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Where would I be without my right-hand (wo)man?: Professional knowledge and technical skills in R&D

Abstract: Background
The emerging debate on the dynamics of skills and employment tends to focus on the institutional supply of suitably trained individuals, on the one hand, and the mechanisms and processes guiding the allocation of these human resources to industries and sectors, on the other hand. Both these approaches are important for understanding how institutions and firms address the demands for new skills linked to such factors as technical change or coordinated strategies to address societal challenges. In relation to the Vocational Education and Training (VET) sector, systematic syntheses of institutional and market processes have uncovered different underlying modes of organizing skills training and quality frameworks that are fundamental to distinguishing the particular strengths and weakness of different national innovation systems (Busemeyer 2009; Thelen 2004).

However, the debate as it stands tends to focus on the supply of skills for specific occupations and how these occupations can best be organized to perform required tasks and build capabilities in the form of organizational routines that are, in turn, open to improvement and the incorporation of innovations. What tends to be missing from these discussions is attention to the relations between different forms of knowledge and skills that are institutionalized in the workplace in the form of patterns of occupations and their interrelations. An analysis of the dynamics of skills and employment is not complete without an understanding of how changes in occupations impact on other interacting occupations. The division of labour is, in this sense, more than the distribution of the knowledge and skills required for the performance of certain activities across a group of occupations. The fact that certain of these occupations are interdependent, and irreducibly reliant on each other, frames an understanding of the division of labour as a social and organizational achievement that is constituted in the practices and contexts of collective work.

In this context an important dimension of the dynamics of skills and employment is the relationship between professional occupations and other supporting occupations. Many professional occupations rely on skilled occupations requiring educational qualifications and practical experience that differ from their own (Barley 1996). Of particular interest in this paper are the relationships between science and engineering occupations and supporting technical jobs. The paper explores the contributions highly skilled craft and technical workers make, alongside their professional scientist and engineer colleagues, in the contexts of collective research and development (R&D) work.

The Study
The study was undertaken in Australia with the aim of better understanding the roles and contributions of skilled trades and technical workers in the diverse contexts of R&D. The

empirical investigation was built around a stratified purposive sampling method, as potential interviewees and interview sites were required to meet a number of conditions to be included (Kemper et al. 2003). Interview sites were selected that matched the major characteristics of entities undertaking R&D in Australia by share of public and private R&D activity, employment size, degree of foreign ownership and diversity in the technologies employed. Access to some significant sectors for R&D was not secured, including automobiles and mining. This limited the study somewhat in terms of the diversity of technical activities and contexts for innovation covered. However, sixteen separate organisations conducting R&D at a total of 23 different worksites participated in the study. This included four PSROs, two universities, nine private firms, and two hybrid organisations. These last were Cooperative Research Centres (CRCs), which are dependent on a mix of public and private funding. A total of 103 in-depth interviews were conducted, with participants including trades and technical workers (n=71), research leaders/managers (n=27) and human resource managers (n=5).

Results

Trades and technical workers are involved in a wide range of activities directly related to fulfilling the objectives of their professional co-workers. These activities included five key roles: installing, calibrating and customizing instruments; design; linking R&D to production; health and safety regulation; and training. The contribution of trades and technical workers to R&D exceeded simple execution of plans or designs provided by scientists or engineers. Key forms of craft knowledge were important to the conduct of research programs and projects. These included knowledge of the properties of materials, the importance of design for maintenance and the carriage of non-codified knowledge – particularly of as-built artefacts and of ongoing adaptation to technical change – from one project context to another.

Professional respondents were clear in their articulation of the importance of highly skilled technical workers to have the necessary capabilities to be their ‘hands and eyes’, whether in the laboratory or in the field. The hands-on involvement of technical workers means they are always ‘close to the action’, from the conceptualization stage of professionals’ plans and designs and continuously into the development, testing and modification stages. Throughout, technical workers interact directly with professionals in a variety of formal and informal contexts. For example, collective engagement with a material artefact such as a prototype was an arena in which the different knowledge bases of scientists, engineers and skilled technicians could be translated and negotiated to settle on a shared understanding of progress and potential future strategies.

The central finding of the study is that trades and technical workers should be understood as providing far more than ‘support’ in R&D contexts. Rather, the appropriate integration and timely involvement of trade and technical occupations in project teams adds dimensions of skill, risk management and collective learning to R&D work processes that can have significant benefits not only for the conduct of knowledge intensive work, but also for the efficient subsequent translation of knowledge between R&D, quality control and production processes.

Discussion and relevance to the special stream

The emergence and decline of innovation cycles, whether they be based in technological advance or societal challenges such as the transformation to 'cleaner' forms of energy, produces intense challenges for the institutional supply of knowledge and skills. The modification of the scientific knowledge base means changes to the education of scientists and engineers. Similarly the rise in demand for 'green' or other skills requires a response from the VET sector. Yet changes in the professional curricula, methods of training and capabilities embodied by engineers do not happen in isolation from interacting occupations such as highly skilled technicians. Over time the frontiers between professionals and technical occupations may even be modified. In design activities, for example, increased reliance on the virtual forms of knowing (Amin & Roberts 2008) that underpin both computer-based modelling techniques and computer controlled workshop machinery can be seen to lead to a convergence of professional and technical skills around the manipulation of digital code (McCullough 1996). The evidence of this paper suggest that, at least in knowledge intensive contexts such as R&D, preserving or enhancing the capacity for complementarities to emerge between professionals and their skilled 'hands and ears' may be a worthy policy goal. The achievement of such a goal in contexts of new skills paradigms and dynamics may be better addressed through an holistic skills ecology, one that is inclusive of multiple forms of knowledge and diverse occupational groups. The emergence of hybrid institutions and/or increased policy emphasis on developing innovative forms of articulation between universities, polytechnics and vocational training institutions may be one important approach to confronting the types of future challenges already clearly on the horizon.

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