

Linking Innovative Potential to SME Performance: An Assessment of Enterprises in Industrial South Wales.

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Abstract

This paper examines the link between innovative activity, outcomes and the performance of SMEs in Wales. A range of European, UK and locally developed initiatives in Wales seek to encourage innovative activity in indigenous SMEs. However, it is the contention of this paper that these initiatives have often been instituted without a clear appreciation of how, if, and which innovative activities feed through to improved business performance. The paper offers a general method of assessing the innovative potential (the configuration of management practices, capabilities, internal and external linkages facilitating the generation of appropriation of ideas) of manufacturing SMEs. This then leads on to an examination of how far innovative potential is connected to operational and general business performance. The paper describes how the model was developed and used to assess the innovative potential of a sample of manufacturing SMEs in Industrial South Wales, and how far the innovative potential can be linked to improved operational and business performance using data from two case study firms.

1. Introduction

The attraction of manufacturing investment from overseas was the main focus of regional development policy in Wales for much of the 1970s and 1980s. Whilst Wales has been particularly successful in attracting foreign enterprise, the contribution of new investors to improving longer term regional economic prospects has been questioned at several levels. With concerns over inward investor stability, embeddedness, and contribution to local value added, increasing weight has been given to the encouragement, and development of innovative indigenous small and medium sized enterprises (SMEs) in the Welsh economy (see Munday, 2000).

General and sectorally targeted initiatives to encourage SME development and innovation in Wales have also taken place against a background of historically low levels of new firm formation¹ in the region (Keeble and Walker, 1995), together with the presence of factors expected to hinder enterprise and SME growth including low levels of capital availability, high levels of external control, and a poorly diversified industry and occupational structure. A recent consultation document produced by the National Assembly for Wales notes that there are a comparatively low number of businesses per capita in Wales, and an over dependence on declining and low value adding industries (see NEDS, 2001). Ultimately, it is hoped that a strongly performing indigenously controlled SME sector will go some way to improving regional growth prospects, and hence play a role in reducing the persistent GDP per capita gap between Wales and the UK.

During the 1990s a series of research and consultancy studies in Wales have been undertaken seeking to audit SME activities, define needs and identify market failures in provision of information and services (Bryan and Jones, 2000). These have formed the basis of policy, and planning of new resource directions emanating at the European, regional and local levels. A critical component of the 'new' agenda for regional SMEs has been attempts to improve their innovative capacity. In part this follows from the development of the Wales Regional Technology Plan (see Thomas, 1997), which designed a strategy to improve the innovative and technological capacity of the region, its firms and institutions. The Regional Technology Plan has served to inform other policy initiatives led by the Welsh Development Agency and its partners. It has also informed Priorities within the European funding framework. For example, the Objective 2 Industrial South Wales programme Priority 2 '*Increasing Innovative Capacity for SMEs*' included measures to assist the transfer and utilisation of technology, and human resource development for innovation (see European Structural Fund Programme, 1996). Similarly, innovation is prioritised under the West Wales and the Valleys Objective 1 programme 2000-2006. Priority 2 '*Developing Innovation and the Knowledge Based Economy*' includes the following objectives:

- creating a culture of innovation,
- diversifying the economic base by growing more technology and knowledge driven firms, and improving their links to the knowledge base,
- increasing investment and R&D, and
- developing more higher level skills to support innovation and R&D.

¹ Wales has the lowest level of new VAT registrations as a proportion of the business stock in the UK.

Underlying the encouragement of innovation within such programmes is the broader aim of improving the productivity and competitiveness of the Welsh economy. However, there is some danger that initiatives encouraging innovative activity in Welsh SMEs are being designed and executed without a clear appreciation of the nature of innovation, and more importantly how innovative activities link to innovative outputs and then feed through to improved business/regional performance. In part these problems are apparent in the monitoring indicators underlying priority measures. Often these are posited in terms of activity indicators such as firms assisted by measures, jobs created and safeguarded, and processes developed (see European Structural Fund Programme, 1996). The nature of these indicators makes it difficult to tie 'innovation activity' to regional competitiveness improvements.

This paper offers a general method of assessing the innovative or change potential (the configuration of management practices, capabilities, internal and external linkages facilitating the generation of appropriation of ideas) of manufacturing SMEs. The approach builds on recent research into innovative structures in multinational firms (the learning factory approach, Leonard-Barton, 1992; Cooke and Morgan, 1998; Delbridge *et al*, 1998). The significance of these perspectives is the assumption that "innovation" is key to sustaining economic competitiveness and is directly connected to the firm's operational and business performance. The current research project sets out to assess the expected connection between innovation and firm performance in Industrial South Wales.

Understanding these connections and the linkages between different types of innovative input and outputs, and then business performance is an important component of policy design. Where these linkages are poorly understood scarce policy resources may be inappropriately targeted. The paper outlines a programme of research assessing the innovative potential of a sample of manufacturing SMEs in Industrial South Wales, and begins to explain how far different innovative inputs and innovation outputs can be linked to improved operational and business performance in practice.

The second section of the paper outlines some issues concerning research on innovation in SMEs and demonstrates the extent to which studies succeed in measuring and then linking the innovative inputs of SMEs to innovative outputs and firm performance. The third section builds upon this review and examines how far organisational innovation perspectives from large firms can be used to understand processes occurring in SMEs. Drawing upon the review in sections 2 and 3, innovation is considered as practice not just new product development or developments in manufacturing processes. The fourth section outlines a model of innovative firms as those that identify, interpret, and apply knowledge effectively, and as appropriate throughout the organisation. This model represents a synthesis of existing research and considers strategy and the techniques and practices deployed to facilitate the development and appropriation of ideas for innovation. Broadly this focuses on SME commitment to innovation, and the management practices supporting this commitment. The fifth section describes how the model was developed into an SME auditing tool, and then used to assess the innovative potential of a sample of manufacturing SMEs in Industrial South Wales. Although the research programme is still in progress the fifth section goes on to review the progress of the research, and provides some preliminary findings and cases. The final section concludes.

2. Innovation and the Link with Performance in SMEs

Hoffman *et al* (1998) provide the most recent and comprehensive survey of the SME-R&D-innovation literature. Their review demonstrates that there are very few studies that adequately deal with the notion of innovation, or assess the link (if any) between innovative activity and firm performance. Although these issues represent considerable conceptual and empirical difficulties this paper reports on progress towards a better understanding of both.

Innovation has meant different things to different scholars though opinions are now gradually forming to the view that innovation involves “the development and implementation of new ideas by people whom over time engage in transactions with others within an institutional order” (Van de Ven *et al*, 1989: 590). This definition reflects a growing interest in the process through which “new ideas, objects and practices are created and developed or reinvented” (Slappendel, 1996:108). In this respect Clark and Staunton (1989) identify two broad classes of innovation:

- *Radical-altering* innovations re-shaping the organisational configuration through the introduction of markedly different equipment, raw materials, forms of knowledge and physical contexts. In consequence existing competencies become redundant requiring *exnovation* as established directions are reversed.
- *Incremental-entrenching* innovations build on existing directions so that equipment is modified and knowledge is extended/reinforced.

Innovations may require significant investments in skills and competencies that involve the co-joining of individuals within and without the organisation. In this sense, successful change relies on ‘the degree of uncertainty embodied and embedded within an innovation and the extent to which users already possess levels of knowledge and skill which enable them to systematically encode the uncertainty and to devise means for handling its level’ (Clark, 1987:51). This is unpredictable because innovations are sets of ideas with technological and organisational dimensions that are embedded in distinct socio-cultural settings that may impact existing hierarchies potentially generating organisational friction (Clark, 1987). Despite the risk of conflict it is reasonable to assume that if innovation is seen as a key activity then structures or organisational routines will be required to facilitate the translation of ideas into reality. The behavioural traits of innovative SMEs have been readily identified. Hill and Neely (2000) offer some clues as to the factors shaping the innovative capacity of UK SMEs:

- *Culture* or the extent to which the firm supports innovation,
- *Resources* including its financial, intellectual, human and physical capital,
- *Competence* meaning the range of capabilities within a firm that supports innovation, and finally
- *Networking* or the extent to which a firm makes use of network ties for innovation.

In turn, Rothwell (1989, 1991) provides a more detailed appraisal of the organisational factors shaping innovative SMEs:

- Suitably qualified in-house engineers and scientists (especially if the type of innovative activity is technically orientated),
- Complementarity between in-house and outside knowledge gathering,
- An established technology strategy to organise the accumulation process.

Rothwell's work in particular indicates that innovative potential relies on a specific configuration of competencies, individuals and processes within the organisational context. SMEs exhibit behavioural features that give them an innovative advantage over larger firms, for example, SMEs are thought to be more able to respond rapidly to external threats or opportunities, they have more efficient internal communications, and exhibit interactive management styles. Conversely, SMEs are thought to lack the material and technological resources that enable large firms to 'spread risk over a portfolio of new products' and fund 'longer-term R&D' (Rothwell 1992, 1994). Thus, it is perhaps unsurprising that 'innovatory advantage is unequivocally associated with neither large or small firms' (Rothwell, 1989:62).

As indicated by Hoffman *et al* (1989) the vast majority of studies considering innovation in SMEs fail to link these practices with performance (e.g., output, exports, employment, market share etc). In the absence of studies assessing innovation and firm performance it is useful to consider, for the purpose of developing an adequate methodology, the relationship between competence and growth. Chaston and Mangles (1997) argue in their study of core capabilities as predictors of growth potential in small manufacturers that growth is linked to organisational capability (i.e., goal specification, positioning strategy, planning infrastructure, resource evaluation) and the revenue performance of the firm. It is assumed that the 'key characteristics exhibited by growth firms are a reflection of the internal capabilities of the organisation' (Chaston and Mangles, 1997:48). Hence, an analysis of current capabilities can be used to define specific activities for enhancing future performance. Cagliano and Spina (2000) demonstrate using a practice-performance link model how the competitiveness of SMEs in the Italian Emilia Romagna region depends on a degree of formalisation of manufacturing practices. They attempt to assess the extent that manufacturing and design practices are linked (directly/indirectly) to business performance. What is of particular interest is their attempt to translate models and concepts developed around large companies and apply them within the context of SMEs. Cagliano and Spina (2000) define external operational performance in terms that include delivery reliability or speed to market while internal operational performance include internal defects or product development cycle time. Manufacturing practices are defined broadly (using 18 variables) as inventory systems, manufacturing strategy, quality measures, customer and supplier relations, training and education, innovation and creativity and employee involvement. Chaston and Mangles (1997:49) also indicate the significance of operational management issues for growth. They include (i) effective new product management, (ii) an appropriate structure for motivating employees, providing job satisfaction and effective personal development, (iii) provision of satisfactory product/service quality, (iv) adequate employee productivity supported by investment in technology to aid continuous improvement, and (v) information flows to permit problem resolution and decision making. In both,

innovation is inextricably linked to organisational design and growth. However, as Cagliano and Spina (2000) point out most of the work considering the link between practice and performance has been conducted in large companies. In this respect, we are also interested in making sense of those linkages most commonly associated with large firm manufacturing.

3. Innovation and the Learning Factory: Large Firm Perspectives

It has become conventional wisdom that a firm's competitive edge no longer rests solely with static price competition instead it increasingly relies on a firm's ability 'to create knowledge a little faster than their competitors' (Maskell and Malmberg, 1995:3). Although innovation is a central concern for those researching SMEs (Cooke, 1996) it is in the multinational firm manufacturing sector that evidence of 'emergent tendencies' is most apparent (Cooke and Morgan, 1998). Cooke and Morgan (1988) suggest leading firms have embarked upon a process of 'experimentation' that involves a 'semi-permanent process of organisational innovation' whose common thread is 'the attempt to create a more collaborative corporate culture, both within the firm and between the firm and its principle suppliers'. These tendencies reflect the gradual but significant transformation of the operations of large manufacturers away from those broadly based on the principles of 'scientific management'. Not only are firms increasingly operating with low levels of inventory 'dedicated to total quality and to active participation in new product development' (Leonard-Barton, 1992), they are now changing the traditional division of labour and integrating shopfloor workers in the renewal and support of existing competencies. The trends leading to these shifts have been summarised by Kenney and Florida (1993) and include:

- (i) Transition from physical skill and manual labour to intellectual capabilities or 'mental labour',
- (ii) Increasing importance of social or collective intelligence as opposed to individual knowledge or skill,
- (iii) Acceleration of the pace of technological innovation,
- (iv) Increasing importance of continuous process improvement on the factory floor,
- (v) Blurring the lines between the R&D laboratory and the plant.

The advocates of lean manufacturing purport an important shift in perspective with the factory floor increasingly seen as a place where knowledge can be created as well as applied, where production workers think as well as do (Womack, *et al*, 1990). These developments are mirrored and encapsulated in the "learning factory model" (Delbridge *et al*, 1998:227):

- (i) Innovation is the central motif of the learning factory. The learning factory generates, codifies and applies knowledge to improve its various products, structures and processes
- (ii) Learning factories are host to continuous improvement activities that are driven by internal sources of information such as tacit knowledge of shop-floor workers, the contextual knowledge of technicians, and the formal knowledge of professionals and craft workers
- (iii) The learning factory also benefits from improvement derived from external sources of information, such as problem-solving suppliers and the supplier development programmes of customers

- (iv) The learning factory is embedded in an innovation network of collaborators with whom there is information exchange and shared learning.

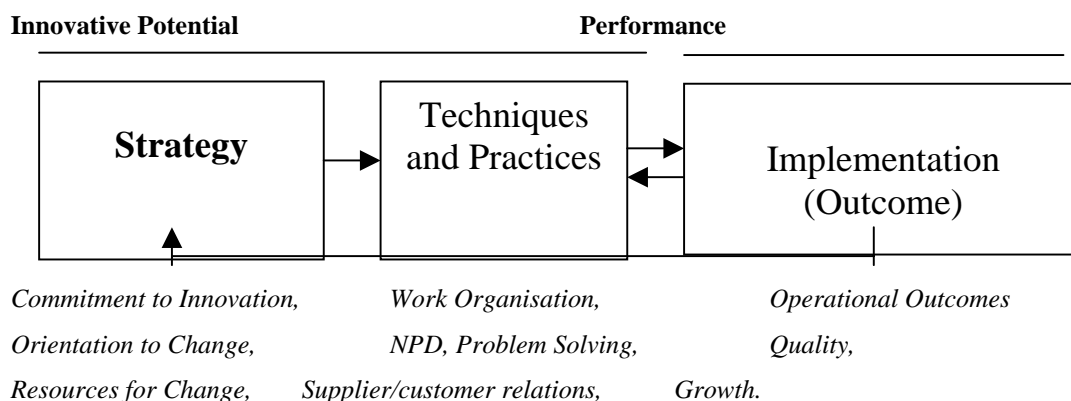
Recent evidence suggests the gradual move toward the learning factory model in large automotive components manufacturers (Delbridge and Barton, 2000). The nature of these manifestations have been shown to vary according to the *degree of specialisation* (relating to the use of specialists or specialist groups in the organisation of problem-solving and continuous improvement activities), the *breadth of participation* (relating to the level of shopfloor inclusion in such activities), the *degree of centralisation* (relating to the role of management in such activities), and finally, the *level of standardisation* or the routines and procedures governing group problem solving.

Despite these trends and observations even the most influential of studies such as the work by Womack *et al* (1990) have been criticised over their analysis of the relationship between lean activities and business performance (see Williams *et al*, 1994). Concerns about studies of innovation in SMEs are substantively different because of the lack of comparable studies. Despite the policy statements affirming the role of SMEs in contributing to economic growth and job creation little is still known of the nature of the link between innovation and performance (Hoffman *et al*, 1998).

4. The Innovative SME: towards a model of innovative potential

In this section we outline a working model of innovative SMEs. Innovation as defined as practice means it not only reflects the introduction of new products or manufacturing processes it also represents the process through which ideas are translated into reality. An innovative firm is one that “*identifies, interprets and applies knowledge (embodied and disembodied) effectively and as appropriate throughout the organisation*”. Hence, innovative potential refers to the skills, competencies and structures that enable “translation” (Figure 1).

Figure 1 – The Innovative SME: A Working Model

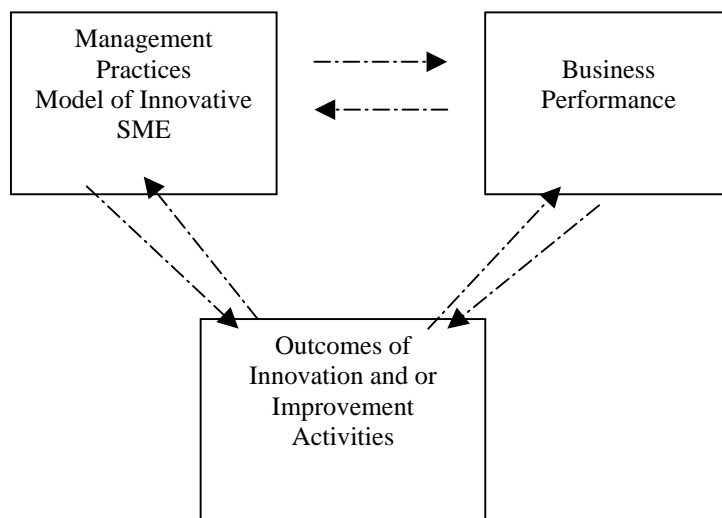


The approach being adopted in this study is to try to identify patterns across a sample of SMEs (profiling exercise) and then focus on particular sets of practices or areas of firm behaviour (case studies) that provide

greater insight about innovation in SMEs. Combining descriptive and analytical methods is mutually beneficial; descriptive surveys provide the empirical outliners or key (inputs and outputs) while analytical methods provide a detailed explication of these factors and trends (Brusoni *et al*, 1998). These are considered in terms of “innovative potential” and relate to organisational practices and operational and business performance measures. For the purpose of modelling these practices the profiling survey is split into ten sections: (i) Firm Characteristics, (ii) Firm Performance, (iii) Manufacturing Performance, (iv) Firm Strategy, (v) Management of Innovation, (vi) Business Information, Communications, Marketing and Accounting, (vii) Human Resource Management, (viii) Worker Responsibility and Organisation, (ix) Supplier Relations; and (x) Customer Relations.

The key conclusion of Hoffman *et al* (1998) is their call for research examining the impact of innovative activity on firm performance. However, in calling for such research the authors fail to suggest which input/output indicators are most suitable. Sources like the Science Policy Research Unit innovation database suggest that innovation involves the introduction of a new product or process (Pavitt *et al*, 1987; Tether *et al*, 1997). In terms of outputs, Smith *et al* (1993) define the performance of innovative small firms according to ‘closure after innovation’ (long-term survival), ‘employment change’ over time, ‘total asset growth’ where assets are taken to reflect not only investment but also the *wealth of the firm*, and ‘return on total assets’, the percentage of operating profit to total assets.

Figure 2: Analytical Links



A key element of the working model is the identification of operational and business performance measures. Not only is operational performance looked at in relation to specific techniques and practice it is also considered in terms of manufacturing metrics. Firm performance is considered in a similar way to try and gain a sense of improvement in relation to these existing or newly introduced techniques and practices (see section 5). Our aim is to establish a practice-performance link model similar to that developed by Cagliano and Spina (2000). Figure 2 infers our aim which is to identify links between operational and business performance and organisational design. However, as Cagliano and Spina (2000) indicate, manufacturing and design practices may only be

indirectly linked to business performance whereas they are likely to be directly consequential for internal operational performance.

5. Auditing Innovative Practices and SME Performance: The Industrial South Wales Case.

The profiling exercise involves the assessment of a broad range of activities. Innovation is not measured simply in terms of new products and processes (although this is asked) rather the exercise also assesses potential (inputs). The link between activities and performance reflects some key assumptions, namely that manufacturing practices such as continuous improvement and problem solving would most likely be accompanied by tangible improvements in manufacturing efficiency and quality. This exercise also allows us to develop some sensitivity because we consider the nature of these activities (formalisation, centralisation and resourcing). It will also be possible via case research (not yet initiated) to investigate discrepancies between activities and performance. Innovative potential is not only measured in terms of the presence or absence of certain practices and resources it is also appraised in terms of operational and business performance measured over a three year period.

The profiling exercise is based on the working model and represents an audit tool for regional manufacturing. As mentioned, the constituent parts are separated into ten sections that cover management practices (sections one, and four to ten) firm performance (section two) and operational performance (section three). Section one, “firm characteristics”, asks for basic details about the firm’s manufacturing activities (primary products and sales revenue) and ownership status. This confirms its eligibility² and provides a basic descriptor for data analysis. Section two on “firm performance” establishes key growth metrics (over the last three years) including employment, turnover, exports, fixed assets and return on capital employed. In an attempt to account for events that are not associated with innovation we also try to establish whether the firm has gone through extraordinary changes during the same period.

Section three on “manufacturing performance” quantifies the key operational metrics (inventory, manufacturing costs, quality, productivity and efficiency) over the same three-year period. As in the previous section the questions are mostly *closed* (yes/no answers) and include scales of change in performance with subsequent *open* questions to elucidate reasons for significant changes in performance (i.e., +/- >10%). Only in the section on “firm strategy” do we concentrate on the attitudes of management toward innovation. Attitudes are based on a response scale to assess the manager’s willingness to take risks (entrepreneurial behaviour) and appraise the business environment. Section five the “management of innovation” examines the organisational properties of innovative potential including continuous improvement, problem solving activities and new product development. Of particular interest is the nature of these activities (formality and participation), how they are resourced (budgets), the value-added accrued in terms of savings and proportion of turnover and when they were introduced. Complementing the collection of hard numerical data we assess the rationale behind the introduction of new and improved products and processes and the barriers that have hampered the firm’s efforts to be innovative in the region.

² This research is funded by the European Union (ERDF) which has stringent criteria about the firm’s that can be included in the audit.

With the pace of technology access to knowledge and resources from sources outside the firm is becoming increasingly important. In section six we establish the extent to which firms are integrated into existing support networks including the funding acquired from UK Government and European sources facilitating innovation. It is now generally accepted that innovative alliances are not solely limited to inter-firm networks but include institutionally heterogeneous actors such as professional groups, government development agencies and academic institutions (Laredo and Mustar, 1996). By mapping intra and inter organisational links (via the internet), it is possible to assess how far the sample SMEs make use of networks of regional ties for innovation (Cooke, 1996).

Firm competence is regularly viewed as a key factor in innovation (Rothwell, 1989; 1991, Hill and Neely, 2000). In section seven, the HRM policies are assessed to glean the level of employee development in terms of training expenditure, and types and length of training on the shopfloor. We also try to establish the competence of employees, labour turnover and absenteeism rate to confirm the stability of the work force. This is important because, with the increasing complexity of technology, competitive advantage is thought to depend on staff working with each other and external sources. Competence development and retention are likely to be a key characteristic of innovative firms. Linked to competence development and retention is operational flexibility and the role of the work force. Worker responsibility and organisation is the theme of section eight. Team working, task rotation and the degree to which these processes are formalised gives an idea of the organisation of manufacturing and the level of complexity. Technological change is measured in relation to the techniques, systems and equipment introduced over the last three years while competence is also measured against the various standards attained over the same period.

In the final two sections we consider supplier and customer relations and in particular the nature of collaborative activity. In both cases we assess whether firms have engaged in planned development activities and if they share the savings from these cost reduction activities. The close co-ordination and tight integration of the supply chain were found to be a key characteristic of world-class manufacturers in the automotive components industry (see Oliver *et al*, 1994). In total, the profiling exercise provides a relatively detailed appraisal of operations and mechanisms. Innovation is assessed not only in terms of new products and processes but also the positioning of management and the systems facilitating organisational change. As with the research into the automotive components industry (Delbridge and Barton, 2000) this study endeavours to identify the behavioural characteristics of high performing manufacturers.

Although the research is still in progress it is possible to comment on the sample and the issues emanating from the fieldwork to date. The study has been running for eighteen months (part of ERDF Objective 2 Industrial South Wales programme) during which 79 small and medium sized manufacturers have been approached of which 26 have so far declined to participate with some 23 in negotiation and the remaining 30 agreeing to be involved (of which 26 have been surveyed by May 2001). The aim is to include 50 or so firms by the summer of 2001. What is of interest about non-participants is their reluctance to allocate time to complete the profile. This was not just a question of available management resource it also reflected the view that there were too many

SME initiatives currently running. Managers felt they were being swamped by help and advice and were uncertain as to the value of the available projects. We feel that our success to date reflects business interest in the issue of measuring the value of innovation. In addition, managers were also enthusiastic that there was research with a South Wales emphasis. The firms are indigenous independently owned SME (employing <250) manufacturers in Industrial South Wales (Objective 2 area) (Table 1).

Table 1– Sample of Manufacturers

Standard Industrial Codes (SIC)	Refused	Negotiating	Accepted
15 – <i>Manufacture of Food Beverages & Drinks</i>	5	0	0
17 – <i>Manufacture of Textiles</i>	1	0	1
18 – <i>Manufacture of clothing</i>	0	1	0
20 – <i>Manufacture of Wood and Wood Products</i>	0	1	0
21 – <i>Manufacture of Pulp, Paper and Paper Products</i>	1	0	2
22 – <i>Publishing, Printing and Reproduction</i>	2	2	1
24 – <i>Chemicals and Chemical Products</i>	2*	0	2
25 – <i>Rubber and Plastics Products</i>	0	3	2
28 – <i>Metal Products</i>	3*	1	4
30 – <i>Manufacture of Office Machinery and Computers</i>	0	1	1
31 – <i>Manufacture of Electrical Machinery and Apparatus</i>	1	0	2
32 – <i>Radio, Television and Communication Equipment and Apparatus</i>	2*	2	1
33 – <i>Instrument Engineering</i>	2	0	0
36 – <i>Furniture, including manufacturing of Accords</i>	1	1	2
Other SIC Code	6*	11	12
Total	26	23	30

*Includes firms gone into liquidation during survey

Not only have face-to-face interviews provided insight about owner managers attitudes to similar research it has had important consequences for the audit tool. In particular, the dialogue generated during data collection has resulted in revisions to the audit tool (*for example*, new questions have been added to try and characterise continuous improvement activities: level of formality) and has led to the collation of useful anecdotal data. This approach has ensured respondents understand the questions and the researchers have understood their answers. In this respect, many respondents have found some questions inappropriate or difficult to answer, for example machine use in production has varied considerably. On the occasion when machine use is minimal it has been practically impossible to specify machine set-up times (i.e., a measure of efficiency) because these are not measured. Some managers have found it very difficult to define and quantify new or improved products because their products are constantly changing (e.g., packaging). The introduction of “new” lines does not represent substantively innovative activities rather they are amendments to generic lines. Such alterations did not require any changes to the production process or the introduction of new skills or expertise. This supports our basic argument that it is not sufficient to simply count new products and infer that these are “innovations”. Not only is quantification an inexact science but innovation is also a complex process. If advances are to be made in our

understanding of innovation in SMEs we need to assess the inputs as well as the outputs of innovation (Hoffman *et al* 1998).

The observations emanating from the returns generated to date provide some initial insight into manufacturing in Industrial South Wales. Perhaps the most significant finding is that 67 per cent of the respondents reported making an increase in profit in the last three years with 29 per cent showing an increase of +50 per cent. Only a small proportion showed a fall in profit (19 per cent) with the rest (14 per cent) showing no change. Although this may reflect the relatively buoyant economy of the past few years it may also represent a bias in our sample with relatively successful companies more willing to become involved in the assessment exercise. Nonetheless, what remains of interest is whether such behaviour can be tied back to innovative activities. Given the research is still ongoing only a very restricted analysis is possible. However, some initial observations based on a limited interrogation of numerical data from two case studies provide useful insights into the various issues with trying to link innovation and performance.

Our main aim is to see whether it is possible to make direct and indirect links between innovative potential and operational and business performance. For our current purposes we limit our discussion of operational performance to the issue of quality. Quality is a useful indicator of manufacturing accuracy and therefore efficiency and cost control. In our study, it is measured in terms of right-first-time rates and customer defect claims. Arguably, sustaining and/or improving manufacturing accuracy depends on management both measuring and continuously re-assessing the product design and their manufacturing processes. It is perhaps surprising then that only 43 per cent of the sample measured right-first-time or customer defect claims. It is even more surprising that a higher proportion of firms not measuring quality (14 per cent) reported an estimated increase in turnover +50 per cent. This compares to 10 per cent of those that measured right-first-time and customer defect claims. Quality is one of many measures used to assess the value of innovative potential in the profile. Hence, it might be expected that a “learning factory” would be actively trying to ensure and measure improvements on a day-to-day, week-by-week basis. It might also be assumed that firms actively taking issue with quality would perform better than those that had not.

6. *The Case Studies: Electrical Assemblies and Music Equipment*

To explore the relationship between practice and performance we present a brief analysis of two firms taken from the sample both high performing SMEs (+50 per cent turnover), but one that measures quality and one that does not. We have called the high performing SME manufacturer that does not measure quality Electrical Assemblies. It was established in 1992 and manufactures cable assemblies and wiring harnesses. The high performing SME measuring quality is called Music Equipment. It makes sub-woofers for home use and was established in 1991. The Managing Partner of Electrical Assemblies put growth down to new customers, increased sales to existing customers and the introduction of new products. In the case of Music Equipment, growth has reflected diversification into new low cost equipment markets and continued growth in existing markets. In this case, exports represented a high proportion of new growth having increased by +50 per cent over the previous three years to represent 62 per cent of turnover. Exports have provided less growth potential for

Electrical Assemblies with the reported increase in export activity (+10-25 per cent) attributed to the re-location of an UK customer in Asia. These two firms offer a useful comparison because they are broadly similar - electrical manufacturers employing 22 and 19 individuals respectively.

Although it is not possible to make general comments about innovative potential across the sample it is useful to consider, using the case study firms, how closely these high performers mirror the innovative model. We should be able to determine whether the lack of manufacturing control is reflected across the organisation. Although this may generate more questions than answers it perhaps provides an indication of the complexities of attributing growth to innovative potential. A summary of the respective factors is given in table 2.

Table 2 – Key factors differentiating Innovative Potential

	Electrical Assemblies	Music Equipment
Firm Strategy	<i>“Follower”</i>	<i>“Leader”</i>
Management Of Innovation	<u>Mgt responsibility</u> <i>NPD – Only</i>	<u>Mgt Responsibility</u> <i>CI Problem solving NPD</i>
Business Information, Communications, Marketing & Accounting	<u>Networking</u> <i>Limited to Professional Networks – some training</i>	<u>Networking</u> <i>Limited to outside expert - NPD</i>
HRM	<u>Training</u> <i>Marginal Activity - <1 day</i>	<u>Training</u> <i>Moderate Activity – 1-5 days</i>
Worker Responsibility & Organisation	<u>Organisation</u> <i>Team based – No problem solving</i>	<u>Organisation</u> <i>Team based – problem solving encouraged</i>
Supplier & Customer Relations	<u>Development Activities</u> <i>None</i>	<u>Development Activities</u> <i>Regular</i>

Firm Strategy: The most significant difference between the two firms is in the way senior management views their positioning toward competitors. Music Equipment see themselves as typically initiating actions to which competitors respond and are often the first firm to introduce new products and processes. In contrast, management at Electrical Assemblies is more likely to respond to than initiate actions with competitors and is very seldom the first firm to introduce new products or processes. In general Music Equipment has a marginally greater emphasis on research and development and is more likely to try and introduce new products and processes. Music Equipment ensures its product range is constantly being updated whereas Electrical Assemblies is more reactive, perhaps due to its sub-contractor status, to the demands of its customers. This suggests it is necessary to understand the relationship between innovation management, organisational design and technology strategy. Music Equipment appears to be a “leader” and may resemble what Jones and Tang (1998) have described as an Analyser (strategic type), first-to-market (technological posture) firm in terms of both process and product innovations. Electrical Assemblies appears to be a “follower” and is perhaps aligned to a cost leader

(strategic type), fast-follower/me-too (technological posture) firm in terms of product innovations (Jones and Tang, 1998).

Management of Innovation: There are some differences in the management practices at these two high performers. In the first instance, only Music Equipment ensures managers have the direct responsibility to conduct continuous improvement (CI), shopfloor problem solving *and* new product development. In the case of CI there is a formal suggestion scheme in operation while 100% of shopfloor operators are involved in problem solving groups. In contrast, although Electrical Assemblies conducts new product development it does not have a manager with direct responsibility for these activities. CI activities are random, as required and unstructured with no suggestion scheme and very little employee participation. Limited employee involvement is also reflected in the problem solving activities where only 10 per cent of production operators directly assist in these activities. So far, the key difference between these two firms is the commitment towards change coupled with the organisational systems that enable the generation and translation of ideas (at least on the shopfloor). It is perhaps unsurprising that in addition to these differences other differentiators include the lack of skilled personnel and lack of information on technology on the part of Electrical Assemblies. In these instances, Electrical Assemblies have found both issues key barriers to change whereas senior managers at Music Equipment found internal skills and expertise instrumental to their leader strategy. Interestingly, the owner of Music Equipment is the archetypal entrepreneur driving the development of new ideas while technical staff within and without the firm translate these ideas into products. Given this, it is important to consider how well embedded each firm is within the regions local support networks (regional development agencies and government).

Business Information, Communications, Marketing and Accounting: Little or no contact has been made with existing professional, supplier or consultant-vendor networks to help with skills or business development or new product development. Electrical Assemblies has made some contact with professional networks to facilitate training and skills development while Music Equipment has called upon outside experts in the design and development of new products. The only support gained over the last three years included Regional Selective Assistance (Electrical Assemblies) and small training grants from the County Council (Music Equipment). In general terms, both of these firms are isolated from the various networks that have been established to facilitate innovative activities and firm growth. As such, apart from the design and development work of Music Equipment Ltd neither firm conforms to the learning factory model. Such discrepancies beg further questions about the quality of the provision available and why such successful firms have not made better use of the resources available.

Human Resource Management: What can be said about skills development is that Electrical Assemblies invests a larger proportion of revenue into training (0.5 per cent of turnover) compared to 0.2 per cent at Music Equipment and it has a training plan. In contrast, Music Equipment spends longer on training 1-5 days on average last year compared to <1 day at Electrical Assemblies. This variation perhaps indicates differences in the complexity of operations in the two firms although it actually takes up to 4-6 weeks for an operator at Electrical Assemblies to be able to work to a satisfactory standard on the normal range of tasks without supervision compared to 1 week at Music Equipment. There seems little between each company in terms of training (both firms have spent in the region of £4-5000 in training course over the last three years) despite Music Equipment

not having a formal training plan. The level of re-training remains relatively marginal in both firms while the level of education on the shopfloor is poor – the vast majority of shopfloor workers have no formal school qualifications. Of the combined 41 employees only one was a graduate.

Worker Responsibility and Organisation: Team based work organisation is present at both firms although Music Equipment is the only one of the two that encouraged team members to work together to solve problems. It seems that management at Music Equipment is more active in attempting to adopt problem solving and learning type work routines as a way to encourage and formally organise the creation and adoption of new ideas on the shopfloor.

Supplier and Customer Relations: It is perhaps because Electrical Assemblies is a sub-contractor that its design and development effort mainly involves work with suppliers and customers. In contrast, Music Equipment usually conducts such activities alone or with the assistance of outside experts but not suppliers or customers. That said, Music Equipment was alone in meeting (10-15 times last year) with suppliers for planned supplier development. At no such time did the same activities occur at Electrical Assemblies. Once again, the distinction between the two is at the level of inter-firm activity. Neither firm shares any gains with customers in cost reductions which further suggests that their supply chains, at least logistically, are not closely integrated.

7. Discussion and Conclusion

Innovative potential has many nuances and may reflect many different competencies and capacities. It should not be restricted to a “traditional” view of the creation of new or improved products a view often emphasised in regional development strategies and European Union single programming documents. Innovative potential should also include actions associated with operational improvements. Our ability to remark on innovation and the practice-performance link depends to a large extent on whether firms measure operational performance. As in this case, we can only provide a limited analysis because it is not possible to comment on the benefit of the use of new ideas on the shopfloor if management does not monitor measures such as quality. Though not supported by specific numerical data it is possible to remark on the gaps in learning processes with reference to other aspects of “innovative potential”.

Electrical Assemblies current organisational design means that management are not well placed to meet the challenge of the pace of technological change a rapidly changing market place or manufacturing problems such as issues of quality. By comparing the two firms in terms of new product development and organisational design it is apparent that Music Equipment is geared towards continuous innovation both in terms of products and processes. For example, during the 1999/00 financial year Music Equipment’s turnover relied totally on new and improved products while Electrical Assemblies wholly relied on unchanged or marginally modified products. Music Equipment was also better positioned to drive organisational changes (if and when required) not only does it monitor and measure for instance, quality (its current defect rate is only 0.002 per cent) it has also systematised these routines including CI and problem solving groups enabling managers to develop an innovative cycle.

Monitoring provides the information to interrogate existing practices. If, as at Electrical Assemblies, these measures are not in place it begs the question of how given the level of current growth, management at Electrical Assemblies will sustain this performance. Maintaining or improving quality while operating at 100 per cent capacity (as reported) relies on the necessary systems and measures to sustain customer satisfaction. In summary we would suggest that in terms of organisational design Music Equipment is better positioned to sustain growth. This reflects what we might term its “innovative potential” or the organisational practices sustaining new product development and broader manufacturing processes and design.

In the case of Electrical Assemblies it is not possible to comment on the link between operational and business performance because there is no way to measure the link. Growth may be linked to improved quality but we are unable to say this with any authority. What we are able to infer is that growth is not necessarily dependent on those factors attributed to “innovative potential”. That said, this does not mean innovation does not lead to growth rather we still have to develop methods to assess the relationship between growth and a long term view of innovation. Developments in our understanding will be aided by the follow-up analytical analysis based on case study research. It may be possible to discern more about the nature of the firm’s operations and market so that further insight and perhaps new hypotheses can be tested.

We would suggest that the current model lends itself to use for cross-regional and cross-sector analysis of firm competencies. Given the current skills and training levels and support drawn down from regional providers by these two firms there seems scope to try and assess if there are any structural reasons (ISW specific) why firms are not drawing on the resources available. It seems this study will have wider implications for policy design and development. Given the complex nature of innovation and the difficulties of measuring the practice-performance link it might be time that policy makers reconsider the apparently unproblematic link that is assumed between innovation and regional prosperity. In particular, the targeting of innovative priorities should take into consideration these softer managerial issues and perhaps more importantly projects should be more rigorously assessed in order to pick apart the direct and indirect benefits of specific measures. The policy implications can be summarised as follows:

- Innovation is unlikely to be readily accounted for using commonly accepted indicators (e.g., patents registered). There is a need to apply the notion of innovation in ways that account for the mechanisms mediating change.
- There is a need for greater rigour in designing the monitoring indicators on European Union structural fund programmes i.e., innovation priority measures.
- There is a need for SMEs to be properly audited before policy measures are designed and instituted.

The current model offers a heuristic and a methodology to measure innovation. It suggests that growth firms do not necessarily depend on innovative cultures or higher levels of skills. In the illustrated cases there is little evidence that the level of success was attributable to regional assistance or the development of skills within the firm. Rather, at least in the case of Music Equipment, much of the innovative advantage of the firm relied on

existing suitably qualified in-house engineers able to liaison with outside experts and a set of mechanisms to measure and maintain employee productivity and quality.

It remains to be seen whether there is a “model” that can be easily translated across SME manufacturers. If, as these results suggest, there is perhaps no clear causal link between innovation and growth then surely policy makers need to reconsider sensitively funding pro-innovation projects. We are endeavouring to develop a self-use audit tool for managers to be able to assess their own competencies and needs so that they are able to develop a better informed overview (benefiting from this benchmarking exercise) of their strengths and weaknesses. In this sense, we would suggest that the current research although in its early stages offers a broad framework for assessing innovation not only in manufacturing but also potentially the service industry and the public sector. It is because innovation is practice based that similar audits are possible across sectors; innovation is not just about “artefacts” it is about “systems”, “competence” and at times luck and serendipity.

References

Brusoni, S., Prencipe, A and Salter, A. (1998) ‘Mapping and Measuring Innovation in Project-based firms’, Working paper series CoPS publication No46, ESRC.

Bryan, J and Jones, C eds (2000) *Wales in the 21st Century*, London Macmillan.

Cagliano, R., and Spina, G. (2000), ‘Success Factors of Italian SMEs: An Operations Management Perspective’ a paper presented at the 7th *International Conference of the European Operations Management Association* Ghent, Belgium June 4-7, 2000.

Chaston, I. And Mangles, T. (1997) ‘Core Capabilities as Predictors of Growth Potential in Small Manufacturing Firms’ *Journal of Small Business Management* January, 47-57.

Clark, P.A, (1987), *Anglo-American Innovation*, Walter de Gruyter Berlin, New York.

Clark, P.A and Staunton, N. (1989) *Innovation in Technology and Organisation* Routledge:London.

Cooke, P. (1996) ‘The new wave of regional innovation networks: analysis, characteristics and strategy’, *Small Business Economics*, 8, 159-171.

Cooke, P. and Morgan, K. (1998) *The Associational Economy: Firms, Regions and Innovation*, Oxford University Press, Oxford

Delbridge, R., Kenney, M. and Lowe, J. (1998) ‘UK Manufacturing in the Twenty-First Century: Learning Factories and Knowledge Workers?’ in *Manufacturing in Transition*, Delbridge, R. and Lowe, J. (Eds), Routledge, London.

Delbridge, R., and Barton, H. (2000) ‘Crossing Boundaries in the Learning Factory: Evidence of Cross-Functional and Inter-Organisational Knowledge Transfer in the Auto Components Industry’ a paper presented at the 7th *International Conference of the European Operations Management Association* Ghent, Belgium June 4-7, 2000.

European Structural Fund Programme (1996), Single Programming Document
Industrial South Wales Objective 2, WEPE, Cardiff.

Hill, J., and Neely, A. (2000) ‘Innovative Capacity: On Why Some Firms Are More Innovative Than Others’ a paper presented at the 7th *International Conference of the European Operations Management Association* Ghent, Belgium June 4-7, 2000.

- Hoffman, K., Parejo, M., Bessant, J. and Perren, L. (1998) 'Small firms, R&D, technology and innovation in the UK: a literature review', *Technovation* 18(1), 39-55.
- Keeble D and Walker S, (1994) TIM change in text to 1994 - New Firms, Small Firms and Dead Firms: Spatial Patterns and Determinants in the UK, *Regional Studies*, 28.4, 411-27.
- Kenney, M., and Florida, R. (1993) *Beyond Mass Production: The Japanese System and Its Transfer to the United States*. New York: Oxford University Press.
- Laredo, P. and Mustar, P. (1996) 'The Technoeconomic network: a socioeconomic approach to state intervention in innovation', in *Technological Collaboration: The Dynamics of Cooperation in Industrial Innovation*, (Eds) Coombs, R., Richards, A., Saviotti, P.P., and Walsh, V. Harcourt Brace Janovich: London.
- Leonard-Barton, D. (1992) 'The factory as a learning laboratory', *Sloan Management Review*, Fall, 23-38.
- Maskell, P. and Malmberg, A. (1995) 'Localised Learning and Industrial Competitiveness' a paper presented at the *Regional Studies Association European Conference on Regional Futures*.
- Munday M (2000) FDI in Wales: Lifeline of Leash in Bryan J and Jones C eds (2000) *Wales in the 21st Century*, London Macmillan
- Oliver, N., Delbridge, R., Jones, D., and Lowe, J. (1994) 'World Class Manufacturing: Further Evidence in the Lean Production Debate' *British Journal of Management*, Vol 5, 553-563.
- Pavitt, K., Townsend, J. and Robson, M. (1987) 'The size distribution of innovating firms in the UK: 1945-1983', *Journal of Industrial Economics* 35, 297-316.
- Rothwell, R. (1989) 'Small firms, innovation and industrial change' *Small Business Economics* 1 (1) 51-64.
- Rothwell, R. (1991) 'External networking and innovation in small and medium-sized manufacturing firms in Europe', *Technovation*, 11/2 93-112.
- Rothwell, R. (1992) Successful Innovation: Critical Factors for the 1990s. *R&D Management*, 22(3), 221-240.
- Rothwell, R. (1994), 'Industrial innovation: success, strategy, trends' in Dodgson, M. and Rothwell, R. (eds) *Handbook of Industrial Innovation*, Cheltenham, Elgar.
- Rothwell, R. and Dodgson, M., (1991), 'External linkages and innovation in small and medium-sized enterprises', *R&D Management* 21/2 125-137.
- Slappendel, C. (1996) 'Perspectives on Innovation in Organizations'. *Organization Studies*, 17 (1).
- Tether, B.S., Smith I.J. and Thwaites, A.T. (1997) 'Smaller enterprises and innovation in the UK: the SPRU Innovations Database revisited', *Research Policy* 2, 19-32.
- Thomas M (1997) Regional Economic Development and the Learning Society – The Need for a New Paradigm, *Welsh Economic Review*, 10.1, 48-53.
- Van de Ven, A.H., Angle, H.L and Poole, M.S. (1989) *Research in the Management of Innovations: The Minnesota Studies*, New York, Harper and Row.
- Womack, J. Jones, D. and Roos, D. (1990) *The Machine that Changed the World*, New York: Ranson Associates.

