledge workers, the research revealed the complexity and richness of specialist and generalist human capital rather than a stark distinction between the two types that is portrayed in Kang & Snell's framework.

In revealing the complexity of specialist and generalist human capital, the research has implications for the types of HR practices that might accompany the development of these two types of human capital. Kang & Snell (2009, p.79-80) suggest that firms will adopt different types of development systems depending on their orientation to either specialist of generalist human capital, and they emphasise the need for a 'fit' between HR practices that support this development. However, our findings suggest that a rigid application of the concept of 'fit' may be problematic in organisations in which large numbers of knowledge workers are employed, particularly given the need for autonomy displayed by these types of employees. Following Wright & Snell (1998), our research suggests that there is a need to consider both 'fit' and 'flexibility' in understanding how human capital systems might be developed in knowledge-intensive situations. Future research might usefully consider how the processes of flexibility in HR practices may work to the advantage of both individuals and organisations.

In addition, the research reinforces the crucial importance of individual learning in understanding the complexities of organisational learning (Argyris & Schon, 1978; Crossan et al., 1999; Swart & Kinnie, 2010) and the need, therefore, to take account of individuals in the design of research that explores learning at an organisational level. Finally, the research adds to the growing body of work that suggests greater attention should be paid to employees' experience of work and the role of individual agency in shaping the nature and outcomes of work (Boselie et al., 2005; Conway & Monks, 2009; Kinnie et al., 2005).

The Implications for Practice

The findings underline the importance of the need for organisations to take account of worker preferences and motivations in pursuing particular human resource strategies. From an organisational learning perspective, it may make sense to devote resources to the development of either specialist or generalist expertise as resources are thereby concentrated and more precisely targeted. But from the individual's perspective, such a strategy may deny opportunities to engage in more interesting and varied work, thus creating problems with motivation and commitment. In addition, as the research revealed, individuals themselves may decide to invest their own time and energy in the acquisition of knowledge and skills which make them more attractive not just to their own organisations but to other potential employers.

The findings also indicate the need for firms to plan carefully the career opportunities that are offered to knowledge workers such as scientists and engineers. In this regard, a mix of specialist and generalist opportunities may provide a set of options that enable individuals to choose career paths that fit both organisational and individual strategies. For example, the provision of access to scientific and professional journals will enable individuals to keep up-to-date with their specialist area of expertise; more extensive use of job rotation will enable individuals to acquire a greater range of generalist skills. Both of these options are relatively inexpensive and can be offered to a wide range of employees. Technical career ladders, such as those found in the UK firms in the study, are a more expensive option but certainly provide a more robust career structure than that found in firms in Ireland. However, discontent was expressed by some individuals at the limitations that they may impose. Thus, these may need to be more flexibly designed so that they include opportunities to engage in the skills training and development that enable individuals to move more easily between technical and managerial positions at different stages of their careers rather than being confined to one very specific technical or managerial career track.

Conclusions

In considering knowledge workers' experience of working in specialist and generalist roles, this article has indicated both the variety and complexity of the roles undertaken by knowledge workers and the very high level of investment in knowledge and skills on the part of both the organisation and the individual that such roles entail.

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Table 1
Profile of Firms

Company	Ownership	Location	Activities	Firm Age (years)	Number of Employees
Pharma1	Multinational subsidiary	Ireland	Manufacture & process development	14	500+
Pharma2	Multinational subsidiary	Ireland	Manufacture & marketing	119	500+
Pharma3	Multinational subsidiary	Ireland	Process Development	152	500+
Pharma4	Indigenous	Ireland	Manufacture & distribution	31	180
Pharma5	Multinational subsidiary	UK	R&D; Manufacture & development; Biopharmaceuticals	11	500+
Pharma6	Multinational subsidiary	UK	R&D; Manufacture and distribution	161	500+

Table 2
Number of Interviews in Each Firm

Company	Knowledge workers	HR, T&D staff	Total
Pharma 1	8	2	10
Pharma 2	5	2	7
Pharma 3	13	2	15
Pharma 4	7	1	8
Pharma 5	6	1	7
Pharma 6	16	1	17
Total	**55**	**9**	**64**

Table 3
Data Matrix of Specialist-Generalist Human Capital

Human Capital Dimensions	**Bench Scientist (22 interviews)**	**Technical Specialist (15 interviews)**	**Technical Generalist (12 interviews)**	**Expert Generalist (6 interviews)**
Knowledge	Masters or PhD degree in science or engineering	Masters or PhD degree in science or engineering	Masters or PhD degrees in more than one science and/or engineering disciplines	Masters; PhD degrees in more than one science and/or engineering disciplines; MBA qualification
Skills & Abilities	Laboratory-based skills	Technical skills	Project management skills	General management skills
Experience	Limited to specific lab-based routine tasks with little opportunity to rotate between jobs or engage in challenging assignments	Experience of working in a limited number of technical roles	Project management, across different areas	Cross-disciplinary general management roles; boundary spanning responsibilities