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Cluster Measurement and Benchmarking – A recent Welsh Approach

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Abstract

Drawing on extensive academic research and theory on clusters and their analysis, the methodology employed in this pilot study (sponsored by the Welsh Assembly Government's Economic Research Grants Assessment Board) seeks to create a framework for reviewing and monitoring clusters in Wales on an ongoing basis, and generate the information necessary for successful cluster development policy to occur. The multi-method framework developed and tested in the pilot study is designed to map existing Welsh sectors with cluster characteristics, uncover existing linkages, and better understand areas of strength and weakness. The approach adopted relies on synthesising both quantitative and qualitative evidence. Statistical measures, including the size of potential clusters, are united with other evidence on input-output derived inter-linkages within clusters and to other sectors in Wales and the UK, as well as the export and import intensity of the cluster. Multi Sector Qualitative Analysis is then designed for competencies/capacity, risk factors, markets, types and crucially, the perceived strengths of cluster structures and relationships. The approach outlined above can, with the refinements recommended through the review process, provide policy-makers with a valuable tool for reviewing and monitoring individual sectors and ameliorating problems in sectors likely to decline further.

Keywords: cluster measurement; multiple methods framework; cluster review and monitoring.

Introduction

This paper reviews the development and testing of a multi-methods framework to examine clusters. A substantial pilot study illustrates a multi-methods framework to investigate cluster development in Wales. In particular, refinements are suggested to the multi-methods framework through this review process. The resultant, modified framework can provide policy-makers with a valuable tool for reviewing and monitoring individual sectors. The framework facilitates identifying strengths and weaknesses in existing cluster structures and processes. It also provides analysis mechanisms that enable insights about support of current areas of strength and development of new/latent sectors. The results of the analyses also provide insights that can assist policy makers and practitioners to ameliorate problems in sectors likely to decline further.

Why Look at Clustering ?

Massive changes have taken place in Wales's manufacturing economy over the last 25 years and are still occurring. Policymakers have responded to the economic situation illustrated with initiatives aimed at reducing reliance on previous sources of new employment, such as inward investment. In particular, they have sought to address the long-standing difficulty in encouraging Welsh people to start their own businesses, and much of the new funding available through the European Union's Objective One project is being directed towards this end. Consideration has also been given to improving the general quality and quantity of regional resources (particularly IT), capital, and infrastructure as these are crucial inputs to attracting investment and creating new firms. Efficient infrastructure is an essential basis for the flow of physical goods, administration, and information and technology. (Porter 2003). This can be seen as relating to the general need to improve Wales's regional competitiveness.

According to Storper (1994) regional competitiveness can be defined as the ability of a region to attract and develop firms with stable or rising markets shares in sectors, whilst simultaneously maintaining or increasing the living standards of the population living in that region. More recently Cooke (1997), in a specific examination of Wales (and Baden-Wurttemburg) as a 'learning region' in the global marketplace, argued that future economic success was expected to come from firms that were active exporters, had competitive products and processes and were innovators through research and development. There are numerous factors that can be associated with the successful economic development of companies, sectors and regions, from infrastructure, fiscal climate, entrepreneurship, and so on. Vickerman (1989) identified labour market conditions and transport costs as important in determining a particular region's competitiveness. Steinle (1992) broadened these to include company size, research intensity, innovative capacity and export orientation as important determinants, whilst Porter's (1990) framework highlighted the importance of factor conditions, demand conditions, related and supporting industries, and firm strategy, structure and rivalry, for specific industries and sectors. Roberts and Stimson (1998) also focus on the competitive advantage of the region and more particularly the sectors within it, in terms of core competencies (combination of resources, skills, technologies and management),

strategic architecture (means to develop core competencies and develop markets) and strategic intent (aims for the future). This can be divided into a sector focus on core competencies, risk factors, trade, and industry structures.

The ideas of networking and clustering can also be seen as important here, and many of the above factors are themselves associated with strong cluster development. Given this, it is perhaps less relevant to ask the question of how important 'cluster factors' are as against 'other' factors in the overall scheme of economic development (given their interrelatedness), but more important to examine why clustering has grown in importance within the economic development policy agenda. The nature of competition, can be seen to be changing in the following ways :-

- More globalised - i.e. more intense, reduced 'room to hide', greater need to focus on what you are good at and doing it better
- More emphasis on innovation- greater emphasis on innovation as a competitive weapon, i.e. the need to compete on more than just price alone
- Greater need for flexibility - the need to be more agile, responsive, faster to adopt new ideas

This has a knock-on impact on development policy, where there is in general also less scope now for what might be termed 'traditional' policy measures. This is true at two levels:-

- Macro level, i.e. protectionism through tariffs barriers, or monetary and exchange rate policy
- Micro level, i.e. subsidies for inward investment, building advance factories etc

Within this changing competition and support policy climate, clusters can potentially provide:-

- Productivity gains through mechanisms such as :-
    - use of specialised inputs and services, and
    - potential for local sourcing;
- Perhaps most importantly :-
    - innovation gains through enhanced supplier-customer interaction
    - Proximity to knowledge centres
    - Easier exchange of tacit information
- Also, there are possibilities to realise higher levels of new business formation due to:-
    - Better information on niches, and new opportunities (therefore lower entry barriers)
    - Better informed Venture Capital system (i.e. reduced transaction costs)

A key objective of UK government policy is to deliver a knowledge-driven economy, within which clusters play an important part. Moreover, at the peak multi-level economic governance stratum for Europe, the EU is similarly committed since the Lisbon (2000) and Barcelona (2002) declarations. Despite 'varieties of devolution' in

the UK (Cooke and Clifton, 2005) each devolved territory has signed up on paper to this broad aspiration. Their strategies are broadly in line with the framework laid out in Department of Trade and Industry's (DTI's) first White Paper on Competitiveness published in 1998. From 1999 until 2000 a joint Ministerial committee reported to the Prime Minister on the Knowledge Economy, and policies and actions in support of improved science infrastructure and better-funded scientific research, industrial innovation, regional innovation and innovative cluster-building can all be traced to that initial impulse. With specific reference to clusters, the stated aim of the DTI policy is to "create the conditions that encourage the formation and growth of clusters, but not to artificially create clusters". (http://www.dti.gov.uk/clusters/)

As far as the nine English regions are concerned, the Regional Development Agencies (RDAs) are now responsible for taking forward the strategic aspects of cluster policy development. The DTI website states that "approaches and priority clusters vary from region to region". It could be argued, however, that the extent of this variation is likely to be limited, given that policy across the *devolved* regions is largely consistent (WERU's (2002) comprehensive list of the clusters and sectors targeted by the Regional Development Agencies (RDAs) within the UK does show large numbers of them concentrating on biotechnology and health, food, and tourism), though they have some explicit scope for policy experimentation. The DTI also notes that "work currently being carried out [by the RDAs] includes commissioning regional mapping studies, identifying and building links with important regional clusters and using clusters as the vehicle for wider economic development initiatives."

Such policies are seen as necessary because of issues of market failure. Generally, pure market interactions prove incapable of transmitting the qualitative information needed in developing new products in interaction between firms (Maskell, 2000). This 'market failure' for the exchange of knowledge between firms centres around the need for the buyer to know the specific merit of the knowledge in question before purchase, while sellers are simultaneously unwilling to divulge these details as this effectively means the potential buyer will have acquired it gratis. Therefore under these conditions, no exchange will take place (see Arrow, 1970, for a full account of this issue). Market failure, therefore, provides both an argument for the benefits of clustering per se, and a justification of policy intervention designed to facilitate knowledge exchange. This could be either indirectly by attempting to enhance cluster development generally, networks and trust specifically, or by taking a direct role as a knowledge broker and/or actual provider of research-based knowledge. For example, Ffowcs-Williams (2004) argues that, whilst cluster development must be driven by the industry itself, government agencies have a 'core partnership role to play' in the process of cluster development, particularly in terms of providing legitimacy facilitating local coordination and collaboration, resourcing facilitations, and analysis. Ffowcs-Williams (2004) developed a framework to guide cluster development (presented at the Competitiveness Institute's 2003 conference in Gothenburg). This synthesises experience and analysis into five cluster development phases and twelve steps in the cluster development process. The five phases are (a) mustering support; (b) building the cluster base; (c) creating momentum; (d) extending the base; and (e) sustaining momentum.

Wales needs to re-evaluate the competitiveness of its industries and seek to develop links between those which can become mutually supporting, utilising public policy support, where this is appropriate, to counteract market failure caused by information asymmetries etc. In order to do this, however, more information is needed on existing business sectors in Wales, their strengths and weaknesses, prospects and problems, and competencies. The piloted approach builds on existing research, such as WERU (2002) the aforementioned DTI (2001) cluster-mapping framework, and Michael Porter's recent work on competitiveness (for example Porter, 1998), to provide new insights into the present and future potential of the economy of Wales. As such it utilises a robust methodology built on synthesising a range of theoretical and practical approaches. This provides an innovative and holistic evaluative framework that can provide a picture of the current situation, the potential capacity of the Welsh economy, and the areas where improvement is required to fulfil that potential. This framework also allows identification of the scale of the current knowledge gap, through its comprehensive evaluation of available quantitative and statistical data on the economy as a whole, complemented by more in-depth cluster-based analysis.

The paper is structured as follows. The next section examines the theoretical contexts of clusters and networks in which the study is conducted. From this the methodological framework is developed. A review of this framework is then undertaken. Finally, conclusions are drawn.

Theoretical Context

Although there are overlaps between some of the clusters described, the literature indicates 8 *basic* types of clusters (Marshallian, Italianate, Hub and Spoke, Satellite, Industrial Complex, Urban Hierarchy, Social Networks, and Virtual organisation). On a superficial structural level there appear to be several elements which can be used for differentiation. These include horizontal (either internalised activities within the firm or across industries linkage) and vertical (external and within industry linkage) attributes of the clusters. In addition, however, there also appear to be cost and knowledge based reasons for the existence of clusters, and transactions, agglomeration and relational processes for their subsequent success.

To gain a better understanding of clusters, there is need not only to examine them from a structural perspective, but also to examine in more detail the processes at work within the clusters. A review of the disparate literature on networks produces six key strategic elements in a network classification scheme which together provide a framework for analysis of cluster processes—namely review of objectives and participant goal (see for example, Coase, 1937; Cook & Emerson, 1984; Lechner & Dowling, 2003); participant conduct (Ahuja, 2000); network type (Ireland, 1990); network system management (Keller, 1991; Snow *et al.* 1992); and learning (Argyris & Schon 1978; Asheim & Isaksen 1997; Freeman, 1995; Lundvall 1993; Lundvall & Johnson 1994; Storper & Walker 1989). There will, obviously be differences for certain cluster types because of the broad structures in which they find themselves. These process elements in the process of classification can then be added into the structural, to give us table 1.

Table 1: Cluster Types, Structures and Processes

Type Cluster Type	Structures Structure	Processes returns	Processes participant Goals	Processes participant conduct	Processes network type	Processes network system management	Processes network learning
1 – Industrial Complex	Formal, Vertical, Transactional	cost	individual	control	Transactions	start – creating	doing things better
2- Hub and Spoke	Formal, Vertical, Relational	cost / knowledge	collective	collective	Trust	survive-connecting	doing things better / doing things differently
3 Italianate District	Informal, vertical, relational	cost / knowledge	Collective / wider	collective / co-operative	Trust / teamwork	survive-connecting / sustain / developing	doing things better / doing things differently
4 Marshallian	Informal, vertical, agglomerational	cost	Individual / collective	Control / co-operative	Transactions / trust	start – creating / sustain-developing	doing things better
5 Urban hierarchy	Informal, horizontal, agglomerational	cost	individual	control	Trust	start – creating	doing things better
6 Social Network	Informal horizontal, relational	knowledge	wider	co-operative	teamwork	sustain-developing	doing things differently
7 Virtual Organisation	Formal, horizontal, relational	knowledge	collective	collective	trust	survive-connecting	doing things better / doing things differently
8 Satellite Industrial Platform	Formal, horizontal, transactional	cost	individual	control	transactions	start – creating	doing things better

The literature summarised in table 1 synthesises cluster types, structures and processes. It creates a logic for policymakers to determine the "ideal" cluster type for each industry sector, and to compare this against the present reality, in order to provide a potential focus for policy in the future. These "ideals" can differ according to the industry in question, because of differences in structures (market type and size, firm type and size, ownership), geography, importance of knowledge and innovation vis-à-vis cost considerations, logistics, etc. The extent to which an industry does or does not fit into the types above can also be used to help determine the current existence and future potential for development of clustering within the sector(s). The actual importance of these ideals against the current reality will also determine whether the ideal is more desirable than the actual reality delivered by "natural" market interactions. From this the efficacy of cluster development policies (such as by Ffowcs-Williams (2004) can be determined. As such these issues also need to form part of the analysis.

Methodological Framework

Generally, the methodology is aimed mainly at steps 2 and 3 of the Ffowcs-Williams (2004) structure for cluster development, prioritising clusters and then placing prioritised clusters "under the microscope" for more in-depth analysis. Ideally, such an analysis should include:

1. Statistical analysis;
2. Information from senior stakeholders within the cluster;
3. Mapping of companies and individuals' relationships and activities, to fully determine the existence and status of the cluster.

Time and cost constraints precluded the third of these within the actual (pilot) study, though we return to this issue in the discussion of the piloted framework.

The Welsh timber sector pilot research thus initially concentrates upon the first two types of analysis. Based on this pilot the first stage of analysis in the methodological framework could thus comprise a general quantitative, statistical audit. This quantifies employment, number of firms, size of firms, GVA, growth rates, location quotients (LQs) (relative to the UK) etc., from which large, general clusters can be identified, as well as the smaller sub-clusters and micro-clusters which make up the larger clusters. In addition, applying the framework in Table 1, it is useful to generate data for analysis utilising the WERU (2002) approach of multi-sector qualitative analysis (MSQA), adapting the DTI analysis, building a second stage to the analysis. This reflects the approach of Porter in examining demand and supply factors, institutions, employment growth and productivity. More importantly, the methodology looks to incorporate the main elements of the MSQA employed in the aforementioned 2002 WERU report, which itself was meant to provide a framework for future analysis. The MSQA method seeks to develop an 'outward looking' regional analysis across a range of factors, classified into various characteristics. The WERU (2002) methodology is itself an adaptation of the work of Roberts and Stimson (1998) on MSQA. Roberts and Stimson (1998) and WERU (2002) saw it as necessary because analytical techniques such as shift-share, LQs, input-output and SWOT were not adequate in themselves in explaining regional competitiveness. This technique is based on the principle of utilising qualitative methods backed by quantitative analysis, generating an interview questionnaire schedule (based on additive scales) to be answered by key experts on the cluster involved (from government, industry, academia etc.), to generate quantitative results for issues such as :-

- regional and sector core competencies
- trade possibilities
- regional economic and industry risk (see Roberts and Stimson (1998) and WERU (2002) for more details of this methodology)

The pilot adopted the Roberts and Stimson (1998) approach of splitting the economy into 20 or so "clusters", but add to their approach by conducting a statistical analysis which builds on the sectorally-based approach of WERU (2002). This approach is easily able to encompass MSQA for the whole economy (the limited number of clusters chosen because of time and resource constraints), with the statistical analysis supporting the MSQA data. In addition, because of the overlapping nature of the clusters, and the potential for sets of sectorally-based and micro-clusters within broader MSQA clusters, one cluster (timber) was also examined in-depth. This data helps to determine participant goals and participant conduct within the cluster. This MSQA derived methodology would also examines the nature of the clusters themselves (network type, management and learning). This study thus aims to identify the cluster structures and processes consistent with different classifications of clusters outlined earlier (e.g. Marshallian, Italianate, etc). In terms of the precise questions and the presentation of the findings, we follow as far as possible the model utilised in WERU (2002), but add a final survey-tool based section (D) on assessing inter-industry linkage potential (i.e clustering and networking), which the WERU (2002) report argued was a desirable next step for their own research. Roberts and Stimson (1998) included a section that looked superficially at potential future inter- and intra- cluster linkages. For reasons of brevity

of the questionnaire this section was omitted from our MSQA, in favour of the specific examination of the structures and processes at work within the individual clusters themselves (future research may of course add such a section).

Given the WERU (2002) use of input-output analysis in this stage, the study also examines the supply chain linkages for clusters chosen for more in-depth analysis, using the WERU (2004) input-output tables for the Welsh economy. This also builds on the methodology utilised by Learmonth et al (2003) in their evaluation of Scottish Enterprise Cluster policy. They used the Scottish input-output accounts and analysis to illustrate aspects of clusters of use for policy-makers, specifically the trade flows within the region between micro-clusters into the larger clusters. Learmonth et al (2003) also point out, however, that it does not identify information and knowledge spillovers, and thus input-output should be used as a companion to more qualitative techniques. They suggest CGE modelling, whereas we use the MSQA methodology outlined earlier. Within the appropriate sections on industry competencies, trade and risk, the questionnaire also included additional cluster-effect based questions.

Methodological Processes and Reporting

In terms of the industry experts chosen, Roberts and Stimson (1998) suggest, as an ideal, panel groups of industry sector actors, both internal and external to the region, derived from either "expert samples" or random samples from lists of private and public sector individuals. Clearly the more extensive the coverage of participants in these Delphi-type exercises, the greater the likely validity of the assessment produced (Roberts and Stimson, 1998). They also acknowledge, however, the time and cost implications of such a procedure. Because of time and resource constraints, the methodology adopted by WERU (2002) was followed, focusing on identifying and asking the person / people who can offer the most informed opinion on the cluster in question, in this sense purposive sample (Patton, 1990) i.e. one in which subjects are selected for a particular characteristic. Clearly the issue then becomes the accuracy in identifying "experts" to answer the questionnaire. This study identified experts (via consultations, examination of industry and government organisational structures, and published literature) from senior directors in the selected sectors, academics with expertise and knowledge of the selected Welsh clusters and their development, government and quasi-government personnel with responsibility for developing policy in the selected industries, and representatives from relevant industry cluster associations. They were also sent guidance notes and additional notes for section D to aid in this process. The questionnaires were sent out in 2 tranches, the first tranche for the general cluster, and the second for the sub-clusters. Deadlines were set and reminder e-mails and phone calls were made both before and after the deadlines.

In terms of the input-output analysis, we follow the processes adopted by Learmonth et al (2003), examining the raw input-output data (from WERU (2004)), and then producing diagrammatical representations of the flows of inputs and outputs between the relevant sectors within the cluster.

The MSQA results for competencies, risk and export markets are reported in the same way as the WERU (2002) report. Graphical (bar chart) representations of the

summarised results have been produced, however, with a commentary provided for each section and additional analysis of areas of specific relevance. This did, however, necessitate some adjustment of the data gathered from the questionnaire.

The section A competencies data was split into 48 criteria and 9 reported themes. Essentially, each of the competencies "accuracy" data was converted from a +1 to +5 scale to a +2 to -2 scale via simple subtraction, which, when multiplied by the importance variable gave a scale from +10 to -10. For each of the themes the values for the criteria within that theme were averaged to generate the 9 reported results for competencies. Important individual criteria were also discussed, where appropriate.

For sector risk the 30 questions were split into 4 key areas for reporting. This time however, the initial scales, for potential impact (of 1-5 for each risk factor, with 1= no impact and 5 = very significant impact) and likelihood of occurrence (1-5 where 1 = very unlikely and 5 = very likely) were calculated together to give results of 1-25. These were then rescaled from 0-10, with 10 indicating the most potential and likelihood of damage and 0 indicating no potential or likelihood. Again, important individual criteria were also discussed where appropriate.

The trade-related results were scaled in the same way, the initial scales being current trade importance (1-5 where 1=irrelevant and 5 = very important) and future trade potential (1-5 where 1= little potential and 5 = very high potential), and a rescaled index of 0-10, where 10 indicates great current and potential for that market. The initial 1-5 scores for current and future potential were also reported and discussed.

For the cluster structures and processes, the results were compared with those necessary for each of the eight basic cluster types. The nine questions asked, therefore generated a 9 point scale for each cluster type, with 9 indicating a perfect fit to a cluster type. This was undertaken both for the current position of the cluster and the ideal structures and processes the experts believed would be necessary to maximise the potential of the cluster (i.e. the structures and processes that should exist). The "ideal" cluster type determined by the experts' responses was then compared with the current results for that cluster type and its score. The importance of the current and ideal structures and processes were also reported and compared. This comparison was a key element of analysis of the state of the cluster, allowing the type and importance of the cluster to be evaluated, areas for future improvement identified, and issues for policymakers and further research to be pinpointed

Discussion of the methodological framework

The methodological framework described generally provides the necessary information from industries and sectors of different types, sizes and structures. Given the nature of this study (a pilot for a hopefully much larger future study utilising the framework), and recognising the time and resource limitations implicit in a study of this type, there are clearly both data and methodological limitations. A number of data related difficulties (that are likely to be more widespread than just Wales) were encountered due to different data sets being used that were not always compatible with each other, for example, regarding the employment and GVA data, and thus the data generated should

be seen as estimations only. This is in addition to more general reporting and data availability difficulties for individual sectors imposed sub-regionally, which was one of the reasons for concentration on larger clusters and large regions (Wales was split into 3 regions as opposed to unitary (local government) authorities) in framing the work. The trade related data from input-output tables is obviously also affected by the length of time before the tables are updated, for example the latest WERU (2004) tables being for the year 2000. There are also potential limitations for the results from the MSQA analysis, if the individuals chosen do not in reality match the expert criteria by which they were chosen. Though we have sought to minimise this risk, it cannot be discounted.

Methodologically, there are also several limitations. First there is the absence of in-depth mapping of companies and individuals' relationships and activities to fully determine the existence and status of the cluster (excluded for time and resource limitation reasons). Second, and related, there is the question of whether some of the 20 or so "clusters" the economy has been split into are clusters in reality. Clearly there are two ways of approaching this issue: you either start with certain sectors, and then analyse where they sit within a cluster typology defined from theory (as we have done), or you define certain types as clusters, and then look for specific examples that are present. The first way avoids any pre-judgement on what types are 'better' and therefore more desirable to examine and what type of clusters there actually may be in existence in any given location. It is also more practical in that you do not have to collect all the data on everything before you start in order to identify the cluster. More practically, there are methodological issues over the length of the MSQA questionnaire and thus its practicality for use as a questionnaire (as opposed to use in face-to-face interviews or focus groups).

Clearly, therefore, our methodology requires the in depth second stage analysis to be undertaken for each of the larger clusters (and the sub-clusters within them), and extended into the mapping of company and individual relationships. It is, therefore, recognised that additional research is required (particularly given the nature of this piloted research paper) in the following areas :-

- Whole economy MSQA at the broad cluster level (either annually or over a small number of years), to fully test the framework, and allow generation of whole economy competencies, risk factors, markets, and cluster information, from which changes over time can be calculated, and the effects of policies measured. For maximum benefit, these whole clusters can also be dissected in a number of ways, to examine sub-clusters where specific policies are required / sub-clusters that exist where whole clusters may be lacking the requisite structures and processes. Prior to this, however, there needs to be :-
    - Development of the MSQA questionnaire to simplify (and reduce number of) questions aimed at identifying core competencies, risks, and trade possibilities. Review of cluster structures and processes questions to enhance information on cluster type, strength and importance as a coherent entity (rather than a collection of structures and processes), to ease the analysis and increase ability to compare across industries and clusters. Examination of potential additional section (or attach to future trade section) to investigate

potential additional linkages to other sectors within Welsh economy (as undertaken by Roberts and Stimson (1998)).
    - Investigation of use of Delphi-focus groups to replace averaging of expert opinions in such a study. Such groups can be used to build knowledge and capacity of use in other policy and analysis, and to give forewarning of change in the economy (e.g. to highlight new developing micro clusters, or problems for the industry). If this were not possible, then face-to-face (or telephone) interviews were found to be the best methods for eliciting the requisite data.
    - Part of this process should also involve further analysis of the eight cell model developed as part of the analytical framework, and if necessary expand it (for example, to cope with hybrid specialty clusters).

- Following the broad analysis, at the level of those sectors with clusters or cluster potential, research is required to examine cluster characteristics in more detail. In this regard, some cluster characteristics lend themselves to multi-level analysis, particularly interactional learning. Multi-level, multivariate analysis could be carried out to facilitate a more comprehensive examination of constructs such as open mindedness, commitment to learning, processes for sharing vision and behaviour based control (Rowe, 2004). As part of this multi-level, multivariate research, an in depth network analysis could also allow the partitioning of patterns of learning behaviour of key stakeholders within firms in clusters and between firms in clusters, to ascertain whether there are level differences in the patterning of learning behaviours. For example, a recent study of 38 executive teams found that executive team learning is not just an aggregation of the learning in dyadic relationships but rather, is better captured at the team level than as an aggregation of dyads as measured in previous empirical studies (Rowe, 2004). Multi-level, multivariate analysis not only has the potential to examine interactional learning in firms and clusters. It also has the potential to compare patterns of interactional learning in clusters with patterns of learning across clusters in regions. This would create the third stage of analysis, generating a full multi-level, multi-method framework, from which policy could then be enacted.

- Simultaneously at the policy level analysis of cluster-related policy is needed to determine examples of good practice and increase the effectiveness of the use of government resources. This should involve examination of the different policies used in creating, sustaining and growing clusters of different types.

CONCLUSIONS AND POLICY RECOMMENDATIONS

Ultimately, of course, employment growth within clusters is business driven, but proactive development policy can link this into the Welsh Assembly Government's wider agenda. Generally, government policy tends to work through clearly defined, formal, top-down conduits, whereas, as we have seen, cluster and network types are often informal and thus may be difficult to identify, or encourage by formal policy initiatives. It is important therefore to be able to evaluate the requirements of policy in respect of different network types, given that government has a potential role

throughout the 12 step Ffowcs-Williams (2004) cluster development framework. The data generated will need to be weighted according to the policy focus of the economic development strategy in place, but this framework allows the judgements necessary to focus scarce resources, to be made from a stronger base of knowledge.

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