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# THE REGIONAL INNOVATION SYSTEM IN WALES: EVOLUTION OR ECLIPSE?

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# INTRODUCTION

In the first edition of this book an initial attempt was made to reveal some evidently path-breaking trends whereby Wales as a pioneer of the first industrial revolution was, in the 1990s leading an unusual pathway out of 'lock-in' and path dependence on a legacy of declining coal and steel industries that had begun production as far back as the 1780s. Unlike, say, the Ruhr region in Germany, where endogenous or, in evolutionary terms 'generative growth' of environmental technologies from steel and coal was apparent (Heinze et al., 1998), Wales was being lifted by the arrival of global transplant firms, mainly from Japan and later the Asian 'Tigers' specialising in electronics and automotive industries. These were familiar with operating in clusters and the chapter showed how, in concert with the Welsh Development Agency, vertical, supply chain clusters were being built, especially in south Wales. Where indigenous suppliers were competitive and innovative, firms received contracts, although these were a minority but regionally significant. Sony, for instance, developed twenty-five regional suppliers in south Wales, from a total of three hundred in the European Union. If the locals were unable to meet requirements, the WDA recruited suppliers, or firms like Sony and Matsushita brought them in from their own *keiretsu*.

Importantly, for the core issues of this book, these Asian firms injected a propulsive innovation element into the economy by demanding globally competitive quality at costs that typically declined by at least 3% per contract period, normally two to three years. This made suppliers innovate in ways they had never been used to before. Firms were generally pressed to take innovation seriously even where they were not supplying the transplants as the Welsh Development Agency became an ambassador for, amongst other things, 'lean production', 'global sourcing and supplying' and 'technology marketing'. So much so, that Wales became, for a brief period in the mid-1990s a darling of the Regional Policy Directorate of the European Union, recognised as such by being given the first pilot Regional Technology Plan contract in 1994. These later became Regional Innovation Strategies, which with the EU Regional Innovation and Technology Transfer Strategies

resulted in over one hundred EU regions having such plans by the turn of the century (Landabaso, 1997).

This chapter reviews that hopeful period, taking the account up to late 2002 when published employment data showed Wales had lost 44,000 manufacturing jobs in the period between November 1998 and November 2002 (UK Office of National Statistics, 2003a). The previous set of statistics showed 23,287 manufacturing jobs having disappeared from the March dates for those years, hence statistics show a catastrophic acceleration in a nine-month period. This is particularly significant since, as will be shown below and in line with statistics appearing in the first edition of this book, Wales was growing as a manufacturing economy within UK. Indeed, as may also be seen from Table 1, Wales was the only part of the UK in which manufacturing employment was not in decline but actually showing an increase 1991-1998. Thus views of critics dismissive of a prevalent perspective of the early and mid 1990s that Wales was experiencing something of an 'industrial renaissance' by comparison with elsewhere in the UK, and even large parts of the EU (Cooke, Morgan & Price, 1994) are clearly to be discounted. What is of far more importance is trying to understand what happened from 1998 to 2002, what its implications for innovation and competitiveness capabilities have been, and what, if any, new forms of innovation and enterprise support have been forthcoming. The chapter is thus organised to tackle these three crucial issues. It does this by, in some places, summarising key events leading to a waxing of innovativeness in Wales as a context for what subsequently can only be characterised as its waning. Elsewhere wholly new data are mobilised to seek to show how, as evolutionary theorist Thorstein Veblen (1899) noted, economies are not determinate in their trajectory, history can be absurd, and downward trajectories are as likely as those pointing upwards.

## THE WAXING AND WANING OF INNOVATION IN WALES: WHAT HAPPENED TO THE REGIONAL INNOVATION SYSTEM?

During the postwar years government policy had encouraged engineering and other manufacturing firms to relocate to the industrial belts of south and north Wales. Thus, companies such as Ford, Hoover, Ferodo, GEC, Ferranti, Hotpoint, Borg-Warner and 3M became established, many demonstrating the importance of American investment in a UK economy dependent for a time on Marshall Aid and seeking to recover traditional markets throughout the world. At this time (1945-1975) there was no obvious pattern to the

incoming foreign investments other than that they were classical branch-plants, mainly in consumption goods industries, seeking and finding large numbers of semi-skilled shopfloor workers, both male and female. Few of these arrivals ever sourced much of their supplies locally with the exception of peripheral items such as packaging and transportation.

The establishment of the Welsh Development Agency in 1976 meant that, for the first time, Wales had a body capable of promoting strategic economic development. Though WDA never produced an economic plan for Wales, not even producing a corporate plan until 1992, nevertheless there developed a tacit sector strategy to intensify the level of investment, both domestic and overseas, in automotive and electronic engineering. This strategy took off spectacularly in the 1980s, mainly because this was the period of most intense job-loss in coal, steel and the first-round of manufacturing industries. For a period of approximately ten years from 1983 to 1993 Wales, with 5% of the UK's population and GDP, consistently attracted between 15% and 20% of inward investment in the UK (Cooke, 1995).

Much of this was Japanese, American and European (especially German) investment in engineering. Sony arrived in 1974, followed by Hitachi, Panasonic (Matsushita), Aiwa, Brother, Sharp and Orion, all in some way involved in consumer or office electronics. Later, LG from Korea, wafer fabrication firms International Rectifier (US) and Trikon (UK), and components firms from Hong Kong and Singapore joined the cluster. Since 1998, Sony has reduced employment by around 700, as has Panasonic, while Hitachi and Aiwa have closed their operations in Wales. In automotive industries, Ford opened an engine plant at Bridgend in south Wales in 1978 and this was followed by acquisitions or new, greenfield investments by Calsonic, Valeo, Lucas-SEI, Robert Bosch, Trico, ITT-Alfred Teves, Ina Bearings, Sekisui, Yuasa, Gillet, Grundy and Hoesch-Camford. Since 1998,Valeo and Lucas-SEI have retreated, the last named to Slovakia and Poland. Finally, in 1992 production of 200,000 engines a year by Toyota began as supply to their assembly plant in Derby and for export back to Japan. From 1999, the Ford Bridgend engine plant became the sole Zetec engine source, producing annually 700,000 of these and 55,000 Jaguar AJ26 V8 engines. In 2001 a new range of Jaguar engines was announced, to be produced at a rate of 325,000 per year. Toyota engine production had expanded to 500,000 engines by 2003. Wales had evolved into a key centre of high-quality, high-skill

automotive engine production in Europe, with 2,400 employed at Bridgend and 600 at Deeside in north Wales.

According to Rhys (2001) the component base consists of some 150 companies, 40 of which are first-tier suppliers, 70 second-tier and the rest lower in the supply chain. Joining global leaders like Bosch and Calsonic since 1995 are TRW, Visteon, Meritor and Magna. These and indigenously developed supplier companies have built a customer base which includes all the UK and major European manufacturers in the automotive industry sector. These firms retain some forty direct and indirect supply relationships to assemblers such as Volvo, Saab, Fiat, Opel and Renault. Of much greater importance are the supply-chain links from Welsh automotive components firms to UK-based, domestically and foreign-owned assemblers such as Rover, Ford, Jaguar, Nissan, Toyota, Honda, GM and Peugeot. Welsh suppliers have over sixty direct supply contracts with these firms and some one hundred and thirty in which they supply the final customer indirectly through another member of the supply-chain. However, Rhys (2001) also notes that gross value per head is below the UK average by some 7% and net capital expenditure by 20%. Thus, although increasingly capital-intensive, the automotive industry in Wales lags in productivity, something to which we shall return.

A cluster story can be told for electronics and Information and Communication Technology (ICT). By 1990, the main industries in this sector were office automation and consumer electronics. Other important industries were telecommunications equipment, instrumentation, components and software. Between 1980 and 1990 these industries grew in employment terms by an average of 110%. However, whereas in the automotive industry all of the Welsh and Welsh-based firms are components, systems or engine suppliers, in IT and electronics, components only account for 13% of the industry. The vast majority of production firms are final assemblers, many of them Japanese such as Panasonic, Orion, Sony, Sharp and Brother. Such firms sought to source their supply requirements within Wales. An example was the Japanese-German television and VDU screen joint venture NEC-Schott, now wholly NEC-owned, located in Cardiff, joining other overseas supply companies located in Wales such as Matsushita Components, Diaplastics, Ninkaplast, and Meiki. This largely explains how Wales became both more of a manufacturing economy than it was and, proportionately, more of a manufacturing economy than the UK.

What now demands investigation is what happened and why to reverse the burgeoning trajectory of the Welsh manufacturing sector, much of it supporting the electronics cluster and the automotive supply chain, especially Corus, the Anglo-Dutch joint venture that absorbed British Steel and has cut employment most. In Table 1 comparative statistics of manufacturing job change 1991-2001 show the point at which the reverse occurred. Table 2 then explores what happened until November 2002, the last date for which Labour Force Survey statistics are available at the time of writing. Briefly, this table shows three relevant things. First, the

| Region | 2001 (%) | 1998 (%) | 1991 (%) | %Change 91-01 | %Change 91-98 | %Change 98-01 |
|---|---|---|---|---|---|---|
| E. Midlands | 20.5 | 21.5 | 26.7 | -6.2 | -1.2 | -1.0 |
| Eastern | 14.5 | 17.1 | 19.7 | -5.2 | -2.6 | -2.6 |
| London | 6.4 | 7.8 | 10.0 | -3.6 | -2.2 | -1.4 |
| North East | 16.5 | 21.1 | 21.6 | -5.1 | -0.5 | -4.6 |
| North West | 16.4 | 20.2 | 22.1 | -5.7 | -1.9 | -3.8 |
| South East | 11.2 | 13.9 | 15.5 | -4.3 | -1.6 | -2.7 |
| South West | 14.2 | 13.9 | 15.5 | -3.2 | -0.7 | -2.5 |
| W. Midlands | 19.9 | 25.7 | 28.0 | -8.1 | -2.3 | -5.8 |
| Yorks. & H. | 17.8 | 21.3 | 23.0 | -5.2 | -1.7 | -3.5 |
| Scotland | 12.8 | 15.4 | 17.6 | -4.8 | -2.2 | -2.6 |
| Wales | 17.1 | 21.7 | 21.6 | -4.5 | +0.1 | -4.6 |
| GB | 14.1 | 17.4 | 19.3 | -5.2 | -1.9 | -3.3 |

Table 1: Manufacturing Employment Change in Great Britain, 1991-2001 (March)
Source: Office of National Statistics

marginally and uniquely positive growth statistic for Welsh manufacturing 1991-1998. Second the higher than average rate of job loss in manufacturing 1998-2001 should be noted(which nevertheless translates into a relatively modest 9,287 jobs, Cooke, De Laurentis & Wilson, 2003) shared with North East England behind West Midlands. Accordingly, third, slippage from third to fourth in regional manufacturing employment share in Britain. The crucial question to be answered next is whether large or small and

medium enterprises mainly account for that manufacturing employment decline. The answer is, overwhelmingly, large firms. Official statistics at UK level show large firms (>250 employees) accounted for 228,000 of the UK's 348,000 manufacturing job loss 1998-2001, approximately two-thirds, and there is no reason to think Wales was any different (Office of National Statistics, 2003b). Now the analysis moves to absolute statistics as well as percentages and the period covered takes us up to November 2002, as shown in Table 2. This table reveals a number of

| Region (000s) | 2002 | % | 2001 | % | 2000 | % | 1998 | % | 1994 | % |
|---|---|---|---|---|---|---|---|---|---|---|
| E. Midlands | 434 | *21.0* | 453 | *21.9* | 455 | *22.6* | 481 | *24.1* | 494 | *26.4* |
| Eastern | 430 | *15.5* | 460 | *16.6* | 444 | *16.2* | 465 | *17.6* | 475 | *19.0* |
| London | 287 | *8.0* | 284 | *8.0* | 282 | *8.1* | 319 | *9.4* | 310 | *10.1* |
| North East | 194 | *17.6* | 210 | *19.1* | 220 | *19.9* | 233 | *21.7* | 205 | *19.6* |
| North West | 557 | *17.4* | 569 | *18.2* | 594 | *19.1* | 622 | *20.4* | 665 | *22.6* |
| Scotland | 336 | *13.9* | 337 | *14.1* | 368 | *15.3* | 375 | *16.1* | 380 | *16.7* |
| South East | 569 | *13.6* | 582 | *14.0* | 567 | *13.8* | 656 | *16.3* | 600 | *16.2* |
| South West | 366 | *14.7* | 364 | *14.8* | 385 | *15.8* | 378 | *16.2* | 377 | *17.1* |
| Wales | 206 | *15.8* | 220 | *17.4* | 223 | *17.7* | 250 | *20.4* | 237 | *19.9* |
| W. Midlands | 563 | *22.5* | 572 | *22.8* | 567 | *23.2* | 639 | *25.8* | 629 | *26.7* |
| Yorks. & H. | 444 | *18.7* | 440 | *18.7* | 479 | *20.3* | 477 | *20.8* | 471 | *21.3* |
| GB | 4,386 | *15.7* | 4,491 | *16.2* | 4,584 | *16.7* | 4,893 | *18.2* | 4,843 | *19.1* |

Table 2: Regional Manufacturing Employment Change, 1994-2002 (November)
Source: Office of National Statistics

important features, especially for the 1998-2002 period. First, although not the largest magnitude in absolute numbers, the Welsh percentage decline in manufacturing was, at 4.6%, the steepest. Second, the two-to-one ratio of large firm to SME job loss suggests that large firms accounted for approximately 30,000 of the 44,000 jobs lost from 1998-2002. Wales slipped from fourth to sixth in regional manufacturing employment share in approximately one year. Wales is now closer to the profile of 'post-industrial' regions like

the South East and South West in its modest share of manufacturing employment than to manufacturing regions like the Midlands towards which its trajectory pointed up to1998.

This point is being laboured because of the swiftness with which change has happened, the manner in which inward investment firms and the linked remnants of the Welsh steel heritage have contracted, and their importance to the emergent Regional Innovation System that had been evolving around engineering sectors or clusters and which now is beginning to unravel. The unravelling occurs when, for instance, a firm like Hitachi, or Aiwa with its local suppliers association shared partly with its parent Sony, disappears. It impacts when a firm such as LG (now LG-Philips) that set up with fanfares and research grants for university academics retrenches and, in crisis, is forced by the South Korean government to sell its undeveloped, last generation semiconductor production and R&D facility to its rival Hyundai, whose subsidiary Hynix wishes to sell it back to the WDA who built it in the first place. It occurs when Corus shuts down its 200-person materials research laboratory, as happened in 2001. Embryonic 'Triple Helix' relations among universities, businesses and government agencies atrophy and die with the loss of regional personnel to act as interlocutors and commissioners of research. This, in brief, is what happened to the, always hierarchical, ultimately WDA animated, but FDI facilitated Regional Innovation System in Wales after 1998.

Of course, this kind of economic evolution is part and parcel of global competitiveness as inward investors activate new locational selection mechanisms in light of changed market conditions. But such experiences betray an important feature about innovation systems for policy makers and academe alike. Systems, by definition, represent and thrive upon stability and reasonable institutional and organisational continuity. Innovation creates uncertainty and is destabilising. The relationship is somewhat like that Latour (1998) specified between 'science' and 'research' as discussed in the introduction to this book. Regional Innovation Systems in particular must develop highly refined sensitivities to change. That this happens in settings like Massachusetts where mini-computing disappeared but biosciences rose to global prominence is testimony to the flexibility to market opportunities inherent in what were referred to in the introduction as Entrepreneurial Regional Innovation Systems (ERIS). This is more difficult in the interventionist Institutional Regional Innovation Systems (IRIS) typical of Europe and paradigmatic in Wales.

So what has been the innovation system's policy response in Wales, and what, crucially, has been the effectiveness of the response? These questions are explored in the section that follows, but as a prelude three major input shifts, one of which also reveals a significant output shift may be mentioned. First, as devolution was meeting demand for a democratic Assembly in Wales, power to determine financial allocations was wrested away from administrators. A re-mapping of Welsh GDP performance led to the discovery that more than half the area of Wales warranted EU Structural Funds Objective 1 designation. Dividing Wales into zones containing wealthy and poor localities had obscured this hitherto. A sum of £1.2 billion over six years was thus earmarked for economic restructuring, including regional innovation expenditure, starting in 2000. Second, the planning process necessary to achieve this objective led to two further economic development strategies. These marked an end to the WDA's love affair with inward investment, now seen to have dried up, something also recognised in the thinking of other regional systems, notably Scotland as discussed in the introduction to this book. These documents shifted the strategic economic development spotlight on to *entrepreneurship*, with a key instrument modelled on the old Regional Technology Plan but transformed into the Entrepreneurship Action Plan. A new investment vehicle, Finance Wales, was set up to channel EU and private funds into loans and equity investments for SMEs and start-up businesses. A 'Knowledge Exploitation Fund' was set up to facilitate exploitation of university research.

As we shall see, apart from the achievement of Objective 1 status, itself automatic once the boundary conditions were complied with, actions involved paper strategies, establishment of delivery mechanisms, renewal of tasks for existing personnel, and recruitment of new public administrators. Coincidentally, the Vocational Training set-up (known by the acronym ELWA) was completely overhauled, at least organisationally, and its size and budget doubled to twice that of the WDA. Finally, the National Health Service in Wales was twice reorganised following the setting up of the Assembly in 1999 and, as in the rest of the UK, large injections of public finance have been provided to bring standards up to the average for the EU, which entails a UK health budget rise to £105 billion from its current £65 billion. The 2003 health budget in Wales was £3.8 billion. Thus, the Welsh Assembly Government had swiftly turned its attention to administrative reforms, absorbing

large amounts of new money, and centralising control of expenditure and management of these budgets.

The effect of this is revealed starkly in Table 3, which gives a comparative analysis of changes in public administration (education, government, and health) employment in British regions since 1994. Wales now has the highest percentage share of public

| Region (000s) | 2002 | % | 2001 | % | 2000 | % | 1998 | % | 1994 | % |
|---|---|---|---|---|---|---|---|---|---|---|
| E Midlands | 502 | *24.3* | 488 | *23.6* | 467 | *23.2* | 438 | *21.9* | 400 | *21.4* |
| Eastern | 640 | *23.1* | 633 | *22.9* | 637 | *23.2* | 570 | *21.6* | 475 | *19.0* |
| London | 850 | *23.8* | 851 | *24.0* | 771 | *22.1* | 769 | *22.7* | 731 | *23.7* |
| North East | 326 | *29.6* | 327 | *29.7* | 301 | *27.3* | 283 | *26.4* | 263 | *25.2* |
| North West | 874 | *27.4* | 856 | *27.4* | 853 | *27.4* | 756 | *24.8* | 720 | *24.5* |
| Scotland | 690 | *28.6* | 671 | *28.1* | 649 | *27.0* | 635 | *27.2* | 583 | *25.6* |
| South East | 1,004 | *24.0* | 974 | *23.4* | 987 | *24.0* | 960 | *23.8* | 864 | *23.3* |
| South West | 653 | *26.1* | 626 | *25.4* | 642 | *26.4* | 588 | *25.2* | 564 | *25.6* |
| Wales | 415 | *31.8* | 368 | *29.1* | 368 | *29.2* | 348 | *28.4* | 311 | *26.1* |
| W. Midlands | 606 | *24.2* | 621 | *24.8* | 568 | *23.2* | 559 | *22.5* | 516 | *21.9* |
| Yorks. & H. | 634 | *26.7* | 592 | *25.2* | 604 | *25.6* | 552 | *24.1* | 513 | *23.1* |
| GB | 7,193 | *25.7* | 7,008 | *25.3* | 6,846 | *24.9* | 6,459 | *24.1* | 5,964 | 23.5 |

Table3: Regional Public Administration Employment Change, 1994-2002 (November)
Source: Office of National Statistics

administration in the land. Reflecting back on the 1998-2002 period that saw a major downturn in the manufacturing labour market, the 67,000 rise in public administration employment more than made up for the 44,000 manufacturing jobs lost in that period.
Indeed, employment overall in Wales has risen, with the ubiquitous 'other business services' growing somewhat, but not the more knowledge-intensive financial services.
Hence, two questions arise: one concerns the effectiveness of the implementation of innovation targeted measures, now aimed at SMEs rather than FDI, the other concerns an even more interesting issue as to whether a public sector led strategy of employment generation is simply a drag on the 'real economy' (Pritchard, 2003) or whether within it,

there might be the seeds of a novel innovation strategy for a more socially nuanced and sustainable regional economy. These and related matters are discussed in the following section.

## INNOVATION PERFORMANCE: WALES COMPARED

While it was true to say in the previous edition that there was a bewildering array of enterprise support instruments available in Wales in the mid-1990s, by 2003 there was, at some 250 listed on the WDA website, a positive cornucopia of aids. Strictly regarding innovation, the most valuable of these in the past were a prototype RITTS and the pilot RTP, since updated under the RIS 2 programme funded by the EU. The latter was evaluated by EU assessors as being good regarding provision of organisational inputs to the programme, organising numerous meetings bringing 'Triple Helix' type actors to meetings to discuss required actions, and, accordingly, building consensus about future development imperatives. However, it was marked down on the outputs and outcomes aspects, the evaluators seeing little by way of new initiatives and much re-packaging of existing instruments drawn from the above-mentioned 250 (Technopolis, 1998). Rather than go into detail on a miasma of policy instruments, the following maximises use of the limited space available to first, in this section, examine some comparative innovation indicators involving Wales, and in the following one, examine a few key initiatives before drawing conclusions about prospects for the Welsh innovation system as it faces an uncertain future.

Three innovation studies involving Wales were published between 1998 and 2002. The first was the EU-funded Targeted Socio-Economic Research project called *Regional Innovation Systems: Designing for the Future* co-ordinated by the present author (Cooke, Boekholt & Tödtling, 2000). The second is the UK Innovation Survey conducted by the UK government in 2001 (DTI, 2001), while the third is a study from Harvard Business School conducted, using secondary data, by Michael Porter (Porter, 2002).

Beginning with the TSER study, this compared Wales and ten other European regions (two in Central Europe) in respect of whether and to what extent regional innovation operated interactively as is proposed in the innovation systems literature. Of the eleven regions,

many of which, like the Basque Country in Spain, Styria in Austria, Tampere in Finland and Wallonia in Belgium were old industrial regions reconverting to newer, more innovative sectors Wales was agreed to be one of only four that warranted being denoted a regional innovation system. Like the three others this was because of conscious practice and policies established at regional level to promote interactive innovation among firms and between them and universities and economic development agencies or ministries. Baden-Württemberg was one, not a reconversion but rather a high performance engineering economy, the Basque Country and Styria the others. Because whole economies could not be surveyed with the resources and timescale available, participant research teams identified their regionally important, propulsive sectors for in-depth study. In Wales this meant the aforementioned automotive and electronics engineering industries plus, perhaps presciently, healthcare. Most other regions had varieties of engineering as their propulsive sectors also, but only a few like Tampere selected healthcare. The reason why healthcare is important for innovation is that it belongs to a technological innovation system that includes Life Sciences, pharmaceuticals and biotechnology as well as care of patients. In some countries this grouping accounts for up to 25% of GDP and even (in the UK) 25% of the total R&D budget. We have seen in Table 3 that the broad employment sector in which UK official statistics place healthcare (excluding Life Sciences, pharmaceuticals and biotechnology) is substantially larger than manufacturing and more than double the size of manufacturing in Wales. The research, technological and production activities associated with healthcare contain the highest levels of private R&D expenditure given the world pharmaceuticals average of 17.5% of sales in 2002 (worth at least $28 billion in 2002) and some of the most innovative, advanced technologies known in history. The annual US public R&D budget for the National Institutes of Health in 2003 is $27.3 billion, most of which is spent in Medical and Life Sciences research centres in US universities (Cooke, 2002). Public health research expenditure in the European Union was estimated at some $10 billion (Senker & Van Zwanenberg, 2001).

The following consists of key innovation indicators arising from the TSER study of Wales and its ten comparator regions. Firms were surveyed regionally by postal questionnaire and asked a range of innovation-related questions. A key one, frequently used in surveys of this kind was how much product, process and organisational innovation had been conducted by the firm during the preceding three years. This referred both to innovations new to the market and those new to the firm. In Baden-Württemberg 64% of firms had innovated

products new to the market but only 12% had done so for processes. In Wales 45% had innovated products new to the market and 19% processes new to the market. Regarding organisational innovation, the most commonly introduced measure among the regions studied was the ISO 9000 business process quality standard. In Baden-Württemberg 68% had introduced this between 1993 and 1996 whereas in Wales the figure was 70%. On total quality management (TQM) the two were equal, both with 50% of firms having introduced TQM during the three years preceding the survey. Recall that this was during the period when the Welsh innovation system was being constructed as 'scaffolding' for the burgeoning automotive and electronics industries. The German region used in the above comparisons was particularly relevant since it was probably Europe's leading region in these industries.

However, to get at the systemic aspects of innovation within and then beyond the region required investigating collaboration among firms and 'Triple Helix' partners among others. This was done by postal survey questionnaire also, and true to most such surveys done subsequently, the leading partner *within the region* on average is the customer, the second is the supplier and the third, in this survey but not all, was universities. Of all firms surveyed, the mean was 44% of firms having innovation partnership with *regional* customers, 35% suppliers and 24% universities. In Baden-Württemberg the figures were 89%, 80% and 25% respectively, while in Wales they were 28%, 22% and 25%. Interestingly, in light of what has already been said about the public governance leadership of the Welsh innovation system even in the early 1990s, the highest-ranking innovation partner with 29% of firms recording it was 'government'. Thus in those days the panoply of enterprise support schemes meant that at least that percentage of firms were using them, receiving government advice on innovation, but interacting with customers and suppliers far less than the average.

But this reflects also the greater strength of the globally-leading German region's innovation system compared with the more open relations already described between firms located in Wales but owned or trading elsewhere. Thus when the question of innovation partners at national level was posed, although Baden-Württemberg firms' innovation interactions with national customers rose to an astounding 93% and with suppliers a still healthy 75% the equivalents in Wales rose to 56% and 51% respectively. Thereafter, when the question was posed regarding European innovation partners, Wales slipped back to a

poor 22% customer and 26% supplier innovation interaction while the German region scored 73% and 36% respectively. Universities at European level were insignificant partners for both in contrast to nationally where the German region had 19% of firms engaged and Wales 25%.

These data and many more published in Cooke, Boekholt & Tödtling (2000) paint a picture of firms in Wales being innovative, though not placing Wales as a European region in the top tier of innovators. They show Wales being modestly interactive for innovation with firms in the region and as much users of university innovation support in the region as the leading performer. Network relationships were high nationally for Welsh firms but nowhere near as high as those of the European regional leader. Notable also is the mid-1990s 'grant-dependence' in Wales suggested by the higher government innovation partnership than for any other of the eleven regions.

The two other studies compare Wales' economic performance with other regions of the UK, and of the two, the government study (DTI, 2001) is the more comprehensive. It shows Wales vying with Northern Ireland for bottom position in Business R&D Expenditure (BERD) over the 1998-2000 period and a declining employment in private R&D by 2000. These statistics reflected the two hundred R&D jobs lost at Corus in late 2000. The DTI survey measured innovation performance regionally for SMEs and large firms over the 1998-2000 period. Wales was shown to have 45% of its SMEs active in innovation compared to the UK mean of 46%. Contrariwise 82% of large firms were active by comparison with the UK mean of 67%, only the North East scoring higher at 89%. Both are branch-plant economies and the statistics confirm the argument of this chapter, which is that it is the FDI sector that is innovative and weakening of its presence weakens regional innovation in Wales. The DTI study also confirms the TSER findings on Wales' prominence as a process innovating region with 18% of enterprises active compared to 15% UK-wide. This is underlined by reference to what is called 'novel innovation' (new to the market) where Welsh SMEs are in first position, 50% above the UK mean. Here large enterprises score below the UK mean. For novel product innovations Welsh SMEs again score higher than average and large firms in Wales score third highest (24% of enterprises producing novel product innovations against an 18% UK mean). Moreover, the mean percentage of turnover from novel products places Welsh SMEs second only to London although for large firms this variable scores well below average. This is where Wales' productivity problem re-appears. Finally, regarding networking and interactive innovation

Wales scored above the UK mean of 28% of firms reporting institutional information exchange as being of value to innovation, but at 295 only marginally and less than four other regions.

This rather rosier picture of innovation performance in Wales suggests three things of importance. The first is the propulsive effect on the supply chain of exacting customers such as those in the FDI sector, the presence of which looks to be waning. Second, and somewhat unusually, two separate surveys have shown Welsh firms to be pronounced process innovators compared to other regional firms in the UK and selected European regions. SMEs are prominent in this, which may again reflect the impact of demanding exogenous customers. Finally, we see that the ten-year and more history of institutional regional innovation system (IRIS) building receives an echo in the marginally higher than average networking propensity of Welsh enterprises, but in truth at one percentage point above the mean and on a fairly weak indicator, this tells us relatively little about all the system building effort that has gone on save that it has hardly constituted a systemic 'quantum leap'.

Finally, we can take a brief look at the results of Michael Porter's reflections upon the Welsh innovation condition (Porter, 2002). Porter shows, first that Welsh economic performance is below the regression line that associates per capita income and annual growth in employment 1996-2000. He also shows Welsh productivity levels to be in the weak quadrant (along with all but London and the South East) on gross value added related to productivity change over the same period. However it is closer to the national averages on both than most UK regions. This can be interpreted as another effect of the FDI sector that raises productivity somewhat more than the domestic sector though not massively, but enough to have given a boost to the Welsh statistic. In the past, EU data have shown GDP per worker high in Wales but all statistical sources show GDP per person low, a reflection of low male and female economic activity rates deriving from past generations of deindustrialisation. Porter places overall (not just BERD) R&D activity below average but higher than three other UK regions. He also shows manufacturing 1990-2000 to have been, along with healthcare, Wales' higher than average large employment location quotient sectors. Finally, and interestingly he shows Cardiff University (with 7) to be Wales' third highest US patent holder, behind Dow Corning and local biomedical devices firm Gyrus Medical Ltd. Cardiff University is also shown to be thirteenth among UK universities on

the same indicator. But the leader, Imperial College, London has only 36 compared to the US leader, the University of California with 1,585. Porter's action agenda for Wales is to improve the Welsh business environment, develop clusters, develop subregional strategies, and create an integrated vision and organisational structure to deliver it. Porter's view on the aforementioned Welsh Assembly Government economic development strategies (Porter, 2002) was that they were a 'wish list' with no obvious mechanisms for delivering success. It was once said by a Welsh shepherd that he guessed the profession 'management consultant' accurately when one of them asked whether, if he guessed the number of his sheep correctly could he have one? Agreeing to the challenge, the shepherd
asked in return if he could have it back if he guessed the challenger's profession. Using global satellite positioning connected to his laptop the man got the number right, chose his animal then waited. 'How did you guess I was a management consultant?' the astonished consultant asked. 'Because you cost a fortune, you tell me what I already know, and you know nothing about my business. Now give me my dog back'.

## DEVOLVED WALES AND ITS KEY INNOVATION INSTRUMENTS

We have observed many of the key and evolving difficulties faced by the Welsh economy and its faltering regional innovation system. In the following, four of the key policy mechanisms for re-tracking the Welsh innovation system are examined to give a flavour of the often noble aspirations embodied as inputs to their supporting policies and the unyielding nature of brute reality when it comes to making judgements on effectiveness measured in terms of outputs. The first example is the large, £1.2 billion EU Objective 1 funding for 2000-2006 in the older industrial and western seaboard belts known officially as West Wales and the Valleys. Not all of this funding is available for innovation; under EU rules measures to promote community enterprise and regeneration, training and general assistance to SMEs are covered as well. Nevertheless, some funding is earmarked for innovation support. One sphere in which such funding is used is meeting the Welsh Development Agency's strategy of constructing twenty business incubators or Techniums, many in the Objective 1 area.

From the outset, as in many earlier recipients of Objective 1 aid in southern Europe, there was a problem of absorptive capacity by the institutional set-up in Wales. Initially an office in the Assembly was created for an Objective 1 'tsar' and the body responsible for managing

the previous Objective 2 programme, the Welsh European Funding Organisation (WEFO) was given responsibility for disbursing project funding. The process of drawing up the priorities on which the money was to be spent had been complex and not entirely successful. Participation by representatives of local government, business and the voluntary sector had led to deadlock with the voluntary sector complaining of being out-manoeuvred by the other parties. Accordingly the new First Minister dismantled the administrative machinery set up by his predecessor and handed the task to the civil service. Time was short as the final submission deadline to Brussels was looming, so they simply allocated the funding in the same proportions as it had been divided in the old Objective 2 programmes. Some of the resulting imbalances were raised in the UK Parliament's Select Committee on Welsh Affairs investigation into The Structural Funds in Wales, and from the evidence given by the First Minister the above account of administrative expedience emerged (Welsh Affairs Committee, 2000).

An extremely complex system of interlocking committees was set up responsible for each programme area, involving Assembly and other government, business, voluntary and academic representatives and experts who were recruited to fill these committees, whose main task was to judge whether grant applications for funding should be approved. At the end of the first year of this process an unofficial estimate of 1,700 was made, by a former European Union senior official who had returned to advise the Assembly on this financial absorption and allocation nightmare, of the number of people that had been recruited to manage the approval system and support it administratively. Such were the complaints from, particularly, the business community at the glacial progress of implementation of the Objective 1 programme that reforms were instituted, consisting of the insertion of a new layer of committees given a 'troubleshooting' function to break the administrative logjams that kept recurring.

Thereafter it was assumed that project funding was being allocated, projects were being implemented, monitored and evaluated with job targets being achieved. Announcements to the effect that, for example, £82 million had been allocated for Techniums and other, community and training measures in Swansea or £60 million allocated to hard-hit former manufacturing communities in West Wales appear regularly on the Assembly website (www.wales.gov.uk). However, in 2003 the Economic Development Minister was asked by the all-party Economic Development Committee for a progress report on the Objective 1

programme and the Director of WEFO obliged, the resulting report being lodged in the public domain in the Assembly Library (WEFO, 2003). Astonishingly, this official report revealed that only £74 million in EU grants and match funding had been paid out and, even more surprisingly, only 44 of a projected 26,000 jobs had been created, with a further 14 being safeguarded. Opposition politicians quickly took the Labour Minister to task on value for money grounds, pointing out that each job appeared to have cost £1.74 million to create. Later, the Minister blamed a computer for the misinformation and claimed the actual number was 'over 6,000' but offered no supporting evidence (Shipton, 2003).

Thus far, it is evident that the absorptive capacity problem has not been satisfactorily dealt with and there are fears that Brussels will have to be repaid a substantial tranche of the funding allocated. Briefly, we can see how three innovation support policies have been affected by governance problems of a different kind arising from an increasingly centralised mode of animating the regional innovation system. *A Winning Wales* the WAG economic strategy document condemned by Michael Porter as a 'wish list', refers to the importance of innovation on its first page. Even its widely criticised predecessor, the *National Economic Development Strategy* was associated with setting up 'Finance Wales' the public-private venture fund for innovation, the 'Knowledge Exploitation Fund' for academic knowledge exploitation although the Technium idea is more recent. In 2003 a *Wales for Innovation* plan was launched and quickly shown to be largely another 're-packaging'.

Beginning with a preliminary 'sense making' account of Techniums, it is worth recalling that twenty of these are planned, some already being in operation in early 2003. In line with UK government policy on building a knowledge-based economy, which supports building incubators as 'seed crystals' for clusters, Techniums aim to offer hosting facilities for university start-ups and other high technology businesses, including those from abroad. Thus far, the first, on the Swansea waterfront has found tenants and a second one is in the planning stage. But *Agilent*, a small American software business that was one of the first, widely trumpeted, arrivals closed at the end of 2002 and other tenant firms were moved to the Technium from a 1980s Innovation Centre on the campus of Swansea University required for academic expansion. Other Techniums in planning or construction stages will have sectoral focus, like the Bio-Technium at Wales' National Botanic Gardens, and media Techniums in Cardiff and west Wales. A possible set of design flaws in the policy include, first an inclination to replicate old incubation approaches that failed to prioritise

management assistance, including allocating part-time space to such services as venture capital, legal advice and management accountancy. Second, true to WDA traditions they are properties leasing space, now for SMEs previously for FDI businesses, thus they are not in themselves innovative. Finally, they assume 400 or more incubator spaces can be filled. A study of this question calculated that, from academia in Wales, where there are less than one thousand tenured scientists and engineers, some 20 to 30 spinouts could be anticipated during the lifetimes of those academics if international rates of academic entrepreneurship prevailed (Jones-Evans, 2002). Clearly, a major 'recruitment' effort is required for aspirations to have any chance of being fulfilled, and this at present is not evident as policy or practice.

The Knowledge Exploitation Fund (KEF) has aspirations that fit the Technium idea in principle, but in practice will make very little impact upon filling the Technium incubators. This is because, like many policies it was designed by and for the public sector. So, to exploit academic knowledge KEF funds Further Education (Community) colleges and Higher Education Institutions to offer training to firms on the advantages of such activities as business networking. This networking approach also applies to higher education itself, as a £1.1 million grant to partners Cardiff University, the University of Wales Medical School and Techniquest, a science museum, to establish a Gene Park testifies. This admirable initiative involves, as a first stage, setting up a virtual Gene Park between the Life Sciences departments of the main universities. Hence much of the funding is earmarked for high speed data transmission cabling and technology. This is one of the more significant research infrastructure investments KEF will have made. However firms approaching KEF for support are informed that the KEF remit is to support public knowledge exploitation as a priority, leaving SMEs frustrated and wondering how this Training Agency funded initiative, supposedly spending between £24 million and £28 million per year can actually help them in other than trivial ways.

Finally, Finance Wales was set up in 2000 to fill the perceived funding gap for innovative businesses seeking investment of a scale beyond that normally met by seed corn funding or business angel networks (in Wales the angel fund Xenox is also managed by Finance Wales). In addition, upon establishment, small firms loan funds were created to assist non-high technology businesses and community enterprises. Although targets were set for the number of firms officially to be assisted with venture capital from the Wales Innovation

Fund (resourced by the EU Objective 1 funding, the WDA and NatWest Bank), interview results from a research project on innovative financing of economic development reveal that an average of only three investments per year have been forthcoming (Cooke & Clifton, 2003). On the other hand the Small Firms Loan Fund has been oversubscribed. A restructuring of the many initial funds into fewer, larger funds has worsened the position in three ways. First, because of some failed investments an Internal Rate of Return double that required by the venture capital industry has been set, thus further discouraging approaches due to more stringent conditions being applied to applicants. Second, administrative expediency by WAG has diverted non-venture capital financial problems Assembly civil servants are incapable of managing into Finance Wales. Key staff are thus diverted from building up a customer base by firefighting on activities the institution was not designed to fulfil.

Thus, because core demand for both equity investment and economic development grants has been slow, especially during the post dot.com stock market 'meltdown', administrators fearful of questions being asked of low performance and concerned not to make future risky investments, have set up rules that require a venture capital seeking firm to first win a Regional Selective Assistance grant for half the sum being sought. The rationale is that the regional aids division does the due diligence on the equity request and the linkage results in 'two hits for the price of one' for the administrators. This flies in the face of modern public investment theory, which is to wean SMEs away from grant-dependence towards a mixed equity and loan package thus encouraging better entepreneurship. In Northern Ireland and Scotland steps have been taken to reduce grant dependence among SMEs but in Wales the opposite is the case. Thus, to conclude this attempt at 'sense making' regarding the Welsh Assembly Government's attempts to grapple with retracking the Welsh regional innovation system, it is clear that the 'public enterprise' approach, popular elsewhere in the 1970s, that is being taken has good intentions but is failing dismally to foster entrepreneurship and innovation. This is because of risk aversity and an unwillingness to loosen an over-centralised grip on control of budgets and the design of enterprise and innovation support instruments for public more than private benefit.

## CONCLUSIONS

This chapter has sought to achieve three objectives, the first of which is to reprise after a decade the evolution of a particular type of state-animated and multinational capital facilitated regional innovation system that could clearly be seen emerging when foreign investment was flooding into Wales, supply chain integration was being effected and innovative cluster interactions were being formed as global firms embedded themselves in a receptive regional economy equipped with appropriate skills and public subsidies. The second has been to investigate recent economic change, which as was shown has been dramatic, heralding the ending of the inward investment boom, the establishment of a devolved, democratic regional administration, its new focus on innovation and entrepreneurship and power to generate jobs in public administration. As we have seen, only the last-named power to invest in employment in public services can be nominated a success currently. This raises problems for innovation theory and practice, since it is unclear but an open question as to whether the public sector can be a 'pacer' in this particular vein, as suggested by Gregersen (1992). The third aim was to examine some key innovation-driving initiatives that have been designed and implemented in Wales since devolution as a 'sense making' exercise (Weick, 1995; Nooteboom, 2001) as to why initiatives taken to foster innovation and entrepreneurship, given the turning away from inward investment, should have proved so recalcitrant and intractable to policy leverage.

Regarding the first aim, the research showed that much had changed since the early 1990s when the previous edition was being researched. In Wales, which was the UK's only growing manufacturing region in employment terms, manufacturing job loss rose sharply after 1998. The reasons for this are complex but affected larger firms mostly, many of which were FDI businesses. Some were relocating to Central & Eastern Europe or North Africa where, in the former case, entry to the EU at substantially lower labour costs was the incentive. In the latter case even lower wage costs attracted, for example, clothing suppliers to UK retailer Marks & Spencer, itself squeezed by intense competition in its home market, leading it also to vacate export markets. Process innovation had been pronounced in M&S supplier firms like Dewhirst, contributor of over 1,000 job losses, as the wholesale transhipment of advanced technology and workforce trainers to Morocco testified. The UK's overvalued currency vis à vis Euroland also gave pause to manufacturers, notably those from east Asia, that had been located in Wales for, in some cases, more than a quarter of a century to re-invest in plant and equipment in new locations. Thus supply chains have become more extended and innovation interactions through the value chain weakened as the

WDA, responsible for animating countless support initiatives in the past, turned away from FDI to concentrate on the stimulation of endogenous growth.

This has proven to be a hard nut to crack. Assessments of performance regarding initiatives such as the Entrepreneurship Action Plan, Knowledge Exploitation Fund and Finance Wales are seldom published but research currently being conducted (Cooke & Clifton, 2003) indicates that the Entrepreneurship Action Plan has only impacted a third of its target businesses since establishment (1,800 SMES out of a target of 4,600) , a report on KEF shows that despite budgets of well over £20 million per year being spent only 5% more entrepreneurship modules were being taught in universities and other higher education institutes, although 25% more were taught in further education colleges. But 75% of the latter had no or few mechanisms for technology transfer, while the statistic for universities was 25%. It can be concluded that there is a significant disconnect in this particular part of the entrepreneurship-driven renewal of the regional innovation system in Wales (Steele & Levie, 2001). The earlier analysis of Finance Wales, a vehicle designed to supply venture capital to innovative SMEs and start-up businesses because of a perceived market failure in private provision, showed that such disconnects register in the far lower than targeted number of businesses coming forward in quest of equity investment. Accordingly, public venture capitalists are redeployed on to firefighting problems with co-funding grant packages for, *inter alia*, a holiday village development in the Objective 1 area. Further administrative expediency and risk aversion has the effect of slowing down and making more difficult acquiring equity investment while encouraging SMEs to become more grant-dependent than many wish to be.

Thus we come to a success story in terms of job-generation which is the 67,000 new jobs created from the Welsh Assembly Government's own block grant financial resources transferred from London. The breakdown between health, education and public administration between June 1999 and June 2002 was 22,000, 18, 000 and 3,000 (Cooke, De Laurentis & Wilson, 1993). Both health and education contribute to innovation, the first in patient treatment, and the second in producing talent. But, as services, they are frequently seen as parasitic on the real economy. Universities perform a valuable export function for the Welsh economy because, of the roughly 15,000 graduates produced each year by the thirteen higher education institutions, half are from outside Wales. Each is worth, notionally, £15,000 per year to the economy or, together, £112.5 million, which over a typical 3-year

degree course is an ‘export’ value of £337.5 million. If to that are added the Welsh students, the figure doubles to £675 million, and adding in the salaries of employees, the sum is over £1 billion, though the ‘export’ value remains at a third of that (Coombes, Davies, Page & Wilson, 2002).

As we have seen the Welsh healthcare budget is £3.4 billion and healthcare has even greater innovation systems potential because of the central role of Life Sciences, pharmaceuticals and biotechnology in scientific and technical support of it. Mention was made above of the winning by a Cardiff-based academic consortium of £4 million from the UK government and Welsh Assembly Government (through KEF) to build a Gene Park. This is virtual to begin with, then after two-to-three years a real Gene Park will be built in Cardiff’s waterfront district. This connects to ambitious plans being realised in 2003 to merge the hitherto separate Cardiff University and University of Wales Medical School, creating two colleges within the new institution, one for Life & Medical Sciences, the other for Science, Engineering, Arts & Humanities. In support of the Biosciences capability that underpins the merger, Cardiff University invested substantially in attracting the ‘star’ scientist in stem cell research, Lasker Prize-winning Welshman Martin Evans and his research team from Cambridge University. A new Biosciences Centre has been built to house the expanded Molecular and Medical Biology department, now renamed School of Biosciences. An existing Medipark in the medical school houses some thirty biotechnology start-up businesses and these will move as they grow on to the Gene Park. In other words there is the seed crystal of a possible biosciences cluster for which the healthcare demand and the education and research supply are crucial components. Government support in and beyond Wales assisted all features in this development, but mainly through research and infrastructure funding. Augmentation of the pharmaceuticals sector is needed, given that Amersham-Pharmacia and Bayer are the principal global representatives of the sector currently in Wales since Parke-Davis and Warner Lambert joined the manufacturing exodus. This is a task in which the WDA ought to be the key source of expertise. But in the absence of a ‘knowledge economy’ strategy comparable to that operating in Scotland, as described in the introduction, such a possibility remains unrealised.

Thus, in conclusion, the title of this chapter inquires of the regional innovation system in Wales whether the economic shifts of the past decade have resulted in its evolution or its eclipse. The account given leans eventually to the judgement that the old FDI-dependent

systems interaction among the engineering Triple Helix (Etkowitz & Leydesdorff, 1997) has effectively been eclipsed, that the efforts of the WAG to develop a new one focused upon generic entrepreneurship and innovation has so far failed to achieve its objectives, but that a new type of public sector interaction involving healthcare and higher education offers a possibility of evolution into an innovative, university led type of innovation system designed to fit the demands of the new 'knowledge economy'.

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