International Journal of Entrepreneurship Education 2(3): 287-308.
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An Appraisal of the SEED University Technology Small Firms Project in Industrial South Wales

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Abstract. The main purpose of the investigation is to focus on the specific needs of university-based technology small firms (UTSFs) making a case for UTSFs' particular contribution to the Welsh economy and why their needs are not well provided for at the present time. The contribution the Sustained Economic Enterprise Development (SEED) project made to the firms and the differences between the University of Wales Cardiff and Swansea that appeared are described. The paper presents findings from two phases of the project. Firstly, pertinent results from the detailed interviews that took place with a wide spectrum of university-based technology small firms detailing grievances towards their own academic institution and towards business support. Secondly, network meetings from the second phase of the work. Twenty 'willing' firms identified in phase one were recruited to both participate in, and develop content for, group meetings and networking events focussing on the particular needs of businesses.

Keywords: university, technology, small firms, enterprise, development.

1. Introduction

This paper relates the formation and outcomes from university-based technology small firms (UTSFs) in the EU region of Industrial South Wales (ISW). The Sustained Economic Enterprise Development (SEED) project was devised in 1998 by the Welsh Development Agency (WDA) to examine the genesis of Further and Higher Education spinout companies and to add value to their existence by bringing owner-managers together to network, share experiences and update knowledge in areas such as management, finance, marketing and selling. The Welsh Enterprise Institute (WEI) at the University of Glamorgan undertook background research that identified the firms and then recruited over twenty to form the network, designing a programme of tailor-made assistance.

1. The authors would like to acknowledge the support of the Welsh Development Agency (WDA) Skills and Enterprise Section for whom the study has been carried out.

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Universities are seen as crucial components by regional and national governments in developing and transferring knowledge to the commercial market place. As a result, there is increasing evidence that the university sector can undertake a variety of roles in developing the technological and industrial potential of a region. These can range from the transfer of technology to smaller firms to the development of a technologically skilled workforce that can attract inward investing multinationals. However, the European Commission has recognised that one of the more direct ways of developing a technological base from academia is through the creation of new firms from the university sector. This is not surprising, as higher educational institutions contain a high proportion of scientifically sophisticated individuals within peripheral regions such as ISW who have the ability to generate innovative ideas and technological knowledge which can be channelled and diffused by new ventures established by academics or students from a university department. As Downes and Eadie (1998) have demonstrated, UTSFs have been recognised as one of the primary routes to the commercial exploitation of university research. Supporting the creation and development of UTSFs through networks can yield medium to long term returns for the dynamism and competitiveness of the local economy (although this process is not an automatic or natural consequence of the existence within a region of a strong university base).

In ISW, the current industrial base consists of manufacturing plants established by inward investors, and small and medium-sized indigenous companies. The multinationals tend not to undertake research or development activity, and their R&D decision-makers are located elsewhere. In addition, many small firms do not undertake research activities, which has led to ISW having one of the lowest incidences of industrial R&D within the UK. As a consequence UTSFs can make an important contribution to the indigenous company base, increasing the levels of R&D activity in the region, as well as the number of technologically skilled workers. The sample of technology companies in the study described in this paper included UTSFs in the areas of manufacturing medical and orthopaedic equipment, chemical products, machine tools, R&D on natural sciences and engineering, technical testing and analysis, software and other computer related activities and other service activities. Various regions of Europe have successful networks of UTSFs, usually based on technologies developed within universities. Whilst the same pattern has not been replicated within the ISW context in the past, there is an important role for universities to play in ISW to support economic growth and development within their local economies, particularly through encouraging networking activities.

Many university-industry linkages in the UK, Europe and globally are focusing on UTSFs to help generate industrial growth. This calls for academic entrepreneurship applicable to the range of institutional and regional settings to overcome the barriers to success. In many cases, universities, usually supported by regional and national government, are adopting a direct entrepreneurial role in

supporting these new ventures (Kinsella and McBrierty, 1997). There is therefore a strong potential for developing UTSFs within ISW if the right policies are instigated. In particular, given the current circumstances, there is a need for a radical approach involving strong drivers to support UTSFs if ISW is to keep pace with higher education activities in other regions of the UK and Europe.

A number of factors will influence the ability to establish and develop UTSFs. Some of these arise from the priorities and views of university researchers and the characteristics of academic culture. Others are from the wider business environment and the ability of the academic-industry infrastructure to promote and support the development of UTSFs. Important factors will include the business background, skills, relevant experience and access to finance, of the founders/co-founders of the UTSF and the research intensities of universities.

The main purpose of the investigation is to focus on the specific needs of UTSFs making a case for their particular contribution to the Welsh economy; why their needs are not well provided for at the present time, and what contribution the SEED project made to the firms. Related to this the paper considers the economic development potential of UTSFs in ISW (from detailed interviews) which has been given insufficient attention and notes the contribution of UTSFs, the lack of support and lack of policy towards them.

The methodology described in the paper involves two distinct phases of the project. Firstly, pertinent findings from detailed interviews that took place with a wide spectrum of university-based technology small firms. These ranged in age from over forty to under one year of existence and were based off and on-campus. They were mainly formed by academics wishing to commercialise their own research, although for most of the larger firms the current 'manager' tended to be a non-academic. The experiences and in many cases grievances of the owner-managers towards their own academic institution and in more general terms towards the 'business support' sector formed the basis for the development work undertaken in future 'network' meetings.

This 'network' formed the second phase of the work. Twenty 'willing' firms identified in phase one were recruited to both participate in, and develop content for, group meetings and networking events. A series of four workshops (October 2000 and January, April and October 2001) were developed, focussing on the particular needs of businesses, providing practical marketing solutions, information on finance and funding, and marketing and selling.

Three of Storey's (2002) six steps were utilised. With regard to step I concerning the take-up of schemes the criteria evidenced by the SEED project shows that some spinouts had taken up schemes but others had not. For step II, recipients' opinions were obtained through interviews with founder/managers. Regarding step III, recipients' views of the difference made by the assistance provided, they reported this at interviews and workshops. Since the SEED project was concerned with monitoring aspects – step IV (comparison of the performance of 'assisted' with 'typical' firms), step V (comparison with 'match' firms) and

step VI (taking account of selective bias), which would have formed an evaluation, were not undertaken since these were not appropriate to the requirements of the project at that time.

The total number of university-based technology small firm owner-managers attending the four workshops between October 2000 and October 2001 was 76 with 57 firms represented. The paper reports and analyses the activities and experiences of firms attending the workshops assembled from notes taken at each meeting, based on the Linköping model in Sweden, and short questionnaire forms issued at the end of each workshop. From the results of the questionnaires and the reports and observations made at the meetings the challenges and requirements of university technology-based small firms are reported and recommendations for the future support of these firms are made. The primary motive behind this paper is to attempt to examine the usefulness of direct interaction between such firms in terms of their experiences and individual perceptions of gain.

The structure of the paper relates to the two distinct phases of the project described by initially conceptualising UTSFs and reporting on the detailed interviews undertaken followed by consideration of the experiences of firms attending the group meetings and networking events finally concluding with policy recommendations for future support.

2. Conceptualising University Technology Small Firms

The last decade has witnessed a growing enthusiasm for entrepreneurs as catalysts for economic development and change, with increasing attention paid to the role of small technology-based companies as contributors to wealth creation, technological innovation and employment in high technology industries (Autio, 1997; Jones-Evans and Klofsten, 1997; Jones-Evans and Westhead, 1996). As a result, there has been considerable academic and policy interest in examining the process of entrepreneurship within such organisations. Early studies identified the research-based academic environment – universities, non-profit research institutes and government research centres (Schrage, 1965; Roberts and Wainer, 1966; Wainer and Rubin, 1969; Cooper, 1971).

UTSFs have played a major role in the development of specific industries. The growth of the biotechnology industry is linked directly to the development of small firms set up by academic researchers who transferred basic research activities into innovations (Dodgson, 1993). During the 1970s, the biotechnology industry influenced universities to give more attention to control over intellectual property by their researchers and professors (Kennedy, 1986). Financing institutions, especially venture capital companies, became interested in academic research, and this led to a shift in the boundaries between non-commercial basic research and commercial research (Mansfield, 1991, 1995). As suggested by Rosenberg and Nelson (1994), commercialisation was possible, since funding in

the biomedical field had created a reservoir of knowledge from which the biotechnology industry developed new products. In the 1970s, participation by universities in commercialising biotechnology research not only led to new knowledge but also academics starting their own enterprises by maintaining or leaving their academic tenure. As a consequence UTSFs play a central role in the growth of new industrial sectors and the innovation process. It must also be remembered that there are new sectors where universities play no role – the 'new coffee shops' are an example.

UTSFs have their roots in university research through at least one of the founders working in an academic research establishment before inception of a firm (Jones-Evans et al, 1998). These enterprises are established to commercialise a product or service developed in a university. They usually occur when a new enterprise is formed by university scientists seeking to develop further the commercial possibilities of their research (Garvin, 1983).

In one of the first studies of small technology-based businesses, Schrage (1965) considered the establishment of new ventures by scientists emerging from their organisations. Since then most studies have related the development of UTSFs to two main criteria. First of all, the business must be related to technology developed at the university and secondly, the founder must be a former employee or student of the university who has worked on developing that technology. For example, Cooper (1971) defined high technology small firms as those that have their roots in a research organisation i.e. at least one of the founders worked in a research establishment before starting the firm and was established to commercialise a product developed in a research organisation.

Olofsson and Wahlbin (1984) defined a university technology small firm as having at least one founder employed at the university when the company was formed and a business idea which is aimed at commercialising knowledge and technology developed at the university. A wider definitional approach by Giannisis et al (1991) considers three types of UTSF models, which are, based on the origins of the business itself. The first – the entrepreneurial model – is a new firm which has been established as a result of a combination of the expertise and independent motivation that the entrepreneurial faculty member has brought to the commercialisation process. The second type – the traditional model – is where the commercialisation of a university-based technology is pursued by an outside business entity. Finally – the institutional model – is where the university through an organisation such as the Industrial Liaison Office (ILO), or a wholly owned not-for-profit subsidiary of the university, manages the commercialisation process.

Other Swedish researchers (McQueen, 1990; McQueen and Wallmark, 1988) have referred to a UTSF as based on a product or service resulting from university research, and founded (or co-founded) by a person (or persons) from a university research group where the founder moved directly from the university to the firm

(McQueen and Wallmark, 1985; 1991). This definition has been adopted for this paper.

As we have demonstrated, various studies have recognised that a significant number of new technology-based businesses have been established by scientists emerging from different types of academic-based organisations, such as non-profit research institutes, government research centres and universities. However, despite the increasing interest in the development of businesses from academic research, there are only a few studies, which have attempted to consider the economic impact of such organisations.

In the USA, a variety of studies have demonstrated how various regions have developed university small firms (Saxenian, 1994; Roberts, 1991) although these have tended to concentrate on Route 128 in Boston and Silicon Valley in California as the main examples for small firm developments from universities such as MIT and Stanford. However, as Malecki (1991) points out, the presence of an outstanding university within a region in the USA does not necessarily lead to the development of an entrepreneurial climate in which UTSFs are created.

In Europe, there are only a few studies, which have examined this phenomenon, and only in limited regional settings. Linköping – one of the fastest growing regions of Sweden – contains a strong high technology industrial environment, which includes the presence of Saab's Aircraft Division, Ericsson Radio and the Swedish Defence Research Establishment, and is at the forefront in the creation and development of new technology-based firms in Sweden. Academics and students from Linköping University have played a leading role in this. To date, over 450 small technology-based firms have emerged directly from academic research activities at the institution (Klofsten and Jones-Evans, 1996), with a high number of the others using or developing university research findings as the basis for their products or services.

In the UK, the most famous study of UTSF activity is that of the 'Cambridge Phenomenon', which found that nearly all of the 350 high technology businesses in the area had ultimately been generated from Cambridge University, especially the departments of physics, engineering and computing (Segal, 1986). Similar clusters have been identified at other universities, for example Imperial College, Heriot Watt and Aston, although these have not been developed to the same extent, and the research on successful UTSFs is quite sparse.

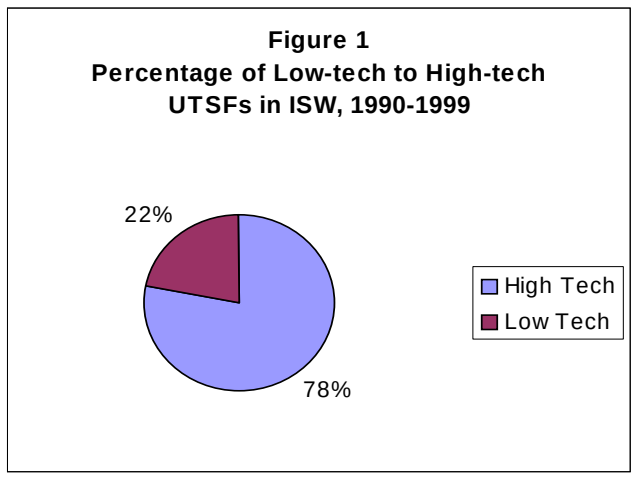
In Wales, the articulation of policy has been through initiatives such as the TOPSPIN and Knowledge Exploitation Fund (KEF) programmes, although it needs to be recognised that since Wales has a low proportion of companies per head of the population (Wales has 7.51 firms with more than five employees per 1,000 population while England has a figure of 9.60 per 1,000 population) the emphasis on UTSF activity will need to relate to this difference.

Whether these approaches are the right way to develop entrepreneurial businesses is still open to debate. The role of universities in creating these milieux of innovative firms within different regions has led to a proactive approach by

universities, usually supported by regional or national government, in adopting direct entrepreneurial roles. However, these can range from the establishment of university-owned holding companies to the promotion of fledgling academic entrepreneurs (Gibson and Smilor, 1991) to the development of specific centres of research and training which promote and assist the process of academic research into a network of industrial firms and business ventures (Klofsten and Jones-Evans, 1996). Although there is no recommended model for the creation of UTSFs on UK university campuses, there are individual university models and this has resulted in the establishment of a variety of commercial infrastructures on campuses, often alongside the development of incubators and science parks.

The method adopted to gather the preliminary data on UTSF activities for the SEED project was a structured questionnaire survey through face to face interviews with Industrial Liaison Officers (ILOs) at Higher Education Institutions (HEIs) in ISW. This was developed through examining previous studies and supplemented through other data sources including data on low and high-tech UTSFs based on SIC codes. Figure 1 shows the percentage of low-tech to high-tech UTSFs from HEIs in ISW for the period 1990-1999.

Figure 1
Percentage of Low-tech to High-tech UTSFs in ISW, 1990-1999



Seventy-eight percent of UTSFs in ISW were high-tech and twenty-two percent were low-tech dispersed between the University of Glamorgan (11% of UTSFs), University of Wales Cardiff (11%), University of Wales College of Medicine (11%) and the University of Wales Swansea (67%). The sample of firms had a heavy bias towards Swansea since the first innovation centre for UTSFs in Wales had been established there in July 1986 and consequently more firms had been set up historically than at the other centres which followed. This

interesting point had resulted in more spinouts being formed at Swansea during the 1990s than at the more research-intensive Cardiff (9 at Swansea and 2 at Cardiff during the sample period). This trend has more recently changed due to new developments such as the Spinout Wales programme and the significance of the University of Wales College of Medicine Spinout Programme, Cardiff Business Technology Centre, Cardiff Research Consortium and the Medicentre. The differences between Cardiff and Swansea arise due to Cardiff having concentrated its spinout activities on a number of research intensive centres and Swansea focusing its spinout activities in its Innovation Centre.

The number of low tech university connected companies would be unusual if this was a current finding but this was not at the time of the study since many had been new start-ups during the 1990s and before. More recently, following initiatives such as Spinout Wales it would seem that there are more companies at the forefront of technology being started-up which are very dissimilar to those that were low tech.

3. Detailed Interviews with University Technology Small Firms

Detailed interviews were carried out with UTSFs in ISW and the findings together with recommendations were assimilated for the development of the group meetings and networking events. Following the initial evaluation work, a database of companies was established. From this twenty companies were identified, involving older, newer, low and high technology businesses, and given the opportunity to benefit from further networking. The interview questionnaire for each company was constructed and analysed by a large number of factors affecting performance. Where possible, the interviews were carried out in meetings with the principal founders of each company. This information has been compared and contrasted with the findings of the initial investigation and provides commentary on the future potential such businesses have. The analysis draws on both the positive and negative sides of the environment in which these businesses operate. It was clear that there is much about doing business both in the university environment and also in Wales more generally, that these firms were unhappy with. Although there was this dissatisfaction the firms did not show a clear intention that they would like to move. However, there were positive features, not least the contribution that they make to the general level of prosperity, which can provide stimuli for further development of these types of businesses.

The analysis shows a clear level of dissatisfaction with many forms of business support provided/supplied by public sector organisations. Levels of scepticism were high and in some cases there was genuine uncertainty about where to go for certain types of help. Perhaps it was not surprising that many companies felt that universities provided the largest range of help, despite a

general view that the academic environment was not a good place to do business. Certain external providers, in particular Business Connect, were singled out for criticism.

The approximate percent split reported by the founders for the activities of their businesses offered to clients was 38% product based and 62% services based. The previous experience of the business founders included 25% having been involved in pure research, 80% in applied research, 20% in development, 10% in consultancy work, 5% with training and 5% in other activities. Technological content of products and processes involved the application of advanced technology (reported by 35% of the founders), the application of established technology (reported by 25%), both the application of advanced and established technology (20%), and those companies with little technological content (20%). Degree of novelty of the products/processes produced by the businesses included 30% with an entirely novel product, 35% with a significant novel enhancement and 35% with products/processes similar to, but better than, products already in existence. Uniqueness of any service provided by the businesses included those that were based on "leading-edge" knowledge (45% of the spinouts), knowledge new to the UK (10%), services not available elsewhere (15%) and standard service (30%).

An important factor involved in the technological development of UTSFs is the percentage of Qualified Scientists and Engineers (QSEs) engaged in Research and Development (R&D) in the business. From the interview survey 15% of UTSFs reported that they did not employ any QSEs, 20% reported that they employed 1-20, 35% 21-40, 5% 41-60, 15% 61-80 and 10% employed 81-100 QSEs (Table 1).

Table 1: Number of QSEs employed by UTSFs

Number of QSEs	0	1-20	21-40	41-60	61-80	81-100
Percentage of UTSFs	15	20	35	5	15	10

The total R&D expenditure by UTSFs interviewed was distributed between 21% having no R&D expenditure, 37% spending up to £50,000, 5% £50,001 - £100,000, 11% £150,001 - £500,000, and 26% over £500,001. R&D expenditure as a percentage of the total turnover was reported by 21% having no expenditure, 26% 1-10%, 21% 11-20%, 11% 21-40% and 21% 41-60%. For the thrust or direction of R&D in the businesses 15% reported that they had no significant research, 30% had product improvements, 45% an extension of existing range of products, 25% development of complementary research and 40% radical new

research. Clearly all of this expenditure is a function of both business type and size with, for example, R&D expenditure being irrelevant to a business that simply acts as a wholesaler. The number of patents or applications taken out by companies is shown in Table 2.

Table 2: Number of patents or applications taken out by UTSFs (%)

Patents	**None**	**One**	**Two**	**Three**	**Four**	**Greater than four**
Before start-up	79	0	0	16	5	0
After start-up	53	5	5	11	0	26
In last 12 months	68	5	11	0	0	16

Table 2 shows that 21% of UTSFs took out patent applications before start-up, 47% after start-up and 32% in the last 12 months before the interview survey. Patenting and protection of Intellectual Property Rights (IPR) emerged as a major issue with many of the scientific businesses. There was concern about how long it takes to protect ideas in the UK as well as the ease with which competitors can get around such protection. Some interviewees felt that it would be useful to revisit the whole area of IPR in the workshops and it was felt that this was an area where (a) expertise is expensive and difficult to access and (b) new firms need to have excellent and early advice. The approximate number of papers published by the founder(s) is shown in Table 3 opposite. The numbers of papers by founder(s) compared like-with-like since they were produced by the academics running the firms rather than the non-executive directors.

Table 3 opposite shows that fewer papers were published after start-up than before start-up for UTSFs. This is consistent with the observation that the founders become absorbed by the day-to-day demands of actually running the businesses. Two interviewees commented that it was extremely helpful to have well known (internationally regarded) academics associated with the companies. This type of link can be used at conferences and in other publicity material and in one case was a constant source of new business leads. It was suggested that prominent academics were sometimes useful when serving in a non-executive director capacity rather than as part of the everyday management team.

45% (9 out of 20) of the spinouts reported that there were gaps in the training and advice available. 45% (9 out of 20) said that there were no gaps and 10% (2 out of 20) did not know. The heterogeneity of the business types means that the range of services needed to plug these gaps was wide. Whilst it was possible to

group requirements into broad categories, the most common requests were for packages of business advice or training tailored specifically to the needs of particular firms at particular times in their stages of development.

Table 3: Number of papers published by founder(s) (%)

Papers	**0-5**	**6-10**	**11-20**	**21-30**	**More than 30**
2 to 5 years before start-up	28	22	28	22	0
Within 2 years before start-up	35	35	24	6	0
Within 2 years after start-up	63	31	6	0	0
2 to 5 years after start-up	72	17	11	0	0

There was a widespread view that the provision of much training by the public sector was 'supplied' without careful reference to actual 'demand'. Some companies felt that individuals with little or no real business experience offered 'support' services. However, since take-up was very low, actual experience of provision had not informed these beliefs in many cases. There was certainly a concern about the number of initiatives on offer and a belief that there were too many business support organisations (e.g. the overlap of Business Connect now Business Eye with the WDA) with too many new programmes and services.

Requirements for the future revolved around the need for individual, tailored support. The key in many cases was mentoring, whilst funding for new technological advances and expansion of the business, marketing advice, succession planning, help with exporting and e-commerce support were also needed.

The largest area of demand for support was in the wide field of marketing. This ranged from help with the costs associated with widening markets and actually physically undertaking marketing activity, to help with more strategic aspects of business planning and generating new opportunities and markets.

Financial support and mentoring were both seen as difficult to obtain. The former was the case primarily because of bureaucracy and red tape, the latter because of a general wariness about trusting others to give advice worth

following. These factors set up barriers to support services being able to actually deliver meaningful help.

There seemed to be some tensions within the firms since they wanted mentors but were not able to take advice. The obvious source of finance and mentoring would be through business angels but it would appear that the owner would be unwilling to take this on.

Despite a general view that Business Eye does not provide an adequate one-stop-shop, it was generally felt that there was a need for a sign posting system to point businesses in the right direction. The key, according to several interviewees, was to provide a service 'that does not compete, but helps'. Most businesses felt that the actual services provided by the WDA were good, but that they suffered from inadequate publicity, were too complex and lacked clarity. In the words of one businessman, "there may be loads of money out there for us, but no one has told me about it." The barrier to overcome was actually linking the businesses and projects with the support that was available. It is apparent that this view rehearses the 'patchwork quilt' argument, although we feel that the tension between what the businesses said they want and what they would accept is an interesting point.

The companies maintained a wide variety of both formal and informal links with many public and private sector bodies. The degree to which these links were felt to be useful, from the point of real business development, was not clear. Some useful links existed with the private sector in the form of accountants and lawyers, although often more established firms found that the business development advice dried up after the initial stages of survival and growth. Larger bodies such as the WDA were useful for specific projects or training needs, although most of the smaller companies relied on personal networks to resolve most problems.

The main forms of start-up finance were personal savings (60%) (12 out of 20), loan/overdraft from clearing bank (25%) (5 out of 20) and finance from public agency/local authority/government department (20%) (4 out of 20). In the growth phase the main forms were retained profits (40%) (8 out of 20) and loan/ overdraft from clearing bank (55%) (11 out of 20). The general picture amongst the smaller companies, especially those still based on a campus, was of a general reluctance to take on debt. Six companies from the sample had never had an overdraft. Risk aversion was the key to both the relative stability and also the growth aspirations of many UTSFs, especially those still run by academics who had contractual ties to their university. With regard to finance there are some interesting points from the findings about risk aversion here but one might expect loans to be made to firms with income flows rather than firms attempting to commercialise new technologies.

Some owner-managers felt that there were still gaps in the availability of particular forms of finance for spinout firms. The list included early stage product development grants, seed corn funding, private sector direct finance, finance for routine as well as "new ideas", venture capital finance, start-up grants, soft loans and a Welsh Innovation Fund. Given that many of these types of package were

actually available from the supply side of the market now, these observations highlighted the need for yet more work to be done to overcome the informational asymmetries that still exist.

In common with most small businesses, the founders of UTSFs felt that it was important to build up a range of both general and specific skills. Prior to formation the usual list of business, financial, people handling, marketing and legal skills were all seen as important. However, a constant over arching theme was the need to be determined to see the business succeed come what may. Almost all of the interviewees felt that 'grit and determination' was more important than any set of theoretical business tools.

Telephone interviews with eight academics who provide consultancy services to outside companies and agencies, but who have not created businesses, were also carried out. These interviews highlighted the following factors as important reasons for their decision: job security, risk aversion, pension rights, family concerns and university regulations. In some cases it seems that the 'regime' of a particular university allowed academics to earn extra monies from consultancy, over and above their normal salary. This tended to be the case with the older universities who had consultancy terms written into contracts. Often a few thousand pounds, which paid for a new car or better holidays etc., was sufficient and the consultants felt no inclination to take their business further. In other cases, universities were seen to provide little or no support for academics who wanted to pursue a new business idea.

These cases were rare and the consensus of opinion was that it was the lack of desire by the academic community themselves to create new business that explained the low number of firm creations. The psyche and make-up of the typical academic was such that they were not (in general) the types of people who were driven to do this sort of thing. This conclusion was not new, as the initial research made clear.

A telephone interview with one firm, formed in England by academics who left Wales, revealed family reasons for the decision not to start in Wales. Further exploration revealed a belief that these entrepreneurs saw no difference between doing business in South Wales to anywhere else. When asked if anything would attract them to relocate back into Wales, the only answer received linked return to rather large financial inducements.

To some extent the interviews confirmed the recommendations of the initial research. There was a market for the future development and encouragement of UTSFs from Welsh university campuses, particularly amongst undergraduates, postgraduates and academic staff. It needs to be recognised that informed experience in starting up enterprises from universities was not prescriptive and flexibility was required for the various university environments in Wales. Although there was no single successful model for UTSFs, there were a number of factors applicable to the successful development of these firms in ISW and beyond.

It is clearly the case that universities can contribute to the local, regional and national economy by being committed to UTSFs. There needs to be a general awareness to starting up enterprises both on and off campus. This culture needs to be instilled right from the research worker to the vice-chancellor.

Funds should be made more readily available, for up to two years, to help develop firms to a stage where they can be self-sufficient. Also specialist venture funds should be made available for growth after incubation and soft start. To help UTSFs develop an environment where they can obtain technical, administration, accountancy, legal and marketing advice, some free services should be provided. Technologies need to be properly protected where intellectual property rights are concerned.

Perhaps the most important recommendation is that although there are support services available for UTSFs to use and there are specific programmes there needs to be proper co-ordination in terms of the help and advice being provided. In these terms the WDA needs to act in a co-ordinating role to bring together all the different initiatives, programmes and schemes (both public and private) available to UTSFs through a single point of contact that is readily accessible to UTSFs in their various stages of growth. These assertions about funding and the role of the WDA are evidenced by the plethora of different forms of support and the confusion regarding what to apply for (one industrial liaison officer had identified many mainstream programmes applicable to UTSFs in Wales that could be approached). This provided strong evidence to the authors as to why, for example, although the firms were capable of getting loans they were unable to do so and this underlined the case for the state supporting companies.

4. Experiences of Firms Attending the Group Meetings and Networking Events

The findings of the detailed interviews with UTSFs in ISW formed the basis for the development of the group meetings and networking events. Following the initial evaluation work, a database of UTSFs was established and from this firms were identified and asked to participate in further networking events. It was recognised that high technology academics are likely to be enmeshed in research networks but lower technology firms might not be. The networks established were based on workshops for firms that were experiencing similar problems albeit in different technology bases. In addition the firms were in different technologies, so, they were not clusters. In order to facilitate networking an Intranet was set up by the WDA. The major issues uncovered by the interviews formed the main themes of the workshops for the second part of the project. The series of four workshops (October 2000 and January, April and October 2001) focused on the particular needs of businesses, providing practical marketing solutions, finance and funding, and marketing and selling. Building on the Linköping model these

were facilitated by experienced practitioners involved with high technology entrepreneurs and supported by members of the WEI.

The first workshop held in October 2000 focused on particular needs of the businesses and the major theme to emerge from the final discussion of the workshop was that of marketing which was the focus of the second workshop in January 2001. Following the discussion of issues and the completion of a feedback form at the end of the second workshop it was decided that the third workshop would be concerned with finance and funding in April 2001. To continue the project the third workshop involved five speakers from Finance Wales, Cardiff County Council, Welsh European Funding Office, Echa Microbiology Limited, and the Innovation and Technology Counselling Service in Wales. The third workshop was concluded by the discussion of issues that needed to be tackled at the last workshop. In order to determine the most appropriate topics for demand led sessions it was agreed that delegates would make suggestions on the feedback form, which had been provided for completion at the end of the workshop. From the feedback received it was decided that the final workshop would consider marketing and selling.

Table 4 shows the attendance at the four workshops for the owner-managers and the firms involved.

Table 4: Attendance at Workshops, October 2000 and January, April and October 2001

Workshop	**Number of Owner-Managers**	**Number of Firms**
First	19	15
Second	18	12
Third	17	14
Fourth	22	16
Total	76	57
Average	19	14

The total number of owner-managers attending the four workshops between October 2000 and October 2001 was 76 with 57 firms involved. This gave average figures of 19 and 14 for attendance by owner-managers and firms respectively.

There was a clear dissatisfaction with the many forms of business support provided/supplied by public sector organisations. It was found that requirements for the future revolved around the need for individual, tailored support. The key in many cases was seen to be mentoring, whilst funding for business expansion,

marketing advice, succession planning, help with exporting and e-commerce support were also needed.

The largest area of demand for support was in the field of marketing. Financial support and business mentoring were both seen as difficult to obtain by the firms. It was generally felt that there was a need for a 'sign posting' system to point businesses in the right direction. For example, start-up finance was seen as particularly difficult to find. The general picture amongst smaller companies, especially those still based on a campus, was of a general reluctance to take on debt. Some owner-managers felt that there were still gaps in the availability of particular forms of finance for UTSFs. Almost all of the companies felt that 'grit and determination' was more important than any set of theoretical business tools. Universities were seen to provide little or no support for academics who wanted to pursue a new business idea and the consensus of opinion was that there was the lack of desire by the academic community themselves to create new business.

It was recommended that those themes yet to be arranged for workshops, such as patenting, licensing, premises, how to either sell or hand on the company, mentoring, funding for business expansion, succession planning, help with exporting and e-commerce, should be considered for future events.

5. Conclusions

The causes of financial market failure can arise for many reasons and these may take the form of tax problems, late payment, administration burdens, lack of finance and information provisions (Storey, 2002). These are not only related to SMEs but also university spinout ventures in particular. With spinout companies market failures may be associated with R&D and learning through experience. This will especially be the case when R&D from universities may be too expensive to recreate under market conditions or is not appropriate to the market situation. Also, there may be little experience of learning by doing from the academic environment as evidenced by the spinout founders leading to naïve market approaches with consequent market failure. There is therefore the need for identification of market failure by policy makers with appropriate government intervention to make things 'better'. This is especially evidenced in programmes derived from public policies to support small businesses.

In these terms the approach described by Storey (2002) to evaluate the impact of public policies to support small businesses in developed economies is appropriate to this study. Since the SEED spinout project was a 'pilot' it can be seen to fall short of the more ambitious objectives of other government programmes such as 'creating an enterprising society' or 'maximising SMEs' contribution to economic development'. These sorts of objectives are more in line with the Wales Spinout programme which followed the SEED project, although on a smaller scale to larger programmes. This is illustrated in Table 5 opposite.

Clearly the Spinout Programme has had a major impact on the generation of spinout companies with 19 being formed in 19 months from 2000-2001 with the associated employment creation, use of technology and increase in wealth.

With regard to the six steps advocated by Storey (2002) it is apparent that the SEED project fulfils the requirements of the criteria specified in steps I-III but does not satisfy those for steps IV-VI. The SEED study therefore has not attempted to demonstrate analytical rigour, to determine the impact of the spinout policy initiatives. This is simply the fact that there were no real explicit policy initiatives during the 1990s which formed the period of study for the SEED project. In fact, with the introduction of the Spinout Programme, as an explicit initiative, following the influence of the findings of the SEED project on WDA policy makers in 2000, this led to the creation of more spinout companies in the 19 months of the programme, as measured in Table 5, than during the 10 years of spinout activity reported by the SEED project in the 1990s. Due to these limitations it can be concluded that in order to attempt to evaluate spinout activity in Wales in line with the six steps enunciated by Storey (2002) there is a need for further, and up to date, research to not only monitor (steps I to III), concerning what has happened since 2001, but also to evaluate (steps IV to VI) in accordance with this framework. It is therefore necessary to accept the limitations of the methodological approach described in this paper and to note with caution/ qualification the policy recommendations made. Therefore, the findings presented should be received bearing in mind that they fulfil the first three steps of Storey (2002). It is hoped that future work will be able to extend this study in line with the other three steps.

Table 5: A comparison of the Findings of the Spinout Programme 2000-2001 and SEED Project 1990-1999 in Wales

HEI	**Number of Spinouts in 19 months 2000-2001 (Costigan, 2001)**	**Number of Spinouts in 9 years 1990-1999 (Jones-Evans et al, 2000)**
Cardiff	3	2
Glamorgan	1	3
Cardiff School of Medicine	3	2
Swansea	7	9
Bangor and NEWI	3	1
Aberystwyth and Lampeter	2	0
Total	19	17

This study has outlined the apparent effect of policy on spinout companies in Wales. It is pertinent to note that there was no control group utilised and the impact of policy has therefore not been measured through the project. Although we are not advocating that policy is the single contribution to assistance to the firms in the study since other factors may have also contributed to influences on the firms. The recommendation to the WDA would be to implement an evaluation stage that addresses the shortcomings of the study of the SEED project in order to measure the impact of the initiative. Since the policy was already in place for the SEED project it was not possible for this study to evaluate the programme. A future study would be able to consider the performance of spinout companies referenced with firms that have not been assisted but broadly of a similar nature taking into account selection bias. This needs to be undertaken bearing in mind that there is a need for the UK government to clearly define the objectives of SME policy involving measurable targets (Storey, 2002). It is apparent that many policy programmes are monitored rather than evaluated. This can be overcome by ensuring this activity is included in plans to attain either a 5 or 6 stage of evaluation according to the Storey (2002) process. By doing this it is possible to be involved with the appraisal procedure before policies are introduced.

This paper has assessed the existing knowledge, detailed information and recommendations for future action for supporting UTSFs in ISW. These businesses are companies whose activities are based on technologies developed as a result of academic research programmes in Wales. Such companies are significant in a local Welsh economic development context, since they are likely to lead to the commercialisation of research in fairly close proximity to the Welsh HEI involved. This has benefit for both the local economy and the HEI itself. Risks and problems in forming and growing UTSFs in ISW must not be underestimated, and it is important to recognise that they represent a significant route to the commercial exploitation of new ideas and technologies. In appropriate circumstances they can make an important contribution to regional and national prosperity. A critical challenge for Welsh HEIs is to ensure that where a firm is an appropriate vehicle, it is properly managed and there are structures to enable its true potential to be realised.

A myriad of factors affects the attractiveness and viability of UTSFs. The Welsh university research and consultancy environments do little at the moment to encourage academics towards commercialisation of their research work. As a result academic researchers considering the formation of a business from their research see the process as difficult. This perception is borne out by the experience of those who start-up. Factors, which have a bearing on this situation in ISW, are rooted in the existing Welsh academic culture and university resource allocation. Change is needed prompted by the fundamental reappraisal of the higher education system by the Dearing Report (1997) and aided by initiatives like ‘Know-How’ Wales (WO, 1998 & 1999) and TOPSPIN.

Finance has emerged as a constraint on the development of UTSFs in ISW and comparisons with the United States experience are illuminating. For example, effective interaction between the financial and academic communities in the Boston Area (Downes and Eadie, 1998) has produced a greater degree of understanding and communication than is evident in ISW. In order to achieve this there is a need for a radical approach to university businesses involving strong drivers to support developmental start-up change as expressed in the introduction to this paper. In these terms the Entrepreneurship Action Plan for Wales (1999) will contribute to this process.

The clear finding of this research is that insufficient attention has been paid to the economic development potential of UTSFs in ISW. The overwhelming evidence from other developed regions and countries is that vibrant university business activity has significant positive multiplier effects. To some degree this potential has been overlooked in Wales. With so many HEIs housing advanced scientific and technological expertise the woeful number of successful new businesses created either by or for the academic community only serves to emphasise how much work remains to be done by the policy makers. Clearly the public sector in Wales has undergone a significant shake-up over the past few years. The newly devolved National Assembly, which has overall responsibility for economic development, has not yet had sufficient time to develop a range of workable policies. This has been accompanied by the formation of a new merged WDA covering the whole of Wales, which now has responsibility for enterprise and small business support. This function has been acquired from the old TECs, the rump of which now forms ELWa, a national body responsible for training and education. To say this has caused confusion is understating the case. Whilst all of these bodies grapple with their respective corporate strategies, individual development themes such as UTSFs appear to take a back seat. Only when strategic direction is given from the centre is it likely that these serious issues will receive the attention they deserve.

With regard to policy recommendations a single factor likely to bring about change in ISW is the recognition that UTSFs not only have a role to play in creating and sustaining a dynamic and prosperous Welsh economy they also represent attractive opportunities for venture capitalists, and may show considerable financial and other returns for the Welsh HEIs from which they emerge. There is a market for the future development and encouragement of UTSFs from university campuses in ISW, particularly amongst undergraduates, postgraduates and academic staff. Informed experience in starting up businesses from universities is not prescriptive and flexibility is required for the various university environments in ISW. Although there are support services and specific programmes available for UTSFs, there needs to be proper co-ordination in terms of the help and advice provided.

The project has provided evidence that indicates that spending tax payers' money on this type of initiative is welfare enhancing and leads to a net benefit.

This is on the basis that the SEED project was supported through European ERDF funding aimed at helping poorer regions in Europe such as ISW.

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