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Abstract

This paper examines the use of European Union (EU) structural funds to support the development of innovation policy within Wales during the period 2000-2006. Drawing on data from the Welsh Government and interviews with key stakeholders, it focuses specifically on the Technium programme, a high-profile technology-based innovation intervention that took a predominantly supply-side approach to supporting innovation, resulting in its eventual failure. Consistent within this is an analysis of the efficacy of supply-side policies using EU funds to support research and development activities to aid economic growth in peripheral, weaker regions.

Introduction

There is little doubt that regional innovation policy is a high priority across Europe and that with the inception of the smart specialisation approach, supporting innovation at the regional level is on the agenda for the foreseeable future (Foray, David, and Hall, 2011; European Commission, 2013; McCann and Ortega-Argilés, 2015). However, a question mark hangs over the effectiveness of regional innovation policy due to the lack of clarity over how successful it has been as a vehicle for bringing about regional economic development and convergence across the regions of Europe (Koschatsky, 2009). Going forward, it is critical that policies and interventions deliver positive results, especially in a time of austerity and declining public spending across Europe.

The focus of this paper is a case study analysis of a weaker European region - Wales - with a long history of implementing innovation policy and engaging in the European Commission (EC)'s efforts to drive convergence across the European regions. Specifically, the focus is on the Technium programme, which was the largest and most significant innovation initiative implemented within Wales since devolution but is now widely regarded as a costly failure. Why this is the case and how mistakes can be avoided in the future are the research questions at the heart of the paper. The overall aim is to question the appropriateness of existing predominant regional innovation policy approaches in Europe in the context of weaker regions and to draw lessons from the Wales case.

This paper is structured as follows. The first section provides the underpinnings in terms of innovation policy and theory. Some explanations are provided of the terms and concepts employed, and an overview of how innovation policy has evolved in Europe and also the theory alongside it. Following this theoretical discussion is the introduction of the Wales case study, which sets the scene for the analysis and discussion that follows. This leads to a discussion of the interesting lessons and insights that emerge from the failure of the Technium programme but which also have a broader relevance to other weaker regions and European innovation policy as a whole. The conclusion suggests that a technology-based approach to innovation, as advocated through the predominant programmes implemented in Wales, may not be wholly appropriate in the weaker region setting. Instead, some broadening and reconceptualization of innovation policy may be necessary going forward to

increase the efficacy and usefulness of the manner in which public monies are being spent. Specifically, more focus on improving human capital and supporting regional communities is called for and policy cognisance of private sector demand, rather than policy over-supply, is identified as the means with which to achieve this.

Theoretical Underpinnings: Innovation Policy and Theory

Innovation and its crucial role in driving economic development has become an increasingly important area of regional policy. As Bellini and Landabaso (2007 p. 231) noted, 'following the Lisbon agenda, there has been a general trend towards policy experimentation at the regional level in the field of the economic exploitation of knowledge and technological innovation as a means of promoting economic growth'. Indeed, four decades of analysis has reshaped our understanding of the role innovation plays in economic development and has resulted in regional innovation policy finally being accepted into the mainstream of public policy today (McCann and Ortega-Argilés, 2015) with policy makers all over the world realising that regional policies for innovation are 'absolutely necessary in the current international economic scenario' (Cooke and Piccaluga, 2006, p.273).

There are numerous examples from around Europe, and indeed beyond, of policies that aim to foster the birth and growth of innovative, high-growth and knowledge-based firms. Particularly popular have been policies that develop a physical infrastructure to enable this, such as science parks and incubators (Diez-Vial and Montoro-Sanchez, 2016; Kautonen et al., 2017). Studies have found variable success in these strategies with some considered as examples

of the 'gold standard' for successful innovation interventions (Etzkowitz and Klofsten, 2005). On the other hand, the proliferation of these approaches across Europe in weaker regions have been described by some as akin to 'cathedrals in the desert' (Morgan, 1997).

In Europe, the idea of regional innovation policy has become something of a popular theme which can be traced back to the creation and implementation of the *Regional Technology Plans*, later known as *Regional Innovation Strategies* during the mid 1990s, which required European regions to come up with their own approaches to innovation policy (Asheim, 2012; Cooke, 2003). Since then, innovation interventions have been pursued across Europe with the financial support of the European Structural Funds, in particular the European Regional Development Fund (ERDF). In today's landscape, innovation remains a priority and 'Smart Specialisation' – where each region identifies and develops its own competitive advantages through a partnership approach involving key actors such as local authorities, academia, business spheres and the civil society - is the current approach to innovation and regional economic development in Europe, and indeed Wales (Foray et al., 2011; Morgan, 2016; Pugh, 2014, 2017). Indeed, member regions are required to produce Regional Innovation Strategies for Smart Specialisation (RIS3) to bring about integrated and place-based economic transformation (European Commission, 2013;). Convergence is one of the principles at the heart of the EC's work based on the premise of narrowing the gap between the wealthiest and poorest regions of the EU and regions such as Wales (with less than 75% of the average EU-25 GDP) qualify for higher levels of funding to help address this situation.

The theoretical construct underpinning the European regional innovation policy approach is a systemic conceptualisation of innovation at the regional level. Policy has been driven by the belief that regional economic growth is dependent upon the creation of successful regional innovation systems (RIS) where innovation is an evolutionary, non-linear and interactive process requiring intensive communication and co-operation amongst firms, between firms, and with other pertinent institutions (Lundvall, 2007). In this context, the institutions referred to are both 'hard' - encompassing innovation relevant organisations such as universities, research institutes, educational institutions, financial organisations and government agencies – and 'soft', referring to rules, routines and norms (Tödtling and Trippl, 2005). As part of this shift in focus, the use of European Structural Funds has been of critical importance in operationalizing policies geared towards leveraging innovation for economic gains at the regional level.

Evidence suggests that regional governments may be required to provide the impetus for innovation because regional innovation systems work more effectively where there is a higher degree of regional autonomy (Morgan, 2004; Cooke, 2013). As well as greater specificity in innovation policy, there is evidence that lagging regions need to build up their institutional capacities and foster webs of co-operative networks among firms, universities and research institutes, financial organisations and governments (Huggins et al, 2012). For weaker (and also post-industrial, peripheral, post-communist) regions, the difficulties raised by these policy challenges may be even greater (Coenen,

Moodysson & Martin 2014; Blazek & Csank, 2016). As Huggins and Johnston (2009) suggest, such regions are uncompetitive due to a lack of strength and depth in the very factors that give leading regions their competitive edge such as a high density of knowledge-based firms and a networked business culture. They are therefore confronted with particular constraints on their ability to reconcile these conflicting demands successfully compared to more advanced regions (Morgan, 2004). Typically, studies of regional innovation systems have focused mainly on regions that have been successful innovators in the past or have adapted effectively to economic change, and which offer potential 'best practice' solutions for policy makers. Consequently, the dynamics of less successful places are underdeveloped both in theoretical and policy perspectives (Benneworth and Hospers, 2007). The RIS and triple-helix approaches to understanding regional innovation suggest that strengthening the relationships between government, business and universities is critical to improving innovation in lagging regions (Etzkowitz and Leydesdorff, 2000).

In terms of the business sector within weaker regions, the regional innovation paradox (Oughton et al, 2002) results in a situation whereby the more innovation is needed to maintain and enhance the economic performance of firms in an increasingly global economy, the more difficult it is for them to invest effectively and absorb funds for promoting innovation. The problem is explained by the institutional characteristics of weaker regions where the system is fragmented and lacks either the necessary interfaces and co-operation mechanisms for the supply of innovation inputs to match firms' demand or the appropriate conditions for the exploitation of synergies and co-operation among

regional innovation actors (Zhang, Mackenzie, Jones-Evans & Huggins, 2016). The capacity to exploit knowledge refers to the capabilities existing within a region to commercialise new knowledge and extract value from it, and can be seen as the reward for absorbing knowledge. In terms of overall knowledge exploitation capacity, weaker regions perform poorly suggesting that there is a strong positive relationship between the capacity to exploit and the capacity to anchor and diffuse knowledge (NESTA, 2008).

The Welsh context

Wales is a peripheral and weaker region within the European Union and sits on the physical edge of the continent with two-thirds of the region (West Wales and the Valleys) receiving the highest level of structural funding. Although the previous round of structural funding ended in 2013, West Wales and the Valleys has retained its status as one of the poorer regions of the EU and has again qualified for the highest level of support in the 2014-2020 phase. Wales is, and has often been, the poorest performing region in the UK in R&D terms, lagging behind most of the rest of the UK since 1995.

Figure 1: Comparison of BERD spending in Wales, Scotland and Northern Ireland (£m).

Figure 1 about here

Source: StatsWales

Figure 1 above illustrates the problem Wales had (and has) in terms of the innovative capacity of its private sector. Despite having twice the population of Northern Ireland, Welsh BERD was only marginally higher between 1995 and 2001 and has since been overtaken. In addition, it remained significantly less than Scotland, which has a population of approximately twice that of Wales but three times the BERD spending. BERD is the most economically beneficial form of R&D by virtue of its stronger contribution to productivity growth than other R&D forms (Sveikauskas, 2007). Wales' poor performance in this measure as compared with other devolved regions of the UK illustrates its weaker region status. A report by the NAW Economic Development Committee identified this problem in 2002 shortly after the first Technium was opened (Jones-Evans, 2002).

The history of the Welsh economy is largely one of natural resources and heavy industry giving way to the manufacturing and service sectors in recent years. From the 1960s onwards, employment in the service sector grew with the establishment of important public sector institutions. Manufacturing became increasingly important during the post-war era, with a high degree of government support to attract industry to Wales (Johnes, 2012, p.250). More recently, foreign direct investment (FDI) has been an important source of jobs. In the 1980s, Wales gained three times the share of inward investment and associated jobs in the UK than would be expected based on its population with these firms attracted by a combination of government regional aid,

infrastructure spending, and relatively low wages (Pickernell, 2011). Cooke (2003, p.4) agrees, stating that from 1983 to 1993 Wales consistently attracted between 15%-20% of inward investment in the UK despite having only 5% of the UK's population. However, from 1998-2008, around 31,000 jobs were lost as companies moved to Central and Eastern Europe, China and South East Asia and to take advantage of lower labour costs, increasing education and skills levels, and growing markets (Evans et al. 2008). The policy discussed here, which sought to grow domestic firms, can be seen as a change of direction in Welsh policy which was ultimately unsuccessful, contributing to the trend recognised by Huggins and Pugh (2015) whereby the Welsh policy agenda has swung between different approaches over time lacking an overarching rationale.

Role of the Welsh Government

Since 1999, the Welsh Government has had the power to develop and implement its own policies in devolved areas such as economic development. When the National Assembly for Wales became operational, its elected government became responsible for developing economic policies within the context of central UK policy frameworks, giving policy-makers in Wales more autonomy than previously. However, the fiscal powers of the Welsh Government are limited as it has no major tax-raising powers and public finance continues to be provided via a block grant from UK central government.

Although innovation falls under the Welsh Government's remit, there are a number of programmes and funding sources (e.g. Innovation UK and NESTA) that are operated at a UK level. Kerton and Bright (2012) analysed the innovation support offered in Wales compared to the other parts of the UK and found that the breadth and types of innovation support offered to businesses are comparable to those of other regions. They also found some unique support for innovation funded by the Welsh European Funding Office (WEFO) which administers and monitors the Structural Funds that flow to Wales from Europe. The present approach to innovation at the European level is set out in the *Innovation Union* document where the key underlying principle is 'smart specialisation' where regions and nations build on their strengths rather than trying to compete with one another in the same few sectors (European Commission, 2010; 2011). This European approach is important in Wales not only in driving the direction of government policy but also in supporting innovation programmes and actions through structural funds where the aim is to strengthen economic and social cohesion in the European Union by correcting imbalances between its regions (European Commission, 2012). Table 1 below summarises the main innovation related policies enacted by the different Welsh administrations since 1993.

Table 1 about here

West Wales and the Valleys has been eligible since 2000 for the highest level of funding based on its convergence status, receiving £1.2bn of European support in the period 2000-2006 under the Objective 1 programme, funds that

were matched by the public, private and voluntary sectors. Of this, approximately £130m of grants was earmarked specifically for innovation interventions costing a total of £284m (Bristow and Jones-Evans, 2008). Thus, it is important to emphasize the role of European Funds in providing the finance for innovation policy support in Wales. These are distributed and managed through WEFO although ultimately, it is the Welsh Government that sets the policy direction within which innovation support is implemented.

Performance of European Structural Funds in supporting innovation

As Bristow and Jones-Evans (2008), and Rhisiart and Jones-Evans (2016) have discussed, one of the key priorities of the European Structural Funding programme in Wales for the period 2000-2006 was the development of innovation and the knowledge based economy. Two key measures were created to achieve this: Measure 2.3 (support for the development of innovation and research and development) that would help in developing clusters and new R&D potential around higher and further education institutions; and Measure 2.4 that would focus on skills for innovation and technology. The performance data obtained from WEFO (Table 2) shows the outputs of activities and results for the 2000-2006 Objective 1 programme for West Wales and the Valleys as of July 2010.

Table 2 about here

It is noticeable that despite a key objective of the programme in terms of innovation being the diversification of the economic base by growing more technology and knowledge driven firms, the range of innovation projects funded failed to have any serious impact in terms of gross new companies in high technology sectors. Whereas the target for the programme was the creation of 2,000 new firms only 456 (less than 25% of the target) were eventually started during this period. Part of this failure could be explained by the fact that of 105 innovation projects under the Objective 1 programme, only 27 were tasked with achieving this result. Of these, nearly half were directly related to Technium.

Technium Programme Performance

The Technium programme was arguably the highest profile innovation intervention in Wales since devolution, featuring in every one of the Welsh Government's changing economic strategies from 2000 until its eventual demise. It also represents a significant infrastructural investment of around £100m on ten physical centres with 89% of this coming from EU Structural Funds and public sector matched funds (DTZ, 2010, p. iv). Originally conceived by two Swansea-based academics and one policymaker (NAfW Enterprise and Learning Committee, 2008, pg. 26), Technium sought to provide office space and support for high technology firms to help them commercialise research and contribute to economic growth (Clement and Davies, 2002). It was especially aimed at university spin-offs and high technology firms, beginning as an alliance between Welsh universities and the Welsh Development Agency (WDA). It was then led by a consortium of the aforementioned alongside the

City and County of Swansea, West Wales TEC, Business Connect and Swansea Institute of Higher Education (SIHE).

According to Clement and Davies (2002), Technium was designed to bridge the gap between advanced University research and commercial exploitation and was designed with four key aims, namely (a) the construction of a high quality environment appropriate to facilitate and support the growth of knowledge driven businesses; (b) to accelerate the rate of increase of creation of new SMEs in the knowledge economy; (c) to support the growth of already existing knowledge driven SMEs; and (d) to create a "one-stop-shop" to encourage the relocation of inward investing R&D operations. Therefore, the rationale behind the programme was that the Higher Education Institutions (HEIs) could leverage their expertise in intellectual property (IP) alongside the WDA's assets and expertise in physical property and business support in order to facilitate enhanced commercialisation of R&D activities in Wales.

In theory, Technium was the operationalisation of the Triple Helix model of innovation with government in its various guises using European funds to facilitate increased engagement between business and academia to foster innovation in order to help grow the Welsh economy (Pugh, 2016). The programme has attracted a moderate interest amongst researchers and evaluators: it received positive analysis in a Regional Studies paper by academics who were themselves directly involved in developing Technium as it was still underway (Abbey et al., 2008), but was reviewed much less positively by evaluation consultants (DTZ, 2010) in a review commissioned by the Welsh

administration. A recent paper used it as a comparative case study for exploring social capital and innovation, reflecting on the Technium experience and linking it to wider debates on the evolution of regional innovation policy in Europe, providing suggestions on how costly innovation policy mistakes can be avoided (Murphy et al., 2016).

The first Technium in Swansea opened in 2001. A new Welsh regional innovation strategy was launched in 2002 with a nationwide Technium network at its heart, despite the fact that the NAW Economic Development Committee published a report suggesting that the research base in Wales was, at the time, inadequate to support the knowledge economy aspirations of the strategy (Jones-Evans, 2002) and that Structural Funding should focus on developing research capacity rather than incubators. Nonetheless, this advice was ignored and Technium was subsequently expanded to twelve centres across Wales using European Structural Funds. The Techniums, rather than being based in the more prosperous parts of Wales, were located exclusively in the European Objective 1 area which is reflective of the European monies used to establish them. Furthermore, there was a demonstrable preference for a South West Wales location with six out of the ten Techniums located within a 25-mile radius of Swansea, the institutional location of two of the three individuals who originated the idea. The then Minister for the Economy and Transport responsible for the programme, Andrew Davies AM, was a champion of the Technium network and the political representative for Swansea West. Davies later blamed Welsh civil servants for the programme's failure, commenting "I think the concept was very sound... It was the management and roll-out that

was deficient”, a point that other politicians in Wales disagreed with (Evans 2010).

Table 3 about here

Figure 2: Locations of individual Techniums in Wales

Figure 2 about here

NB Areas shaded in grey are Objective 1.

In total, Technium received 25% of the total amount allocated to innovation projects under measures 2.3 and 2.4 for the Welsh Objective 1 programme. The overall target for the Objective 1 programme was 2,000 new high technology firms, so it could reasonably have been expected the Techniums would create at least 500 of these given that it was the only dedicated programme focusing specifically on this target. However, expectations were downgraded quickly even before the Techniums were built with only 250 firms projected to be set up.

As table 4 shows, even the re-profiled target of 133 firms was not reached and only 86 new high technology companies were actually created at an overall cost of £74m during the period 2003-2010 (just under £1m per company). In contrast, the Welsh Government’s Knowledge Exploitation Fund - established to encourage greater links between tertiary institutions and industry rather than

to specifically create new firms – generated 239 new businesses at a cost of £20.3m – a tenth of the cost of the Technium programme. Further, Technium also did not reach its targets in increased turnover for supported firms (23% of original target achieved, 32% of reprofiled target); gross jobs safeguarded (47% of original target achieved, 67% of reprofiled target) and gross new jobs (35% of original target achieved, 509% of reprofiled target). Whilst the Techniums reported creating 808 gross new jobs in high technology sectors, this is still considerably below the 1,297 jobs that Davies and Abbey (2007) estimated would be created and lower than the 1,181 target for when all the centres were operational.

Table 4 about here

Within the previous evaluations of the Technium network conducted, a number of key points are worth summarising. Cooke (2003) didn't see the Techniums as innovative, suggesting that they were simply properties leasing space and highlighting a number of 'design flaws' in the concept, predominantly the failure to prioritise management assistance through allocating space to firms providing venture capital, legal advice, and management accountancy support within the buildings. Cooke and Clifton (2006) considered the scheme as overambitious because it assumed that over 400 incubator spaces could be filled. This was despite evidence from Jones-Evans (2002) that calculated, using international rates of academic entrepreneurship, that only 20 to 30 staff spinouts could be anticipated from Welsh universities at the time of the programme. It also concluded that the buildings were not in themselves innovative but merely a

replication of old incubation approaches with the result that the focus on management assistance and advice became lost. There were setbacks in rolling out Technium, with the Bio Technium and the Media Technium in Carmarthenshire both failing during the period 2003-2005. There was also concern expressed by independent Welsh Government advisers on the lack of output from the Techniums with a review of commercialisation activities in Wales warning that 'the evidence suggests progress in meeting [the targets] has been mixed. One of the main reasons for this is the absence of a continuous pipeline of strong technology based tenant companies' (Gibson Review, 2006, pg. 13). This echoed the earlier warnings from the 2002 NAFW report on R&D activities in Wales (Jones-Evans, 2002) and a number of WDA officials in private referred scathingly to the Techniums as 'emptiums' or 'desertiums' (Evans, 2010; Morgan, 2012).

Others disagreed with this view. For example, Bristow et. al. (2008) were more generous suggesting that whilst the cost per job seemed very high, the jobs tended to be graduate level, R&D based positions, and could form the basis for more high value added growth in the future. The most strident defence came, not unsurprisingly, from Abbey et. al, (2008) who argued that Cooke and Clifton's criticisms were 'unsubstantiated' and that the research base of South West Wales was expected to 'have almost tripled' by the time the programme reached maturity. However, recent statistics released by the UK Office of National Statistics show that no such increase occurred in Wales and that the number of full time equivalents (FTEs) remained fairly constant at around 4000 individuals engaged in BERD, the lowest in the UK as of 2013 (Office for

National Statistics, 2014), suggesting that Cooke and Clifton's early concerns were correct.

The failure of the Technium network to make any significant impact on the innovation performance of the Welsh economy as predicted by Abbey et al. (2008) inevitably led to concerns about performance and on value for money. As a result, an officially commissioned evaluation in 2010 using unpublished official data from Objective 1 monitoring forms was carried out. This revealed that each job in the Techniums cost an average of £190,000 of public money, and occupancy rates at Technium Pembrokeshire were as low as 4% (DTZ, 2010). Overall, the evaluation was highly critical of the programme and, in November 2010, the Welsh Government announced that it was closing the majority of the Techniums around Wales with only four remaining, and these were sold to local universities and councils in subsequent years (BBC, 2011).

What went wrong?

To understand Technium's performance, we sought the view of key stakeholders, individuals from business, universities and policymakers to gather informed views on the programme. Interviews were undertaken with the wider intention of seeking to understand innovation policy measures within Wales more generally and the relevant Technium related comments were extracted from NVivo coded data. This section presents a selection of comments and observations from those interviewed blended with analysis of the programme.

The stakeholders interviewed expressed a range of views on innovation in Wales, but were in relative agreement about the Technium programme:

I don't think the Techniums were particularly useful ... It's easy to kick the Techniums I suppose. (University Professional 11)

A common criticism made both by evaluators and stakeholders interviewed was the divergence between the original design and eventual implementation. Techniums were intended to be more than a property-based incubator approach with plans to provide advice and support for companies located within the buildings and links to Welsh universities so that businesses could access their knowledge and expertise. However, in line with many of the early criticisms of the project, these did not materialise with a lack of spin-outs coming from the universities to fill the incubator spaces. Consequently, the Technium programme was seen more as a continuation of the WDA's property investment programmes of the past.

Techniums were always about the property investment people in the old WDA, it was simply a way of continuing to build advance factories... If they could pick up on innovation and technology as the underpinning rationale they could go and build very nice high quality sheds in parts of Wales and call them Techniums. (University Professor D)

According to this respondent, the underlying problem was that the people in charge of implementing the Technium roll-out fundamentally misunderstood the nature of an innovation programme and focussed on the property elements because that was where their expertise and experience lay. These insights provided by the interviewees broadly match those of the evaluations discussed above. Some respondents questioned the rationale and innovation credentials of Technium, seeing it as a continuation of the WDA's property investment initiatives. Their insights question whether Technium really was an innovation programme despite the fact it certainly is presented as such in various policy documents and its original rationale fits the Triple Helix approach to innovation. The suggestion by a former WDA senior official that the Techniums weren't 'proper' innovation centres is tied to the lack of integration and embeddedness with other innovation supporting mechanisms, as well as the lack of demand from the private sector. Another observation was the manner in which the programme was expanded across the whole of Wales based on the perceived success of the first centre in Swansea. The Welsh Government's official evaluation (DTZ, 2010) found no clear rationale for expansion beyond the first centre:

Technium... basis of a very good idea. But we've had a tendency in Wales if something works well once then it will work ten times better if we have ten times as many, and it appears unfortunately that that wasn't the case. (Senior Policymaker B)

The expansion of the programme was problematic because of a mismatch between supply and demand, with too many Techniums and not enough businesses to fill them, a point highlighted by the NAW Economic Development Committee report at the outset. The purported focus on softer support, such as management assistance and advice, was not realised:

Shiny buildings where there is little capacity to use and exploit what the infrastructure provides, because there is either no demand, or little demand; it's been seen as the end in itself rather than the means.

(University Professor E)

The locations of some of the Techniums, and links to European funding requirements, were problematic because there was little actual or identified demand for the service from businesses in the areas concerned.

I think that model was flawed in so much as it was necessarily tagged to European funding, which is necessarily tagged to particular areas of Wales... There was no critical network around it in some areas.

(Wales Director of Business Representative Organisation A)

This issue of determining the location of programmes has been noted more widely across Europe, leading us to question how effective cross-regional policy learning is, and whether there are enough mechanisms to support this and avoid costly mistake-repetition. Rather, we see in Wales an example of

what Morgan (2012) has recognised as 'policy path-dependence', which conditions future approaches based on what has come before.

Wales is not alone in this. If you go around Europe there are many of these examples of effectively white elephants. (University Professor E)

According to one policymaker involved in the Technium concept

...the underlying rationale behind the Technium project is that they should be fully customer oriented, catering for the needs of companies in more ways than straightforward infrastructure provision. (Policymaker A)

If Techniums were to be anything other than standard physical space for early stage companies, university involvement and the 'value-added' approach of linking into other infrastructural support was critical. Technium brought nothing new to the university-side of partnerships. Whilst emphasis was placed on them becoming financially self-sustaining, there was no parallel commitment to facilitate a sustainable commercialisation system by focusing on 'softer' measures of help for companies, for example encouraging academic engagement in entrepreneurial activities (Johnson, Monsen & MacKenzie, 2017). Businesses assisted or created are 'hard' forms of support which are easily measured but offer little detail on the efficacy of support with no tracking of the companies, no detail on the type of support offered, and no assessment of how this helped businesses. The critical lesson here lies in policymakers and

academics better understanding business demand for innovation support activities provided by the public sector (the lack of which was ignored for Technium) and the importance of 'softer' support. When empty spaces arose, the obvious decision for a loss-making entity was to attempt to lease it out, transforming the initiative from an innovation support policy to the Welsh Government effectively becoming a landlord. The lack of a parallel commitment to building absorptive capacity and innovation capabilities in the regional business population, as evidenced by Bristow and Jones-Evans (2008), led to a significant disconnect between supply and demand, undermining the efficacy of the programme.

Discussion and Conclusion

This paper has presented a summary of the development and failure of an innovation policy intervention utilising EU Structural Funds. Questions remain as to why a policy decision was made to allocate a quarter of the overall budget for innovation policy under the Objective 1 programme to a concept that had not yet been fully evaluated, and surprise has been expressed over the lack of a public inquest into the 'failure of an experiment that cost around £111m' (Morgan, 2012, p.16). Despite the DTZ report, the Wales Audit Office refused to undertake a thorough review into the failure of the programme (WAO, 2011) and to examine whether the claims made by Abbey et al. (2008) actually represented value for money for the Welsh taxpayer. There is also little evidence of a learning process to feed back the lessons from the Technium experience into current and future plans under the developing smart

specialisation programme. Whilst this paper takes a critical stance on the Technium programme, it is important to recognise that it at least represented a break from past FDI-premised approaches, and that developing indigenous firms from the bottom up is an important part of a regional innovation strategy.

The first mistake for the Technium programme was the lack of clear rationale for expansion beyond the first incubator in Swansea, especially as two had failed in quick succession after the first opened. Secondly, there were no explicit objectives for the Technium programme and it would seem that the only rationale was to build as many as possible before the European funding ran out. Certainly, there was little consideration of demand from the local business community or universities. Thirdly, the monitoring and evaluation by Technium managers was practically non-existent and this failure on the ground was not noticed by those higher up within the system (Jones-Evans, 2013). Occupancy rates in Techniums were low, and the provision of business support and its take up was minimal. Finally, whilst space within each property was targeted towards innovative businesses, there was no real support provided on site to the firms located there contrary to what is practiced within successful incubator programmes around the world where financial and management advice is as important as the physical space in which firms are based (Bergek and Norman, 2008). Ironically, following the closure of the Technium programme, a number of the buildings are being managed as part of the property portfolios of local authorities and have subsequently attracted various companies as tenants (Wales Online, 2011). However, this owes more to the traditional economic development role of councils rather than the 'Triple Helix interweaving of

government, business and higher education strongly formalised within a single programme' which, according to Abbey et al. (2008), characterised the failed Technium programme.

The closeness of key academics to policymakers and their mutual interest in the creation of Technium combined to create a policy intervention that was destined to fail. This is a salutary lesson for other peripheral weaker EU regions – where there is no business demand for, or capacity to utilise, a particular form of policy support, the chances of it succeeding are severely limited. The construction of new buildings in itself cannot make an innovation system work effectively and they have to be appropriately matched with the private sector's ability and desire to use them. The new policies implemented as part of the Lisbon Treaty and H2020 around smart, sustainable and inclusive growth need to engage with the stimulation of the private sector beyond the creation of physical infrastructure and consider the availability of finance, commercialisation training and, most importantly, the further development of human capital. Less developed regions suffer from deficiencies in these areas so need to be aware of the dangers of projecting modernity through the creation of 'big shiny buildings', tempting as they are. Unfortunately, lessons have not been learnt following the closure of Technium and other projects have repeated many of the mistakes. For example, High Performance Computing Wales (HPC Wales) was established in 2011 to provide a world-class supercomputer facility but failed to address demand in the market-place. It had a target of creating over 400 jobs and supporting 550 firms but created 170 jobs, assisted 247 businesses and generated £3.7m into the Welsh economy at an overall cost of

£33m (HPC Wales, 2015). Similar criticisms have also been recently levelled at the new Swansea Bay City Deal with projects (led by some of the same academics behind Technium and HPC Wales) again focusing on buildings rather than local business demand (Pyke and Youle, 2017).

There is a key lesson from the Technium experience around the co-option of innovation policy to fit the agendas of strong regional players, particularly when a weak private sector is present. This could be especially the case in small tightly networked peripheral regions or nations such as Wales where strong individual actors can influence policy decisions regardless of demand. To counter this, a better understanding of business need for innovation support could be gleaned from surveys such as the Community Innovation Survey or working more closely with business groups (such as the Federation for Small Business in the UK) to understand where policy could make a better contribution to innovation. This would increase effectiveness of such policies by being demand-led and without significantly increasing transaction or opportunity costs. Such an approach would facilitate the integration and place-based economic transformation that Smart Specialisation strategies seek to create, especially in supporting the further development of a competitive SME sector (European Commission, 2013; McCann and Ortega-Argilés, 2015; 2016). More crucially, it would also help in identifying areas where there are strengths and weaknesses, thus recognising the importance of listening to the business community at which the policies are directed, and being able to benchmark against previous policies and changes in opinion.

In addition to lessons in the design and implementation of innovation policies, this paper provides a number of insights into debates on wider regional innovation policy theory. Firstly, the Technium story crystallises the problems of over-supply without addressing the issue of demand amongst the local business community. Secondly, a focus on local specificities and of the existing networks and cultures within which an intervention sits is key if we are to avoid placing innovation interventions in inappropriate locations. Thirdly, as our analysis is on the effects of a policy over time, it contributes to the literature on innovation policies which tend to take cross-sectional snapshots (Roper et al., 2006), which are often considered misleading (Salter and Martin, 2001; Brown, Gregson and Mason, 2016) and negates the detail of how policies are formulated, operated and, in this case, abandoned over time (Bergek et al., 2008). A better understanding of efficacious policy mixes requires analysing the temporal and contextual aspects of how they are created and undertaken (Perchard, MacKenzie, Decker and Favero, 2017). Achieving the right “policy mix” is recognised as a key element for innovation policy in the era of smart specialisation (cf. Flanagan, Uyerra and Laranja, 2011). We have sought to do this by assessing the Technium policy as situated within the wider Welsh and EU contexts in order to illustrate what policy makers actually do (Uyerra and Flanagan, 2010; Arshed, Mason and Carter, 2016).

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Table 1: Timeline of Welsh Innovation Policy

Year	Policy/ Event	Details
1993-4	RTP (later RIS) pilot	Wales is one of the first regions to implement Regional Technology Plans - an early European regional innovation policy
1999	Devolution	Powers devolved to Wales from the UK including innovation and economic development
2001	Technium Inception	First centre is opened in Swansea
2002	Expansion announced	Decision made to create five more centres.
2002	A Winning Wales and Wales for Innovation Published	The first economic and innovation strategies published by the Welsh Government. Led to £150 expansion of the programme in 2003.
2004	Knowledge Economy Nexus published	This policy emphasises the roles of universities as economic drivers through programmes such as Technium.
2005	Wales: A Vibrant Economy Published	The next Welsh economic strategy, with Techniums as a focal point.
2006	Science Policy for Wales published	Again, the focus on driving innovation through knowledge with Techniums as a feature.
2008	Assembly's Internal Audit Service publishes critical report	Welsh Government responds to this by announcing further funding for the programme.
2009	£17 million ERDF funding allocated to programme	This was announced in response to the critical IAS report.
2010	Six Techniums closed following policy review	Pembrokeshire, Baglan, Llanelli, Pencoed, Aberystwyth, and Bangor Techniums closed. The reason being the high costs.
2010	Economic Renewal: A New Direction published	The economic policy, which takes a sector based approach to economic development. Techniums are aligned to sectors.
2010	DTZ report	The report is critical with the programme and underlines a number of shortcomings.
2013	Innovation for Wales	The latest innovation policy is sector based to align with the smart specialisation requirements pushed from Europe.

Table 2: Innovation activities and results from the Objective 1 programme, West Wales and the Valleys, 2000-2006

Measure	Output	PC Target	Forecast		Actual	
			No	% of PC target	No	% of PC target
Activities						
2.4	No of employees helped	15,000	8,112	54%	7,146	48%
	Companies assisted of which:	5,000	17,538	100+%	20,901	100+%
2.3	Companies receiving advice on innovation and R&D	2,000	13,929	100+%	17,328	100+%
2.4	No. of companies helped	3,000	3,609	100+%	3,573	100+%
Results						
	Gross new jobs of which:	8,000	6,830	85%	8,157	100+%
2.3	Gross new jobs	5,000	2,599	52%	4,466	89%
2.3	Gross new indirect jobs	-	1,657	-	1,314	-
2.3	Gross new jobs in high-tech sectors	3,000	2,574	86%	2,377	79%
	Gross safeguarded jobs of which:	7,830	12,631	100+%	22,413	100+%
2.3	Gross new jobs safeguarded	7,230	11,861	100+%	22,276	100+%
2.4	Gross new jobs safeguarded through ESF support	600	770	100+%	137	23%
2.3	Gross new companies in high-tech sectors	2,000	504	25%	456	23%

Source: WEFO data release 31/07/2010

Table 3: Technium Centres funded by European Structural funding (2001-2007)

Map No.	Year Opened	Technium [†]	Town/City	Region	Sector Focus
1	2001	Technium 1	Swansea	SW Wales	None
2	2003	Digital	Swansea	SW Wales	Digital and Software Technologies
3	2004	Technium 2	Swansea	SW Wales	None
4	2004	OpTIC	St Asaph	N Wales	Opto-electronic
5	2004	Aberystwyth	Aberystwyth	Mid Wales	Bio- Environmental and Computing Sciences Digital Tech
6	2005	Digital@Sony*	Pencoed	SE Wales	Tech-based incubation
7	2005	Sustainable Technologies	Baglan	SW Wales	Sustainable Tech and Low Carbon
8	2005	CAST	Bangor	N Wales	Advanced Software
9	2007	Performance Engineering	Llanelli	SW Wales	Engineering
10	2007	Pembrokeshire	Pembroke Dock	SW Wales	Renewable and Sustainable Energy

Adapted from DTZ Evaluation of the Technium Programme 2010.

*Digital@Sony Technium did not receive any European funds

†Both the Media Techniums and the Biotechnium in Carmarthenshire were closed in 2003 and 2005 respectively.

Table 4: Objective 1 Funded Techniums - Results Targets and Outputs

	Target	Reprofile	Achieved	% achieved	
				of Original Target	of Reprofiled Target
Increase in turnover in supported companies	£111.71m	£81.57m	£26.04m	23.31	31.92
Gross new companies in high tech sectors	250	133	86	34.40	64.66
Gross jobs safeguarded	850	600	399	46.94	66.50
Gross new jobs	503	35	178	35.39	508.57
Gross new jobs in high tech sectors	1181	789	808	68.42	102.41
Number of new patents and trademarks	54	54	79	146.30	146.30
Number of jobs accommodated directly	188	188	188	100	100
Number of gross new indirect jobs	0	318	616	N/A	193.71

Source: DTZ: Techniums Objective 1 Application Forms

