THE KNOWLEDGE ECONOMY AND EDUCATION

The Knowledge Economy and Lifelong Learning

A Critical Reader

D.W. Livingstone and David Guile (Eds.)

SensePublishers

THE KNOWLEDGE ECONOMY AND LIFELONG LEARNING

The Knowledge Economy and Education

Volume 4

Scope:
The aim of this series is to provide a focus for writers and readers interested in exploring the relation between the knowledge economy and education or an aspect of that relation, for example, vocational and professional education theorised critically.

It seeks authors who are keen to question conceptually and empirically the causal link that policymakers globally assume exists between education and the knowledge economy by raising: (i) epistemological issues as regards the concepts and types of and the relations between knowledge, the knowledge economy and education; (ii) sociological and political economic issues as regards the changing nature of work, the role of learning in workplaces, the relation between work, formal and informal learning and competing and contending visions of what a knowledge economy/knowledge society might look like; and (iii) pedagogic issues as regards the relationship between knowledge and learning in educational, community and workplace contexts.

The series is particularly aimed at researchers, policymakers, practitioners and students who wish to read texts and engage with researchers who call into question the current conventional wisdom that the knowledge economy is a new global reality to which all individuals and societies must adjust, and that lifelong learning is the strategy to secure such an adjustment. The series hopes to stimulate debate amongst this diverse audience by publishing books that: (i) articulate alternative visions of the relation between education and the knowledge economy; (ii) offer new insights into the extent, modes, and effectiveness of people's acquisition of knowledge and skill in the new circumstances that they face in the developed and developing world, (iii) and suggest how changes in both work conditions and curriculum and pedagogy can led to new relations between work and education.

The Knowledge Economy and Lifelong Learning

A Critical Reader

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Endorsements for *The Knowledge Economy and Lifelong Learning: A Critical Reader*

Given all of the discussion about a knowledge economy in both academic and popular writing, we need a volume that helps us understand both what is actually happening in the real world and what the implications of all this are for education. *The Knowledge Economy and Lifelong Learning* is a substantive and insightful treatment of both of these sets of issues. I strongly recommend it.

Michael W. Apple, John Bascom Professor of Curriculum and Instruction and Educational Policy Studies, University of Wisconsin

This book is a timely and powerful antidote to the half-aware writing about knowledge economies that is wafting around the globe. It shines penetrating lights on assumptions about unilinear trends and illuminates the darker recesses of the power politics involved. In so doing, it expands and reformulates conceptions of knowledge-based economies in ways that can fundamentally reshape the future of lifelong learning.

Karen Evans, Chair in Education (Lifelong Learning) Institute of Education, University of London

It is high time that the notion of knowledge economy is submitted to critical scrutiny. Commoditization and privatization of knowledge and learning need to be overcome by means of careful analysis and viable alternatives. This book takes an important step in that direction. It brings together a rich set of conceptual tools and research insights for the rediscovery of knowledge as use value and common good in service of global solidarity.

Yrjö Engeström, Professor of Adult Education and Director of CRADLE, University of Helsinki

TABLE OF CONTENTS

SECTION TWO: SPECIFIC CHALLENGES

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Sense Publishers and Monica Nerland for 'Professions as Knowledge Cultures.' In K. Jensen, L. Chr. Lahn & M. Nerland (Eds.), *Professional Learning in the Knowledge Society*, Rotterdam (2012).

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Taylor & Francis and Catherine Casey for 'The Learning Worker, Organizations and Democracy.' *International Journal of Lifelong Education* (2003, November–December), *22*(6), 620–634.

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PREFACE

This book grew out of a discussion between the editors and the publisher about the need for a book that provided an overview of critical studies of the emergent knowledge economy and learning activities. We are grateful to many colleagues who offered suggestions as we sought out representative authors and writings from this field of studies. We are especially indebted to the contributing authors, all of whom readily agreed to be included in this reader and many of whom provided updates on previously published material. We thank the publishers who agreed to have papers reprinted here, as indicated in the list of acknowledgements. Stephan Dobson should be complimented on his highly professional editing and formatting of the final manuscripts.

Whether or not a knowledge economy becomes a new global reality and whether or not lifelong learning proves to be an effective strategy to cope with it are the central questions. There are no easy answers and much contestation and debate ahead. We hope this set of readings will contribute to more clearly framing the debate.

DWL DG
Toronto London

GENERAL INTRODUCTION

The focus of this book is on a critical appraisal of dominant claims about a 'knowledge-based economy (KBE),' or 'knowledge economy,' and empirical investigations of the presumed relations between work requirements and learning in this economy. We conclude by suggesting new principles policy makers could use to ensure that policies for lifelong learning (LLL) articulate more purposefully with the expanded conception of the knowledge-based economy that emerges from this collection. Our book therefore differs significantly from another recent published edited collection, *Educating for the knowledge economy: Critical perspectives* (Lauder, Young, Daniels, Balarin, & Lowe, 2012), which focuses critically on the relation between educational policy, provision, and the knowledge economy. Both books nevertheless offer fresh insights into the debate about the relationship between education and the economies of advanced industrial societies.

We start by noting that the existence of a 'knowledge-based economy' is widely taken for granted by governments, mass media, public opinion, and most scholars today. The common view is that a transformation from earlier economies has occurred since around the end of the 1960s (see David & Foray, 2002) in terms of: (1) an unprecedented acceleration of the speed of creation and accumulation of knowledge; (2) a revolution in the instruments of knowledge production including information and communications technologies generally and the internet in particular; and (3) a growing relative importance of intangible capital (investment in research and development; training and education for knowledge production; investment in sustaining the physical stock and health of human capital compared to tangible capital (i.e., physical infrastructure; equipment; inventories; natural resources). The basic notion is that an ever-increasing speed of innovation in new knowledge-intensive commodities is needed for economies to survive in globally competitive markets. An essential corollary of this view is that the current and prospective labour force must engage in greater learning efforts throughout their lives in order to respond to this economic imperative. A primary solution to the demands of this knowledge-based economy is therefore presumed to be the development of a 'learning society,' or 'knowledge society' in which increasing lifelong learning enables further innovation and more knowledge-intensive products.

The basic purpose of the book is to bring together some of the most insightful critical assessments of these widespread assumptions. Taken cumulatively, the chapters in this book suggest that these assumptions are either exaggerated or plainly wrong. Section One offers general critiques of the distinctiveness of the most widely assumed features of the knowledge-based economy and of the general need for greater learning efforts; contrary evidence and arguments are provided for each of these features. Section Two looks more closely at an array of workplaces in which the transformation is presumed to be taking place. The basic finding is that

the multiple forms of knowledge being used to facilitate improvements or innovation to products and services as well as processes of learning in the context of workplace change are both richer and more complex than advocates of the knowledge-based economy ever intimate.

All these authors agree on two basic points. First, knowledge cannot be reduced to a commodity and is not reduced but increased by use. The more we use it, the more there is – in contrast to the nature of most other commodities. Secondly, all authors display keen awareness of the reductionist effects of the efforts of knowledge economy theorists, large employers, and governments to control and manage knowledge. All the contributors to this reader, irrespective of their different theoretical perspectives, shed light on manifestations of these two points.

As many of our contributors suggest, all human economies are knowledge based. The most distinctive feature of our species has been the gathering of information from our environment and processing it into useful knowledge to cope effectively with changes in this environment. These forms of knowledge have ranged from basic language elements to highly sophisticated theories of life. All human civilizations have exhibited a wide range of forms of knowledge. The more we study both ancient and modern societies, the more we appreciate the depth of the knowledge they have relied upon to survive, including informal and tacit knowledge as well as formally documented knowledge systems. Contemporary advocates of knowledge-based economies have tended to focus on cognitive, rationalist, formalist aspects of knowledge and their relevance for production of new knowledge-intensive commodities. Daniel Bell (1973) has argued most influentially that theoretical knowledge, particularly as generated by science, technology, engineering, and mathematical (STEM) research, must be the pre-eminent form of knowledge in modern economies. Some other advocates of a knowledge economy (e.g., Lundvall, 1996), however, have argued that tacit knowledge, by dint of its inaccessibility to standardization, is becoming the most important form of knowledge.

Indeed, it has become increasingly strategic for production of new knowledge-intensive commodities to try to capture knowledge generated in more informal learning environments, or 'learning organizations.' This is merely to recognize workplace learning that has been ongoing since time immemorial, taken for granted, unrecognized, and unrewarded. So-called 'high performance' organizations now try to facilitate the interaction of formal and informal learning activities among their employees to enhance productivity. Such attempts at knowledge management run up against the fact that explicit formal knowledge is always limited in principle. Consequently, as one proponent of a new division of knowledge as the fundamental working principle of the knowledge-based economy recognizes:

> The unique human ability to perceive and act in complex situations without referring to explicit rules, therefore, is indispensably needed in order to make sense of this limited abstract knowledge and in order to make it usable for practical innovations. This basic fact of skill development and knowledge formation makes systematic personnel development and lifelong learning a

> permanent management task in knowledge-intensive processes of value creation … [M]ost of the skills and competences needed are embodied and cannot be expropriated, but must be maintained and developed in and through the work processes in which they are used. All managerial activities … therefore, are directed to achieve this. (Brödner, 2000, pp. 15, 22)

This permanent knowledge management task continually contends with the expansive embodied nature of workers' knowledge and with workers' individual and collective motivation to share (or not share) it. This has been a familiar story in industrial societies.

The tendency for knowledge held in workers heads to be seen by managers as more strategic for commodity production, as well as the emergence of knowledge-based economy theorists advocating this view, can be traced to the rapid decline of employment in the manufacturing sector that began around the end of the 1960s. This is probably the most significant economic shift since the decline of agricultural employment. The development of industrial machinery in the nineteenth century stimulated both massive labour declines in agriculture as well as the massive expansion of manufacturing of all sorts. Many of those forced off the land were drawn into factories. The expansion of manufacturing continued into the mid-twentieth century. Steel, auto, petrochemical, and electrical industries created new mass-produced commodities that quickly became essential needs for urbanizing workforces. Similar processes of devising a marketable product and an efficient division of labour, then an expansion of product markets and labour forces, were replicated for many manufactured goods across the globe. But in recent generations, as automation has increased and market capacity has been exceeded, a spiral of mass layoffs of workers and the mergers or failures of remaining firms have occurred in many manufacturing industries. Between 1970 and the early twenty-first century, the advanced industrial countries lost massive numbers of manufacturing jobs and even most newly industrialized countries have now joined this declining trend (International Labour Organization, 2003; Pilat et al., 2006). We have witnessed the general decline of employment in manufacturing in a much more rapid way than the decline in agriculture in the previous two centuries. But in what sense is this shift indicative of a transformation?

The growth of employment in service sectors coincident with the decline of manufacturing, and the growing focus on non-material service commodities over material goods commodities, have given some credence to the claims that production is becoming more knowledge-based. But knowledge workers such as engineers and other professionals were just as fundamental to early twentieth-century manufacturing as computer programmers and other information technologists are to new knowledge industries today. Growing proportions of jobs explicitly involve information processing. But information is not necessarily knowledge. Information is raw material that may be processed by knowledgeable workers to produce valuable goods and services. It is arguable that a growing proportion of jobs have more explicitly design-based aspects that could be construed as 'intangible capital' (to be discussed further in the book's Conclusion). But whether or not this is true generally or for the newest information-based

industries, it does not necessarily lead to the conclusion made by KBE theorists that today's workers must make greater efforts in relation to the knowledge required to produce today's non-material services.

The increasing prominence of information processing has led many who conflate information with knowledge to conclude that we now live in a well developed 'knowledge economy.' The debate over the extent of transformation still rages among scholars, including those in this book. Most would probably agree with the following social facts pertaining to all advanced market economies:

1. as noted above, declining minorities of jobs are in manufacturing and materials processing occupations, and growing majorities of jobs and of tasks in jobs involve information processing with increasing amounts of the information being mediated by use of computers;
2. growing proportions of jobs in advanced industrial societies are designated as professional and technical occupations distinguished by forms of specialized formal knowledge;
3. growing proportions of labour forces are attaining post-secondary formal education;
4. participation in adult education courses is also increasing throughout the life course;
5. as more married women have entered the paid labour force, the significance of previously hidden unpaid household and community labours is increasingly recognized; and
6. with increasing recognition of information processing as a component of so many peoples' paid and unpaid work, recognition of the importance of informal as well as formal aspects of lifelong learning in work have also increased and knowledge management has become a high declared priority of private corporations and governments.[1]

Most advocates of the knowledge economy presume that knowledge workers are becoming more influential in shaping its future direction and at least imply that capitalism will become more benign and sustainable as a result. None have explicitly suggested the demise of capitalism as an economic system. However material or immaterial its products may be, the capitalist mode of production is distinguished by constantly turning spheres of activity into commodities for sale with the aid of hired wage labour. There is continual change driven by three basic underlying relationships: (1) inter-firm competition to make and sell more and more goods and services commodities at lower cost for greater profits; (2) negotiations between business owners and paid workers over the conditions of employment and knowledge requirements, including their relative shares of net output; and (3) continual modification of the techniques of production to achieve greater efficiency in terms of labour time per commodity, leading to higher profits, better employment conditions, or both. Approaches such as knowledge economy theories that have not attended to these underlying contradictory dynamics of advanced capitalism – including conflicting aspects of the interest relationship between owners and paid workers – have misunderstood the nature and extent of

changes occurring in both work and learning processes. As Livingstone (2009) states:

> A continual reorganization of the factors of production to increase productivity is the consequence of inter-firm competition as well as the productivity increases generated endogenously by a workforce as it learns to labour and produce more efficiently with given tools and techniques. The forces of production, including tools and techniques and their combination with the capacities of labour, have experienced extraordinary growth throughout the relatively short history of industrial capitalism. Such technological developments, from the water mill to the steam mill to interconnected mechanical and electronic networks, continually serve to expand private commodity production and exchange, while also making relevant knowledge more widely accessible. On the one hand, private ownership of production and the attendant wealth become increasingly concentrated in a smaller number of larger corporations, from the joint stock companies of the 1880s to the massive global corporations of the present. Owners strive to control knowledge of specific commodity production techniques for advantage over competitors (e.g., patents, licences, industrial secrets). On the other hand, workers and the general public gain ever-greater access (via public education systems and such forums as public libraries, public radio and television, and the Internet) to knowledge previously restricted for commodity production by private firms, as well as to diverse sources of knowledge for everyday life. In the context of inter-firm competition and labour contracts that cannot specify what workers know, the expansion of publicly accessible knowledge continues to be greater than any enterprise owner's ability to appropriate such knowledge for private gain. (pp. 59–60)

As virtually all authors in this book indicate in their own terms, this opposition between most peoples' widening access to valued knowledge and the efforts by business owners and managers to control knowledge as discrete intellectual property is a central feature of the times. Some express this opposition in terms of a contrast between aspirations for a 'knowledge society' in which there is increasingly equal access to higher education, and a 'knowledge economy' in which exclusive development and sale of intellectual products is an increasing preoccupation of paid work. Whatever the terms, most of these authors see the contest between democratic access to and use of knowledge versus its privatized control as a vexed issue with no easy path toward the dominance of one or the other in the foreseeable future. In terms of widening access to valued knowledge, Kennedy in Section One refers to the general 'logic of labour,' while in Section Two, Fuller et al. refer to 'expansive learning environments' in some workplaces and Sawchuk identifies extensive learning directly related to human needs or 'use-values.' All identify extensive learning efforts and working knowledge among employees that many contemporary paid workplaces as currently organized are unable to effectively utilize. This conflictual view contrasts to the more starry-eyed

visions of those who see the rapid development of either tendency, particularly knowledge economy theorists who envisage full utilization of workers' knowledge for enhanced production of more knowledge-intensive commodities. As long as capitalism survives, this opposition is most likely to persist.

Whether the focal commodities are material or non-material, the quintessential motor of capitalism is competition between firms, which ensures that each of them must grow and reinvest its profits to survive. As Foster et al. (2010) remind us: 'By its nature, capital is self-expanding, and accumulation is its sole aim … The earth and human labour are systematically exploited/robbed to fuel this juggernaut' (p. 109). However much knowledge economy advocates and other mainstream economists focus on non-material aspects of the economy, it is clear that the scale of damage to the earth from continuing material production has reached unprecedented levels, as has the massive polarization of wealth and poverty around the globe. One of the deepest ironies of knowledge economy discourse is that there has been precious little attention in it to the kinds of knowledge of our environment that is needed to aid human survival in the wake of the negative environmental effects of the continual expansion of capitalist production. The knowledge that counts in this context is that which can be applied to producing material or non-material commodities for continuing profit, and anything else – including human and ecosystem survival – remains secondary.

Aside from the indifference in knowledge economy discourse to issues of survival, there is a large contradiction between the widespread assumption in this discourse of skill deficits of current labour forces and their consequent need for lifelong learning and, conversely, the social facts of unprecedented levels of participation in higher education and adult education. Human capital theorists have long argued that investment in formal education leads to economic growth. But we have experienced a generation of unprecedented growth of advanced formal education along with economic stagnation and high unemployment. Many empirical researchers have also documented the existence of growing underemployment of formal knowledge attained in comparison to educational requirements for available jobs (see Livingstone, 2009). In particular, while the ability to use computers and the internet are the most often required competencies for new labour market entrants, these are also the competencies where there is the greatest surplus of underutilized skills (Allen & van der Velden, 2009). If the dominant tendency is for workers to have both unprecedented levels of formal knowledge/qualifications and increasingly recognized extensive embodied informal knowledge, and there is increasing evidence of underemployment and/or underutilization of their abilities, then surely the assumption of a major skill deficit as a significant barrier to further development of a knowledge economy is highly questionable. As some of the authors in this book suggest, the deficit is more likely to reside in the organization of paid work that inhibits many workers from fully using their substantial abilities.

On the basic question of continuity and change in the prevailing economic system, most of the authors in this book would probably agree that the contradictory dynamics of advanced capitalism are still at play in driving both

knowledge management of twenty-first century firms and the lifelong learning of current and prospective workers. Numerous specific features of firms, workers, and their strategic relations have been changing significantly, as the case studies in Section Two amply illustrate. But overall, the following chapters should at least provoke scepticism about the defining claims of knowledge economy discourse, as well as reflection about the most beneficial of these changes and whether alternative ways of organizing economic life should be put on the agenda to utilize our knowledge for a sustainable future.

NOTES

1 For documentation of most of these facts as well as discussion of the distinction between formal and informal learning, see Livingstone (2010). On knowledge management, see Luque (2001).

REFERENCES

Allen, J. & van der Velden, R. (2009, December). Report on the large-scale graduate survey: Competencies and early labour market careers of higher education graduates. Lifelong Learning Program, European Commission. Ljubljana: Faculty of Social Sciences, University of Ljubljana.

Bell, D. (1973). The coming of post-industrial society: A venture in social forecasting. New York: Basic Books.

Brödner, P. (2000, February 24–25). The future of work in a knowledge-based economy. ICT/CIREM International Seminar on 'Economy and Work in the Knowledge Society.' Barcelona.

Foster, J.B., Clark, B., & York, R. (2010). *The ecological rift: Capitalism's war on the earth*. New York: Monthly Review.

International Labour Organization (OECD). (2003). Key indicators of the labour market: Employment by sector. Retrieved from http://ilo.org/public/english/employment/stat/kilm04.htm.

David, P.A. & Foray, D. (2002). An introduction to the economy of the knowledge society. *International Social Science Journal*, *54*(171), 9–23.

Lauder, H., Young, M., Daniels, H., Balarin, M., & Lowe, J. (Eds.). (2012). *Educating for the knowledge economy: Critical perspectives*. London: Routledge.

Livingstone, D.W. (Ed.). (2009). *Education and jobs: Exploring the gaps*. Toronto: University of Toronto Press.

Livingstone, D.W. (Ed.). (2010). *Lifelong learning in paid and unpaid work*. New York: Routledge.

Lundvall, B.-Å. (1996). *The social dimensions of the learning economy*. Working papers. Copenhagen: DRUID: Department of Industrial Economics and Strategy, Copenhagen Business School & Department of Business Studies, Aalborg University.

Luque, E. (2001). Whose knowledge (economy)? *Social Epistemology*, *15*(3), 187–200.

Pilat, D., Cimper, A., Olsen, K., & Webb, C. (2006). *The changing nature of manufacturing in OECD economies*. STI Working Paper 2006/9. Directorate for Science, Technology and Industry. Paris: Organisation for Economic Co-operation and Development.

SECTION ONE: GENERAL CRITIQUES

SECTION ONE

General Critiques

INTRODUCTION

As suggested in the General Introduction, the notion of the emergence of a knowledge economy has become so widespread that it is now commonly assumed in both policy discussions and the mass media. Many advocates have heralded the knowledge economy as transforming the nature of both work and learning. A shift from materials handling to processing of information aided by global electronic technology is seen to be converting much of the labour force into knowledge workers; a direct consequence is that workers must devote more of their efforts to pursuit of lifelong learning to meet the growing knowledge demands of their jobs. The problem, as the chapters in this section make clear, is that this notion remains far from reality.

Carlaw and his colleagues extensively explore the debates across both economics and sociology around the extent of movement into a new knowledge economy and/or knowledge society. They find little clarity or consistency. They then move on to a more specific comparative historical analysis of how intellectual property has been protected and controlled in both the industrial revolution and in contemporary societies through patents, copyright, secrecy, and other means. They conclude that the role of intellectual property remains central to innovation, but that its protection and control has become a harder global challenge with the rise of new forms of communication.

Warhurst and Thompson find that most academic and policy debate about the knowledge economy tends to be prescriptive and inattentive to economic and workplace realities, particularly in terms of the use of knowledge in different levels of the workplace. Much of their critical attention is devoted to discussing the limits of the most common general proxy measures used to demonstrate the purportedly 'knowledge-driven' character of contemporary economies. These are: information and communications technologies (ICT); investment in research and development; formal qualifications of the labour force; and imputation of increasing knowledge from changing occupational composition. In each respect, they find these proxies are misleadingly insensitive to underlying variations and developments. They then go on to suggest a conceptual frame that might more effectively map workplace knowledge with reference to practice.

Jessop takes a broader cultural political economy approach to tracing the development of the knowledge-based economy and its predecessor, the post-industrial economy, as the hegemonic 'imaginary' or dominant frame for interpreting contemporary capitalism and higher education. He traces ways in which Daniel Bell's optimistic projections of democratization of knowledge have been controverted by its reduction to a factor of production oriented to an

D.W. Livingstone and D. Guile (eds.), The Knowledge Economy and Lifelong Learning: A Critical Reader, 3–5.

economizing logic of profit and loss, both in material production generally and in the operation of universities. Jessop offers several case studies to illustrate the construction of the knowledge economy as a very successful economic imaginary. He shows that the rise of the knowledge economy as a dominant frame resulted from competition between social forces in a particular complex historical period. He also delineates differences between economists' approach to the knowledge economy and a sociological approach to the knowledge society as well as between theoretical and policy frames reflecting these phenomena. Finally, he examines the reorganization of education on a world scale, the increasing construal of education as a directly economic factor and – even where it remains beyond the market – the treatment of education in terms of its effect on economic competitiveness. Perhaps most importantly, Jessop's chapter strongly suggests that the categories, structures, and processes repeatedly referred to by advocates of knowledge economy as natural are indeed partial constructions of reality.

Livingstone sees knowledge economy theories as an example of the general evolutionary progress paradigm and assesses their basic claims in their own terms. Empirical evidence indicates only incremental gains in skill requirements and the proportions of the labour force in jobs recognized as requiring specialized knowledge. This contrasts with much larger increases of advanced schooling and adult education. Human capital theory has provided the most compelling rationale for expecting emergence of the knowledge economy and continued economic growth through individual and aggregate investment in education. But increasing numbers of highly qualified people are unemployed or underemployed and most experience decreasing marginal returns for their formal education. Thus, human capital theory may have reached its limit as an explanatory frame; the growing education–jobs gap may be better understood in terms of conflict theories.

Brown and Lauder sceptically assess the now-dominant view that, in the global knowledge economy, developed countries can resolve issues of individual aspirations, economic efficiency, and social justice through the creation of high-skills, high-wage 'magnet' economies. The authors find four key claims to be seriously deficient, namely: high skilled jobs do not necessarily lead to high wages; the bond between education, jobs, and rewards is loosening, not tightening; an anticipated power shift from employers to knowledge workers has not happened; and increased emphasis on individual employability and raising the educational standards of all ignores an oversupply of graduates for good jobs and exacerbates the problem of equality of educational opportunity at a global level. Their analysis seriously challenges both the notion of a 'magnet' economy and the major tenets of the dominant discourse of education, knowledge, and the global economy.

Duguid takes a more general approach to the nature of knowledge in modern societies. He suggests that individualist approaches to knowledge, particularly in mainstream economics, tend to reduce it to calculable units of information to be codified, exchanged, and controlled. He compares the approach of 'community of practice' (CoP, a.k.a. situated learning theory), which recognizes that much knowledge is generated and continues to reside tacitly in social contexts. Duguid counters economists' arguments to substitute tacit with more explicit knowledge

by stressing that the impact of knowing how to do something is at least as important as knowing cognitive details about it. Most pungently, he observes that: 'A brief list of all that is involved in tying a shoelace would overwhelm a learner.' He concludes with cautionary notes about essential tacit aspects of social networks that continue to be ignored by social capital theorists preoccupied with information exchanges between individuals – a caution that could be equally applied to most knowledge economy theorists as well as to theorists of lifelong learning who reduce learning to its most formal, individual dimensions.

Kennedy counterpoises two logics of development: (1) the familiar dominant logic of late modern capitalism that the 'knowledge economy' is evidence of the expansion of capital into new products and services in a search to generate surplus value, with 'life-long learning' responding by supplying the working population with the requisite skills for capital to exploit in the course of this expansion; and (2) a 'logic of labour' argument which accords primacy to understanding the shift towards the knowledge worker and the 'lifelong learner' in terms of the development of the general social power of labour. In line with autonomist labour theorists, he sees surplus value becoming more difficult to locate and control in immaterial forms of labour power because its increasingly socialized character is being drawn into global interconnection via information technology. Kennedy recognizes capital–labour relations as a moving contradictory process. But he discerns an emerging capacity for labour power to become social power, not only limiting necessary labour used for capitalist profits but expanding free labour, identifying, defining, and ultimately controlling production for social need.

Taken together, the chapters in Section One present a compelling argument that a knowledge-based economy in which the existing knowledge and learning abilities of the labour force are being effectively utilized in current forms of employment remains far from reality in advanced industrial societies generally. These chapters also puncture the common assumption that greater lifelong learning effort by this labour force is both required and a most appropriate solution to current economic problems. The second section will look more closely at how these basic claims of knowledge economy advocates apply in diverse contemporary paid workplaces, including in those that such advocates see as the leading edge of transformation to a new economy.

KENNETH CARLAW, LES OXLEY, PAUL WALKER,
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BEYOND THE HYPE

Intellectual Property and the Knowledge Society/Knowledge Economy

INTRODUCTION

Much has been made about whether anything is 'new' about the 'New Economy,' with the conclusion being that we now *are* a knowledge-based society. But in what sense, if at all, are we any more of a knowledge society now than we were in Neolithic times, the Renaissance, and th1e Industrial Revolution? What is the role of intellectual property (IP) and the intellectual commons in the process of innovation, growth and economic development? What role does technology and technological knowledge play both in the process of innovation and economic growth and in the protection of IP itself? To answer some of these questions requires a clear understanding of 'the nature of the beast,' what we mean by the New Economy, how we measure the level and growth of innovations, how we test for association/causation between knowledge (both embodied in human capital and disembodied) and any consequences it might generate (both good and bad), and how we protect IP.

Foss (2002) argues that 'Whatever we think of this journalistic concept [of the knowledge economy], it arguably does capture real tendencies and complementary changes' (p. 62). What might these 'new' tendencies be?

> We define the knowledge economy as production and services based on knowledge-intensive activities that contribute to an accelerated pace of technical and scientific advance, as well as rapid obsolescence. The key component of a knowledge economy is a greater reliance on intellectual capabilities than on physical inputs or natural resources. (Powell & Snellman, 2004, p. 199)

Here the 'modern' emphasis seems to be on 'knowledge' (yes) 'accelerated technical and scientific advance' (yes) and 'greater reliance on intellectual capabilities than physical inputs or natural resources' (yes). Is this all new? Marshall (1890) states that 'Knowledge is our most powerful engine of production' (p. IV.1.2). MacLeod (1988) argues that: 'The unreformed [pre-1852] patent system was at best ineffective, or at worst, a brake on invention and its dissemination' (p. 200). Furthermore Ashton (1955) suggests that 'If Watt's Fire Engine Act had not extended the life of his steam engine patent we would have had a railway system earlier' (p. 107), and Boehm and Silbertson (1967) state that

D.W. Livingstone and D. Guile (eds.), The Knowledge Economy and Lifelong Learning: A Critical Reader, 7–42.

'Evidence placed before the 1851 Select Committee … certainly throws doubt on a strong causal connection between our early patent system and the British industrial revolution' (p. 26).

In this chapter, we will emphasize a *historically grounded* approach to consider what, if anything, is fundamentally 'new' about the knowledge economy/society and whether it constitutes a modern economic and social 'revolution.' The themes we will investigate mirror some of the issues raised above as potential indicators of a 'changed world' and include: (1) *the role of entrepreneurship, technological knowledge creation and obsolescence*; (2) *intellectual capabilities and intellectual knowledge*; and (3) *the role of science and research and development*. In order to consider whether the modern world is 'fundamentally' different we will, through the lens of history, consider these issues with a view to then analysing what the current literature on the knowledge economy/society really has to say.

In particular, in the second section, we explore characteristics of the British Industrial Revolution of the nineteenth and nineteenth centuries and similar episodes in Europe with a view to 'setting the historical scene' for subsequent comparisons with the 'modern eras' of the 'new' 'information' and 'knowledge' societies emerging in the latter half of the twentieth and the beginning of the twenty-first centuries. Section 3 focuses on the role of the *entrepreneur* as risk taker and innovator in a world characterized by uncertainty, complementarities and elective affinities. The analysis is illustrated with references to a range of developments that led to and potentially 'caused' the Industrial Revolution. This section continues to 'set the scene' to allow us to consider whether the world is 'fundamentally different' now to then. In section 4, four particular forms of IP and its protection are considered including patents, secrecy, 'first-to-the-market,' and copyright in order to identify their historical origins, historical developments and their potential roles in the two epochs contrasted here.

Section 5 presents the case for the critical role of *science and research and development* in the European Industrial Revolutions to allow an historical comparison with current debates on the assumed primacy of such elements in 'New Economy' and the potentially changing role of IP that modern developments and ownership create. With this historical background in place, section 6 undertakes a detailed analysis of what might now define a modern knowledge economy/society via extensive reference to what others have said on such matters. The evidence from this section is that 'quantifiable, non-circular' definitions are frustratingly absent; however, 'knowledge' and the resultant role of IP creation and protection are a key component in all the cited authors' discussions. Whether IP and knowledge are 'uniquely' key to the 'New Economy' will be an issue we return to in the concluding section. Section 7 extends discussion of the role of IP in the knowledge society, emphasizing the fundamental role of the Information and Communication Technologies (ICTs), where innovation is increasingly seen as the fuel of the New Economy, with the internet the 'electricity,' and section 8 concludes by looking forward to identify key research questions and methodological challenges to progress these debates.

HISTORICAL BACKGROUND

One of the key questions we try to address relates to whether we are currently living through a period of fundamental change, as radical and extensive as the 'great transformation'[1] (Polanyi, 1944) of the eighteenth and nineteenth centuries. This 'transformation' comprised changes to the technological, economic, political and values base of societies.

To explore this question, we will examine the two historical periods that have been identified as ones of dramatic change. The first created the 'industrial/modern society,' replacing the agrarian period, whereas the second is attributed to creating what many typically call the 'information/knowledge society' (Toffler, 1980).[2] Considerable controversy still lingers around both these claims, with some seeing linear progress (Hirst & Thompson, 1996) and gradual change rather than sharp discontinuities, whereas others subscribe to more radical transformations and argue for difference rather than continuity. Drawing on economic, sociological and historical traditions and critique, we seek to take stock of the debates and identify the key questions still to be addressed in an ongoing research program.

Knowledge has always been important for the development of economic and social life.[3] In the eighteenth- and nineteenth-century industrial revolution, and in the more recent post-1960s information revolution, we see an age-old tension between the desire for an openness to innovation and change and the spread of information that would assist this activity and the need to control the access to knowledge in order to enable those who have created new IP to gain some economic return. Without protection of some kind, it is often suggested that there would be no incentive for a continued investment in the time, energy and capital that is necessary for the creation of yet more ideas. However, sorting out what if anything is different in the two time periods with respect to the role of knowledge has not proven straightforward for most authors. We would argue, however, that it is simply a matter of identifying the *specific types of knowledge* in use in the relevant periods and suggesting how the legal systems are forced to adapt their 'rules of the game' as these technologies emerge and evolve.

A considerable volume of research by both sociologists and economists has been devoted to examining the industrial revolutions that took place in the eighteenth and nineteenth centuries. A substantial change came from the use of new technologies and motive power – from water to coal, electricity and oil. Such technologies allowed new forms of production to take place, expanding the industrial base of these societies. It also changed how things were made, moving products from small craft shops to factories and assembly lines. Human labour was deskilled from craft working and 're-skilled' to skilled and semi-skilled production line work (Hobsbawm, 1975). Larger units of labour required different settlement patterns encouraging the growth of new cities. For example, in the United Kingdom in 1801 there was only one city, London, that had a population of over 100,000, but by 1901 this number had increased to 35 cities of more than 100,000 and containing 25.9 per cent of the population of the United Kingdom (Thorns, 2002). The initial development of industrial cities was marked by tenement

housing and crowded conditions that allowed workers to live close to their work, but was associated with poor living and health outcomes,[4] reflecting the unequal distribution of the cost and benefits of the new system.

Economic changes associated with the development of the industrial system were profound. The source of wealth creation shifted from land-based and raw commodity trading to products of the industrial system. The accumulation of capital from the production and sale of commodities produced by increasing large-scale manufacturing became the key driver of economic life.[5] This led to the formation of the 'Fordist' system whereby reducing the cost of commodities through mass production, paying a wage that allowed workers to consume, and regulating working hours[6] to create leisure became a recipe for expansion (Amin, 1994). The labour process was changed with the growth of scientific management – 'Taylorism.' This created an ongoing debate as to what created increased efficiency and worker satisfaction (Braverman, 1975). Was it through streamlining that the production process (time and motion study) was improved or was it through creating a strong collegial bond between workers and management and developing more of a team approach (Roethlesberger & Dickson, 1939)?

In industrial societies the principal source of value was human labour allied to new technologies of production. A key social change that was suggested as critical to the creation of this new system of economic activity was the 'spirit' of capitalism (Weber, 1930, 1947); a change took place in values as a result of the Protestant reformation emphasizing a more individual understanding of faith and religious work. Weber argued that it was the Calvinist idea of predestination and 'election' that encouraged hard work and the achievement of economic prosperity that then indicated that persons were part of the 'elect.' Weber identified what he termed an 'elective affinity' between the economic, social and religious changes which created a climate that allowed the industrial system to develop extremely rapidly (Gerth & Mills, 1946, pp. 284–285).

However, Lipsey et al. (2005) see the Protestant work ethic as a sub-evolution following the invention of the printing press rather than as a major theme. In particular they identify five key differences between Europe and the rest of the world. The first is pluralism of authority and control. The second is the corporation, in the forms of the church, guilds and universities. Third is the adoption of natural philosophy in place of the doctrine of occasionalism that leads directly into the fourth difference, Newtonian science, that cannot exist without natural laws, and fifth, a legal system that evolves out of canon law. Therefore, lacking these elements, the economies of India and China fell behind in terms of their rates of economic growth. What this shows is that technology on its own is insufficient to create economic growth; therefore, such growth comes from a combination of influences including *changes to the values and ideas* underpinning a particular society.

INDUSTRIAL REVOLUTION AND THE ROLE OF UNCERTAINTY, TECHNOLOGY IDEAS, COMPLEMENTARITIES AND ELECTIVE AFFINITIES

It is broadly recognized (see, e.g., Suatet, 2000) that innovative entrepreneurship is a significant engine of technological knowledge creation, which itself is recognized as the fundamental engine of long-run economic growth.[7] Innovative – typically profit seeking – entrepreneurs have been responsible historically for a large proportion of the innovation necessary to make new technologies commercially viable. For example, much of the mapping of the globe and the refinements to the technology of three-masted sailing ships in the fifteenth and sixteenth centuries occurred because individuals were seeking new ways (routes) to obtain economic profit.[8] This entrepreneurial activity led to the development of complementary technologies in the form of the joint stock company[9] and many other related financial innovations. In fact, *economic incentives* have driven a significant number of major technological innovations throughout history. Writing was invented as a result of a desire to keep records for the purposes of taxation to fund public works.[10] The steam engine was invented to pump water out of mines. Furthermore, while other such general purpose technologies (GPTs) have found their inspiration from non-economic motives (e.g., the computer and internet were originally developed as military technologies), their development and diffusion has been the direct result of entrepreneurs exploiting economic opportunities.

To the extent that economic growth is desirable, it is necessary to understand this entrepreneurial engine of economic growth. In order to do this we must understand how technological knowledge manifests and develops and how it relates to other knowledge, pre-existing technologies and economic structures such as institutions, laws and capital (physical and human). We must also understand the incentives and motivation of the entrepreneurs who drive the process of technological change. Consider the process of economic growth driven by technological change. The critical feature of this process is that it is pervaded by uncertainty. Individual pieces of technological knowledge are complementary with other pieces of technological knowledge and with the economic structure into which they get embodied. The economic growth process exploits complementarities through combinations and re-combinations of technological knowledge. Decision-makers (including entrepreneurs) of the system must form expectations with respect to investment decisions that take into account these features of technological change.

Because innovation implies doing something that has not been done before, uncertainty pervades the process of technological change.

> It is often impossible even to enumerate in advance the full set of outcomes of a particular line of research. Time and money are often spent investigating specific research questions to discover whether the alley they lead up is blind or rich in potential. As a result, massive sums are sometimes spent with no positive return, while trivial expenditures sometimes produce results of great value. Furthermore, the search for one technological advance often produces different, unforeseen advances. (Lipsey & Carlaw, 2000)

Uncertainty implies that different agents may make different innovative choices with respect to the same technology, resulting in different outcomes. Sociologists have drawn attention to the unintended as well as intended consequences from technological and other innovations, which also create uncertainty as we are unable to fully predict the associated or down-stream affects. The environmental effects of chemical fertilizer applications and dioxin-based sprays are good examples in which the unintended consequences of these new ways of enhancing farm production have had major unforeseen consequences upon the health and well-being of local populations. Yet, it is still possible for all outcomes of technology to generate economic value because each outcome can result in a commercially viable product or service. One important point is that while some outcomes may generate more value than others, there is no uniquely optimal outcome that should be chosen above all others, nor do we always measure the long-term effects in making these calculations. Another important point is that no single individual can know in advance all of the potential applications for a given technology. The set of applications that is realized after this fact is the result of many diverse experiments (resulting in innovation) conducted by many different agents.

As an illustration of the importance of complementarities, consider the following thought experiment. How much would a group or groups within society be willing to pay not to have an identifiable technology such as electricity or the computer taken away for a given period, say a year? Think about conducting this experiment for several iterations, replacing the previously removed technology and taking out another. Now contemplate how many times this experiment must be conducted before the entire annual GDP of that national state (i.e., its ability to pay) is exhausted. Our conjecture is that the number of technologies that need to be individually removed to exhaust total GDP is smaller than the total number currently in use creating that national state's GDP.

Why does this occur? It is because of technological complementarities. The removal of electricity from the production system renders several (or most) other technologies in that system useless. There would be no electric light, no telephones, faxes or email, no internet in computers, and so on. The subsequent replacement of electricity and removal of the computer or internet means that the willingness-to-pay calculation has double counted the value of these technologies.

These observations about technological complementarities reveal that there is a major issue of attributing value to *individual pieces of knowledge*, about which we say more shortly. The complementary structure of technological knowledge leads directly to another observation about the innovation process. Elements of technological knowledge can be combined and recombined to make different technologies. For example, many of the components for the Wright Brothers airplane were derived from bicycle parts. Another example is found in the sequence of power technologies: water wheels were displaced by steam, which in turn was replaced by electricity. However, hydroelectricity generation uses a water wheel. This is the characteristic of knowledge that leads to the optimistic view that economic growth driven by technological change is sustainable because the combinatoric possibilities with new and existing knowledge are boundless. These

combinatoric possibilities circumvent diminishing returns in the creation of knowledge. In making such combinations and adaptations of technologies to new conditions, the social and cultural conditions are a major factor. In Kobe, Japan, the local Rugby Union team imported a scrum machine from New Zealand and decided to 'improve the technology' by making the machine work with less friction. However, by doing so they completely defeated the purpose of the technology. Clearly there was no transfer of the complementary cultural information about the purpose and use of the machine!

There are two important aspects of entrepreneurial behaviour with respect to innovation that must concern us. First, given the characteristics (uncertainty and complementarity) of the technological growth process, the entrepreneur plays a critical role in identifying and exploiting the innovation opportunities that new technologies present. Second, entrepreneurs are the economic mechanism which transforms technological knowledge into economic value.

Entrepreneurs are the decision-making force that generates both continuous innovation and economic value from that innovation. The innovative entrepreneur is the opportunist who recognizes the opportunities inherent in new technologies; 'In that sense, the entrepreneur gives life to the implicit [in some cases explicit] demand on the part of consumers' (Sautet, 2000, p. 60). In almost all cases it is impossible to attach probabilities to outcomes and expectations are in many cases best guesses. Thus, entrepreneurs are the risk takers who form a vital linkage in the process of technological change and economic growth, converting technology into commercial value.

With such pervasive uncertainty, how do we appraise the economic value of the IP generated from innovative entrepreneurship and contemplate mechanisms to protect such property? Both are difficult issues. Appraisal requires assigning value often to individual pieces of technological knowledge. The problem exists because the economic value of the individual pieces of knowledge is only generated when they are combined with other pieces of knowledge to form commercially valuable products and processes. Protection provides the incentive to individuals to undertake innovative research, thus overcoming the positive spill over associated with the non-rivalrous characteristic of knowledge.[11] However, it also limits the exploitation of the protected technology by subsequent innovative entrepreneurs who will themselves create innovations by applying the technology in novel ways. Thus, protection slows the diffusion of new technology and limits the value extractable from it.

Economists' accounts of how technical change arises in market economies are influenced by Schumpeter's (1942) work that recognizes the need for profit in 'rivalrous' competition. In contrast, sociological accounts have featured the social and professional aspects of this process and have given more attention to the social actors involved (Nelson, 1989). Increasingly both have recognized the need for an evolutionary approach that takes account of the inter-relationship of the private (market-based) imperatives and the 'public' knowledge creation and application-based aspects of innovation. Evolutionary paths, however, are not smooth. They

may have significant spikes when major technological innovation occurs, as is clearly shown by the work on GPTs.

What was the value of the printing press when Gutenberg first introduced the technology (i.e., before the standardization of the vernaculars of Europe)? The press became much more valuable after the standardization of spelling and dialect. Should we then appraise Gutenberg's IP before or after the standardization of languages? Our problem with appraising the value of Gutenberg's IP is a problem that pervades all of IP over technological knowledge. How should we appraise the value of the individual pieces of knowledge contained in the printing press, many of which Gutenberg did not create himself? For example, movable type was invented in China long before the European version of the printing press was created. Other critical pieces of knowledge, such as the alphabet and language, were also used by Gutenberg but not invented by him. This provides support for the way that ideas and technologies interact with the social and political conditions of particular nation states in specific time periods.

The ability to associate economic value with a particular piece of knowledge is made difficult by the very nature of technological knowledge and the processes that create it. However, if we are trying to get incentives for these agents of change such that they create as much economic value from new technologies as possible,[12] we face some major issues. Some of the value will come from giving agents the incentive to expand the set of application technologies associated with a particular enabling technology as quickly as possible, which implies the need for diffusion. Some of this value implies giving agents the incentive to create the enabling technologies in the first place. (These incentives may take the form of IP protection.) The critical issue is the amount these agents must receive in order for each type to undertake innovative entrepreneurial activities. This amount need not be nearly as large as the appraised value of the technology at any given stage of production. In fact, economic theory tells us that the number need only be sufficient to cover the resource and development costs (including the entrepreneur's opportunity costs and risk premium) of innovation. This minimum reward is sufficient to induce the desired behaviour and in all cases where the innovation is commercially viable it must be less than the total value of the technology over its useful life. The problem then is to appraise IP to get incentives correct for innovative entrepreneurs, which means appraising the costs of innovation and not the total potential value.

INTELLECTUAL PROPERTY PROTECTION AND CONTROLS

1. Patents

In exploring the role of ideas and innovation, the issue of IP is a central one as it concerns the way in which ideas can be diffused (Rogers, 1962). In thinking about innovation, clearly one component is the creation of new ideas, such as the creation of new technical processors, and new ways of organizing and managing work. One way of controlling the flow of ideas and information is to subject these to patents

and copyright restrictions (see, e.g., Liebowitz and Watt, 2006; Ramello, 2006; Towse, 2006). Economists see IP protection as desirable because it gives inventors the incentive to create new technologies in the first instance. However, such protection is potentially a double-edged sword in that it restricts the creation of innovative technologies that exploit the initial technology. For example, Watt's patent on his atmospheric steam engine effectively delayed technological innovation in the form of high-pressure steam engines for 80 years (the length of his patent).

Historically, property rights, especially with respect to IP, have played a major role in technological and economic growth. However, it is important to note that the development of property rights is as often driven by technological change as it is a cause of such change. For example, rights to water access were established only after the need for fast-flowing water to run water wheels to power textile and other manufacturing factories were put in place. A modern example of this problem is the internet's impact on privacy and copyright for music (see Liebowitz & Watt, 2006). The important lesson is that well-defined property rights may help to facilitate the creation of new technologies, but new technologies may also require changes to existing property right regimes. IP comes in a variety of forms and this variety is actually a reflection of the technological knowledge being protected.

On the surface a *patent* seems to be a fairly straightforward way to ensure IP protection. However, in practice patents have little enforcement value for many holders. Pharmaceutical and chemical innovations enjoy nearly complete property right protection from patents, while computer software innovations obtain very little protection. There is a fundamentally different characteristic between these technologies that relates to the technological characteristics of complementarities and combinatorics. Pharmaceutical and chemical innovations are new combinations of complementary components of knowledge that take the form of molecules. The critical feature of pharmaceuticals and chemicals is that there is a unique mapping between the particular molecular combination and the output generated by the combination. Therefore, any marginal variation to the molecular combination will result in a completely different output. This is not the case for computer software (or most other technologies). Variations in computer code can produce virtually the same output. For example, consider the number of different word processors available to consumers. Thus, patents appear to be a useful protection mechanism only for technologies where there is a unique relationship between the combination of pieces of technological knowledge and the output of the technology.

Patenting does, however, have a long history. Machlup and Penrose (1950) note that a rather well-developed patent system existed in Venice in the fifteenth century, and that the practice of granting monopoly privileges by the Crown or by local governments to inventors was widely followed in many parts of Europe in the sixteenth and seventeenth centuries. In England, the policy of granting the privilege of monopoly under royal prerogative culminated in the Statute of Monopolies of 1624, providing the first patent law of a modern nation. Other

countries followed, after a gap of more than a century, with France and the United States enacting patent laws in 1791 and 1793 respectively.

The role of patenting during the British Industrial Revolution, however, is a controversial one. On the one hand, controlling the flow of new innovations through patenting copyrighting and use of trademarks was prevalent and some analysts see this as a factor that limited innovative activity during the industrial revolution; for example, 'Evidence placed before the 1851 Select Committee … certainly throws doubt on a strong causal connection between our early patent system and the British industrial revolution' (Boehm & Silbertson, 1967, p. 26). However, many economists have argued that innovators are 'rational profit maximizers' and as such without the protections of IP laws there would have been little incentive for them to spend time in the research and development that creates new innovations, as they would be unsure as to whether or not they would have an economic return (Drahos, 2005).

Historians' judgements of the consequences for economic development of the precocious English patent system are mixed. Some, including Fox (1947), simply associate the origins of the modern patent system in England with the location of the British Industrial Revolution. MacLeod (1988, p. 198) takes a more cautious approach. She notes that the concept of 'intellectual property' in regard of technical invention was a late development.[13] It was mentioned first in a pamphlet of 1712, and after that the term re-appears sporadically in the patent applications later in the eighteenth century, before being enshrined in the Act extending James Watt's patent in 1775, 'his property in the said application secured.' However, MacLeod argues that the unreformed (pre-1852) patent system was at best ineffective, or at worst, a brake on invention and its dissemination. Ashton (1955, p. 107) suggests that if Watt's Fire Engine Act had not extended the life of his steam engine patent, we would have had a railway system earlier.

Ironically, Dutton (1984, p. 204) argues that the imperfect nature of the British patent system during the Industrial Revolution may have in practice approached the ideal. Inventors paid heavily and separately in England, Scotland and Ireland for the temporary, 14 years in the first instance, and uncertain privileges of patent protection, because property rights were dependent on decisions made by the Courts, not by the Patent Office. Nevertheless, British patents offered a degree of property protection to inventors, but did not provide complete barriers to access and use by others, and this, according to Dutton, was in all probability the most appropriate for the economy as a whole during the Industrial Revolution. The balance eventually swung in the favour of patentees. Sullivan (1989, p. 436) argues that part of the increased patent activity after 1830 was a response to the increased value of patent rights due to favourable treatment of patentees in the courts. Even so, in 1850 the system, according to Boehm and Silbertson (1967, p. 19), was enormously cumbersome, and involved ten stages, stages that involved obtaining the sovereign's signature twice. The Patent Law Amendment Act of 1852, which simplified the process and cheapened the price of patenting, was the outcome of the persistent lobbying by inventors in the years since 1780.

For the period 1780–1851, Dutton's instinct that an imperfect patent system approached the ideal receives the support of classical economists from Smith to Mill, the latter stating categorically that the condemnation of monopolies ought not to extend to patents. Sentiments in favour of abolishing the patent system were not entirely absent in an era that saw the end of Bank of England and East India Company monopolies in the 1830s. Machlup and Penrose (1950, p. 15), for example, cite an editorial from the *Economist* in 1850, which argues that inventors, to establish a right of property in their invention, should give up all the knowledge and inventions of others, which is impossible. Nevertheless in Europe only the Netherlands, in 1869, abolished patents, although its citizens could take out patents in foreign countries, while Switzerland did not enact patent legislation, after torturous debate, until 1888. Schiff (1971) argues that industrialization flourished in these two countries in the absence of a patent system. Whether the property rights afforded to inventors during the Industrial Revolution were a lever to technological and industrial progress is, on the basis of the historiography, unclear. Indeed, Boehm and Silbertson (1967), cite Rogers' (1863) view of the debates of a century earlier, 'that the arguments have not gone further than a *post hoc ergo propter hoc* discussion,' and express doubt there has been much subsequent advance in thinking. The reverse interpretation, that the growth of patenting after 1760 followed industrial development, does appear in the literature. Ashton (1948) postulates that the timing and the direction of Industrial Revolution patenting activity was influenced by economic conditions, including prices, costs and interest rates.

Historians remain divided on the sectoral pervasiveness of Industrial Revolution technological progress. O'Brien (1993), Harley (1993) and Crafts (1985) argue that technological progress was localized in the cotton and iron industries. Alternatively, Temin (1997) and Landes (1969) see the Industrial Revolution as broadly based. McCloskey (1988) adopted an intermediate position, claiming that around 46 per cent of economy-wide productivity growth arose outside the 'modernized sectors.' The linkages between patents, as a measure of 'protected' inventive activity, and the disaggregate records of British industrial growth between 1780 and 1851, have the potential to inform the debates surrounding historians' conceptualizations of the Industrial Revolution. The extent, if any, to which the effects of patented inventions spilled through the industrial economy, will shed light on whether protecting inventors' property rights impinged on the economy-wide adoption of new technology. Conversely, the statistical causality tests will also show if patenting activity was stimulated by particular industrial sectors.

In a series of papers, Greasley & Oxley (1994, 1996, 1997a) use modern times-series econometric methods and macro-level real total industrial production data to identify the origins and likely 'end' of the British Industrial Revolution, dating the period as 1780–1851. Their work uses the Crafts and Harley (1992) amended version of the Hoffman (1955) data set. Using traditional Granger-type and more recent Toda and Phillips (1991) and Toda and Yamamoto (1995) methods, Greasley and Oxley (1997b) and Oxley and Greasley (1997) also consider possible

causal linkages between industrial production (output) and other aggregate level data that have traditionally been identified in the economic history literature as potential candidates for 'drivers/engines of growth.' The candidates included real wages, imports, exports, population and *patents* and affected production *processes*. In that work, bi-directional causality between patents/processes (levels or growth rates) and industrial production (levels or growth rates) was identified. Their work is the only published work we know of that considers the causal relationship between British industrial production and patent activity over the period of the Industrial Revolution.

In related work, however, Sullivan (1989) assumes that because increased growth of patenting *preceded* increased growth of total factor productivity (TFP), a causal relationship can be inferred. However, he does not test for causality or, importantly, consider the effects of the non-stationary nature of the data that would affect the form of chosen causality test. Greasley and Oxley (2000) also consider the sectoral inter-relatedness of the growth of industrial output, and thus of the pervasiveness of technological progress during the Industrial Revolution period, applying co-integrating relationship methods and tests for common stochastic trends, to Hoffman's disaggregate, sector-level data. They conclude that Industrial Revolution technological progress spread widely, but unevenly. From their perspective, the productivity shocks shaping cotton and iron goods output defined the profile of early British industrialization. These two key industries shared a common stochastic trend with a wide group of mining and metal industries, and had long-run causal links to shipbuilding, paper, malt and sugar. The output trends in other important industries, notably woollens, linens, flour and bread, were isolated from the technological progress driving the cotton and iron goods industries. In Greasley and Oxley (2007), they add to the debates surrounding the pervasiveness and the forces shaping Industrial Revolution technological progress by investigating the causal links between patenting activity and industrial output at the sectoral level during the period 1780–1851. Using time-series methods applied to the Hoffman (1955) data set they consider the existence of bi-and multivariate causality between patents and 16 sectors of the British economy comprising copper, copper ore, beer, coal, iron and steel, woollens, worsted, tobacco products, tin, sugar, shipbuilding, malt, linen yarn, cotton yarn, cotton pieces and hemp products. Broadly, their results show that the rise in patented inventions after 1780 was a consequence, not a cause, of the Industrial Revolution.

Because patenting procedures did not change materially in the period to 1851, the simple implication is that the value of protecting the IP embodied in technical inventions rose sharply during the Industrial Revolution. These findings offer support to those historians, including MacLeod (1988), who argue that inventors 'rediscovered' the patent system after 1760 and learned to use it to their best effect. Before this date, inventors did not figure prominently in the debates surrounding IP, which centred largely on the rights of authors, publishers and printers. In contrast, post-1780 the engineering lobby was the most vociferous in the campaigns for patents reform and for cheaper and more certain protection of IP. Interestingly, the results show that patenting activity was associated particularly

with the 'new' fast growth sectors of the Industrial Revolution, notably cotton and iron. Inventors responded to the specific opportunities of the Industrial Revolution, a result that coincides with Ashton's (1948) interpretation of the direction of patenting activity.

2. Secrecy

Secrecy is another illustration of how the particular characteristics of a technology imply which IP protection mechanism is best suited. IP used internally in a particular production process is often usefully protected using secrecy. Using data on 4,688 English innovations at the 1851 Crystal Palace Exhibition, Moser (2005) demonstrates that industries such as watchmakers relying on alternatives to patenting to protect IP (that is, utilizing secrecy), tend to be more geographically concentrated than those that do. Those industries that subsequently shift to patent protection experience a tendency to geographic diffusion. Close proximity is required to enforce secrecy and minimize 'leaks.' Similarly, in the lean (or 'just-in-time') production created in modern Japanese automobile manufacturing firms (particularly Toyota), the technological knowledge was completely internal to the firm's production activities. Even when American automobile manufacturing firms first visited Japanese plants to uncover the secrets of the Japanese success, they misunderstood the technology. The many failed experiments in robotics and complete automation of the assembly line in the United States are a testament to this.

3. First-to-the-Market

Being 'first-to-the-market' is an especially effective protection mechanism for technologies that are complementary to human capital that must be acquired by the user to extract any value from the technology. For example, computer software requires a human capital investment by the user in order to be able to generate output by using the software. In this case, being first-to-the-market means that owners of software capture large segments of the market because there is a cost for consumers to switch to any competing technology that subsequently enters the market. Technologies that require users to invest in complementary human capital in order to use them are most likely to find protection by being first-to-the-market.

4. Copyright

Historically copyright has been a relatively effective mechanism for protecting IP that is stored in a physical medium. For example, owners of IP stored in books, records, cassette tapes and CDs have been able to appropriate much of the value of their property. However, with the new technology of digitally recording music, the physical medium is no longer needed and, thus, we observe the current debate about the rights of internet web sites such as Napster in terms of violation of copyright law (see, e.g., Liebowitz & Watt, 2006 for a fuller discussion of this

particular issue). There are various other mechanisms for IP protection in use today, but the above discussion is sufficient to illustrate the point that the effectiveness of the mechanism depends on the type of technology to which it is applied. This should not be surprising given what has already been said about the complementary nature of technological knowledge. *Intellectual property protection mechanisms are a kind of technological knowledge themselves that are complementary to the particular technology to which it is applied*. Given what we know about complementarities and combinatorics, it should be obvious that these complementarities will manifest in different forms just as different technologies do.

It should also be obvious that the protection mechanisms will co-evolve with technology. Furthermore, as has already been noted, some technological changes undermine existing IP protection mechanisms. In a sense, the technology of these protection mechanisms is rendered obsolete by Schumpeterian creative destruction. Just like technologies themselves, new IP protection mechanisms must be invented and in many cases the inventors of such mechanisms will be entrepreneurs trying to protect research investments and profits they perceive to be available from the opportunities present in the new technologies.

THE ROLE OF SCIENCE AND RESEARCH AND DEVELOPMENT

A further critical component of the 'great transformation' was the role of science. The adoption of a natural philosophy (rather than occasionalism) within the Christian religion brought a challenge to existing authority systems and epistemologies creating a belief in 'scientific knowledge' and exploration. The basis for this was systematic enquiry based on the new methods of science – observation, objectivity, classification, and theory development. The world could be better explained through these means and once understood would be easier to shape and control. Reason was to dominate over the belief in other forms of knowledge. Science expanded and as it did, so too did the demands on it by the growing industrial economy and society. The growth of new applied disciplines of engineering, metallurgy and mining became important and new universities based around delivering these areas of study arose – often in the new industrial cities (e.g., Manchester, Leeds and Sheffield) – and were supported by public funds and civic investment. In part, the rise of these new, more technologically focused institutions occurred because the older established institutions were less sympathetic to these new areas of knowledge. This raises a further interesting question that impinges on our interest in IP and the way ideas flow, which is, how far is growth in knowledge limited by the institutional structures that exist at the time?

In an important contribution to the understanding of how science advances, Kuhn (1962) suggested that this was through paradigm shifts. Kuhn argued that science and technology grew not through the falsification of existing paradigms, but in fact by making a move to a new paradigm. Movements in ideas therefore occurred through 'scientific revolutions' when a new paradigm overthrows an

existing one – rather than paradigms being defeated through careful and systematic study. During non-revolutionary periods, 'normal' science takes place within the dominant paradigm. The work of Kuhn drew attention to the social conditions and institutional restrictions of innovation that can occur through the ways in which disciplines and areas of knowledge become dominated by powerful elites who, as the gatekeepers of knowledge, attest to the quality of work, shape the journals and decide on orthodoxy. Such systems would also strongly support a more restrictive approach to IP transfer and availability. The role of research and development is a critical component of the innovation system and one that impinges on debates around IP rights. In many countries there is substantial public investment in R&D, and this raises the issue of the new subjects and sub-disciplines within science and technology, the rise of more applied subjects and the growth of the social sciences. It also raises the issue of the ownership of knowledge created via public investment (Nelson, 1989). Knowledge, though a commodity, is different from other commodities, in that many can make use of it without degrading it. However, it can also be used to create new wealth-generating activity and thus limitations on its dissemination have attractions. The New Zealand New Economies Research Fund (NERF) is an example of where public money is available to support research, which it is hoped will have possible commercial applications that will stimulate new economic activity. In such cases the release of research results can be restricted and can therefore conflict with the right of the public to know the outcome of funded research activity.

David (2005) identifies three principal institutional devices employed by states to encourage the provision of public R&D – these are patronage, property and procurement. Patronage is where publicly financed research is awarded on the basis of a competitive process, such as the way that the NZ Foundation of Science and Technology administers the Public Good Science Fund of $460 million. Here the assumption would be that the results are in the public domain and are available for wide distribution. However since the 1990s, as the science system has increasingly been based around Crown Research Institutes (CRIs) that operate as profit making concerns and with universities also being encouraged to adopt a more business-like model, holding onto the IP by the research organization has become more attractive and significant for their overall economic performance.[14] Procurement is where the state contracts with a preferred research organization or individual and the decision as to whether or not the information is made available tends to be a decision of the contracting party rather than the researcher. This model has increasingly been adopted within the New Zealand government, especially as the public sector reforms of the 1980s led to the downsizing of the internal research capacity within departments and ministries (Pool, 1999; Thorns, 2000, 2003). Here research can be 'buried' when it is of a sensitive nature and at odds with current policy directions. Release here is often dependent on the nature of Freedom of Information legislation and Statutes of Limitation. The final arrangement is that whereby private producers of new knowledge are granted exclusive property rights that allow them to collect fees and other forms of return for the use of their knowledge. The increasing importance of information, and the

new ways that this can now be accessed, sets the context for new struggles over IP rights and controls within the second period of transition that we are considering in this chapter – the 'information and knowledge revolution.'

INFORMATION/KNOWLEDGE ECONOMY/SOCIETY

So far we have considered a number of themes – that is, the role of entrepreneurship, technological knowledge creation and obsolescence; intellectual capabilities and intellectual knowledge; and the role of science and research and development – in our historical comparisons to set the scene. Up to this point we have not considered the modern meanings and origins of the period that is (currently) referred to as (variously) the information/knowledge economy/society in any systematic or rigorous way. However, if we are to critically and, importantly, fairly to address the fundamental question of whether we are any more of a knowledge society now than we were in the Neolithic, the Renaissance and the Industrial Revolution, we have to be sure that we are talking the same language of those authors we seek to review.

In this section, we will undertake a thorough critical analysis of what current authors appear to mean when they refer to the information/knowledge economy/society and what they identify as the unique characteristics of this period, with a view to ascertaining whether, based upon 'their' definitions of the beast, the world is fundamentally different.

The foreshadowing of the 'new' information/knowledge economy/society can be found in the revival and development of the economies and most of the societies of the protagonists in the Second World War built around a continuation of the pre-war pattern. The basic industries were still mining, steel production and manufacture of commodities within a 'Fordist' system of production. This system was one based around mass commodity production and strong welfare states that ensured full employment and basic social provisions such as health, education and social security (Jessop, 2000). Economic growth was assisted by the recovery required after the destruction of wartime, with strong growth in population as a result of disruptions and delays to marriage and childbirth through war. Growth in population also stimulated housing and the growth of consumer spending on household appliances and motor cars, which became an increasingly significant mode of transport. However, by the 1960s the boom times were ending and the restructuring of the industrial economies was beginning, changes that had far-reaching effects in the 1970s and 1980s. This was a time of 'deindustrialization' in the economies of North America and Western Europe (Bluestone & Harrison, 1983; Massey, 1984; Lash and Urry, 1987). Manufacturing was reduced as a component of the economies and in a number of cases shifted to cheaper labour markets in Southern Europe (e.g., Spain), Central and South America (e.g., Mexico), and into Asia (including the Asian 'tiger' economies). This began the formation of a 'new international division of labour,' and was one of the factors that stimulated the debate as to whether a new 'epochal' transformation was taking

place and what the central drivers of the former industrial manufacturing economies would be (Froebel et al., 1980; Smith & Feagin, 1987; Thorns, 1992).

The idea that the industrial manufacturing society was starting to be transformed into an 'information society' was initiated by, among others, Peter Drucker (1959, 1969, 1994) and Alvin Toffler (1980) and was part of a debate about the role of information and service workers within the changing economy of the time. New areas of activity emerged and new areas of expertise were called upon to run the modern corporation. Strong growth occurred in information management, finance, marketing, and sales. Also, the expansion of the welfare systems created an expanding 'service' population engaged in government work, including education, administration, social welfare services and urban and regional planning. In many of these positions, information was a more significant requirement than it had been in the past. Analysis of the growth of 'services,' as part of a shift from a 'secondary' to a tertiary economy and workforce, was often difficult, as separating out whether the activities of service workers were new rather than an extension of previous forms of work proved very difficult due to the way that occupations were classified and recorded in national statistical databases.

By the 1970s, the understanding of the changes taking place shifted from information (which remains data without human processing of it) alone to a greater emphasis on knowledge (which is processes information embodied in human capital). However, the bulk of the shift occurred in the 1980s and 1990s at a time when the institutional environment was one of deregulation and liberalization that encouraged government to dismantle border controls and other forms of economic regulation.

Thus we see that technological and economic change has been allied with political and social change as it was in the 'great transformation.' This supports the argument that we are living through a time of far-reaching changes to the basis of societies. The key to understanding these changes is being ascribed to the place occupied by knowledge, but what exactly is this role and is it uniquely 'new?'

Central to Stehr's thesis is his argument that 'the origin, social structure and development of knowledge societies is linked first and foremost to a radical transformation to the structure of the economy' (Stehr, 1994, p. 122):

> The economy of the industrial society is initially and primarily a material economy and then changes gradually to a monetary economy … and then becomes as evident recently, a symbolic economy. (1994, p. 123)

Economists as well as sociologists have also identified knowledge as a key driver of contemporary economies. Economists, however, present a wide set of definitions/characteristics of what they believe constitutes a knowledge economy and hence its drivers. Smith (2002) summarizes succinctly the problem one faces with such attempts:

> What does it mean to speak of the 'knowledge economy' however? At the outset, it must be said that *there is no coherent definition* [emphasis added], let alone theoretical concept, of this term: it is at best a widely-used metaphor, rather than a clear concept. The OECD has spoken of knowledge-

> based economies in very general terms, as meaning 'those which are directly based on the production, distribution and use of knowledge and information.' This definition is a good example of the problems of the term, for it seems to cover everything and nothing: all economies are in some way based on knowledge, but it is hard to think that any are directly based on knowledge, if that means the production and distribution of knowledge and information products. (pp. 6–7)

Economists tend to focus on the idea of knowledge-based economies (KBEs), which could be seen as a subset of the knowledge society, and limit the focus to the changed role of knowledge in economic activity. For example, the OECD (1996) defined a KBE as 'Economies which are directly based on the production, distribution and use of knowledge and information' (p. 7). In the Asia-Pacific Economic Co-operation (APEC, 2000) definition, this idea is broadened somewhat to talk about how in such an economy all sectors are being reconstituted around a higher input of 'knowledge,' but fundamentally the circularity persists.

In a series of papers, Quah (2002a, 2002b) and Coyle and Quah (2002) raise the idea of the New Economy as a *weightless economy*. This terminology is inherently 'Quah' and has not been widely adopted even though it has more concreteness than several other leading brands:

> The weightless economy[15] comprises four main elements: 1. Information and communications technology (ICT), the Internet. 2. Intellectual assets: Not only patents and copyrights but also, more broadly, name brands, trademarks, advertising, financial and consulting services, and education. 3. Electronic libraries and databases: Including new media, video entertainment, and broadcasting. 4. Biotechnology: Carbon-based libraries and databases, pharmaceuticals. (Quah, 2003, p. 2)

Central to many authors' views on the New Economy is the importance of digital technologies, the internet, computers, and information and the globalized networks these technologies enable. For Talero and Gaudette (1996),

> the information economy is emerging where trade and investment are global and firms compete with knowledge, networking and agility on a global basis. A corresponding new society is also emerging with pervasive information capabilities that make it substantially different from an industrial society: much more competitive, more democratic, less centralized, less stable, better able to address individual needs, and friendlier to the environment.

Where does all this take us in our understanding of what the knowledge economy is and whether it is a fundamentally different economic form as compared to past ones? All current definitions/ideas explicitly or implicitly have a central role for 'knowledge' in economic activity. We would suggest, however, that historically this is not *fundamentally* 'new.' The entrepreneurs of the Industrial Revolution used 'knowledge' to create new products. Fundamental constraints on the quantity and quality of these products during this and later industrial periods

included, importantly, land, raw material and production technologies (factories and machines) governed by scarcity, rivalry and diminishing returns. However, what is 'new' now is the type of technologies that exist and interact in the current economy and society – digital technologies, built around ICTs. The issue for economists is whether these technologies create a fundamentally new technical environment where, for example, diminishing returns and inflationary tendencies are 'a thing of the past.'[16] According to Gordon (1998), this has led to the growth of the 'Goldilocks Economy:'

> Freed from the restraint of restrictive monetary policy that had choked earlier expansions, and with its fires stoked by the lowest medium-term and long-term nominal interest rates in three decades, the economy charged ahead and achieved a state of high growth-noninflationary bliss that some have dubbed the 'Goldilocks economy' (neither too hot nor too cold, but just right).

Although it is clear that economists talk of knowledge, Stehr criticizes them for not giving the role of knowledge sufficient attention in their work:

> A close examination of the literature in economics indicates, however, that the function of knowledge and information in economic activity is, for the most part, ignored by economists. Either that, or they introduce knowledge as an exogenous variable, as an expense and generally treat it as a black box. (1994, p. 123)

However, although there has been considerable recent growth in the study of knowledge, the view of Adhikari and Sales (2001, pp. 2–3) is that concepts such as the knowledge society are also incomplete and imprecise, for they are found wanting in terms of exact meaning and are of partial and sectarian relevance. McLennan (2003, p. 4) notes that in much of the literature concerning the knowledge society, there has been an absence of a sustained discussion concerning definitional issues. Others, such as Ungar (2003), argue that the idea of the knowledge society is itself a gloss, as it is frequently evoked but rarely ever defined or explored in a systematic way. Moreover, Ungar continues, it is used merely as an extension of the 'more concrete' concept of the knowledge economy. Indeed, it seems apparent that the concept of the knowledge society needs additional clarity so as to differentiate it from other, similar concepts. In the view of Knorr Cetina (cited in Adhikari & Sales, 2001, p. 15), there is a need for a sociological concept of knowledge growth that brings into focus knowledge itself, 'breaking open and specifying the processes that make up the "it."' In other words, a more sociological approach to knowledge needs to identify the social processes in which knowledge is generated and from which it is turned into a commodity.

If the term 'knowledge economy' is primarily concerned with knowledge as a commodity and the value of intellectual labour in the creation of wealth, then the term 'knowledge society' should concern the social climate in which the knowledge economy resides. In other words, the knowledge society concept should relate to the much broader social context that both motivates and mediates the development and exchange of knowledge. This point is elucidated by McLennan

(2003, p. 7), who notes that while some persistently equate the knowledge economy with the knowledge society, in actuality they are concepts that run in two different directions. McLennan notes that while the concept of the knowledge economy involves a 'strenuous reductionism,' the concept of the knowledge society generally accepts that there are broader social and cultural factors that underlie the techno-economic momentum central to the post-industrial order and that the concept acknowledges knowledge's intrinsic value beyond its worth as a commodity.[17] This conceptual position is antithetical to that of the knowledge economy conceived of merely as knowledge as an object of economic value. Knorr Cetina and Preda (2001, p. 30) refer to this an as exteriorized perspective of knowledge, whereby knowledge viewed as a commodity is regarded merely as a product or a research finding. Such an approach to knowledge growth overlooks social and cultural factors, which may be pertinent to how knowledge is generated and valued. This, on the other hand, appears to be what the concept of the knowledge society is attempting to address. Rather than viewing knowledge growth in purely reductionist terms, the concept of the knowledge society acknowledges that there are social and cultural factors that may influence knowledge growth at any point of time. As Thorlindsson and Vilhjalmsson (2003, p. 99) note, although the concept of the knowledge society is not yet well developed, it generally acknowledges that while science, innovation and expertise are the moving forces of economic development, social forces may intervene at any stage. This often relates to issues of power – conferring it on those who own knowledge and those involved in the politics of knowledge-exchange.

In the discussion of the current 'transformation of capitalism' knowledge is viewed as a key driver of production. Typical of this view is that:

> Capitalism is undergoing a transformation from a mass production system, where the principal source of value was human labour to a new era of innovation mediated production, where the principal component of value creation productivity and economic growth is knowledge. (Houghton & Sheehan, 2003, p. 2)

The key element in the transformative properties of the knowledge society is identified as 'information,' and here the major factor has been the ICT revolution and, in particular, the growth of the internet and more recently digitization. This makes the access to information easier and quicker, extends its global reach and makes it considerably harder to control. For all these reasons, Castells (2000a) has suggested that:

> What is new in our age is a new set of information technologies. I contend they represent a greater change in the history of technology than the technologies associated with the Industrial Revolution, or with previous Information Revolution (printing). (p. 10)

Castells has further suggested that the internet is the 'electricity of the information age' (2001, 2004). There has been a phenomenal increase in the expansion of the internet within a very short space of time. In 1989 there were 159,000 internet

hosts and this had grown to 43 million by 2000 (Houghton & Sheehan, 2003, p. 2).[18] However, one must not ignore the fact that there have also been massive gains in computational capacity through Complementary Metal Oxide Semiconductor (CMOS) logic design. This has been far more rapid and for a much longer period of time than the expansion of the internet. Some would argue that the expansion of the internet would not have been possible without the efficiency advances of microchips. What the IT revolution has brought about is the ability to manipulate, store and transmit large quantities of information at very low cost (Houghton and Sheehan, 2003). ICT and digital technology through the power of the modern computer and the next generation of high-speed computers – with storage in terabytes rather than gigabytes – have created new possibilities in the storage, surveillance, linking and processing of data sets that previously were unconnected. This extends possibilities from the tracking of criminals and terrorists across the globe, to profiling markets for products by small geographical areas (Geographic Information Systems [GIS] and other applications) to tracing benefit frauds (Lyon, 2003). New networking opportunities are created through this enhanced connectivity that generates new forms of knowledge and leads to a whole range of new economic activities associated with the creation, storage and retrieval of information.

The new computer and digital technologies have started to transform the way that work gets done across all sectors, but particularly within the 'knowledge generating' areas of science and technology. We can see here the growing impact in the last decade of e-Science and e-Social Science based on collaborations built around shared information transmitted via the new fibre optic superhighways and satellites – creating a much more globally connected world. These transformations are at least partially attributable to particular characteristics of the technology, namely, the sending and receiving capabilities of communication at a very large number of dispersed nodes, generating both a network externality and the non-rivalrous nature of the commodity being exchanged, namely, *information*. This stimulates the demand for new software products and creates new networks, information clusters and incubators that have become key nodes of innovation. The managing of these new information systems has led to knowledge management becoming a critical area of contemporary business development and practice.

We need here to distinguish between the data – which are the units recorded, information which is processed data – and knowledge which is what can be created from the information. What this indicates is that in 'knowledge societies' some would argue that we have a new principle, 'knowledge,' that creates a new source of added value. This leads into the wider debate that has emerged about different forms of capital. Bourdieu (1986) has extended our understanding of capital to include symbolic and cultural capital, and subsequently social capital has also been distinguished (Putnam, 2000; Cunningham, 2005; Pillay, 2005; Marinova & Raven, 2006).

Human capital in knowledge societies has also been reinterpreted and seen to be of increased importance. Knowledge is now a commodity to exchange and for creating new wealth-generating opportunities; thus, those with desired 'human

capital' and access to 'social capital' become sought after. Bell (1973) sees this shift leading to the end of the industrial working class and its gradual replacement by a post-industrial proletariat consisting of poorly unionized, part time, casual workers. Such a core-periphery pattern of employment creates new patterns of social inequalities with the new 'knowledge' class as one of its significant components. Such a class is global in its importance and it significantly increases the value of and need for new skills and capabilities that in turn has altered the way education is thought of and delivered. Drucker (1969) drew attention to the importance of teamwork in a knowledge society, and he drew a distinction between people who work with their hands and people who worked with their minds. Increasingly in the knowledge society, he argues, the dominant class of people is likely to be those who work with their minds.

Contemporary society is coming to *depend more and more* on knowledge in economic production, political regulation and everyday life (Stehr, 1994; Castells, 1997). With the spread of knowledge and the demonstrated loss of scientific legitimacy through a growing realization that there are many areas where there is still limited understanding, a greater questioning and scepticism towards experts is becoming more prevalent. This is part of the wider post-modern critique of the enlightenment scientific paradigm and a move away from meta-narratives and linear theories that embrace a greater range of understandings about how social change takes place. Many now see path-dependent and complexity theories providing greater insights into change than more determinist approaches, either technologically driven explanations or ones that assumed a linear pathway such as forms of modernization theory (Urry, 2003; Law & Urry, 2004). The idea of the knowledge society is not a new form of technological determinism, but rather a new argument about 'elective affinity' (i.e., connections between beliefs, actions, and the unintended consequences of action). Social actors have greater capacities for self-interpretation and action than have been acknowledged in past theories of change (Giddens, 2001). For Castells, 'the information technology revolution did not create the network society. But without information technology, the Network Society would not exist' (Castells, 2000a, p. 139). It is suggested that in a knowledge society the wealth of a company is increasingly embodied in its creativity and information. The place of the creative industries cannot be relegated to a footnote, but now it needs to be seen as an integral component of the 'knowledge'-based industries (O' Brien et al., 2002).

Alongside these views that information technology has generated new social and economic conditions – thus creating a social transformation – are a range of sceptics who consider that there is insufficient evidence for such an assertion (May, 2002). Much of this critique turns on the view that the argument is based on technological determinism through the assertion that 'technological changes bring in their wake major shifts in societies which use them' (May, 2002, p. 24). Bimber (1995) draws attention to three strands of technological determinism: the normative, the nomological and the unintended. Most accounts of the shift to the information society stress the first two rather than the unintended as they are stressing the positive move towards a new social and economic organization of

knowledge and practice of accumulation. Sociological work adopting less determinist views has stressed continuity rather than rupture; thus the information 'revolution' becomes part of the continuing development and utilization of technologies to change the ways that we do things both intentionally and unintentionally (Mumford, 1966; May, 2002). This suggests that we should adopt an approach to the 'knowledge society and economy' that sees it as part of a continuingly evolving history of connection between specific national and international contexts, technological innovations and economic, social, political and cultural opportunities that either facilitate or resist innovation and change.

The other strong link that has been made is between the knowledge society and globalization. The definition of globalization, rather like the knowledge society, is subject to controversy (Scholte, 2000; Holton, 2005). There is some agreement that what we are now seeing is a much greater connectedness across the globe created by the possibilities arising from the IT revolution. This compresses time and space and enables new ways of working, drawing upon globally connected workers. This makes national boundaries and forms of control much more difficult and potentially creates challenges to local and national cultures through the penetration of globalized entertainment, information, ideas and practices. Global communication through a range of new media has now become accessible and available as never before. Competitiveness is now occurring within a global environment that emphasizes free trade and weaker national borders, allowing for the freer flow of capital and labour. A greater importance is attached to flexibility in labour markets, a flexibility that brings an end to stable employment and the predictability of career paths. Growing inequality at both the global and local levels has resulted, with a growing gap between rich and poor at the national and individual levels.

INTELLECTUAL PROPERTY IN THE KNOWLEDGE SOCIETY

One of the major themes that runs through the current literature on the knowledge economy/society is the role of innovation created via human capital with '*a greater reliance on intellectual capabilities*' in production and consumption. These issues are increasingly seen by some as the 'fuel' of the New Economy, with the internet, *enabled by electricity*, as the 'energy/motive power.' In this section we will focus upon the role of IP in modern societies, an area that is typically ignored or subsumed in simple *economy*-based discussions. For advanced societies a greater emphasis appears to be placed upon a culture of innovation and a focus on how this can be generated. The power of the internet and the connectivity that it allows poses new threats to the control of IP and for some raises an issue as to whether it is still possible to protect the flow of information at all. Computer systems are vulnerable to security breaches, and ensuring the security of such systems has become a significant growth industry in itself as web-based activity extends into all aspects of life – from work to shopping, banking, recreational and leisure activities, including gambling and downloading music and video MP3 files onto iPods (see, e.g., Liebowitz & Watt, 2006).

The speed of innovation also raises further questions with respect to the protection of IP in the contemporary environment in which, in some areas, with the current speed of diffusion, the shelf life of new products may be only a matter of months. Computer systems and software are subject to frequent upgrades and changes, making it potentially a 'greedy technology' that constantly demands investment to keep it 'current.'

The importance of networks and clusters within the new environment has led to the creation of new territorial and virtual clusters of innovation as with, for example, Silicon Valley in California and Manhattan's Silicon Alley (see Graham, 2004). Knowledge can now thus be created in 'virtual' research communities that can gain intellectual capital through the participation of cross-national teams working through computer-based collaborative technologies. Such innovations have led to new linkages between universities and commercial enterprises looking to make use of new knowledge areas such as genetics and genetic engineering, biotechnology and nanotechnology. Universities now operate in the new 'enterprise and business environment' in which they are also interested in the commercialization of the IP of their researchers (see Verspagen, 2006). This raises questions as to who owns the IP created (Delanty, 2001). Digital access, broadband and internet connectivity become the key aspects of inclusion in the new knowledge-creating activities and thus become of increased importance. Being part of the 'advanced networks' that allow for fast and extended linkages across national systems and globally are now seen as keys to research and development and maintaining global competitiveness. For example, the NZ government's decisions to invest in the Advanced Network Group Ltd. providing gigabytes of connectivity across universities and CRIs was stimulated by the desire to keep the New Zealand R&D sector globally competitive. Similar networks are now present in 40 other countries, so the absence within New Zealand creates problems for our scientists – the Advanced Network Group Ltd. will 'ensure our scientists are able to catch up with their partners and participate in the exciting world of modern science' (Jarvie, 2005, p. 2). However, there is still a digital divide with the levels of connectivity across and within nations differing that creates a new set of inequalities, as noted in a recent United Nations Centre on Human Settlement (UNCHS) report that talks about

> Enclaves of 'super connected' people, firms and institutions, with their increasingly broadband connections to elsewhere via the internet, mobile phones and satellite TVs and their easy access to information services, often cheek by jowl with much larger numbers of people with at most rudimentary access to modern communications technologies and electronic information. (UNCHS, 2001, p. 6)

The OECD countries have the highest rates of telephone and mobile phone subscribers and internet and broadband connections and, as with many other forms of technology, those with the lowest incomes, globally and locally, have the most restricted access to the benefits of the technology (UNCHS, 2001).

Sociologists have typically focused on the issues associated with power and the limitation of access and the reasons why material might be withheld. Do such restrictions assist in maintaining the power and position of the dominant sectors within society and thus contribute to the maintenance or creation of social inequalities? Information on the new superhighway of the internet is mostly public and therefore freely available as long as the potential user is connected. Although the originators of the internet such as ARPANET shared information among their users, open source software was central for the development of the internet open to a more general public, facilitating open interchange and reducing restrictions on access to information. Acknowledging the power issues is crucial to a sociological understanding of the role of knowledge in society and therefore to the understanding of IP. The concept of IP refers to a number of protections for human creations including patents, trademarks and copyrights (amongst others).

In the shift to a knowledge-based economy, whereby ideas gain economic value, it is believed that the existence of intellectual property rights (IPRs) is absolutely vital in order to prevent others from producing and selling copies of your own ideas (Kenny, 1996, p. 701). Owing to their abstract nature, intellectual technologies are difficult to control and may 'escape' the clutches of their creators to become public goods, to be used and manipulated by others (Kenny, 1996, p. 702). Acknowledging this, it is apparent that assigning IPRs is an exercise in knowledge management aimed at restricting the accessibility of knowledge in order to preserve or enhance its value as a commodity; or in Fuller's words (2001, p. 188), with the assignment of IPRs, knowledge is 'captured' and then delivered as a service. IPRs, in this case, are directly concerned with the privatization of knowledge for monetary gain.

Globally there is a significant digital divide with levels of connectivity that are very different across nations and within nations (Mansell, Samarajiva, & Mahan 2002). One of the changes to IP under the knowledge society is that knowledge has itself increasingly become a commodity, a product that can be traded. The ideas as well as the people creating them are valuable. The cost of excluding people from information can also be high as it can limit innovation or can result in the appropriation of information by the few. The shift to greater emphasis upon ideas and their creators increases the value of the well-educated and trained section of the population, giving rise to 'brain drains and brain gains.' The declining and ageing of the intellectual workforce in the European economies is one of the growing pressures facilitating migration of innovative and highly qualified and trained people from the less developed countries. This has implications for the digital and other aspects of the knowledge divide and is one factor in the continuing inequalities between the wealthier and poorer nations.

One of the key differences 'knowledge as a commodity' has with other commodities is that it is not reduced by use; rather, there is evidence that it is a collective product that is enhanced by many users. This raises a further challenge to determining IP as many of the 'innovations' and 'inventions' within a knowledge society are the products of large international, multidisciplinary teams; thus, ascribing IP to individuals becomes increasingly difficult. Research and

development funding has also had to adjust to these new times and there has been a move towards longer funding cycles and a greater emphasis on inter-and multi-disciplinarity that crosses not only the boundaries of the traditional sciences but also recognizes the contribution of the social science and humanities.

The forms of protection include both statutory systems of protection such as patents from the fifteenth century and, later, copyright, trademark and design protection. The new global environment has focused attention increasingly on international agreements as a new way of trying to enforce IP protection. Examples here are the passing of a directive on the legal protection of databases by the European Union (EU) in 1996. Since then the EU has continued to work for a treaty on this issue. The World Intellectual Property Organization (WIPO) currently administers 23 treaties on intellectual property and WTO members are required to abide by the standards set out in the agreement on the Trade-Related Aspects of Intellectual Property Rights (TRIPS) (David, 2005; Drahos, 2005). These various agreements and statutes have given rise to the growth of national and international bureaucracies and forms of administration. In all these contemporary debates we can see the interconnection of economic, legal and political arguments and decision-making surrounding the need for and ways to control the flow of ideas.

The globalization of IP protection has largely benefited the advanced economies, particularly the United States and the European Union. Such protections are part of the ways that these countries and the corporations based in them (but operating globally) seek to maintain their dominance. Here the increased prominence of transnational companies – many of which have greater annual revenue than the annual GDP of many nation states – as key global players is increasingly significant (Held, 2000). The awareness of the value of IP amongst developing countries and indigenous peoples has also stimulated attention to the protection of such IP from the activities of global corporations. An example here would be the recent UNESCO convention on cultural indigenous knowledge protection (see Marinova & Raven, 2006). Some of these attempts at protection, however, come up against WTO free trade agendas and the desire of the advanced countries to include trade in services and ideas. Interestingly, the development of the internet, especially in its earliest stages, was not through commercial imperatives, but more as a result of the work of researchers and enthusiasts exploring the possibilities of a new form of communication. The ethos of this group was about openness, hence the open source nature of much of the internet. It is interesting to note that high-tech developments in ICT have occurred largely in the absence of IP protections.

As David (2005) notes, there has also been a long-running moral argument about the accessibility of information. Advocates for the openness of government and commercial activity to public scrutiny suggest this is best achieved by the free flow of information and the encouragement of debate on social improvement. Those who support a more open system of exchange generally favour a move towards a greater balance between the interests of the IP holders and users. Drahos argues that:

> The current problem facing knowledge economies is that their law-making processes have been heavily influenced by owners of intellectual property. As a result the rights of owners have strengthened. (2005, p. 149)

Thus, the debate about openness and free dispersal of knowledge versus restriction and exclusivity is not new. In recent times, however, international law has focused on strengthening exclusivity of IP rights rather than making knowledge more accessible, as with, for example, the American Digital Millennium Copyright Act (DMCA) (1998). Prosecuting and policing the increasingly borderless transmission of information is proving difficult. The solution that is being sought is the harmonization of IP rights laws. However, this is likely to provide the greatest advantage to the developed countries. Alternatively the rights and participation of users could be strengthened, creating a more even contest around the access to and use of knowledge. Increasing knowledge becomes the key resource for future economic growth. As a consequence, the struggle over IPRs will intensify, making it even more important that we undertake robust analysis of whether IP protection facilitates or restricts the flow of new innovations and creative activities in twenty-first century societies.

CONCLUSIONS

The concepts of knowledge society and economy are clearly related as both leverage off the idea of transformation to create fundamentally different features of society and economy. Both see information as having a special and significantly different place. Speed and forms of storage and transmission emerge as key elements in its newness. Information as a central driver of production requires new forms of organization favouring the more flexible and responsive idea of networks rather than institutional structures. Thus we see a new form of society emerging, one characterized as a 'network' society, where flows and movement and less certainty are characteristic. Forms of explanation have shifted from linear causality to a greater appreciation of path dependency and complexity. Combinations of technologies and social and cultural practices mediated by local and global political relations are now part of what has to be considered to explain the growth of new forms of technological and economic activity. This favours explanations that explore the past as a way of understanding the present. It requires a sustained empirical analysis, one deeper than is seen in much of the debate about either the knowledge society, knowledge economy or information society. There are substantial challenges facing work in this area. These are at both the theoretical and methodological level. A more consistent set of definitions is required and more robust measures are derived from the theory rather than from what is currently or conveniently available. For an economist the question has been: is the 'knowledge economy' a *fundamentally* new economic paradigm, with new drivers, or is it just '*hype*?' Whereas sociologists have asked: is the 'knowledge society' fundamentally different from what preceded it? The first issue we face is one of potentially viewing a *process* rather than an *outcome*. The period of the 'great transformation' has occurred and although one might debate the relative

importance of patents as a cause or effect of the Industrial Revolution, in the absence of new evidence the historical events have occurred. For those studying the 'knowledge society,' the twin problems of definitional limitations and potential lack of a complete historical lens complicate analysis. We may simply conclude that 'the world is no different than the past' simply because change is incomplete.

Assuming, for the moment, that we can resolve the definitional issues of what constitutes the knowledge economy or the knowledge society and what set of changes is 'fundamental,' what evidence could we call upon to test such hypotheses, in particular the role and consequences of innovation, IP, its creation and protection?

Innovative entrepreneurship operating in a world of uncertainty, where profit seeking innovation creation leads to new product creation with and from new technologies, where IP has an important role to play, could equally describe the Industrial Revolution or the Information Revolution. The technologies differ and the relative mix of land, labour, capital and knowledge differs, but the general paradigm has explanatory power. The historical forms of IP protection remain in place although the mix of users differs. It is interesting to note that one of the simplest and less formal – secrecy, with resultant geographic proximity – has made a comeback when faced with the challenges of protecting digital goods. New challenges for IP protection arise with the rise of 'digital goods,' but this technology generated the need for a technologically new IP protection system that is not, in itself, new. The actual goods produced differ, the *relative* role of knowledge-led produced goods differs; but is the economic world *fundamentally* different?

What has the weightless economy done to workers, firms, ownership and control? The traditional neoclassical theory of the firm (Grossman, Hart, Moore) puts ownership of physical capital to the fore. Do we have a robust theory of the firm in a knowledge economy? We would suggest not. Fully rejecting the notion that the knowledge economy represents a fundamentally new economic paradigm where the 'old rules' do not apply must await a traditional theory of the firm explanation of knowledge-only-driven, weightless goods production.

In the old economy, reading, writing and the access to books was what divided the 'haves' from the 'have-nots.' Those with these basic skills were identifiably different from those without. Here access to a knowledge base of trusted information was potentially 'exclusive' – the knowledge was typically expensive to acquire (books or education), but the knowledge itself was 'trustworthy.' The modern analogy is access to the internet and ICTs more generally. The 'digital divide' is in part about access and acquisition of information, much as it always was. However, the added dimension, above simple access, is about the trustworthiness of the available information. Information is cheap to acquire, but the trustworthiness of its content is low. As in the past, information remains data without the human capital ('wisdom') to create knowledge from combination. Reputation of the provider acts as a screen, with the role of trademarks and brands coming to the fore as they have in the past.

Digital technologies and new forms of connectedness are creating fundamental societal transformations in work, leisure and other relationships across a whole range of aspects of life. Here speed and availability via computers, internet and cellular technologies are potentially transformative, opening up new ways of knowing and choosing and organizing aspects of life from shopping, to travel, to working practices to dating, gambling and selecting and listening to music on the iPod. The technologies in their broadest sense also create new means of sifting and sorting populations, from the web-based 'Up My Street' systems in the United Kingdom to the marketers' databases on tastes and preferences to police and social welfare databases on where at-risk populations are concentrated (Burrows and Ellison, 2004). The new technologies of storage and retrieval also raise issues around protection and authentication of material; we now have the Wiki encyclopaedia, alongside more established ones, claiming its place as a repository of knowledge. Such sources create new challenges to the establishment of authenticity and accuracy of the text. The growth of more 'open source' ways of discovery also poses challenges to established gatekeepers of knowledge and have been seen to open the way to more democratic practices of knowledge dissemination and use. However, will these constrain innovation by undermining its commercial value or enhance it? This is the old debate in the new clothes of the twenty-first century digital and internet world. To move forward, we need a clear understanding of the key elements of change in past transformations to guide us in determining the present and possible future transformations. In finding a way forward it is important to acknowledge both the continuities and discontinuities with the past and to further see how technological innovations and economic, social, political and cultural opportunities both facilitate or resist innovation and change.

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NOTES

[1] One might argue with this terminology of 'great transformation' in that it may have been no 'greater' than the move to settled agriculture in Neolithic times or the transformation that ensued with the invention of writing.

[2] Again, one might challenge this rather contrived demarcation of history if we identify the creation of writing and the printing press as the 'first information society.'

[3] Lipsey et al. (2005) argue that the evolution of technological knowledge has driven economic growth and social transformation since at least the Neolithic agricultural revolution.

[4] However, there is a body of literature that would argue that the lowest classes of serfs and roaming labour were far better off in industrial working activities than they were in the feudal agricultural system.

[5] 'When a man's wages went up in the eighteenth century the first beneficial effects might be expected to occur in the brewing industry, and in the commercialisation of sport and leisure … gambling, boxing, horse racing and the like. When a woman's wages went up the first commercial

effects would be expected in the clothing industries, which provided consumer goods for the home. Her increased earnings released her desire to compete with her social superiors – a desire pent up for centuries or at least restricted to a very occasional excess' (McKendrick, 1974).

[6] In 1767, Steuart wrote: 'workers that had once been forced to work out of poverty or coercion … now men are forced to labour because they are the slaves to their own wants' (Steuart, 1966).

[7] Other engines of technological change include basic science, public and to some extent privately funded research.

[8] Though much was state sponsored.

[9] Here technological innovation is being used more broadly than simply 'physical' technologies (see Lipsey et al., 2005).

[10] One could also argue that this shows the importance of the political process linked ultimately to the development of the nation-state.

[11] Knowledge is non-rivalrous in the sense that one individual's use of knowledge does not preclude another's use of the same knowledge in the same way that one person's consumption of a loaf of bread precludes another's consumption of the same loaf of bread.

[12] This assumes that economic and social objectives are themselves aligned – a heroic assumption.

[13] Intellectual property laws and patents are synonymous in these earlier periods, but this is certainly not the case today when IP is protected via a range of other legal means.

[14] See Verspagen (2006).

[15] The 'weightless economy,' as compared with the label 'weighty economy' of the industrial era.

[16] The view of Lipsey et al. (2005) is that it is the ongoing creation of new technologies that frees us from diminishing returns and not any specific technology in any period of time. ICTs may be a sufficient technology to achieve this at this point in time, but it is not necessary in the light of other new GPTs that might arrive.

[17] However, it is easy to conceive of the knowledge economy as simply being encompassed, or nested within, the concept of the knowledge society.

[18] Between 2000 to 2011, internet usage worldwide has grown 480.4 per cent (Internet World Stats, 2011).

REFERENCES

Abramovitz, M. & David, P.A. (2001, August). *Two centuries of American macroeconomic growth: From exploitation of resource abundance to knowledge-driven development*. SIEPR discussion paper, 01-05. Stanford: Stanford Institute for Economic Policy Research.

Adhikari, K. & Sales, A. (2001). Introduction: New directions in the study of knowledge, economy and society. *Current Sociology*, *49*(4), 1–25.

Amin, A. (Ed.). (1994). *Post-Fordism: A reader*. Oxford: Blackwell.

Ashton, T.S. (1948). Some statistics of the industrial revolution in Britain. *Manchester School*, *16*, 214–223.

Ashton, T.S. (1955). *An economic history of England*. London: Meuthen.

Asia-Pacific Economic Cooperation (APEC). (2000, November). *Towards knowledge-based economies in APEC*. Singapore: APEC.

Bell, D. (1973). *The coming of post industrial society*. New York: Basic Books.

Bimber, B. (1995). Three faces of technological determinism. In Smith, M.R. & Marx, L. (Eds.), *Does technology drive history: The dilemma of technological determinism* (pp. 79–100). Cambridge, MA: MIT Press.

Block, F. (1985). Postindustrial development and the obsolescence of economic categories. *Politics and Society*, *14*, 71–104, 416–441.

Bluestone, B. & Harrison, B. (1983). *The deindustrialisation of America*. New York: Basic Books.

Boehm, K. & Silberstson, A. (1967). *The British patent system*. Cambridge: Cambridge University Press.

Bohme, G. & Stehr, N. (Eds.). (1986). *The knowledge society*. Dordrecht: Reidel.
Bourdieu, P. (1986). The forms of capital. In Richardson, J.G. (Ed.), *Handbook of theory and research for the sociology of education* (pp. 241–258). New York: Greenwood.
Braverman, H. (1975). *Labor and monopoly capital: The degradation of work in the twentieth century*. New York: Monthly Review.
Brint, S. (2001). Professionals and the 'knowledge economy': Rethinking the theory of postindustrial society. *Current Sociology*, *49*(4), 101–132.
Browne, F. (2000). Discussing the papers of Gordon and Felderer. Oesterreichische Nationalbank. Volkswirtschaftliche Tagung 2000. *Das neue Millennium: Zeit für ein neues ökonomisches Paradigma?* OeNB, 28.
Burrows, R. & Ellison, N. (2004, March). *Towards a social politics of neighbourhood informatization*. Paper presented to the British Sociological Association Conference (BSAC). University of York.
Castells, M. (1996). *The rise of the network society* (Vol. 1: The information age). Oxford: Blackwell.
Castells, M. (1997). *The power of identity*. Oxford: Blackwell.
Castells, M. (2000a). Material for an exploratory theory of the network society. *British Journal of Sociology*, *51*(1), 5–24.
Castells, M. (2000b). The contours of the network society. *Foresight: The Journal of Futures Studies, Strategic Thinking and Policy*, *2*(2), 151–157.
Castells, M. (2001). *The internet galaxy*. Oxford: Oxford University Press.
Castells, M. (2004). *The network society: A cross cultural perspective*. Northampton, MA: Edward Elgar.
Choi, S.Y. & Whinston, A.B. (2000). *The internet economy: Technology and practice*. Austin, TX: SmartEcon.
Council of Economic Advisors (CEA) (2002). *Economic report to the president 2002*. Washington, DC: US Government Printing Office.
Coyle, D. & Quah, D. (2002). *Getting the measure of the new economy*. London: ISociety.
Crafts, N.F.R. (1985). *British economic growth during the industrial revolution*. Oxford: Oxford University Press.
Crafts, N.F.R. & Harley, C.K. (1992). Output growth and the British industrial revolution. *Economic History Review*, *45*, 703–730.
Cunningham, S. (2005). Knowledge and cultural capital. In Rooney, D., Hearn, G., & Ninan, A. (Eds.), *Handbook on the knowledge economy* (pp. 93–101). Northampton, MA: Edward Elgar.
Danabalan, D.V. (1999, November). *Knowledge economy and knowledge society: Challenge and opportunities for human resource management*. Paper presented at the Workshop on Human Resource Management organised by the Public Service Department, Malaysia, in co-operation with the Commonwealth Secretariat Langkai.
David, P. (2005). Does the new economy need all the old IPR institutions and more? In Soete, L. & ter Weel, B. (Eds.), *The economics of the digital society* (pp. 113–151). Northampton, MA: Edward Elgar.
David, P. & Foray, D. (2002). Economic fundamentals of the knowledge society. *Policy Futures in Education*, *1*(1), 20–49.
Delanty, G. (2001). *Challenging knowledge: The university in the knowledge society*. Philadelphia: Open University Press.
Drahos, P. (2005). Intellectual property rights in the knowledge economy. In Rooney, D., Hearn, G., & Ninan, A. (Eds.), *Handbook on the knowledge economy* (pp. 139–151). Northampton, MA: Edward Elgar.
Drucker, P. (1959). *Landmarks of tomorrow*. London: Heineman.
Drucker, P. (1969). *The age of discontinuity: Guidelines to our changing society*. London: Heineman.
Drucker, P. (1994). The age of social transformation. *Atlantic Monthly*, *174*, 53–80.
Dutton, H.I. (1984). *The patent system and inventive activity during the industrial revolution*. Oxford: Oxford University Press.

Elmeskov, J. (2000). New sources of economic growth in Europe? Oesterreichische Nationalbank. Volkswirtschaftliche Tagung 2000. *Das neue Millennium: Zeit für ein neues ökonomisches Paradigma?* OeNB, 28.

Enterprise Development, The. (2005). Web site. The knowledge economy. Retrieved from www.enterweb.org/know.htm.

European Commission (EC). (2000). *European competitiveness report 2000*. Luxembourg: EC.

European Commission (EC). (2001). *European competitiveness report 2001*. Luxembourg: EC.

Foray, D. (2004). *The economics of knowledge*. Cambridge: Cambridge University Press.

Foss, N.J. (2002). Economic organization in the knowledge economy: An Austrian perspective. In Foss, N.J. & Klein, P.G. (Eds.), *Entrepreneurism and the firm: Austrian perspectives on economic organization* (pp. 48–71). Cheltenham: Edward Elgar.

Foss, N.J. (2005). *Strategy, economic organization, and the knowledge economy: The co-ordination of firms and resources*. Oxford: Oxford University Press.

Froebel, F., Heinrichs, J., & Kreye, D. (1980). *The new international division of labour*. Cambridge: Cambridge University Press.

Fuller, S. (2001). A critical guide to knowledge society newspeak: Or, how not to take the great leap backward. *Current Sociology*, *49*(4), 177–201.

Fox, H.G. (1947). *Monopolies and patents*. Toronto: University of Toronto Press.

Giddens, A. (1982). Sociology: A brief but critical introduction. London: Macmillan.

Giddens, A. (2001). *The global third way debate*. Cambridge: Polity.

Gordon, R.J. (1998). Foundations of the Goldilocks economy: Supply shocks and time-varying NAIRU. *Brookings Papers on Economic Activity*, *2*, 21–40.

Gordon, R. (2000). Does the new economy measure up to the great inventions of the past? *Journal of Economic Perspectives*, *14*(4), 49–74.

Graham, S. (Ed.). (2004). *The cybercities reader*. London: Routledge.

Greasley, D. & Oxley, L. (1994). Rehabilitation sustained: The industrial revolution as a macroeconomic epoch. *Economic History Review*, *47*, 760–768.

Greasley, D. & Oxley, L. (1996). Technological epochs and British industrial production, 1700–1992. *Scottish Journal of Political Economy*, *43*, 258–274.

Greasley, D. & Oxley, L. (1997a). Endogenous growth or big bang: Two views of the first industrial revolution. *Journal of Economic History*, *57*, 935–949.

Greasley, D. & Oxley, L. (1997b). Causality and the first industrial revolution. *Industrial and Corporate Change*, *7*, 33–47.

Greasley, D. & Oxley, L. (2000). British industrialization 1816–1860: A disaggregate time series perspective. *Explorations in Economic History*, *37*, 98–119.

Greasley, D. & Oxley, L. (2007). Patenting, intellectual property rights and sectoral outputs in Industrial Revolution Britain, 1780–1851. *Journal of Econometrics*, *139*, 340–354.

Harley, C.K. (1993). Reassessing the industrial revolution: A macro view. In Mokyr, J. (Ed.), *The British industrial revolution: An economic perspective* (pp. 171–226). Boulder, CO: Westview.

Harris, R. (2001). The knowledge-based economy: Intellectual origins and new economic perspectives. *International Journal of Management Reviews*, *3*(1), 21–40.

Held, D. (2000) A globalizing world? *Culture, economics, politics*. London: Routledge.

Hirst, P. & Thompson, G. (1996). *Globalization in question*. Cambridge: Polity.

Hobsbawm, E. (1975). *Age of capital*. London: Weidenfeld and Nicholson.

Hoffmann, W.H. (1955). *British industry 1700–1950*. Oxford: Blackwell.

Holton, R. (2005). *Making globalization*. Basingstoke: Palgrave Macmillan.

Houghton, J. & Sheehan, P. (2003). *A primer in the knowledge economy*. Melbourne: Centre for Strategic Economic Studies, Victoria University of Technology.

Internet World Stats. (2011). World internet usage and population statistics: March 31, 2011. Retrieved from www.internetworldstats.com/stats.htm.

Ittner, C.D., Lambert, R.A., & Larcker, D.F. (2003). The structure and performance consequences of equity grants to employees of new economy firms. *Journal of Accounting and Economics*, *34*, 89–127.

Jarvie, C. (2005). *The advanced network*. Wellington: Ministry of Science and Technology.

Jessop, B. (2000). The state and the contradictions of the knowledge-driven economy. In Bryson, J.R., Henry, N.D., & Pollard, J. (Eds.), *Knowledge, space, economy* (pp. 63–78). London: Routledge.

Kenny, M. (1996). The role of information, knowledge and value in the late 20th century. *Futures*, *28*(8), 696–707.

Kling, R. & Lamb, R. (2000). IT and organizational change in digital economies: A sociotechnical approach. In Brynjolfsson, E. & Kahin, B. (Eds.), *Understanding the digital economy: Data, tools, and research*. Cambridge, MA: MIT Press.

Knorr Cetina, K. (1999). *Epistemic cultures: How the sciences make knowledge*. Cambridge, MA: Harvard University Press.

Knorr Cetina, K. & Preda, A. (2001). The epistemization of economic transactions. *Current Sociology*, *49*(4), 27–44.

Kuhn, T. (1962). *The structure of scientific revolutions*. Chicago: University of Chicago Press.

Landes, D.S. (1969). *Prometheus unbound*. Cambridge: Cambridge University Press.

Lane, R.E. (1966). The decline of politics and ideology in a knowledge society. *American Sociological Review*, *31*, 649–662.

Lash, S. & Urry, J. (1987). *The end of organised capitalism*. Oxford: Polity Press.

Law, S. & Urry, J. (2004). Enacting the social. *Economy and Society*, *33*(1), 390–410.

Leadbeater, C. (1999). *Living on thin air: The new economy*. Harmondsworth: Penguin.

Liebowitz, S. & Watt, R. (2006). How to best ensure remuneration from creators in the market for music. *Journal of Economic Surveys*, *20*: 513–545.

Lipsey, R.G. & Carlaw, K.I. (2000). Technology policy: Basic concepts. In Edquist, C. & McKelvey, M. (Eds.), *Systems of innovation: Growth, competitiveness and employment* (pp. 421–455). Northampton, MA: Edward Elgar.

Lipsey, R.G., Carlaw, K.I., & Bekar, C. (2005). *Economic transformations: General purpose technologies and long term economic growth*. Oxford: Oxford University Press.

Lyon, D. (2003). *Surveillance after September 11*. Cambridge: Polity.

Machlup, F. & Penrose, E. (1950). The patent controversy in the nineteenth century. *Journal of Economic History*, *10*, 1–29.

MacLeod, C. (1988). *Inventing the industrial revolution*. Cambridge: Cambridge University Press.

Makarov, V. (2004). The knowledge economy: Lessons for Russia. *Social Sciences*, *35*(1), 19–30.

Mansell, R., Samarajiva, R. & Mahan, A. (2002). *Networking knowledge for information societies: Institutions and intervention*. Delft, the Netherlands: Delft University Press.

Marginson, S. (2006). Putting the 'public' back into the public university. *Thesis Eleven*, *84*, 44–59.

Marinova, D. & Raven, M. (2006). Indigenous knowledge and intellectual property: A sustainability agenda. *Journal of Economic Surveys*, *20*, 587–605.

Marshall, A. (1890). *Principles of economics* (Vol. 1). London: Macmillan.

Massey, D. (1984). *Spatial divisions of labour*. London: Macmillan.

May, C. (2002). The information society: A sceptical view. Cambridge: Polity.

McCloskey, D.N. (1988). Bourgeois virtue and the history of P and S. *Journal of Economic History*, *58*, 297–317.

McKendrick, N. (1974). Home demand and economic growth: A new view of the role of women and children in the Industrial Revolution. In McKendrick, N. (Ed.), *Historical perspectives: Studies in English thought and society in honour of J.H. Plumb* (pp. 152–210). London: Europa.

McKenna, B. & Rooney, D. (2005, November 28–29). *Wisdom management: Tensions between theory and practice in practice*. A paper given at the Second Annual International Conference on Knowledge Management in Asia Pacific – Building a Knowledge Society: Linking Government, Business, Academia and the Community, Wellington.

McGuckin, R.H. & van Ark, B. (2002, January). *Performance 2001: Productivity, employment, and income in the world's economies*. Conference Board of Canada, Report no. 13. Ottawa: Conference Board of Canada.

McLennan, G. (2003). *Sociologists in/on 'knowledge society.'* A paper based upon a presentation given for the Sociological Associated of Aotearoa/New Zealand Sociological Conference, Auckland.

Micklethwait, J. & Wooldridge, A. (2003). *A future perfect: The challenge and promise of globalization*. New York: Random House.

Moser, P. (2005). Do patent laws help to diffuse innovations? Evidence from the geographic localization of innovation in production in 19th century England. MIT Sloan & NBER working paper.

Mumford, L. (1966). *Myth of the Machine* (Vol. 1: Technics and human development). London: Secker & Warburg.

Munro, D. (2000). The knowledge economy. *Journal of Australian Political Economy*, *45*, 5–17.

Nassehi, A. (2004, Summer). What do we know about knowledge: An essay on the knowledge society. *Canadian Journal of Sociology*, 439–450.

Neef, D. (1998). The knowledge economy: An introduction. In Neef, D. (Ed.), *The knowledge economy* (pp. 1–12). Boston: Butterworth-Heinemann.

Nelson, R. (1989). What is private and what is public about technology? *Science, Technology, and Human Values*, *14*(3), 229–241.

Nokkala, T. (2004, December). Knowledge economy discourse: Dominant reality in higher education? *ESIB European Student LINK*, *3*(28). Retrieved from www.esip.org/newsletter/link/2004-03/knowledge.php.

Notes. (2001). Antitrust and the information age: Section 2: Monopolization analyses in the new economy. *Harvard Law Review*, *114*(5), 1623–1646.

Nowotny, H., Scott, P., & Gibbons, M. (2001). Rethinking science: Knowledge and the public in an age of uncertainty. Cambridge: Polity.

O'Brien, L., Opie, B., & Wallace, D. (2002). *Knowledge, innovation and creativity: Designing a knowledge society for a small country*. Wellington: Ministry of Research Science and Technology.

O'Brien, P.K. (1993). Introduction: Modern conceptions of the industrial revolution. In O'Brien, P.K. & Quinault, R. (Eds.), *The industrial revolution and British society* (pp. 1–20). Cambridge: Cambridge University Press.

Organisation for Economic Co-operation and Development (OECD). (1996). *The knowledge-based economy*. Paris: OECD.

Organisation for Economic Co-operation and Development (OECD). (2000, July 3). *A new economy? The changing role of innovation and information technology in growth*. Paris: OECD.

Oxley, L. & Greasley, D. (1997). Vector autoregression, cointegration and causality: Testing for causes of the British industrial revolution. *Applied Economics*, *30*, 1387–1397.

Piazolo, D. (2001). The digital divide. *CESifo Forum*, *2*(3), 29–34.

Pillay, H. (2005). Knowledge and social capital. In Rooney, D., Hearn, G., & Ninan, A. (Eds.), *Handbook on the knowledge economy* (pp. 82–90). Northampton: Edward Elgar.

Polanyi, K. (1944). The great transformation: The political and economic origins of our time. New York: Rinehart.

Pool, I. (1999). *Social sciences and an evidence-based public policy*. Wellington: Royal Society New Zealand miscellaneous series 54, pp. 62–73.

Powell, W.W. & Snellman, K. (2004). The knowledge economy. *Annual Review of Sociology*, *30*, 199–220.

Progressive Policy Institute. (Nd). The new economy index. Retrieved from www.neweconomyindex.org.

Putnam, R.D. (2000). Bowling alone: The collapse and revival of American community. New York: Simon & Schuster.

Quah, D. (2002a, December). *Digital goods and the new economy*. London: Economics Department, London School of Economics.

Quah, D. (2002b, January). *Technological dissemination and economic growth: Some lessons for the new economy*. London: Economics Department, London School of Economics.

Quah, D. (2003). The weightless economy. Retrieved from http://econ.lse.ac.uk/staff/dquah/ tweirl0. html.

Ramello, G. (2006). What's in a sign? Trademark law and the economic theory. *Journal of Economic Surveys*, *20*: 547–565.

Roethlisberger, F.J. & Dickson, W.J. (1939). *Management and the worker*. Cambridge, MA: Harvard University Press.

Rogers, E.M. (1962). *Diffusion of innovations*. New York: Free Press.

Rogers, J.E.T. (1863). On the rationale and working of the patent laws. *Journal of the London Statistical Society*, *26*, 121–142.

Rooney, D., Hearn, G., Mandeville, T., & Joseph, R. (2003). *Public policy in knowledge-based economies: Foundations and frameworks*. Cheltenham: Edward Elgar.

Samuelson, P. & Varian, H.R. (2001, July 18). *The 'new economy' and information technology policy*. Berkeley: University of California at Berkeley.

Sautet, F.E. (2000). *An entrepreneurial theory of the firm*. London: Routledge.

Schiff, E. (1971). *Industrialisation without patents: The Netherlands, 1869–1912, Switzerland 1850–1907*. Princeton, NJ: Princeton University Press.

Schiller, H.I. (1991). *Who knows: Information in the age of the Fortune 500*. Norwood, NJ: Ablex.

Scholte, J.A. (2000). *Globalization: A critical introduction*. Basingstoke: Palgrave Macmillan.

Schumpter, J.A. (1942). *Capitalism, socialism and democracy*. New York: Harper.

Smith, K. (2002, June). *What is the 'knowledge economy?' Knowledge intensity and distributed knowledge bases*. Discussion paper series, 2002–2006. Maastricht: Institute for New Technologies, United Nations University.

Smith, P.S. & Feagin, J.R. (1987). *The capitalist city: Global restructuring and community politics*. Oxford: Basil Blackwell.

Stehr, N. (1994). *Knowledge societies*. London: Sage.

Stehr, N. (2001). *The fragility of modern societies: Knowledge, and risk in the information age*. London: Sage.

Steuart, J. (1966 [1767]). *An inquiry into the principles of political economy*. London. Rpt. Skinner, A.S. (Ed.). Edinburgh: Oliver and Boyd.

Sullivan, R.J. (1989). England's 'Age of Invention:' The acceleration of patents and patentable invention during the industrial revolution. *Explorations in Economic History*, *26*, 424–452.

Talero, E. & Gaudette, P. (1996). Harnessing information for development: A proposal for a World Bank group strategy. Retrieved from www.worldbank.org/html/fpd/harnessing/index.html#contents.

Temin, P. (1997). Two views of the British industrial revolution. *Journal of Economic History*, *57*, 63–82.

Thompson, G.F. (2004). Getting to know the knowledge economy: ICTs, networks and governance. *Economy and Society*, *33*(4), 562–581.

Thorlindsson, T. & Vilhjalmsson, R. (2003). Introduction to the special issue: Science, knowledge and society. *Acta Sociologica*, *46*(2), 99–105.

Thorns, D C. (1992). *Fragmenting societies*. London: Routledge.

Thorns, D.C. (2002). *The transformation of cities*. Basingstoke: Palgrave Macmillan.

Thorns, D.C. (2003). The challenge of doing sociology in a global world: The case of Aotearoa/New Zealand. *Current Sociology*, *51*(6), 689–708.

Toda, H.Y. & Phillips, P.C.B. (1991). *Vector autoregression and causality: A theoretical overview and simulation study*. Working paper, 977. New Haven, CT: Cowles Foundation.

Toda, H.Y. & Yamomoto, T. (1995). Statistical inference in vector autoregressions with possibly integrated processes. *Journal of Econometrics*, *66*, 225–250.

Tofler, A. (1980). *The third wave*. London: Collins.

Towse, R. (2006). Copyright and artists: A view from cultural economics. *Journal of Economic Surveys*, *20*, 567–585.

Ungar, S. (2003). Misplaced metaphor: A critical analysis of the 'knowledge society.' *Canadian Review of Sociology and Anthropology*, *40*(3), 331–347.
United Nations Centre for Human Settlements (Habitat) (UNCHS Habitat). (2001). *Cities in a globalizing world*. London: Earthscan.
Urry, J. (2003). *Global complexity*. Cambridge: Polity.
Verspagen, B. (2006). University research, intellectual property rights and European innovation systems. *Journal of Economic Surveys*, *20*, 607–632.
Wadhwani, S.B. (2001, March 20). *The new economy: Myths and realities*. Travers Lecture, London Guildhall University.
Weber, M. (1930). The protestant ethic and spirit of capitalism. London: Allen & Unwin.
Weber, M. (1946). *From Marx to Weber: Essays in sociology*. Gerth, H. & Mills, C.W. (Eds.). London: Routledge & Kegan Paul.
Weber, M. (1947). *The theory of economic and social organisation*. New York: Free Press.
Webster, K. (1995). *Theories of the information society*. London: Routledge.

CHRIS WARHURST & PAUL THOMPSON

MAPPING KNOWLEDGE IN WORK

Proxies or Practices?

INTRODUCTION

Governments and firms are exhorted, on pain of relegation to the lower divisions of (un-)competitiveness, to embrace the idea of a knowledge economy (Department for Trade and Industry, 1998; European Communities, 2004; Hamel & Prahalad, 1996; Nonaka & Takeuchi, 1995; OECD, 2001a; Reich, 1993; World Bank, 2002). However, this mainstream academic and policy debate tends to be prescriptive and insensitive to real developments in the economy and workplace. It also fails to provide the necessary conceptual definitions and distinctions concerning the use of knowledge in the workplace. Moreover, there is insufficient disentangling of firm strategies and structures, occupational changes and the content of work. With these critiques in mind, this chapter focuses on two main issues: first, how being 'knowledge-driven' is currently measured, focusing on the proxies employed in such assessments; second, how the mapping of workplace knowledge might be undertaken better by reference to practice. This approach builds on existing critical research, including our own earlier work that has argued for a disentangling of knowledge work and knowledgeability in work (Thompson, 2004; Thompson et al., 2001; Warhurst & Thompson, 1998).

There are many types of knowledge with differing workplace usage and purpose, but the central characteristics of knowledge work are that it draws on a body of theoretical (specialized and abstract) knowledge that is utilized, under conditions of comparative autonomy, to innovate products and processes. This is similar to Frenkel et al.'s (1995) definition of a knowledge worker as someone whose work requires high levels of creativity, intellective skills and theoretical rather than purely contextual knowledge. So, while all work is knowledgeable, in that there is at least experiential understanding of it often involving tacit knowledge, only a smaller range of activities (and therefore, occupational and professional groups) meet the aforementioned criteria. That knowledge-intensive jobs are limited in extent does not mean that we are dismissing the 'knowledge issue.' Instead, alternatives are required that can provide more conceptually and empirically robust accounts of knowledge and knowledge work.

D.W. Livingstone and D. Guile (eds.), The Knowledge Economy and Lifelong Learning: A Critical Reader, 43–55.

THE MAINSTREAM AGENDA

If mainstream thinking is interrogated, three assumptions relevant to this article can be distinguished. First, it is argued that the economy is characterized by growing knowledge intensity. This assumption has wide governmental support (see World Bank, 2002). According to the OECD (2001a), the knowledge economy is one in which 'Symbolic resources are replacing physical resources, mental exertion is replacing physical exertion and knowledge capital is beginning to challenge money and all other forms of capital' (p. 148). In what has become known as the Lisbon strategy and 'transitioning' itself, the European Union (EU) has declared that it aims to be 'the most dynamic and competitive knowledge-based economy in the world by 2010' (European Communities, 2004, p. 6). The idea that knowledge displaces traditional factors of production such as land, labour and capital has been around for at least 30 years (e.g., Bell, 1973). However, it is now legitimized by influential social theorists (Castells, 1996; Lash, 2002), policy entrepreneurs (Leadbetter, 1999) and pop management writers (Kelly, 1999). The enduring theme is the intangible, weightless, immaterial nature of knowledge and knowledge work.

The second assumption is that firms need to change their mode of management to adapt to creating, capturing and capitalizing on knowledge (Ichijo et al., 1998). One reason why the commercialization of knowledge is regarded as so difficult rests with its nature and location – inside employees' heads, as the inherent property of the producer (Despres & Hiltrop, 1995). Firms need to facilitate and encourage employee learning and experimentation, communication and trust in order to generate and enable the sharing of ideas and knowledge.

Finally, it is assumed that public policy too must be fundamentally reshaped. While certainly not suggesting intra-firm intervention, the OECD and World Bank are keen for governments to have a proactive, strategic role in stimulating the conditions outside the firm that will foster the knowledge economy. This involves support for the innovative capacities of knowledge-intensive firms, including incentives for creative interaction within high-tech clusters of businesses and universities (Department for Trade and Industry, 1998; European Communities, 2004; Scottish Executive, 2004). In addition, there is a focus on investment that enhances the quality of human capital, with education becoming the priority as governments intervene in and/or 'reform' the supply side of the labour market to improve the quality of labour through its attainment of qualifications (Department for Education and Skills, 2005; European Communities, 2004; HM Treasury, 2004; OECD, 2001a; World Bank, 2002). One key feature of this policy is the creation of more graduates through expanded higher education. Mass higher education creates a mass of potential knowledge workers (Brown et al., 2003) who then stimulate demand for better jobs from employers (Layard, 1997).

CRITIQUE: PROXY MEASURES AND THEIR LIMITS

Given the economic and political imperatives that follow from these assumptions, robust measures might be expected to exist in order to assess the growth of

knowledge and knowledge workers in the economy. Unfortunately, they do not. Although there is an increasingly rich literature on the different types of knowledge used in work and trends identified in which some types of knowledge are becoming more salient (see, e.g., Blackler et al., 1998), this recognition has had limited impact. Instead, measurement rests on a series of general proxies. Ironically, although it is suggested that the knowledge economy is based upon intangible factors of production, assessment in mainstream accounts tends to rely on tangible measures. It is not possible to examine all the relevant dimensions in one short article. Here we critique the four most frequently cited and overlapping proxies; ones used particularly by bodies such as the OECD, EU and the U.K. Government. We should make clear that this is not a rejection of proxies in principle or for all purposes. Their deployment may be inevitable for assessing certain macro-level phenomena such as broad indicators of industrial evolution. What we want to explore is whether these particular proxies can bear the theoretical and policy weight resting on them, particularly with reference to work and employment.

Proxy 1: ICT

The first proxy is information and communications technology (ICT), with an assumption that if an industry relies heavily on ICT, then it must be knowledge-intensive, and that the introduction and use of ICT requires high skill employees (Department for Trade and Industry, 1998; European Communities, 2004). The OECD (2004) makes an explicit link between ICT and improved economic performance when combined with investment in skills but, within the nine countries from which research was reported, the nature of the linkages is unclear. Such inconveniences have not stopped claims that ICT advances require enhanced skills use with a shift to knowledge management (Burton-Jones, 1999).

There is U.K. evidence that the number of jobs involving ICT has dramatically increased since the mid-1980s and, relatedly, that the use of computer skills by employees has increased. Over 70 percent of respondents in the Work Skills in Britain 1986–2001 survey (Felstead et al., 2002) reported using some type of automated or computerized equipment, with 40 percent saying that the use of the latter is now essential to their work. A key issue, however, is the sophistication and purpose of these computer skills. Call centres, for example, are regarded as part of the ‘new economy’ because of their ICT-intensive operations. Yet their employees use few thinking skills: ICT is required for (customer) information transfer and input based on keyboard and screen template usage rather than knowledge-driven innovation of either product or process (Thompson et al., 2001). In the United States, Appelbaum et al. (2003) note greater computer use among workers but, also, how little training is required to acquire the requisite computer skills. Felstead et al. (2002) observe that U.K. workers in clerical and related service work who have high dependency on ICT have only moderate levels of job complexity, a finding supported by Fleming et al.’s (2004) Australian research. Second, technological determinism is an issue. Skill outcomes from new technology must

be examined in relation to managerial strategy. De-skilling is one other possible outcome of workplace ICT usage. Management may be encouraged to use computer systems to sub-divide organizational tasks into 'component processes' that enable the use of less skilled workers (Kanevsky & Housel, 1998, p. 281). As Livingstone and Scholtz (2006) note, with reference to Canada, while new technologies and digital networks have been incorporated by large numbers of enterprises, even the most optimistic estimates put knowledge workers as a quarter of the labour force. Third, any upskilling that might arise from ICT usage appears to be complemented by deteriorations in other work aspects, namely autonomy and discretion (Felstead et al., 2002).

Finally, the introduction and use of new ICT systems should not be simply assumed to involve technical skills. Instead, other, 'new' skills are required of employees, such as adaptability and having the right attitude (Rubery & Grimshaw, 2001). Little wonder that the OECD (2004, p. 80) admits that 'better measurement [of ICT's impact] remains a challenge,' related as it is to other variables such as management practices and work organization.

Proxy 2: R&D

Investment in research and development (R&D) is supposed to indicate the extent of being knowledge-driven (European Communities, 2004; OECD, 2001b). In this context, the EC notes that implementation of the Lisbon strategy has been undermined by inadequate R&D spending across most of the EU. While acknowledging that investment in R&D to stimulate the knowledge economy can be publicly as well as privately-funded (European Communities, 2004; World Bank, 2002), this approach inordinately focuses on manufacturing and so-called 'knowledge-intensive industries,' but again there are problems.

First, as a measurement it can distort the analysis. Industries may invest heavily in R&D, but not all firms operating in these industries are knowledge intensive. The computer manufacturing industry is constantly innovating its products based on continuous R&D. However, manufacturing of these products, such as PCs, can involve routine, repetitive, low skill, low-value added work. Countries that attract such assembly work are mislabelled as knowledge economies because this activity is encompassed within the overall industry categorization (McNicholl et al., 2002). Moreover, it is an approach that conveniently omits any analysis of the content of the work of those employed in R&D. As we have pointed out elsewhere (Warhurst & Thompson, 1998), the capacity for R&D workers to undertake 'blue skies' research is diminishing under the weight of commercial pressures and managerial imposition. Randle's (1995) research on technical workers in the pharmaceuticals industry is a case in point. Here, these employees' discretionary activity, such as their 'ten per cent time' or one–half day per week intended to enable 'a greater degree of creative and independent thinking' on new projects became subsumed into ordinary working time on 'goals emphasised by line managers' (pp. 13–14). More broadly, it is worth noting that the previously-mentioned decline in employee autonomy and discretion at work reported in the Work Skills in Britain 1986–2001

survey findings is experienced most by professional workers and that decline has become sharper in recent years (Felstead et al., 2002).

To overcome the problems with the first two proxies, McNicholl et al. (2002) suggest that a better measure is the level and type of skills embodied in the production of a good or service. Two measures are used to assess this skill: qualification (as a measure of accumulated skills) and occupational position (as a signal of skill usage). These two measures feature prominently in characterizations of knowledge-driven economies and we will deal with them separately and in more detail.

Proxy 3: Qualifications

Qualification is perhaps the widest used proxy for both skills and knowledge, and the most specious. A more and better-qualified workforce is required, it is argued, to meet the assumed high-skill needs of the knowledge economy. The Scottish Executive (2004) overtly cites the number of graduates in its list of measurements of progress towards creating 'a smart, successful Scotland.'

However, the relationship between qualification and skill can be problematic. HM Treasury acknowledges that it is possible to be skilled without a formal qualification and vice versa, and certainly some of the aforementioned new skills are difficult to accredit as qualifications (Grugulis et al., 2004). As a recent twist, the U.K. government has suggested that attainment of a qualification can act as a 'signal' of the possession of these new skills (HM Treasury, 2004). An equally valid signal, however, might be parental class (Nickson & Warhurst, 2007). There is also the issue of whether the qualifications acquired relate to the job being done by an employee. If not, a skills mismatch can occur, raising issues about the relevance of qualifications. A graduate of history might be employed in health management, for example. It might be argued that both the qualification and occupational position involve the same level of skill, but such a belief rests on an untested assumption that all higher education degrees across all institutions produce common levels of 'graduateness.' Brown and Hesketh (2004) note the propensity for 'blue-chip' employers to select graduate training candidates from a restricted number of universities in the United Kingdom. In addition, there is some evidence that qualification inflation is occurring, by which some learning necessary to do a job that was previously sub-degree is now being re-badged as degree level (Rodgers & Waters, 2001). It is just as well, therefore, that employers are less concerned with the knowledge possessed by their graduate employees than their 'new' skills (again), such as 'work ethic' and 'ability to work as part of a team' (National Centre for Vocational Education Research, 2001).

With a bountiful supply of highly qualified labour, firms simply raise the entry tariff to employment without changing the work undertaken by these employees. Since the 1980s, 'credentialism' has risen at graduate (Green, 2004) and other levels in the United Kingdom (Felstead et al., 2002) and in other countries (Brynin, 2002; OECD, 1994). This under-employment reflects a mismatch between the supply and demand for graduates. Using data from the U.K.'s Association of

Graduate Recruiters, Brown and Hesketh (2004) calculate that the ratio of available graduates to available graduate jobs ranges from 7:1 to as high as 20:1. Contrary to government expectations, having more graduates in the labour market does not result in employers creating better jobs to satisfy supply. Instead, having a degree has become an entry ticket to employment rather than a requisite of work. This issue has begun to receive further attention, notably from Purcell et al. (2003), who suggest that it is more useful to acknowledge that there is now a range of 'jobs that graduates do' rather than 'graduate jobs.'[1]

Proxy 4: Occupation and Skill

On skill and occupation, there are two questionable assumptions. First, policy makers, in particular, are quick to conflate knowledge and skill (HM Treasury, 2004; Scottish Executive, 2004), with 'thinking skills' the bridge. Cully (2003) does flag the issue of whether or not skill can be equated with knowledge but argues that 'There is no established literature yet which clearly conceptualises knowledge work,' a point with which we would agree; but he then continues: 'In lieu of this, treating the skills required to do a job as equivalent to the knowledge required to do it seems a reasonable basis on which to begin' (p. 14). In other words, because an attempt to disentangle skill and knowledge has yet to be made, there is no point in doing it – with which we do not agree. Instead, although often interdependent in work, knowledge and skill can and should be practically and conceptually disentangled. A university professor, for example, may have extensive knowledge of mediaeval literature but almost no communication skills that would allow the effective (and required) dissemination of that knowledge to students.

Second, the typicality claim about knowledge workers rests on a particular reading of occupational categorization weightings – that is, economic change is assumed from aggregate occupational change. This is a mis-reading of such changes that has three facets. First, substantive change in the nature of the economy is assumed because the numbers employed in these occupations is rising. We have noted elsewhere (Warhurst & Thompson, 1998) the practice of casually re-labelling many existing and very disparate occupations as knowledge workers. Simply using or applying knowledge in a job is enough for some to be regarded as a knowledge worker. Davenport et al. (1996) note how even front-line workers in restaurants in some accounts can be viewed as knowledge workers. Second, it is a partial reading, ignoring the fact that, while management, professional and technical jobs are expanding, so too are routine services jobs, particularly in personal services and retail and hospitality. Brown and Hesketh (2004) suggest that such trends indicate a polarization of high skill 'knowledge work' jobs and low skill 'routine' jobs – the U.K. hourglass economy identified by Nolan (2001). Fleming et al. (2004) make the same claim for Australian skills and jobs. Third, it equates knowledge workers with these managerial, professional and technical occupations. Statistics Canada is one such example (see Baldwin & Beckstead,

2003). Yet, as even knowledge economy advocate Reich (1993) acknowledges, not all professional workers are knowledge workers.

Such lumpy aggregations obscure more than they illuminate. More sensitive readings of aggregate government data, for example of Australian professional job content by Fleming et al. (2004), suggest that it is important to differentiate between different types of professional jobs. Analysis 'below the surface of the growth in professional employment' reveals that most growth has occurred in jobs 'associated with knowledge handling and servicing' rather than those that are considered to be 'autonomous and empowered knowledge productive jobs' (p. 735). Furthermore, analysis of the job content of Associate Professions in Australia reveals these jobs to be not dissimilar from administrative occupations that have existed for most of the twentieth century and so 'not … particularly distinctive' (p. 738). This outcome is not unique to Australia. Associate Professional and Technical Occupations have increased and are projected to increase most as a percentage of the U.K. employment to 2012 (Wilson et al., 2004). However, a research brief for the U.K.'s Department for Education and Skills (Rodgers & Waters, 2001) admits that the emergence of some private and public sector Associate Professional jobs is simply a result of a reclassification of these jobs, with these jobs incorporating a variety of tasks from occupations traditionally rated at a lower level.

Thus, although policy makers and academics across the United States, Europe and elsewhere have been quick to trumpet the emergence of the knowledge economy, the most frequently used proxy measures are problematic; such measures are too often centred on broad-brush assumptions and aggregate measures that are insufficiently sensitive to underlying sector, industry and occupational variations and developments.

KNOWLEDGE AT WORK: TOWARDS A NEW RESEARCH AGENDA

Instead of being an evidence-driven policy, the knowledge economy is a policy increasingly at odds with the evidence. Its persistence speaks more to the needs of policy-makers for 'an optimistic story that legitimises smaller government in an age of globalisation and low taxes' (Thompson, 2004, p. 51). In the search for data, a range of substitutes for knowledge usage are invoked for measurement purposes. Our argument has been that these measures are often deeply flawed.

In particular, labour or product market measures have been used to sustain claims that ultimately need to be validated in analysis of the labour process. We accept that proxies may serve a more effective purpose when used as measures of broader processes such as knowledge flows in particular industry sectors (see Smith, 2000). More care, we suggest, needs to be taken about the term 'knowledge intensive.' Industries can be knowledge intensive through investment in ICT and R&D, but given that the outcomes of such investment may be the development of expert systems, such investment might not be reflected in the growth of knowledge work characterized, as indicated earlier, by theoretical knowledge, creativity and intellective skills. These proxies may be acceptable if re-directed specifically

towards terrains such as industry knowledge flows. We remain much more sceptical of the use of occupation and qualification as proxies, as these are used to draw direct inferences about knowledge work.

We also accept that as a legitimate feature of public policy, there is a case for better quantitative measures of skill and occupations, as Brown and Hesketh (2004) have begun to undertake. However, there is also a need for research to examine the issues more concretely in relation to the dynamics of different categories of knowledge and labour, and this kind of orientation needs to inform that more complex reading of occupational data. If this is not done, public policy will be mis-directed towards labour markets and human capital rather than the 'under-employment' issue – in other words 'how successfully current labour processes utilize the existing skills of workers' (Livingstone & Scholtz, 2006).

Drawing on work elsewhere (Thompson, 2004; Thompson et al., 2001), we would summarize some of the basic trends as follows. Although routine and expert labour continue to differ significantly in content and context, both have undergone significant changes. A central focus in both instances has been on attempts to enhance the conversion of tacit to explicit knowledge.

The contested politics of knowledge has always been central to the workplace (Jacques, 1996) and became the focal point of conflict through Taylorism's attempts to appropriate the knowledgeable practice of craft workers. Firms are keen to introduce organizational structures and practices that facilitate initiative and innovation in the form of creativity and continuous improvement on the part of routine workers. Such changes are marked primarily by a shift from explicit to tacit knowledge. Explicit knowledge was held either by management through Taylorism or by workers through apprenticeships and related training. As is well known, formal employee knowledge and craft skills development through apprenticeships has been in long-term decline. Teamwork, which provides a collective framework for workers to share knowledge and solve problems, is the preferred alternative.

Admittedly, many of the new forms through which informal expertise is mobilized have proved to be faddish, superficial and compatible with elements of Taylorism. For all these limitations, the search for ways of identifying and utilizing knowledgeability is real and unlikely to disappear from corporate agendas. Though such arguments largely reflect the experience of manufacturing, there is an equivalent direction for interactive services. Increased competition in expanded, heterogeneous and de-regulated markets has led companies to focus their attention on the management of 'front-line' work (Frenkel et al., 1999). Though the form varies according to the work context, attention focuses on control and cost efficiency, with employees selected and trained to deliver consistent service quality and required to take on expanded, delegated responsibilities.

In addition to the move from explicit to tacit knowledge, there is also a shift from the technical to the social. Technical here refers to the abstract and practical pre-conditions in skills and knowledge for workers to be effective in the tasks that they undertake. What is happening is a shift towards 'person-to-person' social competencies, or to what in the past might have been regarded as personal characteristics. Research from France, the United Kingdom, and the United States

has found that attitudes, dispositions and appearance are frequently more important than level of education and training (Mounier, 2001; Grugulis et al., 2004; Lafer, 2004 respectively). As a result, employers may be choosing to invest more in recruitment and selection processes that can identify workers with the appropriate personal characteristics than in skill development and learning. This is particularly the case in service work as studies of call centres, retail and hospitality demonstrate (Callaghan & Thompson, 2002; Nickson et al., 2005). As a U.S. manager in industry remarked: 'It's much more of a challenge to engineer change with people than to hire in new people' (Moss et al., 2003, p. 13).

In contrast, expert labour is generally taken to mean professional or other groups whose position in the division of labour is defined by the existence and use of their specialist knowledge. High-level skills, core strategic knowledge and organizational competencies in manufacturing and services are concentrated in small sub-sections of expert labour and senior management. Nevertheless, the wider category of 'real knowledge workers' is clearly important to individual firms and the wider economy as sources of design, research and innovation. It is also fairly obvious that knowledge-intensive work requires much higher levels of autonomy and trust for particular groups of technical and professional employees.

Admittedly, the newness of much of this emphasis is debatable. The tension between creativity, commodification and control has always been at the heart of knowledge work (see Barrett, 2004, for a recent illustration). What can be said is that this tension has become sharper. There are two main sources. Knowledge-intensive firms are under strong competitive pressures to reduce the life cycle of 'molecule to market' projects (McKinlay, 2002). Meanwhile, public sector knowledge workers have increased constraints on their professional autonomy as a result of a combination of bureaucratic regulation and managerial control of their work, and the introduction of internal markets and associated forms of competition. This is the real meaning of knowledge management with its attendant language of 'capturing,' 'leveraging' or 'converting' knowledge for commercial gain (see, e.g., Nonaka & Takeuchi, 1995). It is, therefore, at the very heart of knowledge management to 'separate knowledge from the knower.'

These trends are by no means exhaustive across occupations and sectors. Compared to routine and expert labour, contemporary research has a less detailed picture of other groups such as the Associate Professionals and Intermediate Occupations (though this latter grouping is emerging as a key concern – see Department for Education and Skills, 2005). In developing such an expanded agenda, we would suggest some key differentiating criteria and research questions related to any exploration of workplace knowledge:

1. Input issues: what, if anything, needs to be known prior to, or as a condition of entry to the job?
2. Output issues: what opportunities are available to use, modify or add to the stock of job-related knowledge?
3. Process issues: what needs to be known to enable a job to be performed appropriately; what degree of learning, training and progression are available to advance access to and acquisition of knowledge?

With respect to input issues, a key research question is to examine whether there is an increasing disconnection between theoretical knowledge and job characteristics, reflecting the view of a Chief Executive of a City financial services company that they are moving towards a workforce where a 'guy with an O level in woodwork sits next to a guy with a PhD in mathematics' (quoted in *The Economist*, 2004, p. 12). Even if an employee enters a job with a body of knowledge, we need to know the extent to which that knowledge is expected to be and can be utilized. For example, schoolteachers may be constrained from using and adding to their knowledge by externally directed syllabi and examinations. More awareness is needed too of the form of knowledge use in the workplace, not just that 'knowledge' is being used. On the process terrain, it is frequently observed that there is a decline in traditional career structures and internal labour markets (Cappelli, 2001; International Labour Organization, 1997). While such trends may be exaggerated, more research is needed on the effects of changes in career prospects and perceptions on opportunities for learning and advancing knowledge.

It is important not merely to map the content of knowledge at work but also its context. Theory and research needs to address the parameters to, and determinants of, access to and use of workplace knowledge. We would suggest that the following represent the key factors:

1. Organizational hierarchy and control systems;
2. Work intensity, effort bargain and reward systems;
3. Skill formation systems;
4. Internal and external labour markets;
5. Professional or occupation structures and cultures; and
6. State, political economy and other institutional factors.

The literatures on knowledge and its management too often give the impression that the pre-conditions and opportunities for knowledge utilization depend solely on the motives and commitment of individual workplace actors when there are wider contextual issues too. For example, the recent (2004) Agenda for Change plans in the U.K.'s National Health Service offer enhanced opportunities of knowledge use and acquisition for nurses, but the pressures on management to keep down or even drive down costs and increase patient throughput places limits on the capacity and willingness of employees to embrace such changes. We do need fine-grained studies of the workplace practices of occupational groups such as technical workers (Barley, 2005) but 'communities of practice' are not islands. Knowledge and skills are formed through broader institutional processes, ranging from labour markets to the variety of capitalism within which the workplace is embedded. Mapping this context suggests that both a critique of and alternative to the current mainstream are needed to better understand knowledge in work, shifting the emphasis away from a concern with proxies and onto embedded workplace practice.

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NOTES

[1] Purcell et al. (2003) offer a five-category classification that identifies 'traditional graduate' jobs such as solicitors and scientists and 'modern graduate' jobs involving the newer professions such as accountants and teachers. The incumbents of both types of jobs are predominantly graduates. Other jobs, 'new graduate' – such as marketing managers and welfare officers, 'niche graduate' – sports and hotel managers for example – and 'non graduate occupations' – such as clerks and sales assistants – are increasingly employing graduates. In the latter two categories 'the majority of incumbents are not graduates' and 'are likely to constitute under-utilization of [graduates'] higher education skills and knowledge' (p. 4).

REFERENCES

Appelbaum, E., Bernhardt, A., & Murnane, R. (2003). Low-wage America: An overview. In Appelbaum, E., Bernhardt, A., & Murnane, R. (Eds.), *Low-wage America* (pp. 1–29). New York: Russell Sage Foundation.

Baldwin, J.R. & Beckstead, D. (2003). *Knowledge workers in Canada's economy 1971–2001*. Ottawa: Statistics Canada.

Barley, S. (2005). What we know and mostly don't know about technical workers. In Ackroyd, S., Batt, R., Thompson, P., & Tolbert, P. (Eds.), *The handbook of work and organizations*. Oxford: Oxford University Press.

Barrett, R. (2004). Working at Webboyz: An analysis of control over the software development labour process. *Work, Employment and Society*, *38*(4), 777–794.

Bell, D. (1973). *The coming of post-industrial society*. New York: Basic Books.

Blackler, F., Crump, N. & McDonald, S. (1998). Knowledge, organisations and competition. In von Krogh, G., Roos, J., & Kleine, D. (Eds.), *Knowing in firms*. London: Sage.

Brown, P. & Hesketh, A. (2004). *The mismanagement of talent*. Oxford: Oxford University Press.

Brown, P., Hesketh, A., & Williams, S. (2003). Employability in a knowledge-driven economy. *Journal of Education and Work*, *16*(2), 107–126.

Brynin, M. (2002). Over-qualification in employment. *Work, Employment and Society*, *16*(4), 637–654.

Burton-Jones, A. (1999). *Knowledge capitalism*. Oxford: Oxford University Press.

Callaghan, G. & Thompson, P. (2002). 'We recruit attitude:' The selection and shaping of call centre labour. *Journal of Management Studies*, *39*(2), 233–254.

Cappelli, P. (2001). Assessing the decline of internal labor markets. In Berg, I. & Kalleberg, A. (Eds.), *Sourcebook of labor markets*. New York: Plenum.

Castells, M. (1996). *The rise of the network society*. Oxford: Blackwell.

Cully, M. (2003). *Pathways to knowledge work*. Leabrook: National Centre for Vocational Education Research.

Davenport, T.H., Jarvenpaa, S.L., & Beers, M.C. (1996, Summer). Improving knowledge work processes. *Sloan Management Review*, 53–65.

Despres, C. & Hiltrop, J-M. (1995). Human resource management in the knowledge age: Current practice and perspectives in the future. *Employee Relations*, *17*(1), 9–23.

Department for Education and Skills (DfES). (2005). *Skills: Getting on in business, getting on in work*. Norwich: Her Majesty's Stationary Office.

Department for Trade and Industry (DTI). (1998). *Our competitive future*. London: Her Majesty's Stationary Office.

Economist. (2004, January 15). *What's it worth*?
European Communities (EC). (2004). *Facing the challenge*. Luxembourg: Office for Official Publications of the European Communities.
Felstead, A., Gallie, D., & Green, F. (2002). *Work skills in Britain 1986–2001*. London: Department for Education and Skills.
Fleming, P., Harley, B., & Sewell, G. (2004). A little knowledge is a dangerous thing: Getting below the surface of the growth of 'knowledge work' in Australia. *Work, Employment and Society*, *18*(4), 725–747.
Frenkel, S.J., Korczynski, M., Donoghue, L. & Shire, K. (1995). Re-constituting work. *Work, Employment and Society*, *9*(4), 773–796.
Frenkel, S., Korczynski, M., Shire, K., & Tam, M. (1999). *On the front line*. Ithaca, NY: Cornell University Press.
Green, F. (2004). *Over-education*. Paper presented at the SKOPE Conference, Lumley Castle, Durham.
Grugulis, I., Warhurst, C., & Keep, E. (2004). What's happening to 'skill?' In Warhurst, C., Grugulis, I., & Keep, E. (Eds.), *The skills that matter*. London: Palgrave.
Hamel, G. & Prahalad, C.K. (1996). Competing in the New Economy: Managing out of bounds. *Strategic Management Journal*, *17*, 237–242.
HM Treasury. (2004). *Skills in the global economy*. Norwich: Her Majesty's Stationary Office.
Ichijo, K., von Krogh, G., & Nonaka, I. (1998). Knowledge enablers. In von Krogh, G., Roos, J., & Kleine, D. (Eds.). *Knowing in firms*. London: Sage.
International Labour Organization (ILO). (1997). *World Labour Report 1997–8*. Geneva: ILO.
Jacques, R. (1996). *Manufacturing the employee*. London: Sage.
Kanevsky, V. & Housel, T. (1998). The learning–knowledge–value cycle. In von Krogh, G., Roos, J., & Kleine, D. (Eds.), *Knowing in firms*. London: Sage.
Kelly, K. (1999). *New rules for the new economy*. London: Fourth Estate.
Lafer, G. (2004). What is 'skill?' Training for discipline in the low-wage labour market. In Warhurst, C., Grugulis, I., & Keep, E. (Eds.), *The skills that matter*. London: Palgrave.
Lash, S. (2002). *Critique of information*. London: Sage.
Layard, R. (1997). *What labour can do*. London: Warner.
Leadbetter, C. (1999). *Living on thin air*. London: Viking.
Livingstone, D.W. & Scholtz, A. (2006). Contradictions of labour processes and worker's use of skills in advanced capitalist economies. In Shalla, V. & Clement, W. (Eds.), *Work in tumultuous times*. Montreal: McGill–Queen's University Press.
McKinlay, A. (2002). The limits of knowledge management. *New Technology, Work and Employment*, *17*(2), 76–88.
McNicholl, I., Kelly, U., Marsh, R., & McLay, D. (2002). *Defining and identifying the knowledge economy in Scotland*. Glasgow: University of Strathclyde.
Moss, P., Salzman, H., & Tilly, C. (2003). *Under construction: The continuing evolution of job structures in call centers*. Center for Industrial Competitiveness, University of Massachusetts-Lowell.
Mounier, A. (2001). The three logics of skills in the French literature. Sydney: NSW BVET.
National Centre for Vocational Education Research (NCVER). (2001). *Statistics 2001: Survey of employer views on vocational education and training*. Leabrook: National Centre for Vocational Education Research.
Nickson, D. & Warhurst, C. (2007). Opening Pandora's Box: Aesthetic labour and hospitality. In Morrison, A., Lashley, C., & Lynch, P. (Eds.), *Critical hospitality studies*. London: Elsevier.
Nickson, D., Warhurst, C., & Dutton, E. (2005). The importance of attitude and appearance in the service encounter in retail hospitality. *Managing Service Quality*, *15*(2), 195–208.
Nolan, P. (2001, December 27). Shaping things to come. *People Management*, 30–31.
Nonaka, I, & Takeuchi, H. (1995). *The knowledge-creating company*. Oxford: Oxford University Press.
Organisation for Economic Co-operation and Development (OECD). (1994). *Jobs study: Evidence and explanations*. Paris: OECD.

Organisation for Economic Co-operation and Development (OECD). (2001a). *Devolution and globalisation*. Paris: OECD.

Organisation for Economic Co-operation and Development (OECD). (2001b). *Science, technology and industry scoreboard: Towards a knowledge-based economy*. Paris: OECD.

Organisation for Economic Co-operation and Development (OECD). (2004). *Economic impact of ICT: Measurement, evidence and implications*. Paris: OECD.

Purcell, K., Wilton, N., & Elias, P. (2003). *'What is a graduate job?' An examination of the skills used in the workplace by graduates*. Paper to the 21st Annual International Labour Process Conference, University of the West of England.

Randle, K. (1995). *The whitecoated worker: Professional autonomy in a period of change*. Paper to the 13th Annual International Labour Process Conference, University of Central Lancashire.

Reich, R. (1993). *The work of nations*. London: Simon & Schuster.

Rodgers, R. & Waters, R. (2001). *The skills dynamics of business and public service associate professionals*. DfES Research Report, RR302. Norwich: Her Majesty's Stationary Office.

Rubery, J. & Grimshaw, D. (2001). ICTS and employment: The problem of job quality. *International Labour Review*, *140*(2), 165–192.

Scottish Executive. (2004). *A smart, successful Scotland*. Rev. Edinburgh: Stationery Office.

Smith, K. (2000). What is the 'knowledge economy?' Knowledge-intensive industries and distributed knowledge bases. Rebild: DRUID Summer Conference on the Learning Economy.

Thompson, P. (2004). *Skating on thin ice*. Glasgow: Big Thinking.

Thompson, P., Warhurst, C., & Callaghan, G. (2001). Ignorant theory and knowledgeable workers: Interrogating the connections between knowledge, skills and services. *Journal of Management Studies*, *38*(7), 923–942.

Warhurst, C. & Thompson, P. (1998). Hands, hearts and minds: Changing work and workers at the end of the century. In Thompson, P. & Warhurst, C. (Eds.), *Workplaces of the future*. London: Macmillan.

Wilson, R., Homenidou, K., & Dickerson, A. (2004). *Working futures: National report 2003–4*. Institute for Employment Research, University of Warwick.

World Bank. (2002). Building knowledge economies: Opportunities and challenges for EU accession countries. Paris: World Bank.