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# The Management of University Business Partnerships in the UK with Special Reference to Wales

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**Abstract:** This study investigates trends and developments in the management of University business partnerships in Wales and benchmarks these against other universities in the United Kingdom (UK). The research documents links universities have with companies in terms of industrial research, Knowledge Transfer Partnerships (KTPs) and other forms of external collaborative partnerships, what these links are and who they are with. Comparison is made between universities in order to benchmark and assess “good/best practice” and potential barriers. Consideration of the commercialisation of Intellectual Property (IP) is undertaken with insights for improvements. Recommendations to improve the management of university Knowledge Transfer (KT) are given.

**Key words:** benchmarking, university, business, partnerships

## 1. INTRODUCTION

This paper investigates the current understanding of the management of the links universities have with companies in terms of industrial research and other forms of external collaborative partnerships, what these links are and who they are with. This has involved an internal study followed by an external assessment. Comparison has been made between universities in order to assess “good/best practice” and potential barriers.

The paper seeks to answer a number of questions regarding University Intellectual Property (IP) and business partnerships. These include what is the nature of the management of university business

partnerships and what types of companies are they with? How does the portfolio of collaborative research at a university compare with other universities and how do they manage similar interactions? The objectives of the paper are to provide accurate information on university business partnerships for business professionals, industrial policy makers, management students, researchers and academicians.

A number of university business partnerships have been identified by the Association for University Research and Industry Links (AURIL) (2001) (Figure 1).

**Figure 1: AURIL Model of University Business Partnerships**

Contract research
Collaborative research
Sponsored research
Other research links associated with third party funding
Postgraduate studentships
Student projects and placements
Sponsored and honorary posts and secondments
University consultancy and associated commercial services
Clubs and networks

Source: AURIL, 2001

In comparison with this the model of university business partnerships in Wales investigated in this research is illustrated in Figure 2.



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**Figure 2: Model of University Business Partnerships investigated in Wales**

Collaborative research
Contract research
Consultancy
Contracts
Patents filed
Intellectual property income
Spin off activity

Although there are many forms of university business partnerships the AURIL model attempts to capture the main types which vary according to the way universities and businesses define institutional goals, manage resources and deal with outcomes and benefits (AURIL, 2001). The findings regarding the management of the main types of university business partnerships are elucidated in terms of this model and are compared with typical models identified from other universities in the UK. In order to set the scene for the analysis of the findings the literature is initially investigated in terms of the characteristics of university business partnerships.

## 2. Literature Review

### 2.1 The nature of University Business Partnerships

University/business collaboration has had an extensive history (Bower, 1993) and there has been a considerable increase in these types of partnerships in the United Kingdom (Duggan, 1997; Powers, 2003), European Union (Caloghirou et al, 2001) and the United States (Baldwin and Link, 1998; Mansfield, 1998), for example. Such an increase is believed to be due to a combination of pressures on both universities and businesses (Meyer-Krahmer and Schmock, 1998; Santoro, 2000). For universities pressures include rising costs, funding and the growth of new knowledge – these have resulted in resource pressures on universities who have sought relationships with businesses to maintain subject area market leadership (Hagen, 2002; Nimtz et al, 1995). For businesses pressures include global competition, short product life cycles and technological change (which have transformed their competitive environment) (Ali, 1994; Bettis and Hitt, 1995). Due to societal pressure on universities they are seen as “engines for economic growth” rather than their past social remit (Blumenthal, 2003; Cohen et al, 1998). Pressures such as these have led to university/business collaborations for the enhancement of economic competitiveness and innovation (Ankrah, 2007). Within this context Autio and Laamanen (1995) talk about “the ability

to recognise technical problems, the ability to develop new concepts and tangible solutions to technical problems, the concepts and tangibles developed to solve technical problems, and the ability to exploit the concepts and tangibles in an effective way” (p. 647). Further to this, knowledge transfer is considered different to technology transfer since knowledge transfer is a wider set of activities than technology transfer (Gopalakrishnan and Santoro, 2004). Technology transfer is viewed as an exchange process by Burati and Penco (2001) where a collaborative venture transpires involving a technology donor and recipient working in partnership to adapt and develop technologies (with the aim of dealing with the customisation of technology required to develop specific applications, applying new technology to create value for the recipient taking into account both internal and external factors, and the needs of potential users).

According to Ankrah (2007) there is a large amount of research on university – industry partnerships especially with regard to technology and knowledge transfer. As a consequence considerable literature is in existence regarding mechanisms developed for interaction between industry and university and collaborative outcomes (Ankrah, 2007). There is also considerable literature available regarding the university/business relationship. Furthermore, what has been published could be described as ad hoc in nature (Ankrah, 2007) and also on a regional basis (Smilor et al, 1990). The nature of the literature shows that co-operation between universities and industry was considered to be less important before 1990 than after (Howells and Nedeva, 2003; Nimtz et al, 1995; Poyago-Theotoky et al, 2002). Since university – industry, and particularly university – business relationships are evolving, contemporary papers build on the findings of the early literature (Blumenthal, 2003; Geisler, 1995; Howells et al, 1998, Newberg and Dunn, 2002). This literature review therefore seeks to answer the research question “what is the nature of the management of the university/business relationship?”

## 2.2 Organisational aspects of university/business collaboration

Various types of inter-organisational relationships undertaken in practice are reported in the literature and these include interlocking directorates, trade associations, alliances, consortia, networks and joint ventures and these vary according to partnership linkages (Barringer and Harrison, 2000). In fact, it has been observed that in the literature a number of terms are used to describe the different inter-organisational relationships

(Chiesa and Manzini, 1998). Furthermore, it is concurred that co-operative arrangements take various forms to a varying degree of complexity and partner involvement (Geisler, 1997). Indeed, it is posited that the possibility for university - industry relationships are fairly wide (Shenhar, 1993). Moreover, forms of university - industry inter-organisational relationships in the case of technology transfer occur according to the technology flow and the length of the relationship (Figure 3) (Chen, 1994).

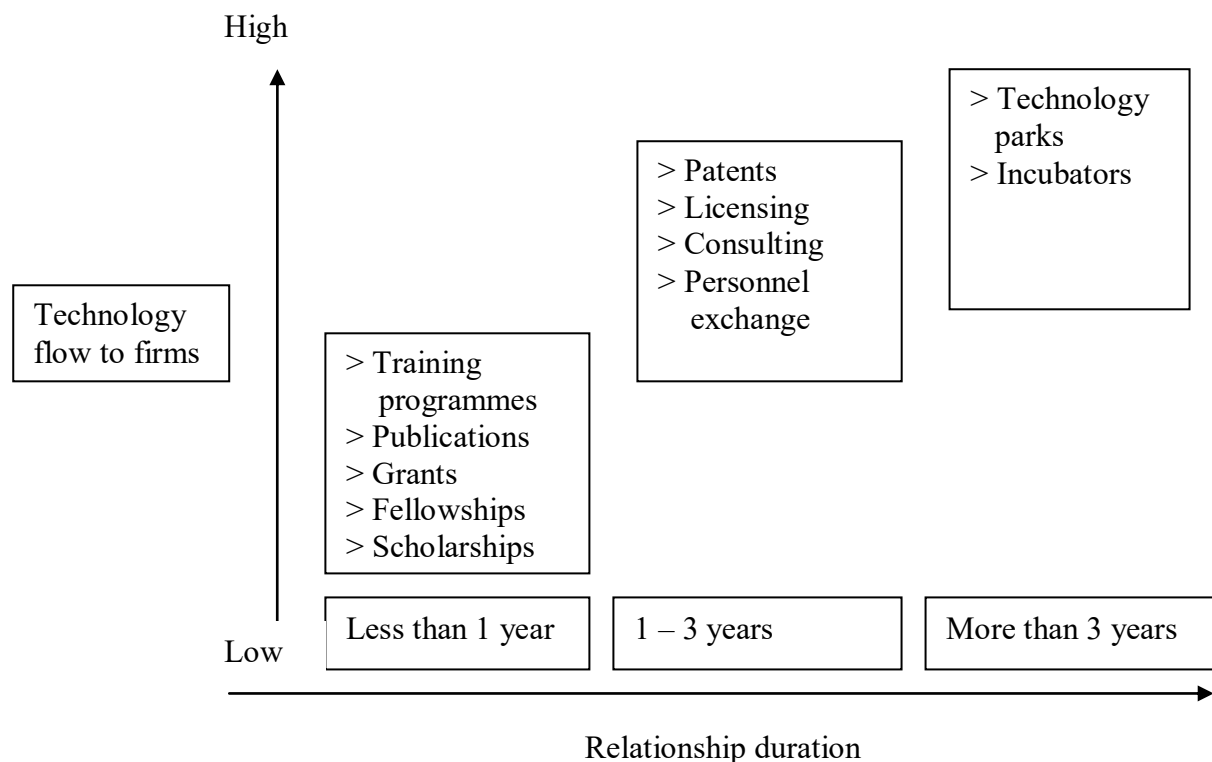


Figure 3: Technology transfer mechanisms (Source: Chen, 1994, p. 451)

Four classifications for university industry inter-organisational relationships have been given and these are research support, co-operative research, knowledge transfer and technology transfer (Santoro, 2000). Research support includes endowments and trust funds, co-operative research - informal intentions, institutional facilities, group arrangements, institutional agreements, knowledge transfer - co-operative education, institutional programmes, personal interactions and technology transfer - commercialisation activities and product development through research centres at universities (Santoro, 2000).

It is considered that the creation of a typology that illustrates the possible links between universities

and industry, and more specifically between universities and businesses, is not easy (Blackman and Seagal, 1991). Furthermore, the framework of Bonarccorsi and Piccaluga (1994) is reasonably wide and consists of the categories of the creation of focused structures, formal non targeted agreements, formal targeted agreements, personal informal relationships and personal formal relationships. It is noted by Boanarccorsi and Piccaluga (1994) that these six groups provide an increasing involvement level according to the degree of formalisation, length of agreement and organisational resource involvement from the university. In fact a university's resource involvement progresses from formal personal relationships through the categories to focused

structures where there is a university wide involvement in industry collaboration structures (Bonarccorsi and Piccaluga, 1994).

Formalisation of agreement can exist for personal formal relationships and third parties whilst in remaining groupings formalised relations are evident (Bonarccorsi and Picaluga, 1994). The issue of formalisation is considered to be significant since formalisation and monitoring of inter-organisational relationships can cause disagreement and loss of trust amongst partners through them attempting to retain independence for their organisations in a situation where interdependence is increasing (Ring and van de Ven, 1994).

### **2.3 Motivations for university/business relationships**

From the literature on inter-organisational relationships between 1960 and 1990 six critical contingencies have been posited by Oliver (1990) across linkages, settings and organisations and these are necessity, asymmetry, reciprocity, efficiency, stability and legitimacy (Oliver, 1990). According to Oliver (1990) two delimiting assumptions are behind the determinants which are that deliberate decisions are assumed to be made to form an inter-organisational relationship by organisations and an organisational perspective involving a top management approach is assumed (the determinants can also explain lower reasons) (Oliver, 1990). The six contingencies show strong correlation with alliance strategy motives (Eisenhardt and Schoonhoven, 1996). Motivations for universities and businesses engaged in inter-organisational relationships appear to closely align with the six critical contingencies/determinants (Oliver, 1990) as motives for organisations to embrace inter-organisational relationships.

Many governments are encouraging collaboration between universities and businesses, in a situation of rapid technological change and international competition, for wealth creation through improving innovative activity (Barnes et al, 2002; Schartinger et al, 2001). It appears that a significant issue for policy making by governments, especially with regard to research council budgets, is the operation of the university - industry interface to enable the exploitation of research to be transferred to industry for economic growth (Hall, 2004; Lopez-Martinez et al, 1994). Universities therefore encourage university - industry relationships in accordance with government and institutional policy (Howells et al, 1998). Whereas industry offers expertise in product development, commercialisation, market knowledge (Sherwood et al, 1994) and employment openings for graduates (Lee and Win, 2004; Santoro and Betts,

2002) universities offer research infrastructure and expertise (Sherwood et al, 2004). Therefore, in order to take advantage of these mutual advantages, there is motivation for universities to develop relationships with industry (Ankrah, 2007).

Increasing pressure on public finance for universities, against a background of government grants for university industry initiatives (Harman and Sherwell, 2002), has given an incentive for universities to look for other revenue to fund research and equipment. This has been through the exploitation of intellectual property rights, licensing of patents and the commercialisation of research to reduce university dependence on public funds (Logar et al, 2001). It has also been reported that relationships with industry appeal to universities since there is more bureaucracy involved with public funding than with industrial funding (Blumenthal, 2003; Santoro and Chakrabarti, 1999). It has also been reported that academic staff are motivated to enter into relationships with industry through personal financial gain (Siegel et al, 2003; Siegel et al, 2004).

It has been found that organisations are motivated to enter into inter-organisational relationships to attain dependability and predictability in order to respond to environmental uncertainty (Oliver, 1990). Related motivations have included the shift to the knowledge based economy and the change in university industry relationships to partnerships from sponsorship involving ongoing interaction (Jacob et al, 2000). Considerable resource pressure has affected universities due to the growth in new knowledge which has resulted in universities entering into alliances with industry to stay at the forefront of academic areas in terms of subjects and research (Ankrah, 2007). In particular university academics consider such links to provide opportunities to enable them to train and place students, develop skills, and develop and test theories (Cyert and Goodman, 1997). It has also been posited that universities undertake collaborative arrangements with industry, including businesses, to enable students and academics to solve practical problems through project work, undertake instructional case studies, gain insights from industrial research and to gain exposure to industrial environments (Meyer-Krahmer and Schmoch, 1998; Santoro and Chakrabarti, 2001). These activities contribute to the improvement of teaching quality and curriculum development (Santoro and Gopalakrishnan, 2001; Meyer-Krahmer and Schmoch, 1998). Moreover, it has been suggested that a significant incentive for Higher Education Institutions (HEIs) to partner with industry, including businesses, is for journal publications (Harman and Sherwell, 2002).

Due to the need for universities to enhance their image they will form relationships with industry (Lopez-Martinez et al, 1994; Mora-Valentin, 2000) and there are societal political and public pressures for them to show their economic relevance to society and to exhibit entrepreneurship and social accountability (Cohen et al, 1998). Through the need for knowledge and technology transfer, and diffusion, they will be motivated to enter into collaboration with industry in order to drive economic development (Blumenthal, 2003; Hagen, 2002; Siegal et al, 2003; 2004). In relation to this it has been found that a fundamental motive of scientists in universities is for recognition in the industrial scientific community (Hagstrom, 1965) and this can be achieved by research grants, presentations at international conferences and joint publications (academic eminence can be achieved through industry supporting university research) (Siegal, et al, 2003; 2004).

Due to the fast changing technological and competitive environment governments have taken action to support research interaction between universities and businesses since it is considered that universities can support economic regeneration and act as engines of economic growth through dissemination of expertise and knowledge by higher education industry linked partnerships (Bettis and Hitt, 1995; Mora-Valentin, 2000). National and regional research programmes have been created by governments and a good example of these in the UK are the Knowledge Transfer Partnerships (KTPs) (Caloghirou et al, 2001) and businesses can benefit from these programmes through collaboration with universities (Howells et al, 1998).

Motivation for businesses to enter into inter-organisational relationships with universities is for financial gain from the commercialisation of academic based technologies and many businesses will require exclusive rights to technologies (Siegel et al, 2003). Industry is therefore interested in controlling the direction of academic research as well as control of the technologies generated (Newberg and Dunn, 2002; Rappert et al, 1999; Siegel et al, 2003). Other motivations for firms to subscribe to university - industry inter-organisational relationships are to have access to students and for hiring and most collaborative research programmes will seek to target the most able students (Bloedon and Stokes, 1994). According to the OECD (1990) university staff and senior researchers will undertake consultancy work for the time they are allowed to undertake activities outside academia.

There will be several motivations for businesses to

have inter-organisational relationships with universities from a standpoint of efficiency (Ankrah, 2007). It has been reported that university - industry research increases patenting activity, research and development (R&D) and firm sales (Cohen et al, 1998). Businesses will partner with HEIs for knowledge creation and exploitation, cost savings, innovative activity and research outputs (George et al, 2002). This will result in businesses having competitive advantage and improved financial performance (Grant, 1996). The enhancement of R&D and technology growth through grants, tax credits and a legal environment underpinning R&D is another motivation for government (Barnes et al, 2002; Bramorski and Madan, 1993). Continuing professional development (CPD), multidisciplinary leading technologies, advanced expertise and research facilities as part of human capital development will also be industrial motives since there will be enhanced competitive advantage and the shortening of life cycles (Bonaccorsi and Piccaluga, 1994).

The move to the knowledge based economy has been considered to be an influencing factor for businesses to enter into relationships with universities (Santoro and Betts, 2002). It has also been concluded that academic research has augmented the ability of businesses to resolve complicated problems (Pavitt, 1998). According to Howells et al (1988) and Klofsten and Jones-Evans (1996) university – industry partnerships are a good way of influencing technology based firms, especially businesses to achieve growth. Lopez-Martinez et al (1994), in their study on university - industry relationships, have illustrated that the lack of in-house ability by industry to undertake technological research has been an important business executive motivation. It has also been found that for firms with an R&D capacity collaboration is still appreciated since it enhances limited human and financial resources and reduces risk (Hicks, 1993). Research networks with other universities and firms and the potential for more complicated collaborative arrangements such as consortia with multiple businesses and universities are a motivation for businesses to enter into inter-organisational relationships with universities (George et al, 2002; Cyert and Goodman, 1997).

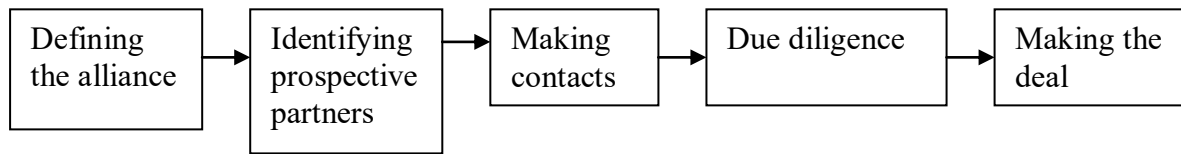
It has also been found that businesses can improve their standing by associating themselves with leading universities (Siegel et al, 2003) and links with prominent research universities are believed to increase a firm's position with regard to important stakeholders (Mian, 1997).

#### **2.4 Formation Process**

Out of the models on the process of inter-organisational relationship formation (Tuten and

Urban, 2001) a model which is believed to be relevant for university – industry inter-organisational relationships formation is the

Mitushashi (2002) business to business alliance formation model which describes a five stage alliance formation process (Figure 4).



**Figure 4: The Alliance Formation Process (Source: Mitsuhashi, 2002, p. 113)**

The initial stage in the formation of a university – business inter-organisational relationship is the determination of the purpose of the partnership and this will be followed by finding an actual partner (Mead et al, 1999) and a number of criteria have been proposed for the selection of partners (Champness, 2000; Dodgson, 1991). It is, however, believed that efforts should be made to undertake prospective partner evaluation, no matter what partner selection criteria are adopted, since there are benefits including ensuring that the collaboration is appropriate (Barnes et al, 2002).

It has been found that if partners have previous experiences of co-operation then the outcomes of inter-organisational relationships are better (Dill, 1990; Geisler, 1995). Existing relationships between partners are crucial since, where experience with an existing partner exists, trust will be developed and universities and businesses will adjust to the demands, evolution and expectations of previous alliances (Gulati and Gargiolu, 1999). Previous collaboration experience (Schartinger et al, 2001) will be important from earlier research, technological and personal interactions and this will reduce organisational and personal obstacles and enhance contact between universities and businesses.

During the formation stage it is critical to define administrative and managerial responsibilities for the inter-organisational relationship, involving financial accountability, and a suitable partnership objective is for the partners to select a project manager (equal collaborative participation by partners will be important) (Peterson, 1995). A project plan needs to be agreed by partners with the specification of milestones (Buttrick, 2000). Differences between partners should be dealt with to avoid collaboration conflict, specification of interim, and end delivery provided, and measures of success identified (Peterson, 1995).

Depending on the complex and formal nature of the inter-organisational relationship it will be essential

to have it legally bound by a contract to underline the commitment of the partners (Kanter, 1994; Burnham, 1997). For the inter-organisational relationship of universities and businesses the intellectual property agreement will be the same as the legal document and will specify partner agreements and relationships during, and after, the project collaboration approved by partners (Ankrah, 2007).

## 2.5 University/business Inter-organisational relationships

The university and business inter-organisational relationship will enter the operational stage (Sherwood et al, 2004) following its formation and this involves a constant evolutionary and learning process (several factors will influence this relationship) (Doz, 1996; Ritter and Gemünden, 2003). A number of activities will take place between the organisations during the operational phase and these will have the objective of attaining the goals of the inter-organisational relationship (Ritter and Gemünden, 2003). In the literature a number of factors are found to induce or restrict inter-organisational relationships between universities and industry (Azaroff, 1982; Dean, 1981; Fowler, 1984). These include capacity and resources, legal issues, institutional policies and contractual mechanisms, management and organisational issues, issues relating to the technology, political issues, social issues and other issues (Ankrah, 2007). The complex interaction of these factors, with the resultant positive and negative impacts, will determine the success of a collaborative project (Barnes et al, 2002). In particular, managerial and organisational issues are critical factors inducing or restricting relationships between universities and businesses (Siegel et al, 2003). It is also considered that substantial managerial effort is needed for university and industry inter-organisational relationships to succeed taking into account the cultural nature of the partners concerned (Dodgson, 1991).

## partnerships

### 2.6 Overview of the university/business inter-organisational relationship

With regard to the research question “what is the nature of the management of the university/business inter-organisational relationship?” a number of typologies have been developed to express the diversity of relationships that may be employed in the collaborative process. Freeman (1991) distinguishes between the following: joint ventures and research corporations; joint R&D agreements; technology exchange agreements; direct investment motivated by technology factors; licensing and second-sourcing agreements; sub-contracting, production-sharing and supplier networks; government-sponsored joint research programmes; computerised data-banks for technical and scientific interchange; and informal or personal networks.

Although there have been many studies indicating the importance of formal relationships for the transfer of technology, a number of recent investigations have also highlighted the key role played by informal relationships as a means for sourcing ideas and information during the development process (Kreiner and Schulz, 1993; Shaw, 1997). However, in relation to informal exchange, this research has typically been anecdotal in nature. This view is supported by Freeman (1991) who argues that ‘although rarely measured systematically...informal networks are extremely important, but very hard to classify and measure’. More in-depth and systematic studies of informal interaction in the innovation process do exist, but these have been largely exploratory and have not been examined in different regional or technological contexts.

It has been noted in the literature that closely related to the subsequent benefits realised are the motivations (Geisler, 1995; Lee, 2000). There is also evidence that there is a positive relationship between outcomes and motivations (Lee, 2000). Although the benefits of university and business inter-organisational relationships will outweigh any costs it is necessary for both sides to be aware of any limitations so that action can be taken to alleviate any problems through management procedures and policies (Harman and Sherwell, 2002). By doing this it will be possible to ensure that the relationship is successful and to make failure less likely (Ankrah, 2007). This will also ensure that the goals of both universities and businesses are met (Harman and Sherwell, 2002).

### 2.7 Analysis of the latest literature concerning the management of university business

A recent review of business university collaboration (Wilson Report, 2012) has reported considerable progress in the cooperation of universities and businesses over the last decade. This has been evidenced through three main methods to stimulate university and business collaboration involving change through good management to improve an institution’s performance to achieve objectives, indirect and direct funding incentives, and regulatory requirements (Wilson Report, 2012). An example of this was the Confederation of British Industry taskforce report (CBI, 2009) which set an agenda to improve the collaboration of universities and businesses. Moreover, businesses appear to value partnership collaboration with universities to a greater extent than linear IP innovation process transactions (Perkmann and Walsh, 2007). Contrary to many universities’ approach to knowledge exchange much contact between external organisations and academics involves direct contact between the academic and the business rather than the university technology transfer or knowledge exchange office (PACEC/CBR, 2011). Here networks between industry and academics are important and a recent study has indicated that some 40% of academics interact with businesses in this way (Abreu et al, 2009). Although these types of collaborations and partnerships in the past have been through personal relationships and ad hoc types of cooperation (Melese et al, 2009), individuals have had to be involved in the early stage development of technologies by businesses and universities (Termouth and Garner, 2009). Further to the activities of individuals secondments, internships and placements are also considered to be good ways to enhance knowledge exchange (CBI, 2009), although secondments for post doctoral researchers has been low (CROS, 2011) and academics tend to be limited in their availability for placements (Wilson, 2012). With regard to global innovation environments a HEFCE study reported that higher education centres of excellence can offer access to expertise by providing networking opportunities and interactions with corporate partners being made aware of centre technical themes (Knee and Meyer, 2007). The establishment of a network of centres to commercialise research in the UK was advocated by the Dyson (2010) and Hauser (2010) reports which would aid the development of business sectors by facilities with public subsidies similar to the Fraunhofer German institutes although offering greater university business collaboration. This was realised through the announcement of funding for 6 technology and innovation centres (TiCs) in 2011 (TSB, 2011). The analysis of the latest literature illustrates that there has been much progress in the



management of university business partnerships built upon the original developments evidenced in previous studies and this is further substantiated through the research findings of this study.

### 3. Research Methodology

The research has been carried out in three stages and has used the most appropriate methodology to address the main research question - what is the nature of the management of university business partnerships and what types of companies are they with?

Stage 1: The nature of the management of University Business Partnerships

This has involved a general analysis from the literature and a specific analysis of universities in terms of the present policy, procedures and management and comparison with other universities.

Stage 2: Benchmarking and Indicators

Through the use of indicators it is possible to benchmark a university against other universities in terms of collaborative research, contract research, consultancy contracts, disclosures of inventions, patents filed, IP income and spin-off activity. This has been undertaken by comparing universities in Wales and also taking into account the average figures for Wales and the UK. Data has been obtained from the Higher education-business and community interaction survey (HE-BCIS). It is reported that Higher Education Institutions (HEIs) provide more than £1 billion a year in gross expenditure to the economy in Wales and in addition to their education role they make an important economic contribution. In particular businesses can access expertise and technology from the local HEI. HE-BCIS is undertaken on an annual basis and investigates the transfer of knowledge between the university environment and business and the community. This informs the nature of Third Mission activity that HEIs and funding bodies undertake. Financial and output data is collected on a yearly basis for the survey and from the results activities such as the commercialisation of knowledge, consultancy and services are measured. Published in 2001 the first survey reported data for 1999-2000. The latest survey shows that HEIs in the UK attracted £2.96 billion from business and the community which was a 5.5 per cent increase from the previous year.

Stage 3: The state of the University-industry relationships in terms of business partnerships

An analysis has been undertaken of the state of university relationships in Wales in terms of industry partnerships and the current model that is in place for the exploitation of intellectual property. This has been contrasted with models at other universities in the UK in terms of efficiency and "good/best practice".

The research is of both academic and practical

significance, contributing to the body of understanding on the processes involved in the management of the University-industry inter-relationship with regard to industry partnerships.

### 4. Research Findings

Table 3 shows income from collaborative research involving both public funding and funding from business for universities in Wales and provides comparison for the total/average figures for Wales with the UK. For 2007-08 the institution with the highest figure was Swansea University with a total of £21,412,000 income from collaborative research followed by Cardiff University with £12,262,000, Bangor University £4,309,000, Aberystwyth University £2,809,000 and the University of Glamorgan £1,488,000. There are six other universities in Wales with smaller amounts of income from collaborative research. The average figure for Wales was £3,954,000 and for the UK £4,356,000.

The total number and value of contracts for contract research (excluding any already returned for research councils) is shown in Table 4 for Wales and the UK. This shows that Cardiff University had the most number of contracts for 2007-08 with 440, followed by Swansea University with 336, Aberystwyth 210, Bangor University 154, University of Wales Lampeter 34, University of Wales Institute, Cardiff 22, Glyndwr University 21, University of Glamorgan 8, and University of Wales, Newport 3. Cardiff University also had the most income with £9,811,000, followed by Aberystwyth University with £7,825,000, Bangor University £4,612,000 with the University of Glamorgan in ninth position with £66,000. The average figure for Wales was £2,401,000 and for the UK £5,216,000.

The total number and value of contracts for consultancy for Wales and the UK is shown in Table 5. This shows that Cardiff University had the most number of contracts for 2007-08 with 1,160 and a value of £8,060,000, followed by UWIC with 608 and value £2,523,000, Bangor University 83 and £2,255,000, and the University of Glamorgan 156 and £992,000. The average number and value of contracts for Wales was 229 and £1,400,000 and for the UK 402 and £2,092,000. Disclosures and patents filed by or on behalf of HEIs is shown in Table 6 for Wales and the UK. With regard to disclosures Cardiff University had the most in 2007-08 with 74, followed by the University of Glamorgan with 19, Aberystwyth University with 12, Bangor University 6, Glyndwr University 4 and Swansea University 2. The average figure for Wales was 11 and the UK 23. The cumulative portfolio of active patents for 2007-08 showed that Cardiff University had 494, Bangor University 51, Aberystwyth University 29, Swansea University 24 and the University of Glamorgan 10. Again the

average figure for Wales was 55 and the UK 87.

Table 7 shows IP income for Wales and the UK including the sale of shares in spin-offs, total revenues and total costs. With regard to total revenues for 2007-08 Cardiff University had the most with £1,000,000 followed by Aberystwyth University with £197,000, Bangor University £86,000, University of Glamorgan and the University of Wales, Newport with £4,000 and the University of Wales Institute, Cardiff £2,000. The average for Wales was £118,000 and for the UK, £414,000.

Spin-off activity for graduate start-ups is provided in Table 8. For the number of graduate start-ups established in 2007-08 the University of Wales Institute, Cardiff had the most with 69, followed by Glamorgan with 28, Cardiff University 23, and Swansea Metropolitan University 18. The number of graduate start-ups that were still active which had survived at least three years in 2007-08 showed that Swansea Metropolitan University had 55 still active, the University of Glamorgan had 28, Cardiff University 18, and Aberystwyth University 10. For the number of active graduate start-up firms in 2007-08 Glamorgan had 104, Swansea Metropolitan University 47, Cardiff University 45, and Aberystwyth University 40. The estimated current employment of all graduate-start-up active firms for 2007-08 showed that the University of Glamorgan had 204, Cardiff University 200, Swansea Metropolitan University 120, and Aberystwyth University, 60.

HE-BCI 2007 survey (part B)		Table 3: Income from collaborative research involving both public funding and funding from business (£000s)									
		OSI Research Councils		Other UK Government departments		EU government		Other		Total	
HESA code	Institution	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08
hesainst	instname	a1d0405	a1d0506	a2d0405	a2d0506	a3d0405	a3d0506	a4d0405	a4d0506	a5d0405	a5d0506
H-0177	Aberystwyth University	151	670	354	1,804	87	266	0	69	592	2,809
H-0178	Bangor University	462	308	1,115	1,566	1,174	1,164	1,773	1,271	4,524	4,309
H-0179	Cardiff University	1,647	4,067	3,127	2,521	3,898	4,710	4,982	964	13,654	12,262
H-0089	University of Wales Institute, Cardiff	5	0	614	320	0	10	0	46	619	376
H-0090	University of Glamorgan	279	446	153	142	1,205	900	0	0	1,637	1,488
H-0087	Glyndwr University	31	49	498	272	97	103	0	0	626	424
H-0176	University of Wales, Lampeter	0	0	0	0	0	0	0	0	0	0
H-0086	University of Wales, Newport	17	32	3	20	0	0	0	17	20	69
H-0180	Swansea University	13,291	4,227	25,331	16,397	4,056	604	3,247	184	45,925	21,412
H-0091	Swansea Metropolitan University	42	31	0	49	0	0	140	127	182	207
H-0092	Trinity University College	0	143	0	0	0	0	0	0	0	143
	Total Wales	15,925	9,973	31,195	23,091	10,517	7,757	10,142	2,678	67,779	43,499
	Average Wales	1448	907	2836	2099	956	705	922	243	6162	3954
	Total UK	233,412	234,015	187,222	193,294	178,860	204,346	69,175	63,375	668,669	697,030
	Average UK	1459	1463	1170	1208	1118	1277	432	396	4179	4356

Source: HE-BCI, 2007

HE-BCI 2007 survey (part B)		Table 4: Contract research (excluding any already returned in 1a and Research Councils)							
		Total number of contracts				Total value of contracts (£000s)			
HESA code	Institution	2006-07	Sub-total RDA area	2007-08	Sub-total RDA area	2006-07	Sub-total RDA area	2007-08	Sub-total RDA area
Hesaint	Instname	b7d040	b7drda040	b7d050	b7drda050	b8d040	b8drda040	b8d050	b8drda050
		5	5	6	6	5	5	6	6
H-0177	Aberystwyth University	277	0	210	0	8,226	0	7,825	64
H-0178	Bangor University	158	0	154	0	3,700	0	4,612	0
H-0179	Cardiff University	431	0	440	0	9,749	0	9,811	0
H-0089	University of Wales Institute, Cardiff	17	0	22	0	433	0	588	0
H-0090	University of Glamorgan	13	3	8	2	121	54	66	3
H-0087	Glyndwr University	26	0	21	11	486	0	473	203
H-0176	University of Wales, Lampeter	61	61	34	0	336	336	429	0
H-0086	University of Wales, Newport	9	4	3	2	219	39	165	62
H-0180	Swansea University	120	0	336	0	1,678	0	2,447	0
H-0091	Swansea Metropolitan University	0	0	0	0	0	0	0	0
H-0092	Trinity University College	0	0	0	0	0	0	0	0
	Total Wales	1,112	68	1,228	15	24,948	429	26,416	332
	Average Wales	101	6	112	1	2268	39	2401	30
	Total UK	26,872	5,403	27,051	5,619	782,698	130,865	834,627	137,604
	Average UK	168	34	169	35	4892	818	5216	860

Source: HE-BCI, 2007

**HE-BCI 2007 survey (part B)**
**Table 5: Consultancy contracts**

		Total number of contracts				Total value of contracts (£000s)			
		2006-07	Sub-total RDA area	2007-08	Sub-total RDA area	2006-07	Sub-total RDA area	2007-08	Sub-total RDA area
HESA code	Institution	c7d040	c7drda040	c7d050	c7drda050	c8d040	c8drda040	c8d050	c8drda050
hesaint	Instname	5	5	6	6	5	5	6	6
H-0177	Aberystwyth University	14	0	28	21	277	0	135	104
H-0178	Bangor University	265	0	83	0	3,016	0	2,255	0
H-0179	Cardiff University	1,164	0	1,160	0	5,560	0	8,060	0
H-0089	University of Wales Institute, Cardiff	1,714	0	608	0	2,702	0	2,523	0
H-0090	University of Glamorgan	128	96	156	82	1,076	829	992	524
H-0087	Glyndwr University	3	1	16	13	6	0	56	52
H-0176	University of Wales, Lampeter	6	6	2	0	37	37	30	0
H-0086	University of Wales, Newport	322	156	404	214	668	457	648	388
H-0180	Swansea University	26	0	29	0	411	0	502	0
H-0091	Swansea Metropolitan University	14	0	32	0	86	0	138	0
H-0092	Trinity University College	2	0	3	0	19	0	58	0
	Total Wales	3,658	259	2,521	330	13,858	1,323	15,397	1,068
	Average Wales	333	24	229	30	1260	120	1400	97
	Total UK	57,945	16,463	64,292	16,256	287,791	90,345	334,768	107,363
	Average UK	362	103	402	102	1799	565	2092	671

Source: HE-BCI, 2007

HE-BCI 2007 survey (part B)	Table 6: Disclosures and patents filed by or on behalf of the HEI													
	Number of disclosures		Number of new patent applications filed in year				Number of patents granted in year				Cumulative portfolio of active patents			
			Sub-total overseas		Sub-total overseas		Sub-total overseas		Sub-total overseas		Sub-total overseas		Sub-total overseas	
	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08
Institution	g1d040	g1d050	g2d040	g2dovr040	g2d050	g2dovr050	g3d040	g3dovr040	g3d050	g3dovr050	g4d040	g4dovr040	g4d050	g4dovr050
Instname	5	6	5	5	6	6	5	5	6	6	5	5	6	6
Aberystwyth University	34	12	4	1	4	1	0	0	0	0	28	0	29	24
Bangor University	13	6	3	1	6	0	27	24	1	0	53	45	51	38
Cardiff University	82	74	69	55	48	0	0	0	7	0	574	504	494	0
University of Wales Institute, Cardiff	0	0	1	0	1	0	0	0	0	0	0	0	0	0
University of Glamorgan	22	19	6	0	1	0	0	0	0	0	12	10	10	0
Glyndwr University	3	4	0	0	0	0	0	0	0	0	0	0	0	0
University of Wales, Lampeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0
University of Wales, Newport	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Swansea University	4	2	8	0	14	0	0	0	0	0	17	0	24	0
Swansea Metropolitan University	0	0	22	0	30	0	0	0	0	0	0	0	0	0
Trinity University College	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Wales	158	117	113	57	104	1	27	24	8	0	684	559	608	62
Average Wales	14	11	10	5	9	0	2	2	1	0	62	51	55	6
Total UK	3,746	3,616	1,913	836	1,898	663	647	481	590	357	10,624	6,231	13,978	8,038
Average UK	23	23	12	5	12	4	4	3	4	2	66	39	87	50

Source: HE-BCI, 2007

<b>HE-BCI 2007 survey (part B)</b>		<b>Table 7: IP Income (£000s)</b>					
		<b>Sale of shares in spin-offs</b>		<b>Total revenues</b>		<b>Total costs</b>	
		<b>2006-07</b>	<b>2007-08</b>	<b>2006-07</b>	<b>2007-08</b>	<b>2006-07</b>	<b>2007-08</b>
		<b>m1d0405</b>	<b>m1d0506</b>	<b>m2d0405</b>	<b>m2d0506</b>	<b>m3d0405</b>	<b>m3d0506</b>
<b>HESA code</b>	<b>Institution</b>						
<b>Hesainst</b>	<b>Instname</b>						
H-0177	Aberystwyth University	42	0	64	197	0	0
H-0178	Bangor University	0	0	138	86	0	0
H-0179	Cardiff University	0	0	1,500	1,000	433	406
H-0089	University of Wales Institute, Cardiff	0	0	0	2	0	0
H-0090	University of Glamorgan	0	0	4	4	1	1
H-0087	Glyndwr University	0	0	0	0	7	15
H-0176	University of Wales, Lampeter	0	0	0	0	0	0
H-0086	University of Wales, Newport	0	0	3	4	0	0
H-0180	Swansea University	0	0	0	0	0	0
H-0091	Swansea Metropolitan University	0	0	0	0	0	0
H-0092	Trinity University College	0	0	0	0	0	0
	<b>Total Wales</b>	42	0	1,709	1,293	441	422
	<b>Average Wales</b>	4	0	155	118	40	38
	<b>Total UK</b>	18,070	20,786	58,400	66,271	20,597	21,003
	<b>Average UK</b>	113	130	365	414	129	131

Source: HE-BCI, 2007

HE-BCI  
2007  
survey  
(part B)

Table 8: Spin-off activity: Graduate start-ups

HESA code	Institution	Number established		Number still active which have survived at least three years		Number of active firms		Estimated current employment of all active firms (FTE)		Estimated current turnover of all active firms (£000s)		Estimated external investment received (£000s)	
		2006-07	2007-08	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08
hesainst	Instname	o4dest	n4dest	o4dactive3	n4dactive3	o4dactive	n4dactive	o4dempl	n4dempl	o4dturn	n4dturn	o4equity	n4equity
H-0177	Aberystwyth University	20	12	10	10	46	40	92	60	0	0	0	0
H-0178	Bangor University	15	11	10	1	0	0	0	0	0	0	0	0
H-0179	Cardiff University	16	23	15	18	40	45	80	200	2,000	5,200	0	0
H-0089	University of Wales Institute, Cardiff	27	69	0	0	0	0	0	0	0	0	0	0
H-0090	University of Glamorgan	39	28	21	28	80	104	143	204	4,940	6,390	690	810
H-0087	Glyndwr University	2	1	2	4	9	10	13	18	0	0	0	25
H-0176	University of Wales, Lampeter	5	8	5	6	12	22	12	22	240	440	0	0
H-0086	University of Wales, Newport	16	12	4	7	22	36	0	0	0	0	0	0
H-0180	Swansea University	0	0	0	0	0	0	0	0	0	0	0	0
H-0091	Swansea Metropolitan University	13	18	12	55	40	47	84	120	3,200	4,400	0	120
H-0092	Trinity University College	6	1	5	0	12	7	15	11	280	263	300	6
	Total Wales	159	183	84	129	261	311	439	635	10,660	16,693	990	961
	Average Wales	14	17	8	12	24	28	40	58	969	1518	90	87
	Total UK	1,506	1,977	1,037	1,322	3,716	3,960	5,732	6,303	276,405	694,773	110,266	59,250
	Average UK	9	12	6	8	23	25	36	39	1728	4342	689	370

Source: HE-BCI, 2007



## 7. Comparison with Other UK Universities

In order to compare the business partnerships investigated with other universities a sample of six UK universities were considered which include the universities of Oxford, Imperial College, Warwick, Portsmouth, Hertfordshire and University College London, which were highlighted by Tang (2008). According to Tang (2008) five key findings with regard to business projects and processes are: the speed of response from academics in contract agreement is important when dealing with business; it is essential to have an effective incentive structure to encourage academics to engage with business; of particular importance are R&D research partnerships which help generate academic intellectual property and are a route to commercialisation; universities need to engage in active measures in order to increase the knowledge about the commercialisation process and the benefits that arise from it for students, researchers, lecturers and faculty heads; for university business partnerships to be successful there is a need for expertise and commitment by university senior administrators to support and build partnerships who need to understand academia and industry technology/knowledge transfer dynamics; and in order for good practice there is a need for internal university cultural change especially at senior management level.

The importance of university business partnerships, in a policy context, can be traced to the 1993 Government White Paper "Realising Our Potential" (OST, 1993) which recognised the need for universities to identify 'potential users' of the results of their research in industry and other areas, and with these to ensure successful exploitation. Furthermore, the Lambert Report (Lambert, 2003) also identified the importance of universities working with industry to optimise the exploitation of outputs.

According to Tang (2008) there is a wide range of practices undertaken by University technology transfer offices (TTOs) to enhance university business partnerships ranging from a relaxed approach to structured proactive business facing strategies. These practices include market and sector research, regulatory developments to increase demand for products, creating new businesses and supporting businesses, exploring new opportunities and R&D partnerships, collaborative agreements and projects.

University TTOs/business development units are central to the exploitation of university business partnerships and they undertake many activities to bridge the academic industry divide including the creation of networks of industrial links.

Three models of TTOs have been identified from Tang (2008) that have different approaches to university business partnerships with industry and these are:

- Internal model – TTO integrated into the university administrative structure;
- External model – TTO operates outside the university either as a subsidiary or independent entity with autonomy over its operations;
- Hybrid model – A hybrid consisting of a combination of the above.

Through working with industry (Rogers et al, 2000) there is greater experience and professionalism of the TTO (Siegel et al, 2003).

Developing the work of Tang (2008), the three different approaches are illustrated with reference to the sample of six UK University TTOs (Table 9) below (Oxford, Imperial College, Warwick, Portsmouth, Hertfordshire and University College London).

**Table 9: Different Approaches to University Business Partnerships for a sample of six UK universities**

University	Technology Transfer Office	TTO Model	Business Partnerships approach	Structure
Oxford	Oxford ISIS	External Model	Externally organised approach	Twenty seven project managers
Imperial College	Imperial College Business Development Unit	Hybrid Model	Hybrid approach	Three units: Imperial Consulting, Imperial Innovation, Business Development
Warwick	Warwick Ventures	Internal Model	Internally organised approach	Director, Five business managers, marketing manager and administrative assistant
Portsmouth	Portsmouth Research and Knowledge Transfer Services	Internal Model	Internally organised approach	Four managers of priority areas and a Business Development Manager
Hertfordshire	University of Hertfordshire Intellectual Property and Contracts Services	Internal Model	Internally organised approach	Head of IP and Contracts Support and academics
University College London	University College London Business Plc	External Model	Externally organised approach	Four divisions and about forty staff

Source: Developed from Tang (2008)

Table 9 shows that there is a mixture of business partnership approaches among UK universities. The large research intensive universities, such as Oxford and UCL, have an externally organised approach or a hybrid approach as illustrated by Imperial College with Business Development Higher Education Funding Council for England (HEFCE) supported and Imperial Innovation traded publicly. Since the TTOs of Warwick, Hertfordshire and Portsmouth are integrated into the university administration they have an internally organised approach. They are mainly supported by the University and the Higher Education Innovation Fund but they are not all profit generating. Furthermore, the TTO at Portsmouth does not have a central objective to be a for-profit organisation and neither is the Business Development Unit of Imperial. All these universities have a mix of methods of

exploitation practices (Tang, 2008) and all practice the three phases of (i) opportunity recognition, (ii) opportunity development, and (iii) opportunity exploitation (Van der Veen and Wakkee, 2006). A major part of the metrics of business related activities of universities involve spin outs, licences and patents and they are the key proxies for university commercialisation activities resulting in them being grouped together (spin outs are the best mechanism for “disruptive” technologies) (Tang, 2008). It appears that building good relationships between academics and industry underpins successful university industry partnerships.

Existing university business relationships can be strengthened through networks and they offer the possibility for new relationships to be developed with increased benefits from working with other industrial participants,

which can lead to not only new collaborations and sources of expertise but also provide awareness of company competition (Tang, 2008). Networking activities can help SMEs who are excluded from networks involving research intensive corporations and universities (for example the universities of Portsmouth and Hertfordshire target SMEs in their networking activities). Networking through clubs/associations/societies can link researchers with industry, a notable example being the Oxford Innovation Society, and can result in the commissioning of studies by members (Molas-Gallart and Tang, 2007). Furthermore, the use of the alumni office for networking can be of particular benefit through contacting alumnae to obtain research sponsorship and the commercialisation of university IP (the University of Hertfordshire has attempted to harness alumni with the aim of exploitation).

Collaborative R&D projects are important university business partnerships and this form of “joint research” is a significant factor for connections with industry and knowledge transfer (Tang, 2008). This type of research enables the university researcher to keep up-to-date with industrial research, to obtain access to industrial research expertise and to increase the exploitability and applicability of university research (D’Easte-Cukierman and Patel, 2005). Collaborative projects and partnerships are a significant form of exploitation of academic research for the Research Division at Oxford University, for example, and together with agreements they are a major mode of exploitation for the University of Portsmouth (Tang, 2008). They are also the second most important mechanism for the University of Hertfordshire. With Knowledge Transfer Partnerships in an area outside the company’s business the industrial partner will allow the university to exploit the IP. Since the innovation process is moving towards an “open” model (Chesbrough, 2003a&b) protecting IP in collaborative projects is a vital consideration (Tang and Molas-Gallart, 2008).

Collaborative projects undertaken for the Engineering and Physical Sciences Research Council (EPSRC), Technology Strategy Board (TSB) and Faraday Partnerships with industry are another important form of university business projects. Faraday Partnerships are networks of organisations aimed at improving innovation competitiveness and performance of UK industry through research and development, knowledge transfer and exploitation of science and technology from the science base, and involve Research and

Technology Organisations, businesses and universities (DTI, 2006a&b). The value of these partnerships has been recognised by the Economic and Social Research Council (ESRC), and through its Business Engagement Strategy, has encouraged academics involved in ESRC funded projects to work with industry.

## 8. Conclusions

This paper has investigated the trends and developments in the management of University Business Partnerships in Wales and benchmarked these against other universities in the UK. The paper has documented the recent links the universities have with companies in terms of industrial research, Knowledge Transfer Partnerships (KTPs) and other forms of external collaborative partnerships, what these links are and who they are with. This initially involved an internal study followed by an external assessment of companies. Comparisons have been made between universities in order to assess “good/best practice” and potential barriers. A review of IPR policies and procedures has also been included with recommendations for improvements.

Good practices (Tang, 2008) for identifying university business partnerships include: establishment of a professional TTO with a staff mix involving academic and business experience; commitment to building and maintaining trust between academics and industrialists involving an understanding of the workings of academia and industry; maintaining continual contact on an informal basis with academics; adopting a transparent approach to explaining the process of commercialisation to academics; establishing an incentive structure for academics to engage with – consultancies as an entry point to understanding how companies operate to develop client lists and joint R&D projects/partnerships to exploit university IP; and avoiding over bureaucratisation of processes and procedures for engaging industry.

Good practices (Tang, 2008) for the successful exploitation of university business projects include: support from, and ability of, the TTO to undertake university business partnerships through three activities: (i) opportunity recognition; (ii) opportunity development and (iii) opportunity exploitation (Van der Veen and Wakkee, 2006); licensing is important; spin outs to provide a route to market and engage investors; Research and Development

Partnerships to provide more academic IP and a route to commercialisation; consultancy to provide an initial route to exploitation; a “capabilities map” or “capabilities audit” to match industry needs coordinated with the Research Office and academics; implementation of active measures to raise awareness and knowledge about potential university business projects and the benefits with heads of faculties, lecturers, researchers and students; and submissions of bids to invitations to tender that require an industrial partner.

As well as the current proxies for successful university business projects and processes that focus on spin outs, licensing and patents other paths for successful university industry partnerships include support measures for entrepreneurial undergraduates and postgraduates, continuous professional development and training services, networking, collaborative research and consultancy partnerships and maintaining a strong relationship between industrialists and academics (Tang, 2008).

Following the conclusions and the consideration of good practices a number of recommendations can be made based upon the findings of this paper. The Association for University Research and Industry Links (AURIL) model of university business partnerships (Figure 1) has identified the main partnerships for university business activities. In relation to this the model of university business partnerships for Wales (Figure 2) shows contract, collaborative, sponsored and other research links are categorised under research projects together with postgraduate studentships. Student projects and placements take place under programmes like KTPs and university consultancy and associated commercial services occur mainly as consultancy projects.

Those areas where universities in Wales could possibly seek to develop are sponsored and honorary posts and secondments and clubs and networks, especially with regard to alumni networks.

For university business partnerships to be successful there is a need for expertise and commitment by university senior managers to support and build partnerships who need to understand academia and industry technology/knowledge transfer dynamics (as noted by Tang (2008) in relation to findings from a study of university TTOs’ exploitation of intellectual property in the UK). Research and Knowledge Transfer Services could make

greater use of the services of the university business school (an example being Portsmouth University). The identification of university business partnerships could have greater assistance provided by the Research Office (as evidenced at the University of Hertfordshire). The three phases of (i) opportunity recognition, (ii) opportunity development, and (iii) opportunity exploitation need to be practiced similar to the universities of Oxford, Imperial College, Warwick, Portsmouth, Hertfordshire and University College London (Tang, 2008). The key proxies for university commercialisation activities of spin outs, licences and patents need to be recognised as a major part of business related activities of a University. Good relationships need to be built between a University and industry to underpin successful university industry partnerships. Existing University business relationships can be strengthened through networks and they offer the possibility for new relationships to be developed with consequent increased benefits. Greater networking, through clubs/associations/societies, needs to be undertaken by university researchers with industry to enable the commissioning of research projects. The development of an alumni office to enable networking is of particular benefit involving contacting alumnae to obtain research sponsorship and commercialisation of a university’s IP (the University of Hertfordshire for example has harnessed alumni with the aim of exploitation). Protecting IP in collaborative projects is a vital consideration (Tang and Molas-Gallart, 2008) for a university since the innovation process is moving towards an “open” model (Chesbrough, 2003a&b).

## 10. References

- [1] Abreu, M., Grinevich, V., Hughes, A. and Kitson, M. (2009) *Knowledge Exchange between Academics and the Business, Public and Third Sector*, Report, Cambridge: UK-Innovation Research Centre (UK-IRC).
- [2] Ali, A. (1994) Pioneering versus incremental innovation: review and research propositions, *Journal of Product Innovation Management*, Vol. 11, pp. 46-61.
- [3] Ankrah, S.N. (2007) University-Industry Interorganisational Relationships for Technology/Knowledge Transfer: A Systematic Literature Review, *Leeds University Business School Working Paper Series*, Vol. 1, No. 4, June.
- [4] Association for University Research and Industry Links (AURIL) (2001) *Partnerships for Research and Innovation between industry and universities*, London: Confederation of British Industry (CBI).
- [5] Autio, E. and Laamanen, T. (1995) Measurement and evaluation of technology transfer: review of

- technology transfer mechanisms and indicators, *International Journal of Technology Management*, Vol. 10, No. 7/8, pp. 643-664.
- [6] Azaroff, L.V. (1982) Industry-University Collaboration: How to Make it Work? *Research Management*, Vol. 3, pp. 31-34.
- [7] Baldwin, W.I. and Link, A.N. (1998) Universities as Research Joint Venture Partners: Does Size of Joint Venture Matter? *International Journal of Technology Management*, Vol. 15, No. 8, pp. 125-144.
- [8] Barnes, T., Pashby, I. and Gibbons, A. (2002) Effective University – Industry Interaction: A Multi-case Evaluation of Collaborative R&D Projects, *European Management Journal*, Vol. 20, No. 3, pp. 272-285.
- [9] Bettis, R. and Hitt, M. (1995) The new competitive landscape, *Strategic Management Journal*, Vol. 16, pp. 7-19.
- [10] Blackman, C. and Seagal, N. (1991) Access to skills and knowledge: Managing the relationships with higher education institutions, *Technology Analysis and Strategic Management*, Vol. 3, No. 3, pp. 297-303.
- [11] Bloedon, R.V. and Stokes, D.R. (1994) Making university/industry collaborative research succeed, *Research Technology Management*, Vol. 37, No. 2, pp. 44-48.
- [12] Blumenthal (2003) Academic-Industrial Relationships in the Life Sciences, *The New England Journal of Medicine*, Vol. 349, No. 25, pp. 2452-2459.
- [13] Bonarccorsi, A. and Piccaluga, A. (1994) A Theoretical Framework for the evaluation of University-Industry Relationships, *R&D Management*, Vol. 24, No. 3, pp. 229-247.
- [14] Bower, D.J. (1993) Successful joint ventures in Science Parks, *Long Range Planning*, Vol. 26, No. 6, pp. 114-120.
- [15] Bramorski, T. and Madan, M.S. (1993) University-Industry partnership in technology management in Poland: the system in transition, *International Journal of Technology Management*, Vol. 8, Nos. 6/7/8, pp. 554-564.
- [16] Burati, N. and Penco, L. (2001) Assisted technology transfer to SMEs: lessons from an exemplary case, *Technovation*, Vol. 21, No. 1, pp. 35-43.
- [17] Burnham, J.B. (1997) Evaluating industry/university research linkages, *Research Technology Management*, Vol. 40, No. 1, pp. 52-55.
- [18] Buttrick, R. (2000) *The Interactive Project Workout*, Financial Times, Prentice Hall.
- [19] Caloghirou, Y., Tsakanikas, A. and Vonortas, N.S. (2001) University-Industry Cooperation in the Context of the European Framework Programmes, *Journal of Technology Transfer*, Vol. 26, Nos. 1-2, pp. 153-160.
- [20] CBI (2009) *Stronger Together: Businesses and Universities in turbulent times*, London: Confederation of British Industry.
- [21] Champness, M. (2000) Helping industry and universities collaborate, *Research Technology Management*, Vol. 43, No. 4, pp. 8-10.
- [22] Chen, E.Y. (1994) The evolution of University-Industry technology transfer in Hong Kong, *Technovation*, Vol. 14, No. 7, pp. 449-459.
- [23] Chesbrough, H. (2003a) The Era of Open Innovation, *Sloan Management Review*, Vol. 44, No. 3, pp. 35-41.
- [24] Chesbrough, H. (2003b) *Open Innovation: The New Imperative for Creating and Profiting from Technology*, Cambridge, MA; Harvard Business School Press.
- [25] Chiesa, V. and Manzini, R. (1998) Organising for technological collaborations: a managerial perspective, *R&D Management*, Vol. 28, No. 2, pp. 199-212.
- [26] Cohen, W.M., Florida, R., Randazzese, L. and Walsh, J. (1998) Industry and the Academy: Uneasy Partners in the Cause of Technological Advance, in Noll, R. (ed.) *The Future of the Research University*, Brookings Institution Press, Washington, DC, pp. 171-199.
- [27] CROS (2011) Analysis of UK aggregate results, Careers in Research Online Survey, Cambridge: Vitae.
- [28] Cyert, R.M. and Goodman, P.S. (1997) Creating Effective University-Industry Alliances: An Organisational Learning Perspective, *Organisational Dynamics*, Vol. 25, No. 4, pp. 45-57.
- [29] Dean, C.W. (1981) A Study of University/Small Business Interaction for Technology Transfer, *Technovation*, Vol. 1, pp. 109-123.
- [30] D'Este-Cukierman, P. and Patel, P. (2005) University-Industry linkages in the UK: What are the factors determining the variety of interactions with industry?, DRUID summer conference, Copenhagen Business School, Copenhagen.
- [31] Dill, D. (1990) University/Industry Research Collaborations: AN Analysis of Inter-organisational Relationships, *R&D Management*, Vol. 20, No. 2, pp. 123-132.
- [32] Dodgson, M. (1991) The management of technological collaboration, *Engineering Management Journal*, August, pp. 187-192.
- [33] Doz, Y.L. (1996) The evolution of co-operation in strategic alliances: Initial conditions of learning processes, *Strategic Management Journal*, Vol. 17, pp. 55-83.
- [34] DTI (2006a) Annual Report 2006: Knowledge Transfer Networks, London: Department of Trade and Industry.
- [35] DTI (2006b) The Faraday Partnership Annual Report 2004-2005, London: Department of Trade and Industry.
- [36] Duggan, R. (1997) Promoting Innovation in Industry, Government and Higher Education, *Journal of Product Innovation Management*, Vol. 14, No. 3, pp. 224-225.

- [37] Dyson, J. (2010) *Ingenious Britain: Making the UK the leading high tech exporter in Europe*, Report, London: Conservative Party.
- [38] Eisenhardt, K.M. and Schoonhoven, C.B. (1996) Resource Based view of Strategic Alliance Formation: Strategic and Social Effects in Entrepreneurial Firms, *Organisation Science*, Vol. 7, No. 2, pp. 136-150.
- [39] Fowler, D.R. (1984) University-Industry Research Relationships, *Research Management*, Vol. 1, pp. 35-41.
- [40] Freeman, C. (1991), Networks of Innovators: A Synthesis of Research Issues, *Research Policy*, Vol. 20, No. 5, pp. 499-514.
- [41] Geisler, E. (1995) Industry-University technology co-operation: a theory of inter-organisational relationships, *Technology Analysis and Strategic Management*, Vol. 7, pp. 217-229.
- [42] Geisler, E. (1997) Intersector Technology Cooperation: Hard Myths, Soft Facts, *Technovation*, Vol. 17, No. 6, pp. 309-320.
- [43] George, G. Zahra, S.A. and Wood, D.R. (2002) The effects of business-university alliances on innovative output and financial performance: a study of publicly traded biotechnology companies, *Journal of Business Venturing*, Vol. 17, No. 6, pp. 577-609.
- [44] Gopalakrishnan, S. and Santoro, M.D. (2004) Distinguishing Between Knowledge Transfer and Technology Transfer Activities: The Role of Key Organisational Factors, *IEEE Transactions on Engineering Management*, Vol. 51, No. 1, pp. 57-69.
- [45] Grant, R.M. (1996) Prospering in dynamically competitive environments : organisational capability as knowledge integration, *Organisation Science*, Vol. 7, No. 4, pp. 375-387.
- [46] Gulati, R. and Gargiulo, M. (1999) Where do inter-organisational networks come from? *American Journal of Sociology*, Vol. 104, pp. 1439-1493.
- [47] Hagen, R. (2002) Globalisation, university transformation and economic regeneration: A UK case study of public/private sector partnership, *The International Journal of Public Sector Management*, Vol. 15, No. 3, pp. 204-218.
- [48] Hagstrom, W.O. (1965) *The Scientific Community*, Basic Books, New York and London.
- [49] Hall, B.H. (2004) University-Industry Research Partnerships in the United States, Department of Economics, European University, *EU Working Paper ECO*, No. 2004/14.
- [50] Harman, G. and Sherwell, V. (2002) Risks in University-Industry Research Links and the Implications for University Management, *Journal of Higher Education Policy and Management*, Vol. 24, No. 1, pp. 37-51.
- [51] Hauser, H. (2010) *The Current and Future Role of Technology and Innovation Centres in the UK*, Report, London: Department for Business, Innovation and Skills (BIS).
- [52] HE-BCI (2007) *HE-BCI Survey*, Bristol and London: Higher Education Funding Council for England (HEFCE).
- [53] Hicks, D. (1993) University-Industry Research Links in Japan, *Policy Sciences*, Vol. 26, No. 4, pp. 361-395.
- [54] Howells, J. and Nedeva, M. (2003) *The international dimension to industry-academic links*, *International Journal of Technology Management*, Vol. 25, Nos. 1-2, pp. 5-17.
- [55] Howells, J., Nevada, M. and Georghiou, L. (1998) Industry-Academic Links in the UK, *A Report to the Higher Education Funding Councils of England, Scotland and Wales*, PREST, University of Manchester.
- [56] Jacob, M. Hellstrom, T., Adler, N. and Norrgren, F. (2000) From sponsorship to partnership in academy-industry relations, *R&D Management*, Vol. 30, No. 3, pp. 255-262.
- [57] Kanter, R.B. (1994) Collaborative advantage: The art of alliances, *Harvard Business Review*, Vol. 72, No. 4, pp. 96-108.
- [58] Klofsten, M. and Jones-Evans, D. (1996) Stimulation of technology-based small firms – A case study of University-Industry co-operation, *Technovation*, Vol. 16, No. 4, pp. 187-193.
- [59] Knee, P. and Meyer, M (2007) *Global Innovation Environments*, Study A, Report, Bristol and London: Higher Education Funding Council for England (HEFCE).
- [60] Kreiner, K. and Schulz, M. (1993), Informal Collaboration in R&D: The Formation of Networks Across Organisations, *Organisation Studies*, Vol. 14, No. 2, pp. 189-209.
- [61] Lambert, R. (2003) Lambert Review of Business-University Collaboration.
- [62] Lee, J. and Win, H.N. (2004) Technology transfer between university research centres and industry in Singapore, *Technovation*, Vol. 24, No. 5, pp. 433-442.
- [63] Lee, Y.S. (2000) The Sustainability of University-Industry Research Collaboration: An Empirical Assessment, *Journal of Technology Transfer*, Vol. 25, No. 2, pp. 111-119.
- [64] Logar, C.M., Ponzurick, T.G., Spears, J.R. and France, K.R. (2001) Commercialising intellectual property: a University-Industry alliance for new product development. *Journal of Product and Brand Management*, Vol. 10, No. 4, pp. 206-217.
- [65] Lopez-Martinez, R.E., Medellin, E., Scanlon, A.P. and Solleiro, J.L. (1994) Motivations and obstacles to university industry co-operation (OIC): A Mexican case, *R&D Management*, Vol. 24, No. 1, pp. 17-31.
- [66] Melese, T., Lin, S.M., Chang, J.L. and Cohen, N.L. Open innovation networks between academia and industry: an imperative for breakthrough therapies, *Nature Medicine*, Vol. 15, p. 502.

- [67] Mansfield, E. (1998) Academic research and industrial innovation: an update of empirical findings, *Research Policy*, Vol. 26, pp. 773-776.
- [68] McCracken, G. (1988) *The Long Interview*, Beverly Hills, CA, Sage Publications.
- [69] Mead, N., Bechman, K., Lawrence, J., O'Mary, G., Parish, C., Unpingco, P. and Walker, H. (1999) Industry/university collaborations: different perspectives heighten mutual opportunities, *The Journal of Systems and Software*, Vol. 49, pp. 155-162.
- [70] Meyer-Krahmer, F. and Schmoch, S. (1998) Science-based technologies: university-industry interactions in four fields, *Research Policy*, Vol. 27, No. 8, pp. 835-851.
- [71] Mitsuhashi, H. (2002) University in Selecting Alliance Partners: The Three Reduction Mechanisms and Alliance Formation Processes, *International Journal of Organisational Analysis*, Vol. 10, No. 2, pp. 109-133.
- [72] Mora-Valentin, E.M. (2000) University-Industry co-operation: a framework of benefits and obstacles, *Industry and Higher Education*, Vol. 14, No. 3, pp. 165-172.
- [73] Molas-Gallart, J. and Tang, P. (2007) The Practice and Policy Impacts of ESRC Funded Research: A case study of the ESRC Centre for Business Research (Cambridge University), A report prepared for the Evaluation Committee, ESRC, Brighton: SPRU.
- [74] Newberg, J.A. and Dunn, R.L. (2002) Keeping secrets in the campus lab: Law, values and rules of engagement for Industry-University R&D partnerships, *American Business Law Journal*, Vol. 39, No. 2, pp. 187-241.
- [75] Nimtz, L.E., Coscarelli, W.C. and Blair, D. (1995) University-Industry partnerships: Meeting the challenge with a high technology partner, *SRA Journal*, Vol. 27, No. 2, pp. 9-17.
- [76] Oliver, C. (1990) Determinants of interorganisational relationships: Integration and future directions, *Academy of Management Review*, Vol. 15, No. 2, pp. 241-265.
- [77] Organisation for Economic Co-operation and Development (OECD) (1990) *Report on University-Enterprise relations in OECD member countries*, Paris.
- [78] OST (1993) *Realising our Potential: A Strategy for Science, Engineering and Technology*, London: HMSO.
- [79] PACEC/CBR (2011) *Understanding the Knowledge Exchange Infrastructure in the English Higher Education Sector*, Working Paper, Bristol and London: Higher Education Funding Council for England (HEFCE).
- [80] Pavitt, K. (1998) The social shaping of the national science base, *Research Policy*, Vol. 27, No. 8, pp. 793-805.
- [81] Perkmann, M. and Walsh, K. (2007) University-industry relationships and open innovations: towards a research agenda, *International Journal of Management Reviews*, Vol. 9, p. 259.
- [82] Peterson, S. (1995) Consortia Partnerships: Linking Industry and Academia, *Computers Industrial Engineering*, Vol. 29, Nos. 1-4, pp. 355-359.
- [83] Powers, J.B. (2003) Commercialising academic research: resource effects on performance of technology transfer, *The Journal of Higher Education*, Vol. 74, No. 1, pp. 26-47.
- [84] Poyago-Theotoky, J., Beath, J. and Siegel, D.S. (2002) Universities and Fundamental Research: Reflections on the Growth of University-Industry Partnership, *Oxford Review of Economic Policy*, Vol. 18, No. 1, pp. 10-21.
- [85] Rappert, B., Webster, A. and Charles, D. (1999) Making sense of diversity and reluctance: Academic-Industrial Relations and Intellectual Property, *Research Policy*, Vol. 28, pp. 873-890.
- [86] Ring, P.S. and van de Van, A.H. (1994) Developmental Processes of Cooperative Interorganisational Relationships, *The Academy of Management Review*, Vol. 19, No. 1, pp. 90-110.
- [87] Ritter, T. and Gemünden, H.G. (2003) Inter-organisational relationships and networks: An overview, *Journal of Business Research*, Vol. 56, pp. 691-697.
- [88] Rogers, E.M., Yin, J. and Hoffman, J. (2000) Assessing the effectiveness of technology transfer offices at U.S. research universities, *Journal of the Association of University Technology Managers*, Vol. 12, pp. 47-80.
- [89] Santoro, M.D. (2000) Success Breeds Success: The Linkage Between Relationship Intensity and Tangible Outcomes in Industry-University Collaborative Ventures, *The Journal of High Technology Management*, Vol. 11, No. 2, pp. 255-273.
- [90] Santoro, M.D. and Betts, S.C. (2002) Making Industry-University partnerships work, *Research Technology Management*, Vol. 45, No. 3, pp. 42-46.
- [91] Santoro, M.D. and Chakrabarti, A.K. (1999) Building Industry-University Research Centres – Some Strategic Considerations, *International Journal of Management Review*, Vol. 1, No. 3, pp. 225-244.
- [92] Santoro, M.D. and Chakrabarti, A.K. (2001) Corporate Strategic Objectives for Establishing Relationships with University Research Centres, *IEEE Transactions on Engineering Management*, Vol. 48, No. 2, pp. 157-163.
- [93] Santoro, M.D. and Gopalakrishnan, S. (2001) Relationship Dynamics between University Research Centres and Industrial Firms: Their Impact on Technology Transfer Activities, *Journal of Technology Transfer*, Vol. 26, Nos. 1-2, pp. 163-174.
- [94] Schartinger, D., Schibany, A. and Gassler, H. (2001) Interactive Relations Between Universities and Firms: Empirical Evidence for Austria, *Journal of Technology Transfer*, Vol. 26, No. 3, pp. 255-238.
- [95] Shaw, B. (1993), Formal and Informal Networks in the UK Medical Equipment Industry, *Technovation*, Vol. 13, No. 6, pp. 349-365.

- [96] Shenhar, A.J. (1993) The Promis Project: Industry and university learning together, *International Journal of Technology Management*, Vol. 8, Nos. 6/7/8, pp. 611-621.
- [97] Sherwood, A.L., Butts, S.B. and Kacar, S.L. (2004) Partnering for Knowledge: A learning framework for University-Industry Collaboration, *Midwest Academy of Management*, 2004 Annual Meeting, pp. 1-17.
- [98] Siegel, D.S., Waldman, D.A., Atwater, L.E. and Link, A.N. (2003) Commercial knowledge transfers from universities to firms: Improving the effectiveness of University-Industry collaboration, *Journal of High Technology Management Research*, Vol. 14, No. 1, pp. 111-124.
- [99] Siegel, D.S., Waldman, D.A., Atwater, L.E. and Link, A.N. (2004) Toward a model of the effective transfer of scientific knowledge from academicians to practitioners: qualitative evidence from the commercialisation of university technologies, *Journal of Engineering and Technology Management*, Vol. 21, Nos. 1-2, pp. 115-142.
- [100] Siegel, D.S., Waldman, D. and Link, A. (2003) Assessing the impact of organizational practices on the relative productivity of university technology transfer offices: an exploratory study, *Research Policy*, Vol. 32, pp. 27-48.
- [101] Smilor, R.W., Gibson, D.V. and Dietrich, G.B. (1990) University spin-out companies: Technology start-ups from UT-Austin, *Journal of Business Venturing*, Vol. 5, pp. 63-76.
- [102] Tang, P. (2008) Exploiting University Intellectual Property in the UK, A Report prepared for the UKIPO, London: Intellectual Property Institute.
- [103] Tang, P. and Molas-Gallart, J. (2008) Intellectual Property in collaborative projects: navigating the maze, *International Journal of Technology Management*.
- [104] Termouth, P. and Garner, C. (2009) *Valuing Knowledge Exchange*, Report, London: Council for Industry and Higher Education (CIHE).
- [105] TSB (2011) *Technology and innovation centres: Strategy and implementation plan*, London: TSB.
- [106] Van der Veen, M. and Wakkee, I. (2006) Understanding the entrepreneurial processes, in Davidsson, P. (ed.) *New Firm Start-ups*, Cheltenham: Edward Elgar, pp. 27-65.
- [107] Wilson Report (2012) *A Review of Business-University Collaboration*, London: Higher Education Funding Council for England (HEFCE) and Department for Business, Innovation and Skills (BIS).