Swansea University
Prifysgol Abertawe

The development of Knowledge Transfer and Technology Transfer with Port Talbot Waterfront Enterprise Zone

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Abstract

Key Words: Knowledge Transfer, Technology Transfer, Innovation, Regional Innovation System

Wales has recently seen a concerted attempt by the Government, Academia, and Industry to transform into a knowledge-based economy through increased collaboration across these three sectors. Industry and Academia must share knowledge and technology to assist regional growth.

Key to this change has been the emergence of policy-led programmes like Enterprise Zones to catalyse regional growth by focusing support on a specified area. Such efforts to foster innovation in a region have been contested. Can Enterprise Zones benefit from university innovation in Wales? The Port Talbot Waterfront Enterprise Zone is a unique illustration of how Enterprise Zones foster regional progress.

This study used a qualitative, Action Research approach to map the South West Wales Port Talbot Waterfront Enterprise Zone's context. This involved identifying key issues that impact Knowledge and Technology Transfer in the region to identify barriers and possibilities.

A careful evaluation of the literature and policy contexts revealed initial focus areas of interest to test throughout the investigation. Interviews were conducted in Academia, Industry, and Government to understand people's experiences and identify enablers and barriers to knowledge and technology transfer. The research findings give examples of regional knowledge and technology initiatives and suggested areas for improvement that might help South West Wales and the Port Talbot Waterfront Enterprise Zone promote these activities in the future.

This analysis finds that stronger collaboration between Academia and projects like the Port Talbot Waterfront Enterprise Zone would boost South West Wales' knowledge and technology transfer potential. The Port Talbot Waterfront Enterprise Zone gives a chance to foster Industry, Academic, and Government collaborations. This would minimise the 'University Structure' barrier by allowing Academic stakeholders to work with Industry in a neutral setting. This thesis helps Academics and practitioners understand and create innovation in post-industrial regions.

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Other sources are acknowledged by footnotes giving explicit references. A bibliography is appended.

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Acknowledgements

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I would like to thank my family and friends for their everlasting support through this process that has tested my intellectual potential to its maximum and mental fortitude to stay motivated throughout the work.

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List Of Abbreviations

AJG Academic Journal guide
AR Action Research
CABS Chartered Association of Business Schools
EPO European Patent Office
EPSRC Engineering and Physical Sciences Research Council
ERDF European Regional Development Fund
ERIS Entrepreneurial Regional Innovation Systems
EU European Union
EZ Enterprise Zones
FCM Four Central Measures
FT Financial Times
FTZ Free Trade Zone
GII Global Innovation Index
GVA Gross Value Added
HEI Higher Education Institutions
HESA Higher Education Statistics Agency
HOC House of Commons
IP Intellectual Property
IPO Intellectual Property Office
IPR Intellectual Property Rights
IRIS Institutional Regional Innovation Systems
KS Knowledge Spillover
KT Knowledge Transfer
NIS National Innovation Systems
NPM New Public Management
NPT Neath Port Talbot
NPTCC Neath Port Talbot Count Council
OECD Organisation for Economic Co-operation and Development
OI Open Innovation
PEI Public Research Institutions
PIC Private Investment Community
PTWEZ Port Talbot Waterfront Enterprise Zone
R&D Research and Development
RIS Regional Innovation System
RSI Regional Systems of Innovation
SBCD Swansea Bay City Deal
SI Social Innovation
SME Small Medium Enterprise
TT Technology Transfer
TTO Technology Transfer Office
UEZ University Enterprise Zone
UKRI UK Research and Innovation
USW University South Wales
UWTSD University of Wales Trinity Saint David
VC Venture Capital
WAG Welsh Assembly Government
WG Welsh Government

List of Publications from this Research

Bourne, J., Davies, G. H., & Williams, M. (2020, September). Knowledge and Technology Transfer in the Port Talbot Waterfront Enterprise Zone. In *ECIE 2020 16th European Conference on Innovation and Entrepreneurship* (p. 137). Rome, Italy. Academic Conferences limited. *(See Appendix 5.1.)*

Bourne, J., Davies, G. H., & Williams, M. (2021, September). *The 'Freeport' dilemma in the Regional Innovation System of South West Wales.* In *ECIE 2021 17th European Conference on Innovation and Entrepreneurship*. Lisbon, Portugal. Academic Conferences limited. *(See Appendix 5.2.)*

1. Introduction

Chapter One presents the research context, research objectives, research design and approach undertaken. Following this introduction, the chapter will summarise the structure and ordering of the thesis presented.

1.1 Research Context

Since the Bayh-Dole Act (1980) was introduced to encourage the process of technology transfer, there has been a domino effect in Research & Development (R&D) expenditure (OECD, 2021) and subsequent growth in patents applications from Industry and Higher Education Institutions (HEIs) (EPO, 2020). However, this growth has been accompanied by w various challenges, such that South West Wales is now regarded as a region that is economically lagging (Reid, 2018; The South Wales Crucible, 2018; Office for National Statistics, 2021) . The South West region has long been amidst a transition from its traditional industries such as steel production, with Tata Steel being a significant stakeholder in the region (WAG, 2004, 2005, 2010; WG, 2019b) and comprising the UK's biggest steelworks overall. However, supply and demand issues have arisen regarding the availability of materials needed, causing the prosperity of the region to suffer (Singh, 2006). There have been attempts in policy and practice to reduce dependency on these traditional industries, by evolving into a post-industrial economy that uses a knowledge-based economy (Huggins et al., 2008). Central to transitioning into a knowledge-based economy is successful (Foray & Lundvall, 1998; Hudson, 2011) Knowledge Transfer (KT) and Technology Transfer (TT) between Academia and Industry (OECD, 2012; Perkmann et al., 2013; Bourne et al., 2020), highlighting the key role of the university (David B. Audretsch & Lehmann, 2005; Albert N Link & Welsh, 2013).

This has sparked interest in Regional Innovation Systems (RIS) (P. Cooke, 1992) and how it affects a specific context, while the literature by Leydesdorff and Etzkowitz (1998) around the Triple Helix Model can act as a tool to understand the connections between the key stakeholders of Industry, Academia and Government. A key theme around the literature is clusters (Martin & Trippl, 2015; Vestal & Danneels, 2018) and how an Enterprise Zone (EZ)

can impact this, in addition to the impact that EZ's may have on KT and TT activities (Argote & Ingram, 2000; Bozeman, 2000).

Use of EZ's within the UK has grown exponentially in recent years and they have become a popular means to boost regional economies (GOV, 2011; WG, 2019a), with EZ's being endorsed by both UK and Welsh Government. EZ's are hereby defined as GOV (2011) "*Geographically defined areas. Agreed between the local and enterprise partnerships and Government*" (GOV, 2011). The Port Talbot Waterfront Enterprise Zone (PTWEZ) was formed in March 2016 to support innovation between Industry, Academia, and Government (BW, 2019). A key argument in the literature is the effects of policy-led initiatives to support the economy (Orsenigo, 2001; Y.-S. Su & Hung, 2009; Kowalski & Marcinkowski, 2014) and the impact of spatial economic development (Trippl & Maier, 2011; Acs et al., 2013). Finally, the importance of regional economies to support their growth is a significant discussion in the literature (Foray, 2013; Morgan, 2013; Foray, 2014; Morgan, 2015; Marques et al., 2019).

1.2 Research Aims and Objectives

The three primary research aims, and four objectives of this thesis are listed below. They will be discussed and further elaborated upon in chapter three.

Aims:

- To understand how the PTWEZ can positively impact on innovation activities in the region
- Map the factors that impact KT&TT activities in the region
- Develop tools/initiatives that can support KT&TT activities in the region

Objectives:

Identify key factors that impact KT&TT through the literature review and data collection cycles

- Development of a reference model and how it relates to South West Wales
- Implement themes synthesised from key stakeholder within the innovation system
- Implement recommendations to support different innovation contexts in their KT&TT activities.

The main research question will be described later, following the establishment of the research context.

1.3 Research Design and approach

To accurately answer the research question and research objectives, a detailed literature review was conducted to form the conceptual model of RIS of South West Wales. This is discussed in *chapter two* and *chapter three,* while testing factors that motivate KT and TT against the literature review is presented in *chapter two*.

Insight gained from the literature review and conceptual model allowed for a context specific approach to be undertaken for this RIS. The applied nature and embeddedness of this approach has supported Action Research to answer the research question, highlighted and discussed in *chapter three*. The context of South West Wales was chosen in part because of the researcher's and PhD sponsors' location, who saw an opportunity to better understand the region's innovative context. An inductive approach is undertaken, due to the broad nature of the research, which justifies designing a research question and aims to investigate this research. Natural breaks between delivery allow further refinements to be made and justify the Action Research approach. Further testing was carried out in later interview rounds, through a cyclical approach of semi-structured interviews, which allowed for refinements to be made. Detailed secondary data collected on EZs in the UK allowed for a detailed understanding of the PTWEZ and how these fit in the RIS of South West Wales.

1.4 Contribution to knowledge

The major research topic, which is addressed in this study, adds to the body of knowledge on KT&TT in relation to its facilitators and inhibitors of productive collaboration, and the effects of Government-led initiatives like the PTWEZ. In South West Wales, the Triple Helix Model attempts to comprehend the dynamics of interaction between Industry, Academia, and Government.

The research sets to examine the RIS concept's applicability and how it connects to KT and TT in a context with the characteristics of South West Wales. Through accurate mapping of the major players within an area, these findings aim to contribute to the body of literature as an essential component of the innovation process. Additionally, research and literature point to the significance of the financial sector in the RIS to assist KT&TT initiatives that the Government is unable to. Private investors will be more willing to invest in TT projects that

will generate the crucial funding required for further development. This is consistent with theories on smart specialisation that aim to recognise a region's advantages (Foray, 2014; Morgan, 2015). The research also contributes to the body of knowledge on cluster theory and its significance for Government-led policy by informing the importance and dynamics of KT&TT (Trippl & Tödtling, 2007; R. E. Pugh, 2014; SQW, 2014).

Finally, by analysing a context-specific location, this thesis seeks to add to the growing body of scholarship on UK Freeport (Sunak, 2016; Lavissière & Rodrigue, 2017; GOV, 2020; Bourne et al., 2021). According to the findings, if the main players in the RIS of South West Wales correctly implement and support this project, it can foster innovation within the area.

The research described herein aims to support the Welsh EZs and PTWEZ WG programme by offering insight and knowledge that may support the future development of these Government-led initiatives. For instance, Mott MacDonald has used the information from this research to identify opportunities for infrastructure in a current feasibility analysis for the PTWEZ. The results also corroborated claims made by Reid (2018) and Diamond (2016) that collaboration and the creation of "Industry-led innovation hubs" are crucial. The new Bay Technology Centre, which can serve as a focal point for important stakeholders from area institutions (including AgorIP), the NPTCC, and businesses eager to engage, is one way that the PTWEZ can take use of this concept (WAG, 2010; SQW, 2014).

One of the main conclusions of the study was how crucial it was to KT&TT activities that finance was available. The amount of capital necessary to maximise these activities' success is fundamental to KT&TT. The funds for this should come from both public and private sources. Despite the fact that Welsh Government (WG) provides a variety of funding options for companies to work with Academic institutions, Industry stakeholders showed a lack of understanding of this. This highlights the need for Welsh Government to increase Industry awareness of available financing sources and programmes. With their distinctive perspectives on the particular environment of South West Wales, these findings should complement the anticipated innovation report for Wales.

1.5 Thesis Structure

The present thesis is structured into six chapters, with chapters two to six being summarised below:

- *Chapter two* provides a summary of the literature review. This clarifies the socio-economic context that underpins the research, while providing a detailed analysis of KT&TT and the factors that motivate this. In addition to this, the content here assesses innovation and attempts to summarise how this has been addressed by Industry, Government and Academia. This builds upon the study. Furthermore, *chapter two* gives a detailed view of the conceptual models used to support this thesis, namely the RIS and Triple Helix Model which underpin the structure of the study. These models are tested against the rounds of data collection carried out.
- *Chapter three* sets out the research methodology used. This discusses the nature of the qualitative interviews carried out, with support of the secondary data collected on EZs. This chapter also describes how the conceptual models of the RIS and Triple Helix Model will be tested and provides a detailed overview of the analysis techniques carried out in the thesis.
- *Chapter four* presents the findings collected from the stages of interviews and secondary data collected, which is in design of the action research approach taken.
- *Chapter five* contains the discussion, which discusses the findings in relation to the evidence presented in the literature review, while also highlighting key implications arising from the research.
- *Chapter six* details clear conclusions of the research. Here, the key findings are summarised and contributions to knowledge and practice are further emphasized. Key limitations are reviewed before potential avenues for future research are identified.
- Finally, appendices are presented to conclude the thesis.

1.6 Chapter Summary

This chapter has introduced the thesis, with an on overview of the rationale, research design and objectives of this thesis. The following chapter will provide a detail literature review.

2. Literature Review

2.1 Introduction

Chapter two explores the literature on the economic challenges associated with Wales, the UK and internationally. By doing so, it addresses the university role in relation to economic development and gives a detailed understanding of recent policy initiatives, for instance, Enterprise Zones and Freeports (WAG, 2010; Kolko & Neumark, 2010; Huggins & Strakova, 2012; Marques et al., 2019; Neumark & Young, 2019; HOC, 2020) C. The literature review examines key areas, including 'Innovation', the 'triple helix model' and 'Regional Innovation Systems'. Later, this chapter sets out an analysis of the key concepts in this thesis of 'Knowledge Transfer' and 'Technology Transfer'.

2.2 Global Economic Context

Recently, the global economy has seen much fluctuation in its markets, initially from the financial crisis in 2007-2008 and subsequent austerity through cuts in public services expenditure and increases in taxation across the UK (Ginn, 2013). More recently again, the global economy has been hit by the Covid-19 pandemic, which has resulted in catastrophic effects (McKibbin & Fernando, 2020). Despite this, there has been evidence of a steady increase on Research and Development (R&D) expenditure throughout (David B Audretsch, 1995), signifying the already established importance of knowledge-based economies (David B Audretsch, 1995; David B Audretsch & Belitski, 2020). The graph overleaf depicts the increase of R&D globally from the Organisation for Economic Co-operation and Development (OECD, 2021).

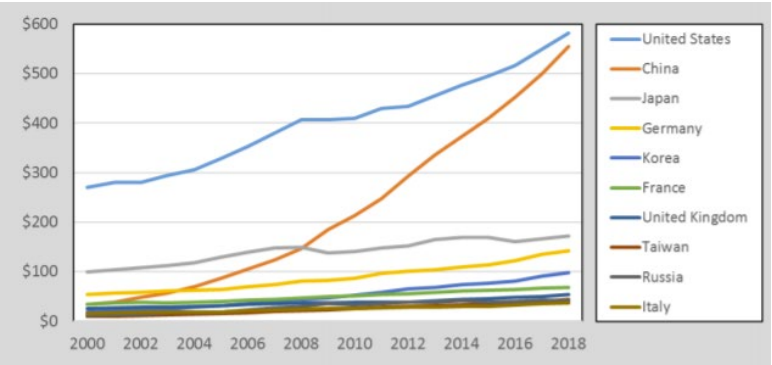


Figure 2. 1 R&D expenditures of selected countries 2000-2018 (in billions of dollars)

The 10 major nations represented in the graph above have seen a rise in R&D spending over the past 8 years, though with the United States and China having increased much more than countries in Korea, Russia, and Europe. Figures 2.1 and 2.2 support the literature on the growing role of the university (Albert N. Link et al., 2007; Albert N Link & Welsh, 2013; David B Audretsch & Belitski, 2020; OECD, 2021). Indices such as the Global Innovation Index (GII) note the importance of Intellectual Property generation for developing the knowledge-based economy (WAG, 2004; Warren et al., 2010; HOC, 2013, 2017). A report carried out by the European Patent Office (EPO) gives a breakdown of the main countries carrying out patents (EPO, 2020).

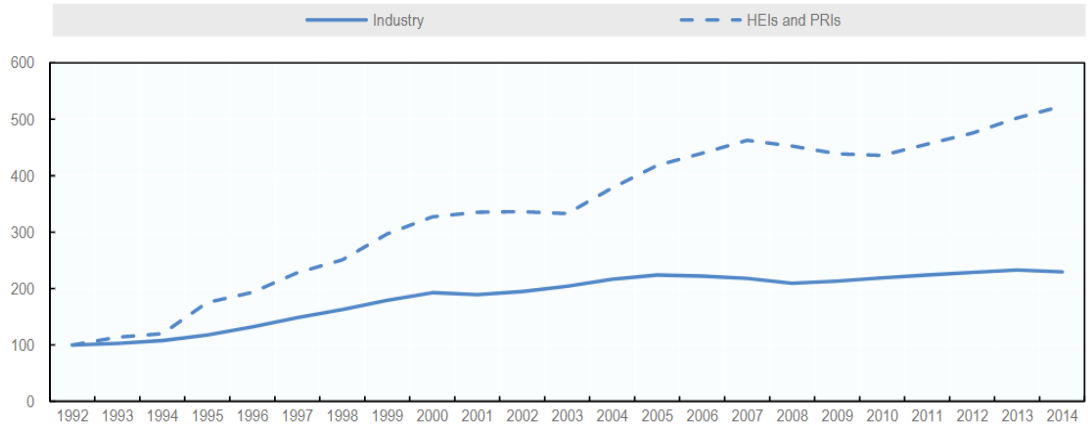


Figure 2. 2 shows Trends in number patents from European Patent Office globally (EPO, 2020).

The global rise in patents filed by higher education institutions (HEIs), public research institutions (PRIs), and business that is proportional to global R&D expenditure, as depicted in *figure 2.2* overleaf. While the Industry's patent output doubled between 1992 and 2014, HEIs and PRIs grew their output fivefold (OECD, 2021). However, the number of patents does not always correlate with commercialisation that is shown in *Figure 2.4 & 2.5 overleaf*. Furthermore, *Figure 2.2* of EPO patent trends does not give a representation of the proportion of patents produced. Overleaf *Figure 2.3* shows the share of the applications within Europe (EPO, 2020). With the breakdown of the share of patent applications, it shows that the majority are coming from large enterprises (74%), with Small Medium Enterprises (SMEs) & individual inventors with (21%) followed by universities and public research institutions with (5%).

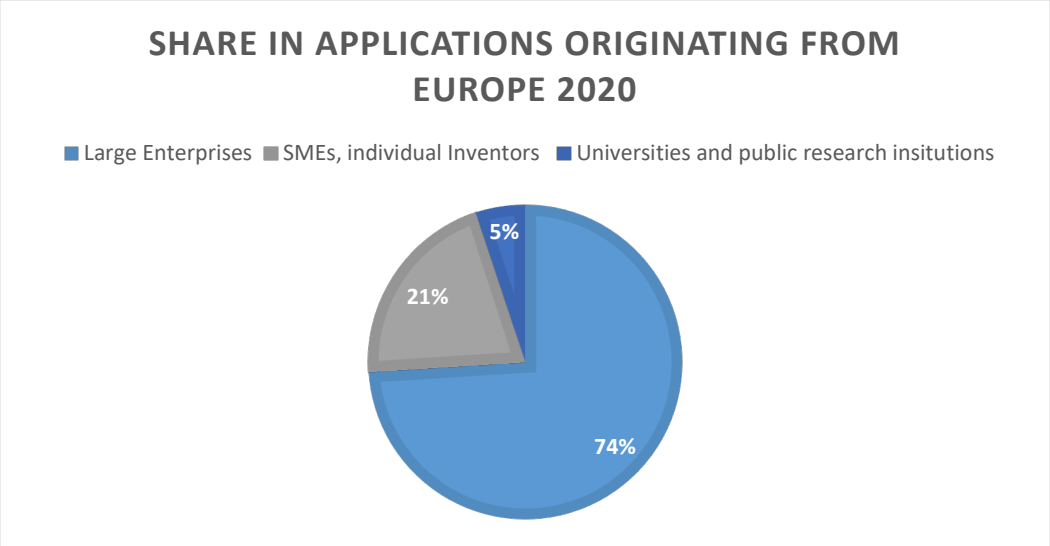


Figure 2. 3 depicting share in applications originating from Europe 2020 (EPO, 2020)

2.2.1 UK Academia

In the UK there are 164 universities (Statista, 2021a) categorised as either 'low research intensive' or 'high research intensive' Universities (Hewitt - Dundas, 2012). Hewitt - Dundas (2012) concluded that there is strong evidence that universities contribute significantly to economic growth, as demonstrated in a number of methods, including licencing, spin-outs, IP generation, and collaborative research. Government incentives have been implemented to boost business activity and scholarly research (HOC, 2017; WG, 2020). Furthermore, the concept of the triple helix model by Etzkowitz and Leydesdorff (2000a) plays a vital role in the importance of Academia, Industry and Government, which will be later discussed. A review carried out by the Intellectual Property Office, IPO (2020) detailed an overview of UK output from patent applications to HEI spin-outs showed that 140 had at least one trade mark registration, 121 had at least one published patent, and 39 had at least one design registration. *Figure 2.4* overleaf relates to findings by Intellectual Property Office (IPO, 2020) that out lines and shows the HEI patent application by year of first application (1999-2018) (PATSAT, 2021).

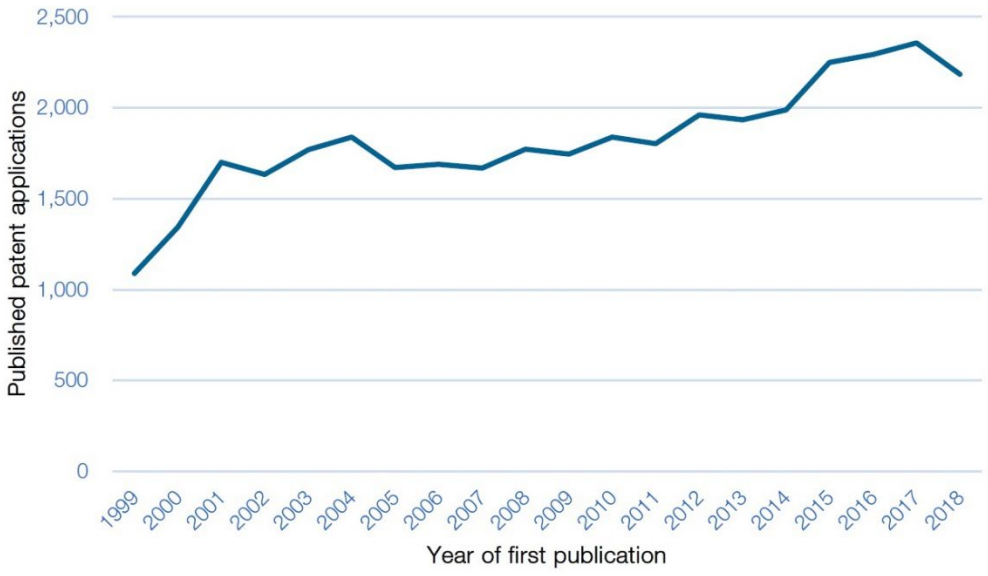


Figure 2. 4 Graph showing HEI patent application output (1998-2018) (PATSAT, 2021).

Even while UK patent applications have gradually increased, there was a modest decline between 2017 and 2018. This correlates visually with the trend of total spin outs from HEIs shown in *Figure 2.5*. *Figure 2.5* overleaf shows the total count of HEI spin-outs from 2000-

2016 (PATSAT, 2021). Compared to the global statistic in *figure 2.4* the UK has only grown by just over double. This suggests opportunity for HEIs & PRIs for greater growth in patent applications, compared to spin-outs that presents a fivefold growth between 2000-2016 (PATSAT, 2021).

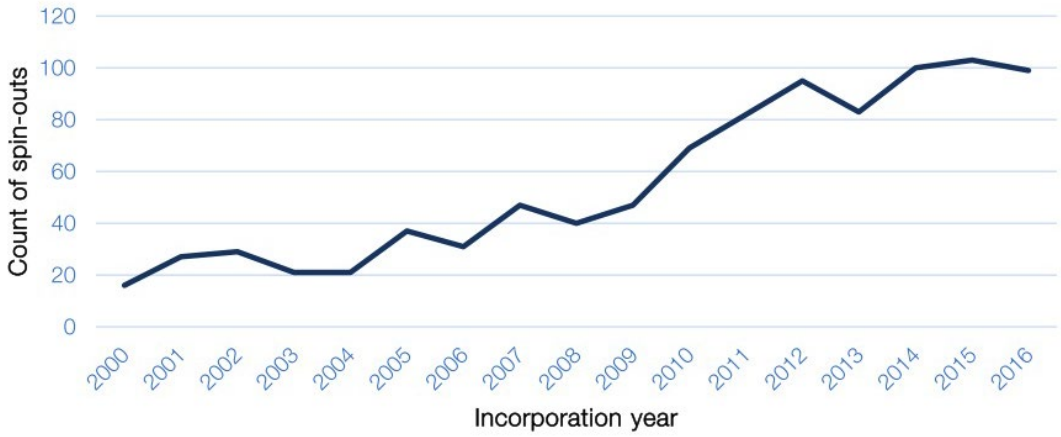


Figure 2. 5 Number of UK HEI spin-outs by incorporation year from 2000-2016 (PATSAT, 2021)

An important aspect of spin-out behaviour is their likelihood of staying in the region they were formed (Egeln et al., 2004; Berchicci et al., 2011). The *Figure 2.6* overleaf shows that 74.8% of all spin-outs stay within the region where they are commercialised. Contributing factors for spin-outs to stay in the region are, the support of the Technology Transfer Office (TTO) (Powers & McDougall, 2005), a supportive organisational culture (Henrekson & Rosenberg, 2001), and Government support initiatives, such as Science parks, Incubators and Enterprise Zones.

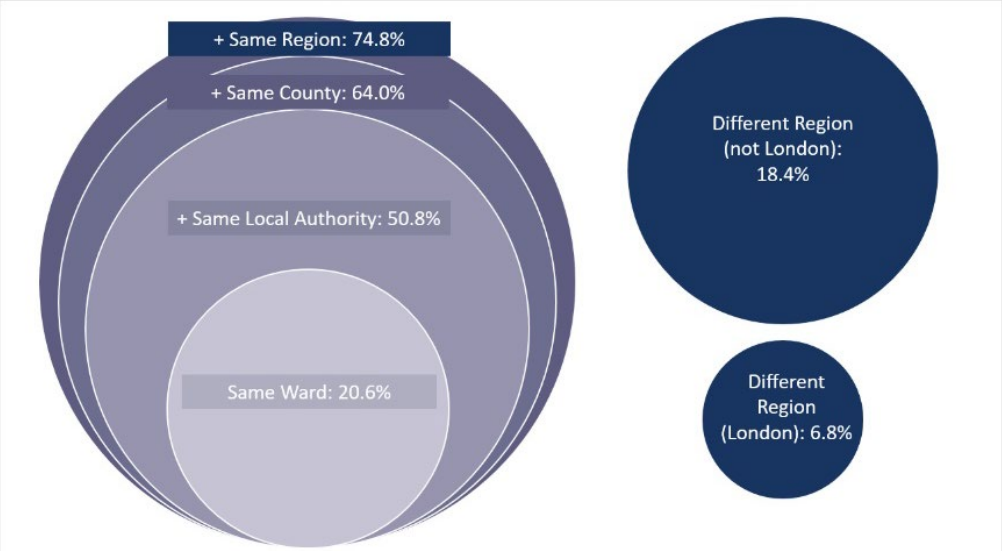


Figure 2. 6 Venn diagram showing the proximity of spin-outs to their parent university (2000-2018) (Beauhurst, 2016)

2.2.2. Wales Context

Wales once led the world in industries such as coal and steel (Day, 2010). Over time there has been a contraction in these traditional industries; coinciding with the emergence of global markets of similar trades, forcing Wales to transition in 2000 to a knowledge based economy (P. Cooke, 2004). This contraction was followed by sustained policy interventions by the Welsh Assembly Government (WAG) (WAG, 2005, 2010) and Welsh Government (WG) (WG, 2015, 2019c, 2020), which had the continued support of the European Union (EU) funding.

2.2.3. Economic context

On the 23rd June 2016, the UK voted to leave the EU, which has caused concern to find substitute funding (National Assembly for Wales, 2018). There is evidence that shows that the Welsh economy is still lagging compared to the rest of the UK (Office for National Statistics, 2018). Table 2.1 describes UK Gross Value Added (GVA) for each country, with productivity measured by GVA for Wales in 2017 accounted for 3.4% of total UK GVA, set against Wales representing 4.7% of the UK population (Office for National Statistics, 2018).

Table 2. 1: UK National GVA statistics (Office for National Statistics, 2018)

COUNTRY	POPULATION	TOTAL GVA (£M)	GVA PER HEAD (£)	ANNUAL GROWTH IN GVA PER HEAD (%)
UK	66,040,229	1,819,754	27,555	3.0
ENGLAND	55,619,430	1,562,707	28,096	2.9
SCOTLAND	5,424,800	138,231	25,485	2.8
WALES	3,125,165	62,190	19,899	2.7
NI	1,870,834	39,613	21,172	3.1

The challenging economic context in Wales is set though in a context of a lower percentage of unemployment compared to its respective counterparts in the UK, which states 4.3% in Wales, compared to 4.9% in England (Office for National Statistics, 2021). However, the level of skilled workforce in Wales (45.3%) is not as strong compared to the average in the UK (50%) (Nomis, 2021)(*see fig. 2.3 overleaf*). This is supported by Reid (2018) who states that *"the level of skills and knowledge within the Welsh workforce will need to increase significantly to deliver Welsh Government ambitions for enhanced productivity, competitiveness and prosperity."*

2.2.4. The Well-being of Future Generations (Wales) Act 2015 (FGA)

The first policy interventions introduced in accordance with the devolved power of Wales were the Environment (Wales) Act 2016 (WAG, 2016) and the Planning (Wales) Act 2015 (WAG, 2015). This led to the legislation of The Well-being of Future Generations (Wales) Act (FGA) that received royal approval on 29th April 2015. The FGA act is unique in approach and takes consideration for future generations, that is done by the development and implementation of policies by Government and public bodies that aim to satisfy the seven well-being goals depicted below in *Figure 2.7* (WG, 2015).

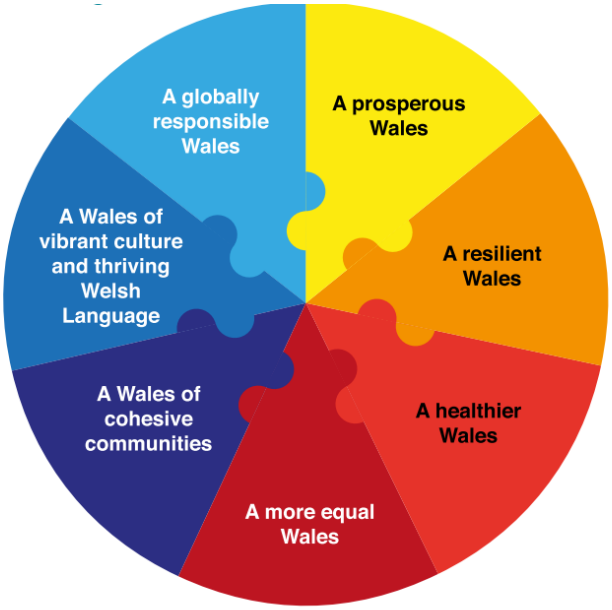


Figure 2. 7 The well-being of Future Generations act 2015 (WG, 2015).

Wellbeing goals (WG, 2015)

- *A globally responsible Wales – A Wales that takes responsibility for a positive contribution to global well-being*
- *A prosperous Wales – Innovative and low carbon society, with a well-educated population, which provides employment opportunities*
- *A resilient Wales – develops biodiverse functioning ecosystems and increase capacity to adapt to change*
- *A healthier Wales – improvement on society's physical and mental well-being*

- *A more equal Wales – allows for every individual to fulfil their potential regardless of their background*
- *A Wales of cohesive communities – attractive, safe and well-connected communities*
- *A Wales of vibrant culture and thriving Welsh language – promotes and protects culture, heritage, and the Welsh language. With the aim to get the public to participate in arts, sports, and recreation*

H. Davies (2017) provided an analysis that concluded with some caution with the 'long-term' ambitions relating to the FGA act, where there should be more information on quite how long term the WGs desire for the sustainable development of initiatives in Wales. Also, he makes the point made that only £1.62 million of funding has been allocated, which may be stretched to achieve the seven well-being goals suggested above. A recent conference paper G. H. Davies et al. (2019) gave a context based analysis of FGA in accordance to South West Wales and AgorIP that is the TTO of Swansea University. The paper presents how the AgorIP goals could be viewed from the FGA perspective.

- Supporting commercialisation of technologies to further health & well-being, with focus on benefit to communities within the region – A healthier Wales, A prosperous Wales
- Supporting commercialisation of low carbon technologies, while promoting wider resource efficient solutions to partner organisations– A prosperous Wales, A resilient Wales
- Engaging with hard-to-reach communities and groups to promote opportunities, including employment and supply-chain activities – A more equal Wales, A Wales of cohesive communities, A resilient Wales
- Increasing opportunities for under-engaged communities and groups to participate in related Academic, clinical and industrial activity – A more equal Wales, A Wales of cohesive communities (G. H. Davies et al., 2019)

This signifies the importance of proper integration of the FGA act into policy objectives and the development of future initiatives like AgorIP of Swansea university, so organisations can be held accountable for improving Wales for future generations (H. Davies, 2017; G. H. Davies et al., 2019).

2.2.5. Universities in Wales

Despite evidence of low economic performance, Wales boasts a successful roster of universities, producing thousands of graduates annually. This comprises of 10 universities, with three (Aberystwyth University, Cardiff University and Swansea University) ranked within the world's top 500 (QS Top Universities, 2021). Furthermore, Welsh universities rank highly in their ability to publish number and quality of articles relative to the number of researchers, where they have a share of 0.30% for published articles, compared to 0.14% for total researchers (Elseiver, 2016). Wales has contributed to 0.85% of all references to journal published articles cited by patents, which is a key part of the relationships with Industry (Elseiver, 2016). However, while Wales has a low percentage of patents, the number of references in patents has increased and has stayed above the UK benchmark from 2009 to 2012 (Elseiver, 2016). *Table 2.2* summarises the key research outputs from the main universities in Wales (The South Wales Crucible, 2018).

Table 2. 2: Research outputs from Welsh Universities adapted from (The South Wales Crucible, 2018)

	Aberystwyth	**Bangor**	**Cardiff**	**Swansea**
REF 2014: Units of assessment with at least 10% of outputs rated world leading (4*)	11	13	25	14
REF 2014: Overall GPA ranking	58	42	6	26
REF 2014: Overall Impact rating	55	41	5	22
REF 2014: Overall research power ranking	51	59	18	42
FTE students 2016/17 (% postgrad)	8,455 (13%)	11,270 (24%)	31,595 (27%)	19,160 (17%)
Collaborative research income	£3.7m	£4.8m	£32.2m	£30m
Contract research income	£2.2m	£5.7m	£6.9m	£3.3m
Times Higher Education World University Ranking – Globally (and UK) (2018)	301-350 (=39)	301-350 (=39)	= 162 (25)	251-300 (=35)
QS World University Rankings (2018)	481-490	441-450	=137	431-440

The Gibson et al. (2007) review of commercialisation in Wales, detailed the importance of growing collaboration between Higher Education Institutions (HEIs) and Industry, through increased deal flow and flexibility for Academia to adapt to the demands of Industry, while Welsh universities receive only 2% from InnovateUK against 5% population sources (The South Wales Crucible, 2018). However, between 2014-2020, European Regional Development Fund (ERDF) programmes had allocated £2.23 billion for innovation and research (WEFO, 2014). A report funded by UK Government, the Science and Innovation Audit, revealed South Wales contributed £44 billion in GVA to the economy, which makes up of 3% of the UK total (The South Wales Crucible, 2018), detailing strengths within the key institutions at Swansea, Cardiff, Aberystwyth and Bangor. This audit examined key areas such as Steel Innovation, Smart Manufacturing, Agri-food tech, Health Innovation, digital technology and sustainable energy (The South Wales Crucible, 2018). Overleaf *figure 2.8* maps key innovations and sciences in Wales (The South Wales Crucible, 2018).

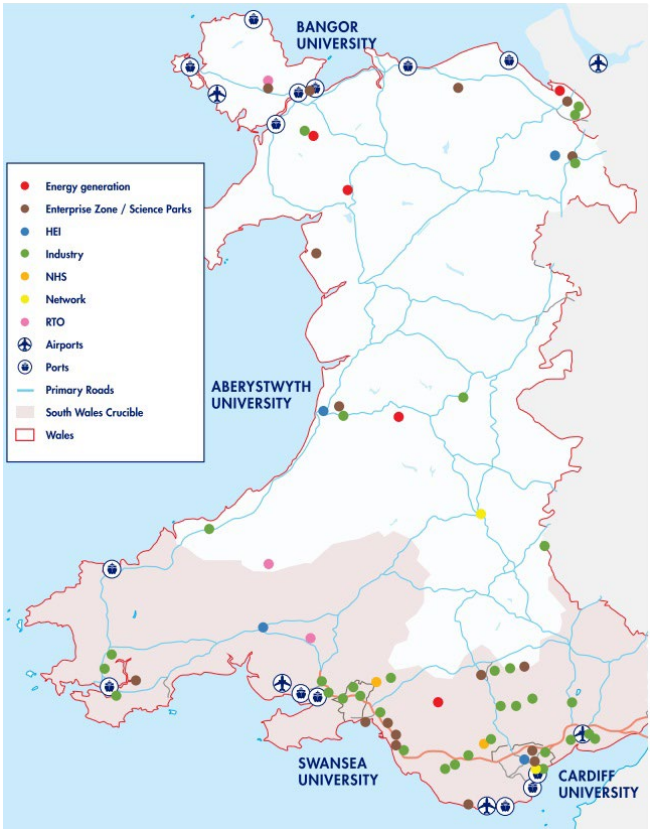


Figure 2. 8 Map of key science and innovation assets in Wales (Original map) (The South Wales Crucible, 2018).

The map 2.8 signifies the clustering of key HEIs, transport links and Industry. IP has been seen as a significant factor in the TT process (HOC, 2013, 2017). Analysis carried out by HESA (2021) shows Intellectual Property through license numbers, which is shown in *figure 2.9.*

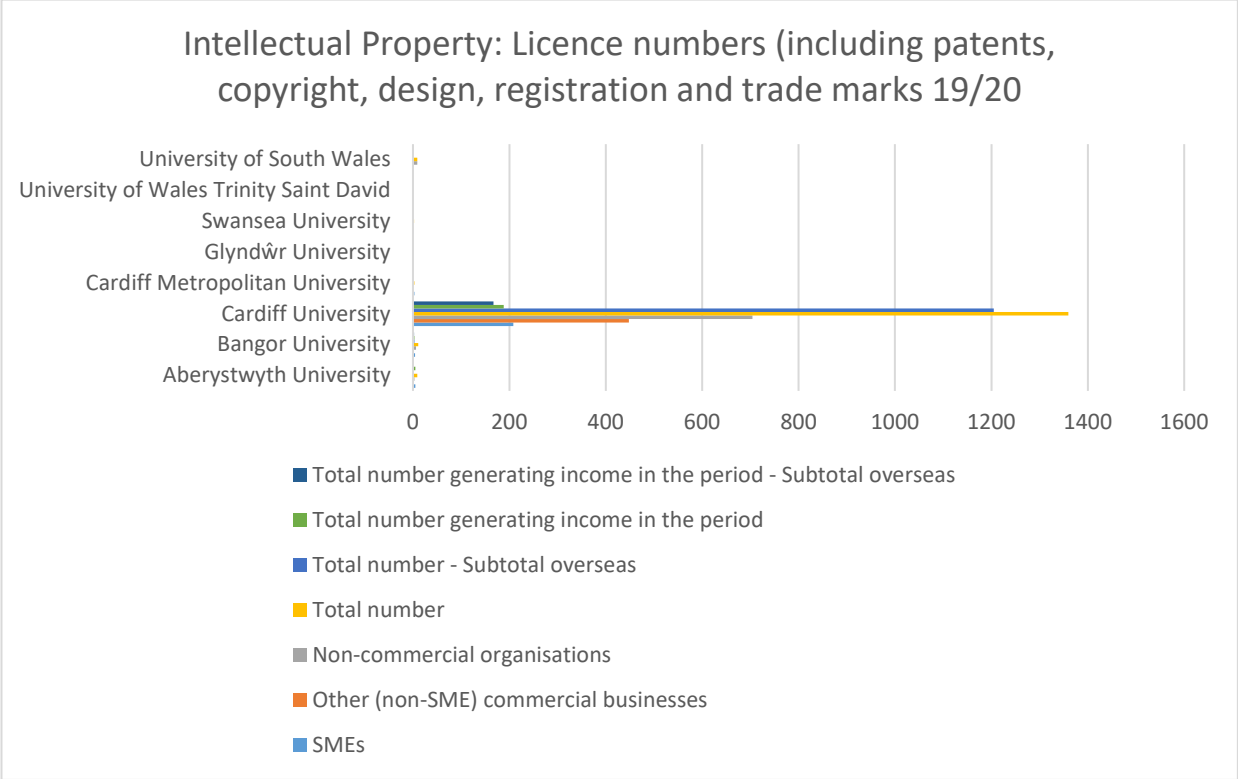


Figure 2. 9 Intellectual Property: Licence numbers (including patents, copyright, design, registration and trade marks (HESA, 2021).

Figure 2.9 demonstrates the notable role of Cardiff University in producing a significant share of Intellectual Property (IP) generation compared with other Welsh Universities. Cardiff produced 1360 licenses, compared to 2 from Swansea University. This statistic is of concern; however, this only shows one part of the picture, *figure 2.10* overleaf shows income from collaborative research, which can be seen as KT activities (HESA, 2021).

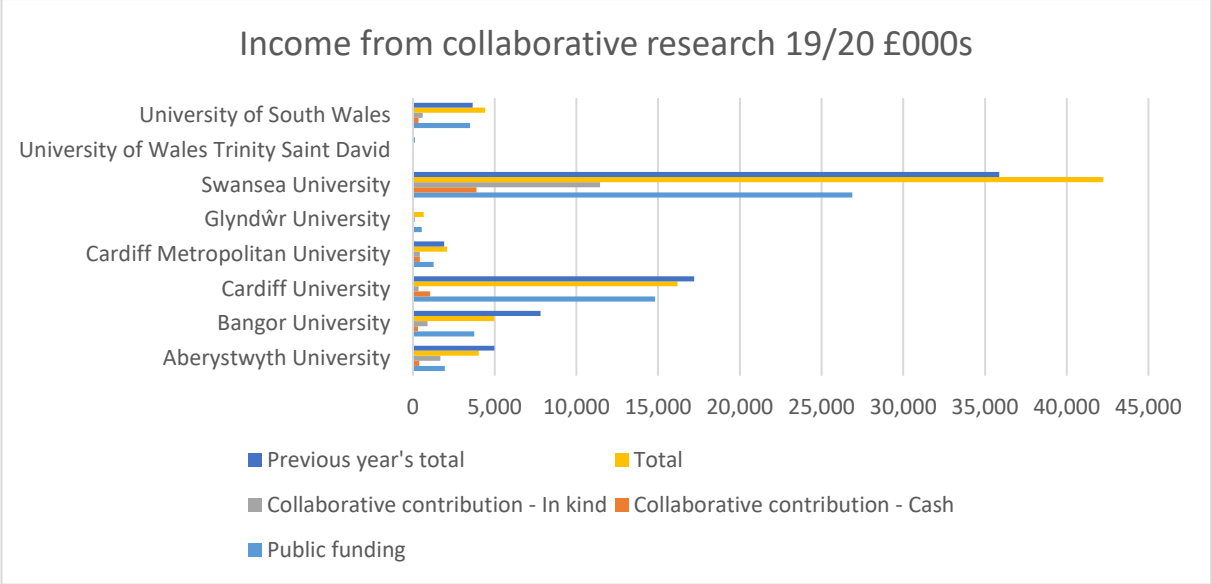


Figure 2. 10 Income from collaborative research 19/20 (HESA, 2021)

In parallel, Swansea has received the highest amount of capital for collaborative research, with a total of £42,238,000 (HESA, 2021). Compared to the UK universities, Swansea ranks 14th (QS Top Universities, 2021). This shows that Welsh universities are contributing to KT&TT activities (HESA, 2021).

2.2.6. South-West Wales and the PTWEZ

Wales has a population of 3.136 million people, with much of the population situated within South Wales. Below is *figure 2.11* that represents the country, Wales.

Figure 2. 11 Wales

The Port Talbot Waterfront Enterprise Zone (PTWEZ) set within South West Wales *(See section 1.2.11. for summary*), has brought significant interest to maximise the potential for this initiative (WAG, 2005; GOV, 2011, 2012; WG, 2019c, 2020). Below is *Figure 2.12* that highlights the places of interest, such as Neath Port Talbot, Swansea, and Cardiff, highlighted in red is the PTWEZ.

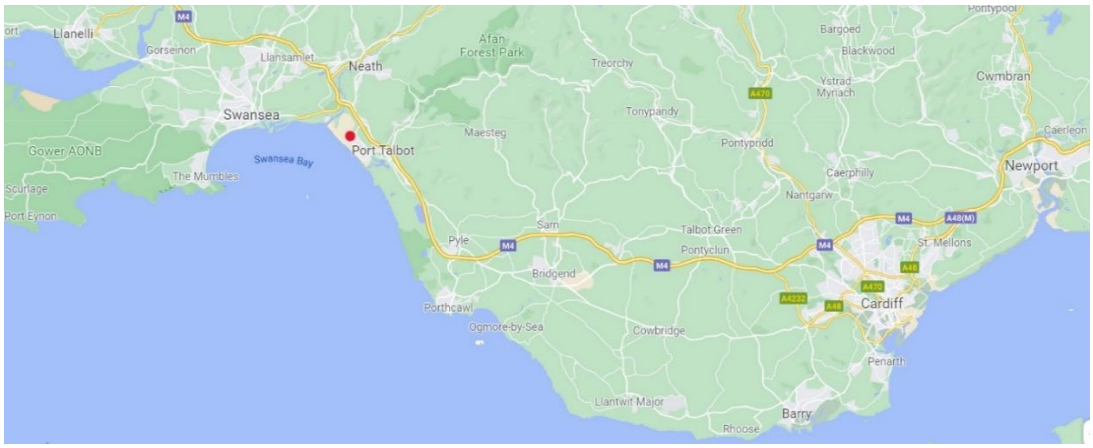


Figure 2. 12 presents South-West Wales and the PTWEZ

Neighbouring major conurbations, Cardiff has a population of 369,202, Swansea 246,563 and Neath Port Talbot (NPT) 144,386, which gives a catchment of 760,151 people within an hour of the PTWEZ (Statista, 2021b).

In a Nomis (2020) report, it stated that 8% of the workforce in NPT are in the category of process Plant & Machine Operatives, compared to the average of Wales, which is 6.3% and the UK 5.5%. Table 2.3 overleaf highlights the low proportion of professional occupation in NPT (12.6%) compared with Wales (20.3%) and the UK (22.8%).

Table 2. 3: break down of workforce in Neath Port Talbot, compared to Wales and Great Britain (Nomis, 2020).

Employment by occupation (Jan 2020-Dec 2020)

	Neath Port Talbot (Numbers)	Neath Port Talbot (%)	Wales (%)	Great Britain (%)
Soc 2010 Major Group 1-3	20,100	32.8	45.3	50.2
1 Managers, Directors And Senior Officials	4,100	6.6	10.2	11.5
2 Professional Occupations	7,800	12.6	20.3	22.8
3 Associate Professional & Technical	8,100	13.0	14.6	15.8
Soc 2010 Major Group 4-5	15,700	25.7	20.4	19.3
4 Administrative & Secretarial	8,800	14.1	9.9	10.0
5 Skilled Trades Occupations	6,900	11.1	10.5	9.2
Soc 2010 Major Group 6-7	13,800	22.6	17.9	15.7
6 Caring, Leisure And Other Service Occupations	7,000	11.2	9.8	8.8
7 Sales And Customer Service Occs	6,900	11.0	8.0	6.9
Soc 2010 Major Group 8-9	11,500	18.9	16.3	14.8
8 Process Plant & Machine Operatives	5,000	8.0	6.3	5.5
9 Elementary Occupations	6,600	10.5	9.9	9.2

Source: ONS annual population survey
Notes: Numbers and % are for those of 16+
% is a proportion of all persons in employment

Given the desire by WG to develop their workforce (WG, 2019c), this has become a complex issue that is being addressed in policy (The South Wales Crucible, 2018; WG, 2019c, 2020). One of the key areas for focus in South West Wales, has been the Steel Industry, with Tata Steel being a key stakeholder and one of the biggest regional employers (WG, 2019b), reflecting the PTWEZ being established to support the adjacent site (Hatch, 2018).

2.2.7. Enterprise Zones

Enterprise Zones (EZs) have been of longstanding interest in the literature (Roger Tym & Partners, 1984; HMSO, 1987; Potter & Moore, 2000; Boarnet, 2001; Neumark & Kolko, 2010; Wainwright, 2012; Neumark & Young, 2019; Hooton & Tyler, 2019) and with policy makers in regional development (GOV, 2011, 2012; WWC, 2016; WG, 2018; HM Government, 2018; WG, 2019a; HOC, 2020).

EZs were introduced in the 1980s by Lord Heseltine, with the first Enterprise zones opened in 1981, followed by a second round in 1983 (HOC, 2020). This was first seen as an experiment to test potential gains in certain areas. A Government consultation paper circulated in 1980 was quoted; *"The Government has announced its intentions to legislate for the creation of*

Enterprise Zones. These zones test as an experiment, and on a few sites, how far industrial and commercial activity can be encouraged by the removal of certain fiscal burdens, and by the removal or streamlined administration of certain statutory or administrative controls" (HMSO, 1987). Following this experiment, there was an comprehensive evaluation of these enterprise zones produced by HMSO (1987), that was funded by the Department of the Environment.

The first iteration of EZs opened a debate on the effectiveness of the initiatives, because of businesses moving to these areas for 'tax breaks' (Dawson & Sparks, 1982; Anderson, 1983; Roger Tym & Partners, 1984; Bromley, 1987). Subsequently, a redesigned enterprise zone was developed in Canary Wharf (HMSO, 1995). This was a big success that inspired the UK Government to replicate this across the country. Moreover, Dawson and Sparks (1982) argued that since the reform of this enterprise policy in the 1980s, it has brought about the inclusion and growth of retail parks in EZs that included a large amount of retail activity. This was partly because of the incentives being offered in these areas, compared to being outside, which weighed in favour of retailing and warehousing (Anderson, 1983) p336-7. Consequently, this meant a rise of retail in these zones, which was against the original policy set out for these enterprise zones (Roger Tym & Partners, 1984). In a South Wales context, Bromley (1987) described the evolution of the Swansea Enterprise Zone into a 'Retail Park'. This concluded that if it had been marketed as a 'retail park' from the beginning, then there would have been an increase in potential commercial development (Bromley, 1987). while this key criticism of EZs caused a change to 'commercial retail parks' (Roger Tym & Partners, 1984; Bromley, 1987).

A review carried out of the first round of EZs gives a model of the interactions from the EZ, which is shown in *figure 2.13 overleaf* (HMSO, 1995). These findings concluded that additionality within these zones varied hugely depending on the types of Industry that located into the areas. The lowest level of additionality was from retail and distribution companies locating to a zone (HMSO, 1995)

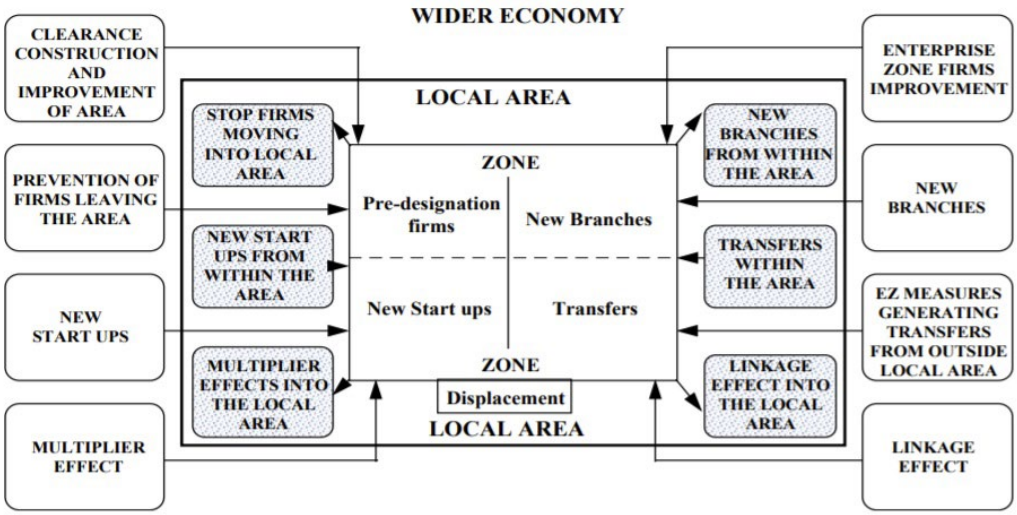


Figure 2. 13 Understanding the Sources of Economic Benefit s from EZs policy (HMSO, 1995)

Following from the original set of EZs; the later UK Chancellor George Osborne came to Cardiff and stated in March 2011 *"Today I confirm that in the Budget we will introduce new enterprise zones across parts of Britain that have mussed out in the last ten years… I am delighted that Nick Bourne and the Welsh Conservatives have said they want to make these new enterprise zones work here in Wales too,"* (Osborne, 2011). Map 2.14 produced by UK Government detailing the 39 EZ's in England (GOV, 2012).

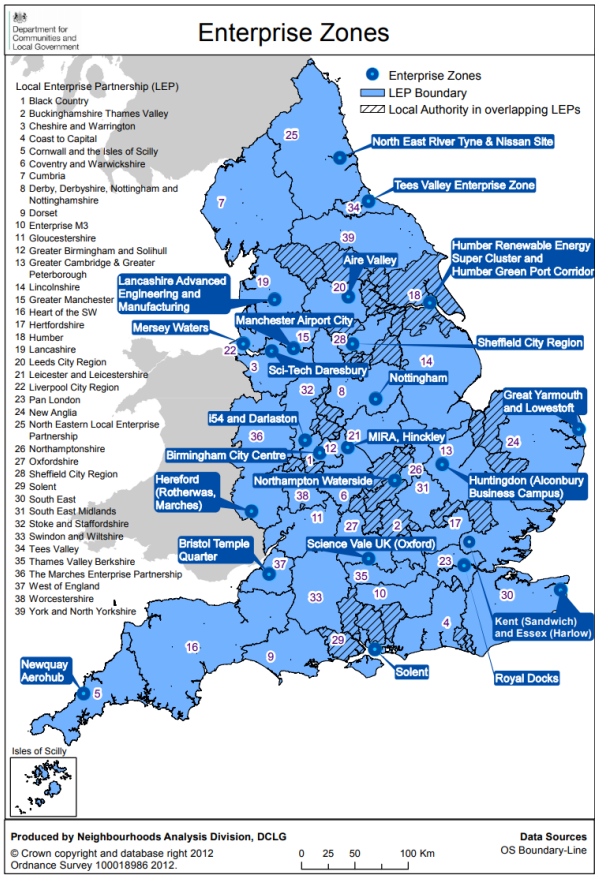


Figure 2. 14 Map of EZs in the UK (GOV, 2012).

It was stated that each location would have a business-led partnership with a goal for driving sustainable economic growth (GOV (2012) *Table 2.4* illustrates the increase in jobs, companies and private sector investment across English EZs for the period 2012-2016 (HM Government, 2018).

Table 2. 4: Sub national breakdown of data from April 2012-2016 (HM Government, 2018).

	April 2012-September 2016	April 2012-December 2016	Numerical change	% Change (rounded)
Jobs	35,897	38,393	2,497	7%
Companies	827	877	50	6%
Private sector Investment (£m)	3,323	3,504	181	5%

Statistically, the above table shows that while there have been advantages to EZs in England, it still leaves the questioned unanswered regarding how many of these jobs were displaced from another region within the UK (Serwicka & Holmes, 2019) and what job creation and private sector investment would have happened if there were no EZs. An article produced by the Financial Times, FT (2013) on the effectiveness of EZs, argued that these zones will take longer to realise results than originally expected by politicians. For the quickest potential results, they are achieved through building on existing strengths. However, friction has occurred from Governments being slow to react (FT, 2013). This was supported by Neumark and Simpson (2015) that long-term benefits are unlikely to provide impact on their own.

A Review conducted by Hooton and Tyler (2019) on EZ literature found that 48% of empirical studies concluded with a positive effect of EZs, compared with 26% with an unsuccessful effect, and 28% had mixed impacts. This analysis also undertook a case study review of empirical EZ research which is shown in *table 2.5* overleaf.

Table 2. 5: Case Study Locations form Empirical EZ Research, adapted from (Hooton & Tyler, 2019)

Case Study	**Number of Studies Examining Impacts in Case Studies.**
California	18
New York City	11
USA	10
Atlanta	9
Florida	8
New Jersey and United Kingdom	7 in each
Baltimore, Pennsylvania and Virginia	6 in each
Chicago, Detroit and France	5 in each
Indiana and Philadelphia	4 in each
Cleveland, Colorado, Kentucky, and Maryland	3 in each
Connecticut, Danville, DC and Ohio	2 in each
England, Europe, Los Angeles, Louisville, Lynchburg, Manchester, Newport News, Norfolk, Paris, Portsmouth, Roanoke, Saltville, Swansea and Texas	1 in each

Table 2.5 above shows that the majority of case study analysis has come out from USA and their regions, with only 7 carried in the UK and one in Swansea (Hooton & Tyler, 2019). This suggests opportunity for further case study analysis to take place of the UK EZs introduced in 2012. Of further interest is the unique perspective highlighted by Martin et al. (2016) of the proportion of total tax revenue raised for EZs by local state with a breakdown shown overleaf in *Table 2.6*.

Table 2. 6: Proportion if Total Tax Revenue raised by Local State. Adapted from (Martin et al., 2016).

Country	1975	2012	Governance Model
United States	34.2%	35.7%	Federal
Canada	42.4%	49.5%	Federal
Germany	31.3%	29.8%	Federal
Switzerland	47.3%	40.0%	Federal
Spain	4.3%	42.1%	Decentralised
Sweden	29.2	36.9%	Unitary
Japan	25.6%	24.7%	Unitary
Italy	0.9%	16.4%	Unitary
France	7.6%	13.2%	Unitary
UK	11.1%	4.9%	Unitary

The above table shows the low proportion of local tax revenue raised by the UK (4.9%) that is the lowest of all the countries shown above post 2012. The low proportion of tax revenue had made it very difficult for local authorities to deal with the challenges, with little support from central Government (Martin et al., 2016; Hooton & Tyler, 2019). However, from 2011, UK Government allowed local authorities to increase their ability for longer-term fiscal capacity that the zones have given them. With an announcement in 2020 from UK Government allowing local authorities to fully benefit from the local business tax base with 100% retention of revenue received (Hooton & Tyler, 2019).

While there is disagreement in the literature on the effectiveness of EZs, a study carried out by Neumark and Kolko (2010) presented that American EZs have been ineffective in supporting increased employment. Moreover, evaluations of EZs found associated challenges including differing zone performance based on Industry mix (Kolko & Neumark, 2009). EZ expansions can produce mixed results, of impact on existing zones (Greenbaum & Engberg, 2004), impact on rent in an area, which often benefitting owners more so than the renter (Bond et al., 2013) and lining up the outcomes with the available incentives (Boarnet, 2001). Neumark and Young (2019) concluded that they are still ineffective in job creation, while Hanson and Rohlin (2011) found that EZs can cause displacement in some cases.

In contrast, Ham et al. (2011) and Busso and Kline (2008) found that EZs in the US provide benefits to the labour markets and that EZs should be properly integrated within their

context to maximise the benefit to a region (Briant et al., 2015). In a strictly economic sense, Hooton and Tyler (2019) found that zones can have a positive impact on economic growth or 'mitigate decline', but not have a catalytic effect in altering the economic trajectory by themselves. EZs have more benefits for new businesses relocating than they do for existing businesses (Givord et al., 2018). The success potential of EZs has also been shown to depend on if they are rural or close to a city (Mayer et al., 2017). Finally, although these studies often look at the tangible benefits associated with EZs rather than intangible benefits, EZs can have a positive impact socially to a region and to the broader policy strategies (Granger, 2012; Hooton & Tyler, 2019).

2.2.8. University Enterprise Zones (UEZ)

There has been a growing interest to have increased integration of Academic stakeholders in Enterprise Zones (SQW, 2015; GOV, 2019; Hatch, 2020). UK Government had piloted the idea of University Enterprise Zones (UEZ) (GOV, 2019), stating a project in 2019 with a Hatch evaluation of the £20.9 million initiative carried out over a two-year period. Overleaf is *table 2.7* listing the UEZ and their sector of focus (Hatch, 2020).

Table 2. 7: Summary of UEZ Sector focus (Hatch, 2020)

UEZ University	Description of Sector Focus
Birmingham City University	STEAM (Science, technology, engineering, arts and maths)
University of Bristol	Life Sciences % broader science-based businesses
University of Cambridge	Digital Health & MedTech
Cranfield University	Aerospace
Durham University	Photonics, surface science, energy biosciences, satellite application 7 data intensive research
University of Essex	Digital & Creative
University of Falmouth	Digital/Games
University of Hertfordshire	Broad sector focus
Keele University	Data Analytics
Lancaster University	Advanced manufacturing and digital health
University of Lincoln	Food
Oxford Brookes University	Artificial intelligence & Data Analysis (for the service sector, Creative industries, social scientist & law, also applicable for HR & Lifesciences
Queen Mary university of London	Life Sciences
Sheffield Hallam University	Health & Wellbeing
University of Southampton	Futures towns Innovation
Staffordshire University	Advanced materials & manufacturing
University of Sunderland	Digital/Media
Teesside University	Digital
University College London	Third Sector

The recent origins of this initiative limit the amount of analysis by Academics, although a report on it has been produced by Hatch Consulting (Hatch, 2020). They provided key findings that were; *'additionality'* where 60% of projects believed it would not have happened without UEZs, the other 40% reported the development would have happened but at a

smaller scale. This finding contrasts the idea that the jobs would have occurred regardless, which was discussed in *section 2.2.6.* on Enterprise Zones (Kolko & Neumark, 2010; Neumark & Kolko, 2010; Hanson & Rohlin, 2011; Neumark & Young, 2019). There has been an increase in partnerships between universities and Industry to support delivery and governance, 857 business assists have been targeted across 17 projects. While over a third of the target has been achieved by the universities (Hatch, 2020).

The UEZ initiative also provided support in the development of R&D infrastructure to the surrounding region. Due to the COVID-19 pandemic much of the capital build and opening of the UEZ facilities was delayed. Finally, there have been suggestions that the UEZ programmes could be further developed if they were to increase interactions with other UEZs (Hatch, 2020). More specifically, Hatch (2020) found a failure in the co-ordination between UEZs and key stakeholders. Table 2.8 breaks down the output achieved so far in the project.

Table 2. 8: Core outputs and outcomes achieved to date (Hatch, 2020).

	Target	Achieved	% Of target achieved	Based on X/20 projects
Business Assists	860	330	33%	17
Workspace delivered (m2)	12,500	5,500	44%	10
Jobs created	790	250	31%	12
Collaborative R&D/ Products developed/ Markets accessed	90	100	103%	9

The outputs achieved thus far may be quite modest, though these data were collected in the two-year period, during the COVID-19 pandemic. Also, the collaborative R&D, Product Development & Markets indicators collected show that these targets had been achieved, which would make the UEZ a success so far, with potential for further job creation to be achieved.

The formation of clusters have been a significant benefit to this programme, where the inclusion of incubators into the formation of clusters are beneficial to the survival of start-up companies (Gazel & Schwienbacher, 2019; Hatch, 2020). *(See section on clusters 2.3.2.)*

2.2.9. Freeports

UK Government have recently introduced Freeports to be implemented across England, Scotland and Wales (Sunak, 2016; GOV, 2020; Webb & Jzepa, 2021), which can have a possible compliment to EZs that have been used instead of Freeports (Millett & Lassen, 2018; Serwicka & Holmes, 2019).

Freeports, also termed Free Trade Zones (FTZ), and are defined as a geographical area which sits outside the legal customs territory of a nation (Jayawardena, 1983). Compared to the definitions by the World Bank Akinci and Crittle (2008) who define freeports as similar to FTZ, but define this being a large area and that covers a wide range of activities to support economic development and trade that shows similarities in the definitions described (Jayawardena, 1983; Akinci & Crittle, 2008). However, Sunak (2016) describes the freeport definition in more detail of how the process will take place. This Freeport was defined as "*Goods can be imported, manufactured, or re-exported within the Freeport incurring no customs duties or taxes; these fees are only paid once the good enters the domestic market*". Additionally, this definition differs from the one provided by the international trade banks by noting the necessity for innovation to take place among the pertinent parties involved in the Freeport and by proposing "hotbeds for innovation" (Sunak, 2016).

Freeports are not a new phenomenon, they have been around for thousands of years (Lavissière et al., 2014; Sunak, 2016). Freeports have multiplied consistently throughout the globe for many years, with approximately 50 Free Trade Zones (FTZ), employing 66 million people across 135 countries, while there is not one in the UK (Sunak, 2016). The importance of Freeports has risen globally, directly impacting on Foreign Direct Investment (FDI) in these zones (Farole, 2011).

Freeports exist because of their capacity to lower the obstacles to trade that are frequently caused by borders and varying regulatory frameworks (Lavissière et al., 2014). However, this endeavour to create jobs could result in the workforce being displaced (Serwicka & Holmes, 2019; Webb & Jzepa, 2021).

While there are variations of Freeports globally, Lavissière and Rodrigue (2017) designed this model to best depict Freeports in its most versatile form. Though this model is comprehensive, it does not consider one of the main objectives, to provide a "hotbed for innovation" (Sunak, 2016). This offers a progression in UK Government policy from the most recent potential Freeport model by Lavissière and Rodrigue (2017). It might be regarded in a context of collaboration between Academic institutions, scientific parks, and other centres of excellence (GOV, 2020). Presented below is a model by Lavissière and Rodrigue (2017) illustrating the variations of Freeports and their structure.

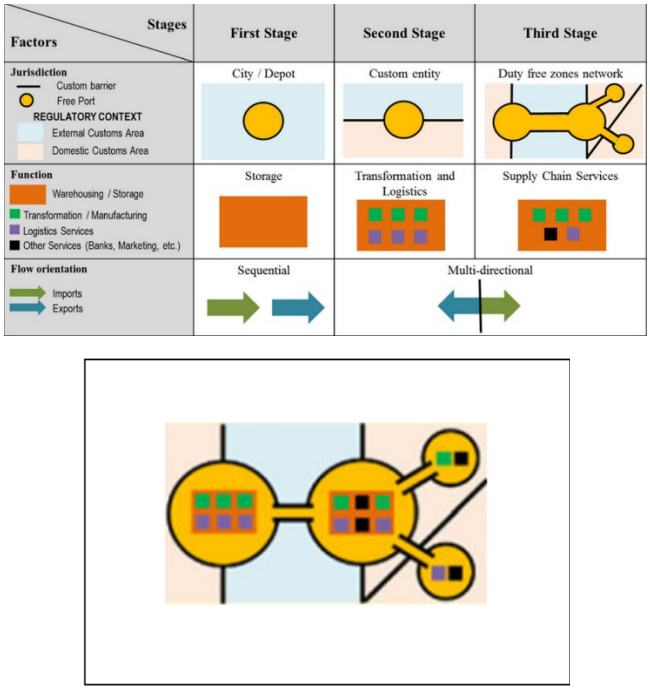


Figure 2. 15 Depicts the prospective model of Freeports, while also providing a key to describe this (Lavissière & Rodrigue, 2017)

The model above developed by Lavissière and Rodrigue (2017) splits Freeport development into three stages;

- ***First stage*** is the simplest form of a Freeport classed as 'city/depot' that would have a warehouse/storage that would allow sequential movement of imports and exports to occur with the tax avoiding benefits associated with this.
- ***Stage two*** is a 'custom entity', where the Freeport is within an external customs area and domestic customs area to facilitate multi-directional imports and exports. Within the Freeport boundaries, there will be warehouses/storage as the first stage. However, there will also be transformation/manufacturing and logistics services within the boundary.
- ***Stage three*** is a 'duty-free zones network', which is the most complete form of a Freeport. Similar to stage two, however, this stage can have multiple sites to take advantage of the reduced custom rates. Also, there is the option to have other services within the zones, such as banking and marketing.

Concerns were raised by WG GOV (2020), because Freeports have been announced in England before agreement with Wales, Scotland, and Northern Island. This presents a lack of joint decision making between UK Government and the devolved regions (Webb & Jzepa, 2021). A GOV (2020) report details a step-by-step breakdown of how these freeports will be adapted to the UK. Most notably, they will be set up in a unique model to cover three objectives:

- Establish Freeports as national hubs for global trade and investment across the UK
- Promote regeneration and job-creation
- Create hotbeds for innovation

The Freeport perimeter will be 25-45km, with the primary location near a port. Outside these boundaries, proposals are case-by-case. (GOV, 2020; Webb & Jzepa, 2021). This has raised questions about how the devolved nations should react to this and the potential location of a Welsh Freeport.

The Webb and Jzepa (2021) report found that Academic involvement in Freeports can have advantages. The significance of connecting Freeports to the local ecosystem "like UK Research and Innovation (UKRI) catapults" was also emphasised by local authorities.(GOV, 2020).

Data collected by GOV (2020) has been undertaken on the prospects of Freeports in the UK, with limited responses made by devolved regions, such as Wales. *Table 2.9* below provides a summary of Freeport policy levers in Wales, which supports consideration of devolved regional Government perspective.

Table 2. 9: Overview of Freeport policy lever in Wales, retrieved from (GOV, 2020).

Policy area	Wales
Customs	Customs policy is reserved by UK Government, with few exceptions including sanitary and phytosanitary control, which are mainly devolved
Taxation	Some tax policy is reserved by UK Government. However, some aspects, such as Business Rates and Stamp Duty and Tax, are devolved.
Planning	All planning policy is devolved
Regeneration	Regeneration policy is in part devolved
Innovation	Innovation policy is part-reserved by UK Government, part-devolved. The Freeports innovation measures are reserved, except as stated otherwise.

This comparison of policy levers between Wales and England reveals that while Wales is devolved and has its own ministerial administration, some areas are still within the power of the mainland Government, which can lead to problems when new policies, like EZs and Freeports, are enacted (GOV, 2020).

The Freeport consultation report by GOV (2020) also raised the importance of planning these under local economic and infrastructure strategies (GOV, 2020; Webb & Jzepa, 2021). In a Welsh context, this should support the perspective of the FGA Act (H. Davies, 2017) as well as recent WG policy prioritisation of Smart Specialisation (Foray et al., 2011; R. E. Pugh, 2014; Morgan, 2015; Marques & Morgan, 2018). Therefore, this thesis sets out to look at the views of key stakeholders in Government, Academia, and Industry (Etzkowitz & Leydesdorff, 2000a) in Southwest Wales; to understand if this is a suitable location for a Freeport to be located, while also considering the local economic and infrastructure strategies that are already in place.

2.2.10. Welsh Enterprise Zones

The Welsh Government announced EZs in September 2011 describing them as "*where we create the best possible conditions for your business to thrive*" (BW, 2019). The incentives offered infrastructure and business rate support that allows businesses up to a maximum of £55,000 to offset the cost of their business rates incurred during the previous financial year or their rates bill paid, whichever is lower. In addition, firms within the zones are offered enhanced capital allowance to claim a 100% first-year allowance for the capital cost of investment for plant and equipment (GOV, 2012). Below is an image showing the Welsh EZs (WG, 2019a).

Figure 2. 16 Welsh Enterprise Zones (WG, 2019a).

The Port Talbot Waterfront Enterprise Zone was initiated slightly later then the first lot of Welsh EZs that was a direct response to the steel crisis in March 2016 (WG, 2019a). The sectoral focus was on advanced manufacturing, energy and environment and construction sectors (BW, 2019; HOC, 2020). A report produced by HOC (2020) goes into detail of the different EZ's across England, Scotland and Wales, which details the relevant Industry foci. *Table 2.10* overleaf shows the speciality for the Welsh EZ's.

Table 2. 10: List of Welsh Enterprise Zones and Sector focus (HOC, 2020).

Enterprise Zones	Specialist sector
Anglesey	Low carbon energy
Central Cardiff	Business and professional services
Deeside	Manufacturing
Ebbw Vale	Manufacturing
Haven Waterway	Energy
Snowdonia	Engineering
St Athan – Cardiff Airport	Aerospace/Defence
Port Talbot Waterfront Enterprise Zone	Advanced manufacturing, energy and environment and construction sectors

The main objectives outlined by WG for these zones were to increase local economic growth and the creation of new jobs, serve as a catalyst for growth elsewhere in Wales, make enterprise zones more appealing to investors, and increase the competitiveness of the Welsh economy (BW, 2019; HOC, 2020). However, it is very hard to measure exactly how much benefit these zones have done to the economy (Granger, 2012; Hooton & Tyler, 2019).

Between the original 'Enterprise Zone' being established in 1980s and the new generation of 'Enterprise Zones' (2011) there have been attempts to improve the innovation capacity within Wales that has not been as successful as originally planned (WAG, 2004, 2010; WG, 2019c). An example of an attempt to improve innovation capacity was the 'Technium Centres' (WDA, 2001). This started out relatively successful in Swansea and was expanded throughout Wales (G. Davies, 2019b). However, once the scaleup of this initiative happened across Wales; the initial success was not replicated and failed to reach the aims set out for these centres (Abbey et al., 2008; R. Pugh et al., 2018). These criticisms were brought up by R. Pugh et al. (2018) where it mentioned issues such as people seeing more of a property investment programme than an innovation hub. Further perspective is offered by (P. Cooke & Clifton, 2005; Abbey et al., 2008), with relative consensus on the need for effective long-term investment into the infrastructure and innovation activities in Wales.

Conversely, inadequate statistical evidence is often provided to support claims of how unsuccessful these 'Technium centres' were. Recently, (G. Davies, 2019b) provides further detail of the longer-term effects, including statistical data exploring the legacy of these

'Technium' centres arguing they are seen now as an established infrastructure to the region than just a 'historic project'.

SPECIFIC, which stands for Sustainable Product Engineering Centre for Innovative Functional Industrial Coating in Southwest Wales, is one of seven Innovation and Knowledge centres that assist new enterprises commercialise by integrating universities and industries (SPECIFIC, 2021). While SPECIFIC also being a significant stakeholder within NPT and other key stakeholders such as Tata steel, who are all addressing the renewable energy problems and solutions (Tata Steel, 2021). *see section 2.5.4*. for more information.

2.2.11. Port Talbot Waterfront Enterprise Zone (PTWEZ)

The PTWEZ opened in March 2016 as a direct response to the Tata Steel crisis at the time, making it the last EZ to be formed in the UK (WG, 2019a). The PTWEZ is a Welsh Government-led industrial zone, made up of three areas: Baglan Energy Park, Port Talbot Docks, and Baglan Industrial Estate (WG, 2019a). Combined, these areas represent 120.86 Ha of potential real estate, targeted for use by companies ranging from technology start-up to heavy Industry and specialising in advanced manufacturing and materials, energy and environment, and construction (WG, 2019a). The plan presented below shows the boundaries of the 3 areas of the PTWEZ and its location in Wales.

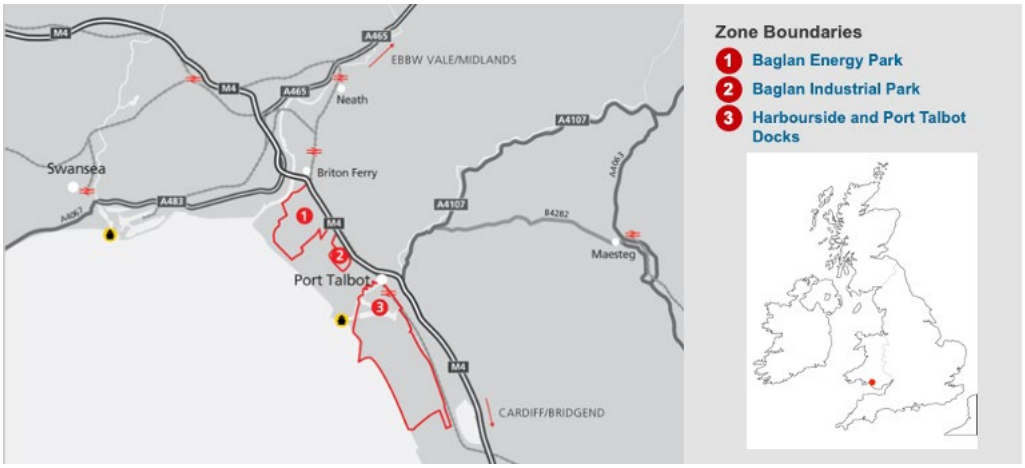


Figure 2. 17 shows boundaries of the PTWEZ (BW, 2019)

An annual report by WG (2018) on public investment into Welsh Enterprise Zones, showed the PTWEZ as being one of the lowest invested with a sum to date of £1,778,928.74, compared to Central Cardiff Enterprise Zone of £5,176,723.09. Table 2.11 breaks down are shown in the table below.

Table 2. 11: depicts the breakdown in public investment for the PTWEZ (WG, 2018).

PUBLIC INVESTMENT 2017-18	SOURCE
£1,453,100.00	Transport
£296,762.74	Direct Business support
£29,066.00	Infrastructure
£1,778,928.74	Total

Further data presented that after 2 years of operation, a total of 141.5 jobs had been safeguarded, 8 jobs created, and zero jobs 'assisted'. These figures are quite modest, though the time since its beginning till now make it hard to be compared to the other Welsh EZs, due to them being established in 2011 (WG, 2018). Central Cardiff Enterprise Zone had presented 711 jobs safeguarded and 16 jobs created and 352 assisted show the difference in these EZs and opportunity for PTWEZ for regional growth. A property review carried out by JLL (2016) found that there is a need for further development of grade A offices that are readily available for Industry to re-locate and spin-outs to move in to.

2.3. Innovation

Innovation has been increasingly studied as a concept over the past 20 years, becoming prominent in regional and national Government policy (Osborne & Gaebler, 1993; WAG, 2004, 2005, 2010; UK Parliament Science And Technology, 2013; HM Government, 2017; BEIS, 2017). The concept has been discussed substantially throughout the literature (Mansfield, 1985; Cohen & Levinthal, 1990; David B Audretsch, 1995; Peter F. Drucker, 2002; Etzkowitz, 2003; Du Preez & Louw, 2008; Barbosa & Faria, 2011; Bessant, 2015; Jones, 2016). Historically, innovation has been difficult to define (Feeny & Rogers, 2003), lacking a universally agreed definition (Rosanna Garcia & Calantone, 2002), partly due to innovation describing both 'product' and 'process' (Dodgson et al., 2008; OECD, 2018). Schumpeter's

(1934) seminal work on *the theory of Economic development*, paved the way for innovation to have a meaningful impact in Industry describing that innovation exists for certain reasons that is described below.

- *The introduction of a new good or a new quality of the good*
- *The introduction of a new method of production*
- *The opening of a new market*
- *The conquest of a new source of supply*
- *The carrying out of the new organisation of an Industry*

This was reflected in the work of Aulet (2013) suggesting innovation needs both technical knowledge and paralleled commercial skill. Furthermore, Gault (2018) gives the most generalised definition to date. This is because of its ease of use and measurement across multiple areas, while also supporting 'product' and 'process':

"An innovation is the implementation of a new or significantly changed product or process. A product is a good or a service. Process includes production or delivery, organisation, and marketing processes. A new or significantly changed product is implemented when it is made available to potential users. New or significantly changed processes are implemented when they are brought into actual use in the operation of the institutional unit, including the making of product available to potential users."(Gault, 2018).

Governments have also begun defining innovation in policy, by suggesting that innovation cannot be measured or managed, until it is defined OECD (2010). The most notable definition in Government policy is in the OECD 'Oslo' manual, where they describe the two forms of innovation being product innovation and business process innovation (OECD, 2018) p.20. This aligns with the definition described by (Gault, 2018).

Set against this concept, Michael E Porter (2004) described the link between the standard of living and the economic growth, which implies the greater the capacity for innovation, the higher standard of living an area has. Other Academics have recognised the link between innovation and universities, both are important actors within the growth of an economy and Knowledge Transfer activities that support innovation (L. Johnston et al., 2010) (as later discussed).

Universities have been seen as critical source of innovation opportunity and relating to the potential for economic development and growth within a region (Leydesdorff & Etzkowitz, 1998; Etzkowitz & Leydesdorff, 2000a; Breschi & Lissoni, 2001; Etzkowitz, 2003; Huggins et

al., 2008). Huggins and Strakova (2012) raised the importance to realise the 'new value' of knowledge from universities.

2.3.1. Open Innovation

One of the most important paradigm developments of Innovation theory to date is Open Innovation (OI), coined by Henry William Chesbrough (2003), with significant discussion in the literature (Laursen & Salter, 2006; Gassmann, 2006; Henry William Chesbrough, 2006; Van de Vrande et al., 2009; S. Lee et al., 2010; Filiou, 2021). H. Chesbrough and Crowther (2006) extended this by explaining how OI could apply in other scenarios. In its simplest version, OI can be distinguished between inbound and outbound innovation(H. Chesbrough & Crowther, 2006). Inbound open innovation is described by the internal use of external data (Parida et al., 2012). Conversely, outbound innovation is the external exploitation of internal knowledge (H. Chesbrough & Crowther, 2006). *Figure 2.18* depicts OI as a process (Henry William Chesbrough, 2003).

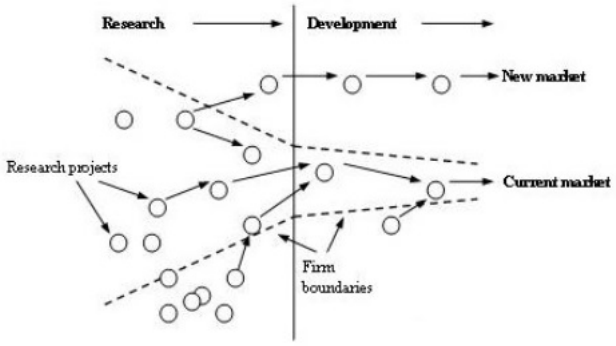


Figure 2. 18 OI process model (Henry William Chesbrough, 2003)

OI researchers generally follow two ideas, 'outside-in' and 'inside-out', as categorised by Enkel et al. (2009) reflecting the literature on 'inbound' and 'outbound' innovation (H. Chesbrough & Crowther, 2006). Perkmann and Walsh (2007) brought insight and conceptualisation to open innovation in the relationship between universities and Industry. Subsequent components were distinguished as; collaborative research, University-Industry research centres, contract research, and Academic consulting. This produced a framework to distinguish between University and Industry relationships compared to collaborative

organisational relationships (Perkmann & Walsh, 2007). More recently, Enkel et al. (2009) in their special issue on the topic, broke down open Innovation into 9 separate research themes that involve the following perspectives; *spatial; structural; user; supplier; leveraging; process; tool; institutional; and cultural*.

More recently, Academics Rauter et al. (2019) defined OI in 2 categories; Economic Innovation Performance (EIP), and Sustainability Innovation Performance (SIP), introducing the route of incorporating a sustainability approach to open innovation, increasing the benefits of this process to more stakeholders than originally suggested. Rauter et al. (2019) also backed this approach by suggesting that managers will not have to make any trade-offs to achieve their desired goals. SIP discussion was developed further by Cillo et al. (2019). However, Aka (2019) found in their analysis that various managerial practices can help support the effectiveness of SIP.

There is an argument on the effectiveness of OI approach, due to the of lack of empirical evidence relating to the benefits (Wang et al., 2012), although OI appears consistently in the literature giving support for the model (P. Cooke, 2005; Laursen & Salter, 2006; Enkel et al., 2009; H. W. Chesbrough & Garman, 2009; Gassmann et al., 2010), including to be linked to other key literature, such as Regional Innovation System RIS (P. Cooke, 2005) *(see section 2.4.).* Limited studies have assessed OI at the level of Small Medium Enterprises SMEs (Bianchi et al., 2010; H. Kim & Park, 2010; S. Lee et al., 2010; Parida et al., 2012; Santoro et al., 2019). These studies will have more relevance for the context of Southwest Wales, as there is an emphasis on SME's working together to help increase the success of the region (Huggins & Kitagawa, 2012; Morgan, 2013; G. H. Davies et al., 2018).

One mode of OI is out licensing, described by Bianchi et al. (2010), concluding that out-licensing in SMEs is much more challenging compared to larger companies, because of the unique setting of the market, while lacking in additional resources to perform a successful OI strategy. This work presented a framework for potential opportunities for out-licensing technologies (Bianchi et al., 2010). H. Kim and Park (2010) found that external R&D had a substantial positive effect on innovation output. However, they also determined that external knowledge had no impact, while external ideas had a negative impact (H. Kim & Park, 2010). This conclusion was deduced using panel data from the Korean Innovation Survey. Further panel data collected from the 2005 Technology Innovation Survey in Korea, S. Lee et al. (2010) found that networking between SMEs will have a positive effect when performing OI. Through studying 252 technology-based SMEs in Sweden, Parida et al. (2012)

found that certain innovation activities will give a variety of beneficial outcomes. For example, technology sourcing may support a radical innovation outcome while innovation activity such as technology scouting will provide an incremental innovation outcome (Parida et al., 2012).

Other studies suggested that organisations that participated in OI had no significant benefit to the organisation or sector (Van de Vrande et al., 2009). However, it was revealed that on average, medium-sized companies were more involved with open innovation activities, compared to SMEs (Van de Vrande et al., 2009).

2.3.2. Social Innovation

The growing interest in Social Innovation (SI) can be traced back to the 1980s through reforms brought on by New Public Management (NPM) (Osborne & Gaebler, 1993). SI can be defined as the development and implementation of new ideas (products, Services and models) to meet social needs and create new social relationships or collaborations (EC, 2013). This is a popular topic within policy for societal needs and the ever-changing demand for social improvements (D. Adams & Hess, 2010; EC, 2013). The growth of SI in policy has been reflected in emergence of scholarly articles (Pol & Ville, 2009; Osburg & Schmidpeter, 2013; Van der Have & Rubalcaba, 2016).

SI has come under scrutiny due to it being *"too amorphous and too heterogeneous a concept, straddling too many sectors and activities, for it to be assimilated into the innovation studies literature in an unproblematic fashion"* (Richardson et al., 2014). SI has been seen as too context dependant, which leads to a lack of clarity (Pol & Ville, 2009), whereas it can be considered as being on a spectrum like business innovation. This allows for easier categorisation between the two concepts (Pol & Ville, 2009). Van der Have and Rubalcaba (2016) set out to bridge the gap between SI and Innovation studies, to support policy makers in future SI agendas.

The Basque country has been implementing SI into policy effectively, through incorporating user-led focus groups to help solve societal issues which have the potential to bring on transformational change within society (EC, 2013). This was further assessed by Morgan

(2016) as an example of a region with an old industrial history, that reinvented itself through sustainable development and smart specialisation policy (see chapter 2.5.2).

2.3.3. Clusters

The agglomeration of individuals and organisations, often coined as clusters, has been a common theme throughout history and therefore will not easily disappear (Malmberg et al., 1996; P. Cooke, 2002; Breschi & Malerba, 2005; P. Cooke, 2005; Reve, 2011; Kowalski & Marcinkowski, 2014; Bergman & Feser, 2020). Alfred Marshall discussed the framework '*the concentration of specialised industries in particular localities'* in the late nineteenth century (A. Marshall, 2009). Clusters have been framed as a localised concentration for specialised activity of three key areas: the availability of a skilled labour, the support of relevant trades, and the positioning of firms at different stages of the production life cycle (A. Marshall, 2009). M. E. Porter (1998) admitted that the concept of clusters was not a new phenomenon. However, as the leading Academic to contextualise the concept (Porter 1998) he defines clusters as; *"geographic concentrations of interconnected companies and institutions in a particular field. Clusters encompass an array of linked industries and other entities important to competition".* (Porter, 1998).

The validity of clusters was argued by Martin and Sunley (2003), highlighting issues related to Porters '*Cluster Theory',* suggesting it is a *'chaotic concept'* due to the vagueness of the definition in terms of the geographical scale and internal socio-economic dynamics. This has subsequently allowed for the concept to be used in an array of layouts that has brought about confusion (Martin & Sunley, 2003). They also mention how the theory is an accumulation of agglomeration theory and social network theory, further confusing the concept.

Martin and Sunley (2003) describe the *'cluster brand'* as a well-marketed strategy that was taken on by Porter enthusiasts in regional and national policy, before it was rigorously analysed. Martin and Sunley (2003) further challenge the definition of cluster theory, by highlighting the limitations associated with each element, mainly relating to the lack of specificity for the geographical terminology used in those definitions. Moreover, the contribution of such criticism remains given that Porter himself highlighted these limitations when he first defined clusters (M. E. Porter, 1998).

Sölvell et al. (2003), defined clusters as the composition of Industry, Academia and Government, with finance and institutions for collaboration (IFC), with cluster initiatives as a policy-led approach to increase growth and competitiveness within a region (Kowalski & Marcinkowski, 2014).

Powell et al. (2002) determined that venture capitalists have a preference to operate within clusters, due to an increased return on investment. C. F. Kim et al. (2012) suggested the market value of an organisation is increased when they are in a political agglomeration of the controlling Government. This was a study carried out in the US and showed reflecting implications to other countries (C. F. Kim et al., 2012). W.-H. Liu (2013)'s study stated that companies near universities increase the amount of co-located patents. This was also supported in the literature around the benefits associated with Academia in clusters (Trippl & Tödtling, 2007; Breznitz et al., 2008; Reve, 2011; Lu et al., 2018). Lu et al. (2018) literature review supports the importance of universities in clusters and their ability to create knowledge, along with the benefits of Knowledge Transfer occurring when Academia is close to a cluster (Kantor & Whalley, 2014). Similarly, the development of clusters has the potential to build business relations (Bramwell et al., 2008). More recently, Valero and Van Reenen (2019) carried out an extensive evaluation across the globe of clustering involving universities and businesses, where they found universities have a positive impact on growth.

Reve (2011) coined the idea of *'global knowledge hubs'* that supports the importance of universities in building clusters. This also supports suggestions by Youtie and Shapira (2008) regarding the significance of a '*innovation hub'* and the impact universities can have on this. This is progressed with the discussion of digital innovation hubs that can complement a physical hub through maximising networking capabilities between universities, research institutions and Industry (Rissola & Sörvik, 2018)

Clusters have been shown to help grow regional economies (Bottazzi & Dindo, 2013). However, for them to be successful other factors are considered, which are; business environment, a regions productivity and labour cost (E. R. Hansen, 1990) and cluster dynamics (Ketelhöhn, 2006).

A key debate in the Cluster literature is whether clusters can only be spontaneous or can be realised on demand (Orsenigo, 2001; Y.-S. Su & Hung, 2009). Many Asian countries are able to develop policy-driven zones for economic growth (Cheng et al., 2014; Heikkila & Xu, 2014). Y.-S. Su and Hung (2009) analyse the differences between the two approaches. They conclude that although spontaneous clusters produce more effective networking, there are still

benefits shown for the development of policy-driven clusters, because of their incentives and financial support. However, benefits of entrepreneurship and social capital are yet to be facilitated (Y.-S. Su & Hung, 2009). *Table 2.12* overleaf draws the comparisons between the two approaches.

Table 2. 12: Comparison for two types of clusters (Y.-S. Su & Hung, 2009)

CLUSTER TYPE	SPONTANEOUS CLUSTER	POLICY-DRIVEN CLUSTER
EXAMPLE	Bay Area in United States	Zhangjiang Hi-Tech Park in China
ORIGIN	Birth with the founding of Genentech: the cooperation between a scientist and a venture capitalist in 1976	Birth in a Government planned area in 1996
GROWTH: SUCCESS FACTORS		
HUMAN CAPITAL (SCIENCE BASE)	Strong scientific capacity supplied by leading universities	Policy-planned manpower: Government actively attracts research talents locally and oversea.
FINANCIAL CAPITAL	Abundant Government and venture capital funding	Most funding comes from the Government
ENTREPRENEURSHIP	Splendid entrepreneurship	Emerging entrepreneurship
SOCIAL CAPITAL	Valuable social capital for innovation and competitiveness	Different kind of social capital: Quanxi
NETWORKING	Tight networking among biotech companies, Venture capital and research institution at first. Now the direct links among biotech companies became the main networking	Loose networking among biotech companies, venture capital and research institutions, Biotech companies make more efforts to network with local Government

There have been critics of policy led Clusters (Swords, 2013), who talk about the battle between Government promoting clusters, while other critiquing this simultaneously. The complex nature of these clusters between the different actors can have a negative effect on its efficacy (Swords, 2013). This was also supported in the literature of examples of clusters that have not succeed (Gilding et al., 2020)

Recently there has been an argument that the increase in digitalisation may impact the desire for clustering to still take place (Iammarino & McCann, 2006). However, Gazel and

Schwienbacher (2019) found in their analysis of clusters with fintech companies, that the clustering of these high tech companies is still benefit with *'survivorship'*.

In a UK context, the country's 31 biggest clusters contain 8% of the UK's businesses, though contribute 20% of national GVA (McKinsey, 2014). In Mckinsey's report, they evaluate clusters in the UK and some of the key findings are.

- lack of infrastructure to grow the areas
- Clusters are not fulfilling their potential to contribute to innovation within an area
- Improved relationships between universities and having them involved in more with the businesses situated within an area

A more recent review by SQW (2014) was undertaken, which was a continuation of the McKinsey (2014) report and also the Adonis (2014) review. The review concluded that clusters are significant to help minimise risk for economic activity (Adonis, 2014). However, a one size fits all approach does not work, where they should all be treated on a case-by-case basis. This idea still brings significant attraction to policy makers such as the European Commission EC (2019a) that state a 13.5% increase in revenue, if a cluster is formed. Other Governments support this view, such as the UK (BEIS, 2017) and WG in the formation of the South Wales Industrial cluster (SWIC, 2021) and historically the *'Technium'* initiative in Wales. However, some argue the effectiveness of the Governments to implement cluster theory (M. E. Porter, 2000; Chiaroni & Chiesa, 2006; Menzel & Fornahl, 2010). A more recent example of Government led policy to enhance clusters, is the EZ and the PTWEZ in South West Wales (BW, 2019) *(See Section 2.2.6. on EZs).* Hatch (2020) found that initiatives like the UEZ may struggle to form clusters, due to not being appropriately recognised *(See Section 2.2.7. on UEZ).*

2.3.4. National Innovation Systems (NIS) – Regional Innovation Systems (RIS)

Following the inception of clusters and the theory behind this, RIS offered to contextualise cluster theory (P. Cooke, 1992). To understand the origin of RIS, it is to recognise the origin of the National Innovation system (NIS) approach (B.-A. Lundvall, 1992; Richard R. Nelson, 1993; Richard R Nelson & Rosenberg, 1993; B.-Å. Lundvall, 2010). NIS originated from Freeman (1984), who developed the concept to gain an understanding of why some nations have a competitive edge over other nations. This was predominately measured through economic performance. Freeman (1984) developed NIS in a direct response to the dislike of the theory of comparative advantage that was first defined by Balassa (1965). (Richard R. Nelson, 1993) defined NIS as; *"a set of institutions whose interactions determine the innovation performance … of innovation firms".* B.-Å. Lundvall (2010) further defined NIS as being bounded by national borders.

RISs were first developed in the 1990s that was described by P. Cooke (1992), in a Geoforum article examining the concept of innovation systems at a regional level and has since grown exponentially in the literature (P. Cooke et al., 1997; Bjørn T Asheim & Isaksen, 2002; P. Cooke, 2004; Bjørn T Asheim & Gertler, 2005; Leydesdorff & Fritsch, 2006; Bjorn T Asheim et al., 2011; D'Allura et al., 2012; G. Davies, 2019b). This article provided the original discussion of structures of RIS. P. Cooke et al. (1997) further develop RIS as a sign of decentralisation of power to give more autonomy to regions to implement policy objectives. Devolution in the UK supported the idea of RISs to give more autonomy to regions, such as Wales, with further support throughout the EU by policy makers, has shown a trend in RISs and their ability to maximise the innovation potential within these regions (OECD, 2010, 2013, 2020). B.-A. Lundvall (1992) summarises this in his definition describing the importance for all the key actors benefiting from these innovative activities.

"*The narrow definition would include organisations and institutions involved in searching and exploring – such as R&D departments, technological institutes and universities. The broad definition … includes all parts and aspects of the economic structure and the institutional set-up affecting learning as well as searching and exploring - the production system, the marketing system and the system of finance present themselves as subsystems in which learning takes place*" (B.-A. Lundvall, 1992).

Seminal literature of the broader concept can be broken down RIS into two sub-categories of Institutional RIS (IRIS) and Entrepreneurial RIS (ERIS) (P. Cooke, 2004). Cooke (2004) argues

that IRIS are better positioned for incremental innovations that can be supported by user producer interactions, public R&D investment, and long-term perspectives from investors. ERIS present conditions for radical innovations that can be supported by venture capitalists, and short-term investment opportunities (P. Cooke, 2004). A failure of the effectiveness of agglomerations in a region is the lack of knowledge exchange in the different subsystems between university and Industry (Fritsch, 2003).

One of the most important factors of an innovation system is the knowledge that is accumulated (P. Cooke et al., 1997; Nordberg, 2015; Lew et al., 2018). This is exemplified by Hudson (2011) describing how regions that are most likely to succeed are those that have constructed a system around capitalising knowledge. This performance will allow for more knowledge to be produced and taken advantage of quicker, which can be transformed into innovative products and processes (Hudson, 2011).

Autio (1998) first described the conceptual model of RIS as Regional Systems of Innovation (RSI), shown below in *figure 2.19 overleaf*. This model allows for a mapping of the original definition, which separated the two core components of this model as '*Knowledge application & exploitation system'* and *'Knowledge Generation System'*. However, notable by its absence in this early model is the role of Governmental stakeholders.

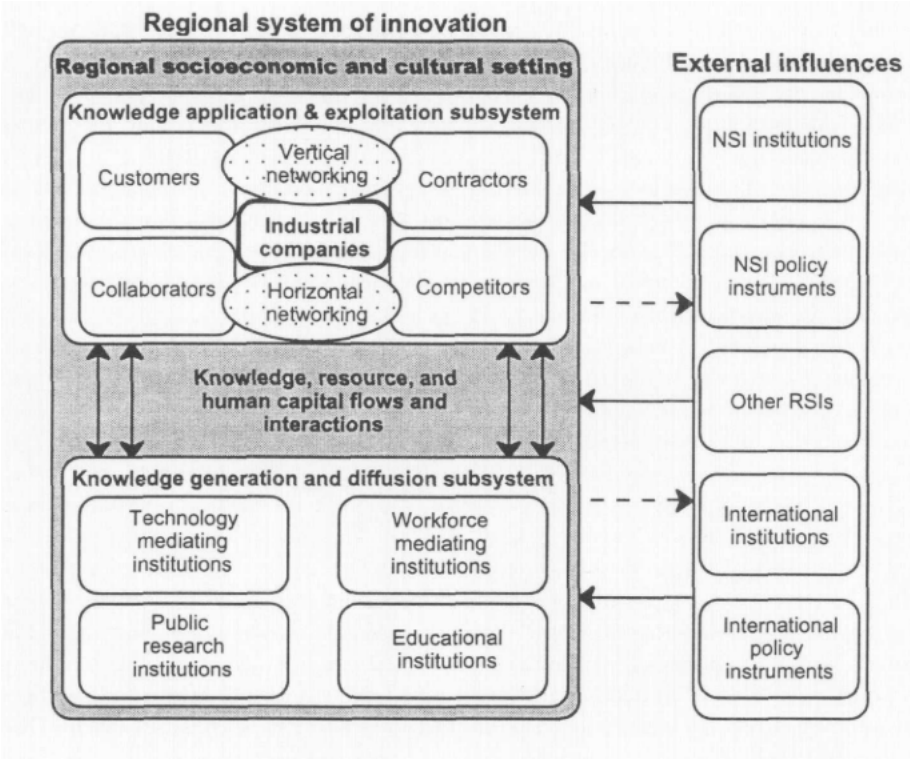


Figure 2. 19 Regional systems of Innovation (original model) (Autio, 1998)

Tödtling and Trippl (2005) adapted this framework to consider the Government stakeholder in the RIS. Previous analysis of RIS mainly considered institutional set-ups, subsystems, and the relationship between them (Tödtling & Trippl, 2005). Relatively little analysis had been taken into entities such as universities until then, which would change significantly over the coming years. Trippl and Tödtling (2007) further discussed how regional clusters have been successful due to the infrastructure created through angel investors, research organisations, skilled mobile labour, and good communication networks.

B. T. Asheim and Coenen (2005) in their comparative analysis of RIS Nordic clusters, distinguished between RISs and clusters. They explained that clusters are a lot narrower in their scope comparatively to RISs, where they described clusters as having 'a strong sectoral connotation' compared to RISs where they work across different sectors.

This model of RIS explains a high output of spin-outs from universities to Industry, as indicated by G. H. Davies et al. (2020) in Swansea university and the AgorIP model (see section 2.5.1.). Swansea University and Pfizer, one of the world's leading pharmaceutical/biotechnology corporations, have maintained a cooperation (G. H. Davies et al., 2020). Hopkins et al. (2013) found that UK biotech companies lack financing instruments. Due to their various designs, RIS can be hard to characterise (Doloreux, 2002).

RIS's value is based on the importance of geographical proximity for information transfer. Information Communicate (KT) includes tacit knowledge, which is harder to transfer over distance (Gertler, 2004). (See section 2.4.1. for KT). Academics have generated RIS literature in Southwest Wales (P. Cooke & Morgan, 1994, 1995; Bjørn T Asheim & Isaksen, 1997; Morgan, 1997; Bjørn T Asheim & Gertler, 2005). Geography fosters knowledge spillovers (Lundquist & Trippl, 2013).

Bjorn T Asheim et al. (2011) found that the literature does not address the inherent failures of RISs. They posit that the literature for RISs fails to analyse the importance of labour markets and human capital, compared to the importance of education and training systems, and R&D personnel and qualified staff. In recent times, there have been extensive reviews of the growing literature in RIS (Fernandes et al., 2021), with emphasis placed on four key areas in understanding RISs: knowledge institutions, R&D, and networks (Fernandes et al., 2021). Decision-makers in political institutions, corporations, and other organisations are part of dynamic strategic alliances found in RIS (Bjørn T Asheim et al., 2019).

2.3.5. Knowledge Spillover

"We are not so concerned that our knowledge will spill over to competitors. Some of it will. But by the time it does, we will be somewhere else. We are a moving target." Michio Tanaka, International Purchasing General Manager, Toyota.

Two of the original definitions of Knowledge Spillover (KS) were by Richard R Nelson (1959) and Arrow (1972) which have so far held the test of time, as; *"agents in the research or technological development phase will subsequently facilitate agents' innovation efforts"*. KS can be done both intentionally and unintentionally (Coe & Helpman, 1995; G. Lee, 2006). However, (Fallah & Ibrahim, 2004) suggested that KS is the unintentional transfer of knowledge, compared to TT being the intentional movement. This emphasises that KS is an informal transfer of knowledge, which can be received in multiple ways.

Academics have examined variations of KS, such as Foreign Direct Investment Spillover (G. Lee, 2006; Smeets, 2008) and localised knowledge Spillover (Trippl & Maier, 2011). Management scholars have debated that tacit knowledge is the most important resource a firm can possess (Grant, 1996). Originally defined by Polanyi (1962) is described, "*tacit knowledge is non-verbalised, intuitive and unarticulated knowledge that has a personal quality, which makes it hard to formalise and communicate.*" However, it is argued there are often hidden costs associated to effective transfer of tacit knowledge (Venturini, 2019).

Academics (A. Jaffe, 1989; D. Audretsch & Stephan, 1996) emphasise the spatial dimension of KS. They conclude through their findings that KS is geographically bound and localised within spatial proximity to the knowledge source. However, these early studies identify the factors that convey the knowledge resource (Acs et al., 2013). Where they are assumed to exist naturally, but only within a specific area Acs et al. (2013) believed the underlying *"trigger"* between geographical proximity and Knowledge Spillovers is tacit knowledge. In parallel, codified knowledge is viewed through academies articles, books, and patents; for the ability for these to be transferred across a much larger distance.

The KS theory of entrepreneurship describes the potential benefits associated with the development of knowledge (Acs et al., 2009; Acs et al., 2013; Ghio et al., 2015; Stuetzer et al., 2018). It was shown that regions with a high level of KS from universities have a generally greater number of start-ups being produced (David B. Audretsch & Lehmann, 2005). This is

done two-fold by increased infrastructure for KS and increased research activities from universities (David B. Audretsch & Lehmann, 2005).

Being in proximity to universities has greater importance for accessing social sciences, rather than natural science research that is supported by David B Audretsch et al. (2005) regarding spatial proximities to universities. This was backed by (Qiu et al., 2017) of the importance of being located close to university spillovers. However, there should be links to global KS to maximise the potential knowledge gained (Coe & Helpman, 1995; Papanastassiou et al., 2020). The most frequent types of interactions between firms and universities are the employment of university graduates (Schartinger et al., 2002).

2.4 Role of the university

The literature supports the importance of universities to transfer knowledge into economic knowledge (David B. Audretsch & Lehmann, 2005; Albert N Link & Welsh, 2013). This has been of particular prominence since the 1980s in the US, following the passing of the Bayh-Dole Act in response to the 1970s decline in industrial productivity. In a key piece of work Hall et al. (2003) questioned what are the roles of the universities in these partnerships and how they impact the economy.

A big factor for businesses to collaborate with universities, is their ability to facilitate potential synergies for quality interactions (Albert N Link & Scott, 2003). This can be done through collaborations such as meetings, joint research, conferences, workshops etc. (Bozeman et al., 2008; D. P. Leyden et al., 2008). In addition, universities' impacts are not just through collaboration, for they offer human and technical capital, that may be limited in the private sector (D. Leyden & Link, 2013).

There have been three main trends that have occurred to support the role of the university:
1. Implementing Government funding for Academic research policy and economic policy;

2. The development of increased long-term relationships with firms and Academic researchers.

3. Increase in commercialisation of research by universities (Etzkowitz & Webster, 1998).

Cohen and Levinthal (1990) posit that the effectiveness of KT from universities to firms is based on their capabilities. Firms need to have an appropriate process in place to capture the knowledge and intergrate this into the organisation.

Wolfe (2016) concluded that it is the responsibility of the universities to add the '*social capital'* of the local economic community by increasing commercial activity to the firms with which they collaborate. Additionally, the continuation of public support for both teaching and research mandates is noted as important, as they are an integral factor in the development of local and regional economies (Wolfe, 2016).

The notion that network capital describes value gained from knowledge can be used to increase economic activity and innovation in a regional context (Huggins, 2010; Huggins & Thompson, 2014). Huggins and Prokop (2017) found challenges associated with the role of the university that are considered geographically indiscriminate. While also suggesting that a bias towards local ties reflects a weak regional innovation performance (Huggins & Prokop, 2017).

2.4.1. Knowledge Transfer

Polanyi (1966) initially coined tacit knowledge, describing when expert scientists *"know more than they can tell".* Polanyi believed that the essence of work was based on the *"building of personal knowledge".* A seminal piece by Nonaka and Takeuchi (1995) discusses the *"sticky"* nature of knowledge. Nonaka and Takeuchi (1995) define the distinctions of knowledge as *'tacit'* and *'explicit'* (which in other cases further down is classed as codified). This distinction is further separated into four modes of knowledge conversion (or transfer) of tacit to tacit; tacit to explicit; explicit to explicit; explicit to tacit. Nonaka and Takeuchi (1995) emphasised the importance of capitalising on the tacit knowledge produced on an individual level into an organisationally level. Examples of this are networking, face-to-face conversations, apprenticeships, and brainstorming sessions (Gopalakrishnan & Santoro, 2004; Landry et al., 2010; Terroir, 2019). This cannot happen by chance, meaning processes need to be put in place for KT to be successful.

When defining knowledge specifically, one of the most credible definitions to date was by Peter F Drucker (1989) who described this as information that has the potential to change something or somebody, either by becoming grounds for action or by making an individual or institution capable of different or more operative actions.

One of the most significant perspectives in economic thinking is that the creation and propagation of new knowledge underpins economic growth (Romer, 1990). When defining KT this can be put as "*The process through* (which) *one unit (e.g., group, department, or division) is affected by the experience of another*" (Argote & Ingram, 2000). This definition may be perceived as broad, it provides a useful reference for further discussion. KT can be seen as quite a fluid process, because it can happen in a variety of ways, in different situations (Argote & Ingram, 2000). Kogut and Zander (1992) stressed that KT requires "a set of higher-order organising principles acting as mechanisms by which to codify technologies into a language accessible to a wider circle of individuals", so even the transfer of tacit knowledge requires a certain codification meaning again for TT to happen, KT is a necessary process (Kogut & Zander, 1992).

KT was originally perceived as a linear form of action (Gopalakrishnan & Santoro, 2004; Ulhøi et al., 2012). Gibbons et al. (1994) discusses the 'modes of production of knowledge' which can be shown in *Figure 2.20* discusses three modes for transfer. They concluded that the process of KT is quite an informal process of transfer where it would involve development to the recipient of that knowledge, which he classes as mode 1. Compared to Technology Transfer (TT) being a more formal process where it will eventually lead to commercialisation of this technology, which is known by mode 2. Finally, mode 3 shows how knowledge exchange will involve interactions in a bi-directional fashion that would benefit everyone involved in this process.

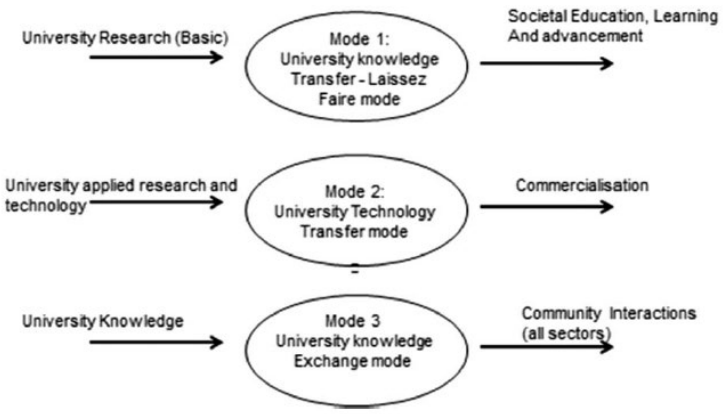


Figure 2. 20 Knowledge production modes and university KT(Gibbons et al., 1994)

Over the past 30 years, public policy to promote and support KT has seen increasing efforts with both significant research (Siegel et al., 2004; Jane Zhao & Anand, 2009; Huggins &

Kitagawa, 2012; Ulhøi et al., 2012) and innovation policy development in the UK and devolved regions such as Wales. (EC, 2007; OECD, 2012, 2019).

Perkmann et al. (2013) suggested Four Central Measures (FCM) that characterise this process of KT: 1. Activities related to KT; 2. Motivation to develop university-Industry links; 3. Barriers to KT; and 4. Outcomes of the process. FCM is worth considering when attempting to measure how successful KT is in a certain situation. However, this framework has come under some scrutiny by (Rossi & Rosli, 2013), where they discuss the limitations of this, because the complexity of KT can be measured in a variety of other ways, such as Spillovers from the KT process. KT often occurs through interactions, rather than transactions, which makes it harder to measure around these parameters (Rossi & Rosli, 2013).

KT has subsequently been regarded as a two-way process where it moves Academic knowledge from one place (usually universities) to specific users and Industry sectors (Abreu et al., 2009). This has meant the preference of '*knowledge exchange'* instead of *'knowledge transfer'* (ESRC, 2009). Kitagawa and Lightowler (2013) discuss the term *'Knowledge Exchange'* where there are a broad agreement that this process is considered as a bi-directional process, contrary to the original belief of a unidirectional process (Gopalakrishnan & Santoro, 2004; Ulhøi et al., 2012).

Bjørn T Asheim et al. (2011) contributed to insight on KT mechanisms and processes to support innovation. This included human capital, local labour markets, and the awareness of local and non-local sources of knowledge. While understanding how they were transferred from the source to the organisation.

A report produced by Lord Sainsbury (2007) stressed the importance of having a *"diversity of excellence*" in the research base, distinguishing between "*research universities focusing on curiosity-driven research, teaching and KT, and business-facing universities focusing on the equally important economic mission of professional teaching, user-driven research and problem-solving with local and regional companies".* The Sainsbury review concluded that there had been a "*dramatic increase in recent years in the amount of KT from British Universities*" (Lord Sainsbury, 2007).

2.4.2. Technology Transfer

Compared to KT, TT has been inherently difficult to define from the beginning. Equally challenging is the term '*technology*' because of the varying use in definitions (Blomström & Kokko, 1998; Wahab et al., 2012). A seminal work by (Autio & Laamanen, 1995) was quoted: *''TT is intentional, goal-oriented interaction between two or more social entities, during which the pool of technological knowledge remains stable or increases through the transfer of one or more components of technology."* This was further supported by a review by (Battistella et al., 2016) of the terms KT&TT being described together through referring to a framework as a *"model of technology/knowledge Transfer".*

Sahal (1981) discussed alternative concepts of technology and how they can cause confusion when not described properly. Also, when technology is being transferred, related knowledge is also transferred (Sahal, 1981). Without knowledge of the product, it cannot be put into practice. This theory is also backed by more recent Academic contribution of Ankrah et al. (2013) defining KT as *"any activities aimed at transferring technology or knowledge to help either the company or university to further pursue its activities".*

The term '*Technology Transfer*' was originally contextualised by economists Zhao and Reisman (1992) who define this as the development and diffusion of innovations in society. This meaning is purposeful as improving society and the economy aligns with universities being established as a charitable in their values (Chew & Osborne, 2009). However, in recent times has been adapted to consider the view of receiving capital for the activity, as '*Technology commercialisation*' used interchangeably (Kirchberger & Pohl, 2016). This highlights how universities have developed to be more than just a charitable entity, they are now required to capitalise upon their research outputs (Beverungen et al., 2014). This is shown in the definition by Ambos et al. (2008) *"technology commercialisation is the design, manufacturing, and marketing of products with the developed technology or the transfer of technology through licensing or other collaborative activities".* This highlights that complex processes are happening that opposes more simplistic definitions of TT (Zhao & Reisman, 1992; Kirchberger & Pohl, 2016). Conversely, due to the progression of this definition of TT and 'Technology Commercialisation' being used to define the same process in some situations, it may be considered that universities are losing sight of their original aims and objectives to help improve society, instead of capitalising from this. This consideration of

mission leads to the pivoting of what universities stand for, because of their 'charity' classification (Beverungen et al., 2014).

Consideration of roles is reflected in the Triple Helix Model developed by Etzkowitz and Leydesdorff (2000a) set out to present how Government, Industry and Academia are configured in a location to support TT activities. The importance of these interactions can enhance regional economic growth and social development (Klofsten, 2010; Urbano & Guerrero, 2013) see *section 2.4.4.* for further discussion.

TT is inherently difficult to achieve, because of the substantially different aims and missions between private firms and universities that can lead to mutual distrust (Slaughter & Leslie, 1997). In addition, there are many elements and social factors that have an impact when the TT happens (Bozeman, 2000; Siegel et al., 2004; Perkmann et al., 2013).

A recent report by the UK House of Commons, '*Managing Intellectual property and technology transfer'* emphasised the need for TT with the support of Government to catalyse these activities (HOC, 2017). HOC (2017) further concluded that an overvaluing of IP has occurred, blamed on the Technology Transfer Offices (TTOs) of the respective universities. A report predating (HOC, 2017) by Sir Richard Lambert questioned *"how to raise the overall level of demand by business for research from all sources"* (Lambert, 2003). In addition, a further Government report called *"bridging the valley of death"* in 2013 concluded that *"the Government's objective should be to create a commercial demand for university engagement to which they are already primed to respond"* (HOC, 2013). Even though these reports span 15 years with similar conclusions, Government has still had not solved this problem. This was even highlighted by the Cambridge Enterprise that is arguably the most successful TT office in the UK Cambridge Enterprise (2017), pointing out that the Government has only been concentrating on the supply side of the formula. Where they said; *"until the demand side is addressed, the commercialisation challenge will remain for universities"* (Cambridge Enterprise, 2017).

Due to the significant interest and established literature, comprehensive literature reviews have been carried out examining this field (Bozeman, 2000; O'shea et al., 2005; Rothaermel et al., 2007) *(See table 2.13).* Common to these reviews is concentration upon certain aspects of the TT process, rather than its broader context. However, more recent literature review work has looked at the whole process. For example, K. Miller et al. (2018) discusses the potential for the evolution of the triple helix framework towards a quadruple helix approach

which takes into account the social side and end user inclusion to the process. Below is *table 2.13* showing the evolution of the literature around TT and KT.

Table 2. 13: Adapted from (Battistella et al., 2016). Literature review on TT

Author (Year)	Title of paper	Focus	Method
Geisler (1993)	Technology transfer: toward mapping the field, a review, and research directions	Technology Transfer	Narrative literature review
Bozeman (2000)	TT and public policy: a review of research and theory	Domestic TT from university and Government laboratories	Narrative literature review
Malik (2002)	Aiding the technology manager: a conceptual model for intra-firm technology transfer	Intra-firm technology transfer	Narrative literature review
Reisman (2005)	Transfer of technologies: a cross disciplinary taxonomy	Technology Transfer	Taxonomy
Cottrill et al. (2010)	Co-citation analysis of the scientific literature of innovation research traditions	Diffusion of innovations and Technology Transfer	Bibliometric analysis
Hsieh et al. (2014)	A literature review with citation analysis of Technology Transfer	Technology Transfer	Citation analysis
Battistella et al. (2016)	Inter-organisational technology/knowledge transfer: a framework from critical literature review	Technology Transfer – Knowledge Transfer	Narrative literature review
De Wit-de Vries et al. (2018)	Knowledge Transfer in university-Industry research partnership: A Review	Knowledge Transfer	Systematic Literature review
Roslielia & Ana (2019)	Knowledge Transfer in interorganizational partnerships: What do we know?	Knowledge Transfer interorganisational	Narrative literature review

Table 2.13 further supports the coupling use of KT&TT processes, as earlier mentioned (Kogut & Zander, 1992; Battistella et al., 2016). Also, it has been argued that technology is itself a form of knowledge (Garud & Nayyar, 1994). Literature on the University-Industry relationships further supports the view that KT&TT activities should be considered together when discussing these stakeholders from a holistic view (Schumpeter, 1934; Berbegal-Mirabent et al., 2015; Scandura, 2016; Rajalo & Vadi, 2017; Mascarenhas et al., 2018; Williams & Allard, 2018; Sjöö & Hellström, 2019; OECD, 2019). However, it is important to understand that this was not always the case, where previously KT was categorised as the informal transfer of knowledge, compared to TT, which was classified as the formal mode of transfer (Gibbons et al., 1994). When discussing KT and TT it should be done so concurrently, while there are still inherent differences with the Knowledge and technology, which is shown by Gopalakrishnan and Santoro (2004) in *table 2.14.*

Table 2. 14: Key dimensions of technology and knowledge transfer, adapted from (Gopalakrishnan & Santoro, 2004).

Dimensions	*Technology*	*Knowledge*
Breadth of construct	Narrower and more specific construct. Technology can be seen as an instrumentality or set of tools for changing the environment	Broader and mor inclusive construct. Knowledge embodies underlying theories and principles related to cause-and-effect relationships
Observability	More tangible and precise	Less tangible and more amorphous
Overreaching characteristic	More explicit and codified where learning can be taught and information is stored more in blueprints, data bases, and manuals	More tacit where learning is by doing and information is stored in people's heads
Management phase of most consequence	Post-competitive phase of technological development (integral for the commercialisation of ideas and inventions)	Pre- and Post-competitive phases of technological development
Organisational learning	More reliance on controlled experiments, simulations, and pilot-tests	More trial and error, wider use of gestalts
Nature of interactions	Inter- and Intra-organisational interactions that deal most with operational issues and how things work	Inter- and Intra-organisational interactions that deal most with strategic issues and why things work the way they do

A key feature from Table 2.14 is the conclusion that knowledge and TT are distinctly different in the motivations and barriers, such as Trust. However, culture is effected for both KT & TT activities (Gopalakrishnan & Santoro, 2004). Examples of KT&TT activities will be discussed in the following section.

2.4.3. Knowledge Transfer & Technology Transfer Activities

The diagram below produced by Terroir (2019) provides a breakdown of the full KT&TT process in the context of the university-Industry relationship. Terroir (2019) signifies the importance of both KT&TT by describing the whole process in one model.

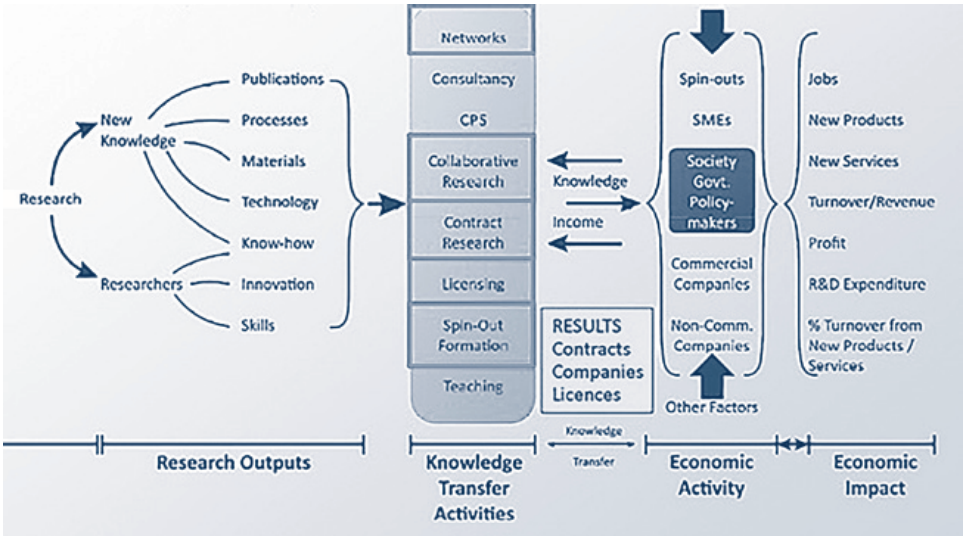


Figure 2. 21 The different channels of University-Industry Relationships (Terroir, 2019).

Research outputs are broken down into, publications, processes, material, technology, know-how, innovation and skill. KT activities are separated into; networks (Inkpen & Tsang, 2005), consultancy (Hewitt - Dundas, 2012), collaborative research (J. N. Cummings & Kiesler, 2005), Contract research (Mirowski & Van Horn, 2005), licensing (Mowery et al., 2001; Jerry G Thursby et al., 2001), spin-out (Druilhe & Garnsey, 2004; Djokovic & Souitaris, 2008), and teaching tie in (McKeough et al., 2013). Following these inputs would be the development of contracts, companies, and licences, which is the more codified aspect of TT (Mansfield, 1985; González, 2018; Arenas & Gonzalez, 2018; Holgersson & Aaboen, 2019). Furthermore, economic activity, such as spin-outs SMEs, commercial and non-commercial companies would be realised. Finally, this activity can produce economic impact, such as jobs, new products, new services, turnover/revenue, Profits R&D expenditure, and percentage turnover form new products/services (HOC, 2013, 2017).

2.4.4. Triple helix model

As introduced earlier, the Triple helix model that was first devised by Leydesdorff and Etzkowitz (1998) highlighting the importance of how the three key stakeholders of Industry, Academia and Government working with one another in the attempts to increase innovative activities. It has been a common theme mentioned throughout literature (Etzkowitz, 2003; Brannback et al., 2008; Galvao et al., 2019; Cai & Etzkowitz, 2020; Yoda & Kuwashima, 2020). More specifically, they highlighted the growing importance for Academia to be involved in the transition from Industry to knowledge-based society (Leydesdorff & Etzkowitz, 1998). Etzkowitz and Leydesdorff (2000a) subsequently discussed the different configurations of the *'Triple Helix'*, where the optimal scenario is the configuration that allows for *"Tri-lateral networks and hybrid organizations"* that would allow the optimal environment for spin-offs, tri-lateral initiatives for knowledge-based activities and strategic alliances *(figure 2.22 below).*

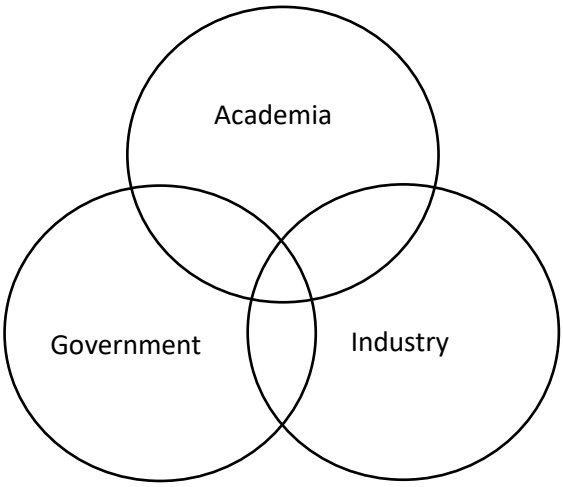


Figure 2. 22 adapted from (Etzkowitz & Leydesdorff, 2000a) describing the triple helix model of University-Industry- Government relations.

In order to fulfil the objectives stated by Etzkowitz et al. (2000) of simultaneously working with the key stakeholders of Academia, Industry, and Government, it involves the breaking down of the structural, organizational and cultural barriers for the development of the regional socio economy (Goldstein, 2010). There have been limitations suggested by Brannback et al. (2008) of the over simplification and generalisation of this conceptual model. They also suggest that it is missing a fundamental element, which is the innovator

and entrepreneur in the interactions between these key stakeholders (Brannback et al., 2008). Also, debate has questioned the effectiveness of the triple helix model and if it can achieve the expectations for innovation, employment, and GDP (B. T. Asheim & Coenen, 2005; R. McAdam et al., 2012).

Limitations of this Model have been highlighted (Brannback et al., 2008; R. Pugh, 2017), this does not prevent use of the model in where appropriate (B. T. Asheim & Coenen, 2005; Dalmarco et al., 2018; Schot & Steinmueller, 2018; Xing et al., 2018; Ferrannini et al., 2021). Furthermore, Leydesdorff and Deakin (2011) discussed how the triple helix model can be adapted to a context of a city, through *'Smart Cities'* supporting its adaptability to different contexts. This was further developed in a review by Albino et al. (2015) describing how *'Smart Cities'* can vary in nature, depending on the aims that they are set out to achieve.

The literature on Triple Helix policy in Wales, highlights some challenges with a one-size fits all approach for collaboration between Industry, Academia and Government, while universities have a varying ability to transfer knowledge into regional businesses (Huggins et al., 2008; Huggins & Kitagawa, 2012; R. Pugh, 2017). Furthermore, it has been considered that theories such as The Triple Helix can oversimplify in weaker regions where they are expected to succeed with these particular cases (R. Pugh, 2017). Also in a south Wales context, Howson and Davies (2018) contextualise this model with the Life sciences and health ecosystem in South West Wales.

2.4.5. Quadruple Helix model

Since the Triple Helix Model, the focus of related Academic enquiry has shifted towards the quadruple helix model (Ivanova, 2014; Elias G. Carayannis & Rakhmatullin, 2014; M. McAdam & Debackere, 2018; K. Miller et al., 2018). Elias G Carayannis and Campbell (2009) class the 4th of the helices as "media-based" and "creative-based public". This was subsequently addressed by Leydesdorff (2012) who supports the idea of inclusion of "society" into the triple helix dynamic, proposing the idea of N-tuple or alphabet of helices, which can be developed (Leydesdorff, 2012). Though there is not a defined response for the fourth helix, it varies between researchers (Ivanova, 2014; Nordberg, 2015). Höglund and Linton (2018) discovered that when they work with people outside of their respected country, they are better off collaborating.

M. McAdam and Debackere (2018) found in their review of the literature on the advantages of the quadruple helix model; by arguing that this model can facilitate more effective and efficient learning *"socioeconomic, socio-political, and socio-technical and complex configurations*" by increasing the innovative and entrepreneurial ability in a specific context (M. McAdam & Debackere, 2018).

2.4.6. Drivers/barriers of University-Industry, Technology Transfer & Knowledge Transfer

Due to KT and TT both occurring, their drivers and barriers will be mentioned together (Kogut & Zander, 1992; Garud & Nayyar, 1994; Battistella et al., 2016). This is supported through recent literature reviews discussing these two terms as one (Battistella et al., 2016). While the University-Industry literature further supports this reasoning (Schumpeter, 1934; Berbegal-Mirabent et al., 2015; Scandura, 2016; Rajalo & Vadi, 2017; Mascarenhas et al., 2018; Williams & Allard, 2018; Sjöö & Hellström, 2019; OECD, 2019). The following section will discuss the key themes for KT&TT.

Process

With any process, there will be benefits and issues associated (Blumenthal et al., 1996; Campbell et al., 2000; Jerry G. Thursby & Thursby, 2002; Jensen et al., 2003; Siegel, 2003; Siegel et al., 2004; D'este & Perkmann, 2011). None more so when knowledge or technology is transferred from one entity to another. For example, a key reason for transferring knowledge is for the incentives associated with this transfer (Jensen et al., 2003) that can be in the form of capital recognition and potential promotion. This also provides the added benefit of allowing the individual to have increased amounts of social networking to further the individual's career (Jensen et al., 2003). Academics often benefit from these interactions that help increase their research capabilities, and direction (D'este & Perkmann, 2011). However, Academics have highlighted some potential issues, such as increase in secrecy on the industries side (Campbell et al., 2000) that could lead to delay in disclosure of research findings (Blumenthal et al., 1996; Jerry G. Thursby & Thursby, 2002; Siegel, 2003; Siegel et al., 2004). Additionally, C. Lee et al. (2018) reported that commercialisation of TT can take 15-16 years from knowledge creation and application that shows the lag in potential results that should be considered when analysing outputs out of

universities. This finding underpins the need for longitudinal perspectives within this area of the literature.

Collaboration

Collaboration is a significant part of the KT&TT activities (Ankrah & Al-Tabbaa, 2015). Albert N. Link et al. (2007) and J. D. Adams et al. (2005) suggested an increase in team size can allow for a more effective development of ideas. Academics have concluded that universities allocated a higher percentage of royalties are usually more productive (Albert N Link & Siegel, 2005b). This is supported by Friedman and Silberman (2003). Ankrah et al. (2013) found the motivations associated with these activities can benefit them in economic development while these collaborations can increase the chances for commercialisation (Adler & Kwon, 2002). Furthermore, Self-motivation in Academics is considered a key driver for these activities to occur with Industry, rather than external regulations (Tartari et al., 2014).

Structure

Structural issues have been a common theme from the literature(Abreu & Grinevich, 2013; Ghauri & Rosendo-Rios, 2016; Galan & Plewa, 2016) Albert N Link and Siegel (2005b) found that certain organisational structures have the potential to improve technology licensing. The 'royalty distribution formula' that is a percentage given to employee's for developing the new technology. These Academics found that the universities that gave a higher proportion to the employee are more likely to take part in 'technology transfer' activities than those that do not(Albert N Link & Siegel, 2005a). A literature review analysis by K. Miller et al. (2018) found that organisational structure impacted on the efficacy of university TT activities and is also supported by (Kotha et al., 2013). Galan and Plewa (2016) who found that the differences in time scales between Academia and Industry can act as a barrier for the KT&TT activities to occur.

Culture

Culture has been seen as a barrier between Industry and Academia, the difference in pace and timescales can affect the outcome of the relationship (Francis-Smythe, 2008; Ghauri & Rosendo-Rios, 2016; Sapuarachchi, 2021). In addition, Academics also believe that getting involved in the TT process could be detrimental to their careers (Albert N Link & Siegel, 2005b). Malik (2013) concluded that language barriers can have an impact on the

effectiveness of the relationships. However, they also suggest that often similar outcomes can be achieved, which acts as a driver (Malik, 2013).

Politics

The impact of bureaucracy has been seen to affect Academics within universities (Hughes & Kitson, 2012). Francis-Smythe (2008) concluded that the amount of paperwork required effects the KT activities being carried out. Issues have arisen regarding the '*publish or patent dilemma'* (R. McAdam et al., 2011). This has put Academics in an unnecessary position because they have to decide whether they want to carry out research in an Industry setting without issues impacting their Academic careers. This then can be perceived to add another layer of bureaucracy to the process (Belitski et al., 2019)

Previous Engagement

Previous engagement has been shown to have a positive effect on KT&TT activities, with more realistic expectations shown to all parties involved, whilst understanding the needs of the partner (Wallin et al., 2014; Steinmo & Rasmussen, 2018). Plewa et al. (2013) found that previous engagement has a direct positive effect on trust being built. When everyone upholds what was first agreed upon and is upfront about what they can achieve, the initial connection is beneficial (L. Johnston et al., 2010; Ghauri & Rosendo-Rios, 2016).

Trust

Trust was seen as significant in the Academia to Industry relationships (Van Wijk et al., 2008), where Bruneel et al. (2010) found that the forming of trust reduces barriers associated to KT&TT activities. Often Industry saw lack of motivations to collaborate were down to trust issues (Vick & Robertson, 2018). Trust was seen as significant in the formation of a relationship (Plewa et al., 2013). Similarly, if IP is discussed too early in the relationship, this can effect trust (Canhoto et al., 2016). '*Trust'* is additionally increased through consistent communication (Malik, 2013) (Ankrah & Al-Tabbaa, 2015). This is reflected when there is less contractual obligation (de Wit-de Vries et al., 2018), while Development of communication can be used to minimise barriers between Academia and Industry (Plewa et al., 2013; Estrada et al., 2016).

Technology Transfer Office

TTOs can play an important role in the KT&TT activities, although the literature suggests that TTOs can be seen as a barrier, due to having lack of resources and capabilities (Siegel,

Veugelers, et al., 2007). Also, TTOs have received growing criticism regarding inexperienced staff, being under staffed and lack of business knowledge (Holgersson & Aaboen, 2019; Belitski et al., 2019). This can be explained by the linear and complex TT models to support IP and licensing (Grindley & Teece, 1997; Holgersson et al., 2018). Subsequently, TTOs have a tendency to inflate commercial potential of patents (Hertzfeld et al., 2006) that could have a detrimental effect to the potential for commercialisation of these patents that can put off businesses wanting to invest. The literature suggests stakeholders within universities have different objectives that could cause an imbalance between different entities (Demil & Lecocq, 2010) (Brickson, 2002; O'Kane et al., 2015). If TTOs are supported with a science park this can have a positive effect on commercial activities coming from the university (Caldera & Debande, 2010).

Intellectual Property Rights

Intellectual Property Rights (IPR) has been seen as a barrier to the successfulness of KT&TT activities, with it having a direct effect on TTOs (Siegel & Wright, 2007; El-Ferik & Al-Naser, 2021). El-Ferik and Al-Naser (2021) concluded that negotiations should start early on to improve the chances of success. However, some Academics suggest that there are greater barriers between Academics and Industry, compared to IP barriers (Tartari et al., 2014). Moreover, barriers are often associated with IPR, then the IP (Lockett et al., 2008). Some Academics suggest the idea of giving away free licenses, to improve the chances of Industry being successful that can have a positive impact on society (Alexy et al., 2009; Peters et al., 2013; Holgersson & Wallin, 2017; Holgersson & Aaboen, 2019). IPR management has been seen as a critical part of the process and should not be overlooked (Alessandrini et al., 2013; O'Kane et al., 2015).

Swansea University have addressed their processes of royalty allocation by giving a higher percentage to the inventor (SU, 2016). Because AgorIP only owns a small portion of the royalties, this not only enables broader participation but also enables AgorIP to handle more transaction flow without investing as much money in the legal documentation for ownership. (SU, 2016). Abreu and Grinevich (2013) discovered the challenges with IP protection for informal forms of KT, since Academics handling these activities are frequently more knowledgeable in their field.

Economic Development

One of the main recommendations in a recent Government study on "creating our industrial strategy" was to boost innovation by commercialising a sector of world-class research more effectively (HM Government, 2017). This shows the importance the Government sees in enhancing benefits to the economy, especially as it was labelled no.1 in '*ten pillars for an industrial strategy'.*

Huggins and Kitagawa (2012) highlight university KT in the context of devolved regions such as Wales, stating the importance that universities play in the development of the knowledge economy. This should be done through realising the benefits associated with performing KT activities (Warren et al., 2010). Specifically in peripheral regions like Southwest Wales, it is essential for regional cooperation (Siegel, Wright, et al., 2007).

Finance

Funding has been lacking in the KT activities, compared to that for teaching, which can be seen as a barrier (Kitagawa & Lightowler, 2013). Hughes and Kitson (2012) found that Industry lacks the internal resources to carry out KT activities. However, when funding is in place, it can be seen as beneficial to support IP and commercialisation (Feldman et al., 2002). Lawson (2013a) found that public funding is more likely to produce patents than from private funding. Furthermore Rodríguez-Gulías et al. (2018) highlights the impact private funding can have on the success of TT activities such as spin-out from universities.

Distance/connectivity

Distance and proximity between Academia and Industry improve the chances of a relationship forming (D'Este et al., 2013; Helmers & Rogers, 2015; Sapuarachchi, 2021). However, Laursen and Salter (2014) found that distance was less of a barrier when the firms absorptive capacity was high. Morandi (2013) found that more experiences with firms does not change the effects of distance for KT&TT activities. Ambos and Ambos (2009) found that the strength of a relationship allowed for a better understanding of *'general bias*'. Renato Garcia et al. (2018) found that while close proximity is significant to learning, technology plays a part in decreasing the effects of distance as a barrier.

When looking at TT on an international scale, Malik (2013) found that national language and industrial distance appear to be a barrier between universities and organisations; but education, social and religious differences show to be drivers in international technology transfer (Malik, 2013), within the biopharmaceutical sector. However, Agrawal (2006) found

that distance and being situated within the same country do not effect licensing activities, but the success of commercialisation is affected by proximity. However, little Academic literature has investigated the drivers and barriers for TT between different entities such as Academia, Industry, and Government.

2.4.7. Drivers/barriers of Industry-Industry, Technology Transfer & Knowledge Transfer

Collaboration

The cost-cutting and synergy-seeking motivations for these activities are one of the first elements for the drivers and barriers of Industry-Industry KT&TT (S. Lee et al., 2010). This is also highlighted by Segrestin (2005) where common objectives can act as an enabler for a joint venture. The example given in this case was between Renault and Nissan.

Previous Engagement

An additional factor that has come up in the literature is the experience associated with previous relationships (Zollo et al., 2002). This form of partnership is usually less formal and subsequently easier to establish, though it is also considered as an '*inter-organisational routine'* (Zollo et al., 2002). Contrary to this statement, '*Previous Engagement'* can be considered as a barrier (Dyer & Hatch, 2006). This is because the knowledge attained will require a new set of routines for the recipient company to succeed (Dyer & Hatch, 2006).

In addition, Academics highlighted the importance of experience through previous partnerships, enabling them to learn and improve their KT activities (Inkpen & Tsang, 2005; Hagedoorn et al., 2009). However, even though experienced, new knowledge attained can only be successfully implemented when training is in place to codify this (Argote & Ingram, 2000; Lane et al., 2001; J. L. Cummings & Teng, 2003). Finally, issues can occur through the companies' lack of adaptability (Milagres & Burcharth, 2019).

Absorptive capacity

The significance of absorptive capacity has a big impact on KT&TT (Dyer & Hatch, 2006; Jane Zhao & Anand, 2009). Jane Zhao and Anand (2009) substantiated that the higher the '*absorptive capacity'* within a firm, the higher the chances for a firm to overcome challenges associated with KT, such as coordination and motivation. Dyer and Hatch (2006) concluded

that barriers even occur when both partners are motivated and show high levels of '*absorptive capacity'.*

Trust

A standout factor in the literature is the importance of trust (Ireland et al., 2002; Inkpen & Currall, 2004; Szulanski et al., 2004; Gopalakrishnan & Santoro, 2004; Howard et al., 2016). Trust can be formed through the repetition of interactions between two entities, which can also enhance tacit information exchange (Howard et al., 2016). Ireland et al. (2002) also found that there is a positive relationship between trust and partnership performance. However, trust may be limited in some circumstances when there is a higher level of control in the relationship, which can act as a barrier (Inkpen & Currall, 2004). An additional thread from trust is the term classed as common sense of justice which stated by Luo (2005), is an outcome from the establishment of partnerships that will have a positive effect on KT.

Social

Another important factor considered in the transfer of knowledge and technology is the social side (Bozeman, 2000; Van Wijk et al., 2008). T. Hansen and Winther (2011) discussed the relationships between different individuals will have a positive effect through increasing the processing capacity of data. However, if the motivation lacks or differs, in these relationships, then this can be a barrier (Marcos & Denyer, 2012).

Additional important social factors are the intensity of the connections between different entities (Bozeman, 2000; De Long & Fahey, 2000; Van Wijk et al., 2008). However, one of the biggest barriers to KT is by causal ambiguity (Kogut & Zander, 1992). Though the formation of clusters can reduce this barrier (Speldekamp et al., 2020).

Distance/Connectivity

'Distance/Connectivity' also plays as a significant part in the literature (J. L. Cummings & Teng, 2003; D'Este et al., 2013). Uzzi (1996) specified that the transfer of tacit knowledge causes less friction when entities working together are within a network, compared to company firms. More specifically, Rogers (2010) found that companies situated in close proximity have a greater impact on smaller companies compared to large companies. Van Wijk et al. (2008) stated an effective way to gather new knowledge is to have a central location in the innovation system, thus synthesising information more efficiently. However, the success of this hinges on the actors' ability to absorb information well enough to continuously analyse the data and determine what information is pertinent to them (Kogut & Zander, 1992). This

is also backed by Reagans and McEvily (2003) who concluded that stronger connections within the innovation system, allow for a higher amount of successful KT.

When looking at distance in an international context, Kotabe et al. (2003) confirmed that KT from one country to another is not as beneficial for either party involved. However, more recently there has been a disagreement by Cheung et al. (2010) as they point out that due to the development of globalisation and the cross-pollination beyond borders, this has brought about an increase in multicultural managers that can bridge the cultural distance gap.

The physical distance between entities can have an additional cost and time with communication (J. L. Cummings & Teng, 2003). It has been shown that the greater the distance between entities, the less effective TT is (Galbraith, 1990).

Culture

Following this factor, culture has shown to have a significant impact in the transfer of knowledge (Gertler, 2004; Gopalakrishnan & Santoro, 2004). Culture distance can have effects on operational factors such as lack of understanding of norms, values and institutions for KT to be successful (Ahammad et al., 2016). The distance can also lead to misunderstanding, which may reduce the effectivity of this process (Szulanski et al., 2004). Bhagat et al. (2002) summarised that KT is at its optimal level when their partners are in contexts of identical cultural standards.

Finally, Knowledge has been a topic raised in KT&TT activities (Zander & Kogut, 1995; Battistella et al., 2016). For example, the more specific the context of knowledge is, the greater the challenge for that information to be implemented in a different context (Battistella et al., 2016). This was previously supported by Zander and Kogut (1995) who discussed how the complexity of knowledge can make it harder for this to be transferred.

Pace of change

Other additional factors that have an impact is the ever-changing speed of the environment (Ferdows, 2006). Also, external factors can influence transfer of technology, such as Government subsidies, legislation, barriers and protections to the market (Bozeman, 2000). More general factors that will have an impact are Political, Economic, Environmental, Social and Technological should be considered (Liyanage et al., 2009).

Successful TT by corporations does not guarantee future success; in order for technology to be applied effectively, meticulous preparation must be made about not only TT but also the knowledge and skills that go along with it (De Toni et al., 2011; De Toni et al., 2012).

2.4.8. Smart Specialisation

A recent policy evolution for the development of successful clusters and RIS is Smart Specialisation (EC, 2014a, 2016, 2019b). Smart Specialisation is most consistently linked with Dominique Foray and his colleagues (Foray et al., 2009; Foray et al., 2011; Foray, 2014; R. E. Pugh, 2014; Morgan, 2015; Foray, 2018). Foray (2011) defines this concept by: *"Smart Specialisation is a process addressing the missing or weak relations between R&D and innovation resources and activities on the one hand and the sectoral structure on the economy on the other".* The definition is seen as broad, due to its usability to different contexts in policy. Though it is important to note that the term "Smart Specialisation" is context specific, and every region must have a tailored framework (Morgan, 2013, 2015).

It has subsequently been discussed in detail by Barca (2008) and Foray (2018), even Dominque himself concedes that this is not a new phenomenon and that it has been going on for hundreds of years. He even uses an example from 1796, Pierre-Hyacinthe Caseaux, a merchant and Blacksmith in Morez (France) (Foray et al., 2011). Dominique Foray gives this concept a structure and shows how it may be implemented into innovation strategy, as the EU has done with the EU 2020 innovation agenda (EC, 2014a, 2014b, 2016, 2019b).

One of the earliest reviews, Morgan (2015) book review of Smart specialisation, initially questioned why this idea got so much political traction than other credible ideas. This echoes what Martin and Sunley (2003) highlighted with Porter and *'cluster theory' see section 2.3.2*.. Morgan (2015) highlights a strength of this book through its concise language covering the key questions within the European Regional policy community. However, it is almost impossible to cover every issue that people would want to address from this one book (Morgan, 2015).

Foray (2018) discusses the importance of the relationship between smart specialisation and the processes of modernisation and diversification of economic structures for opportunities associated with 'general purpose technologies', which is a technology with broad economic

implications. A recent Government paper provides context for smart specialisation and an overview of recently completed research (EC, 2019b).

A Report produced by the EC (2016) regarding Smart Specialisation in Wales has given a unique perspective and understanding of how this can be adapted to the South West Wales context. This has allowed for the contextualisation of cluster theory (M. E. Porter, 1998; Trippl & Tödtling, 2007; Swords, 2013) and RISs (P. Cooke, 2004; D'Allura et al., 2012; Höglund & Linton, 2018). In addition, this has given subsequent focus for Wales and South West through the development of structured support programmes aiming to develop the fifth cluster on semi-conductor (EC, 2016).

2.5 Support Programmes

The support programmes described are within the context of South West Wales and are shown in the table 2.15 below.

Table 2. 15: Support programmes in South West Wales

Programme	Description	Area of Focus
AgorIP	TTO of Swansea University	Life Sciences, Engineering & ICT.
SMART Expertise	Government led initiative to support KT activities	No area of focus
FLEXIS	Government, Industry, and Academia led programme to generate research income and clusters	Energy Systems
SPECIFIC	Swansea University led programme in partnership with Tata Steel UK to commercialise functional glass and steel	Energy Technology research & full-scale demonstration

2.5.1. AgorIP

Gibson et al. (2007) highlighted the need for greater commercial activities to occur between Academia and Industry. AgorIP was designed to support the research and Academics in innovative activities, by finding the right Academic and Industry partner for collaboration (SU, 2016; G. Davies, 2019a; G. H. Davies et al., 2019). AgorIP is Swansea University's TTO that was developed in partnership with the WG and Industry to commercialise Intellectual Property from university and health board research output (SU, 2016). The PTWEZ, follows the '*Triple Helix'* model framework (Leydesdorff & Etzkowitz, 1998) *(see section 2.2.10.)*. The AgorIP concept claims a unique 'zero-waste' approach, allowing most opportunities to proceed to maximise success (SU, 2016).

AgorIP adopts the 'Open Innovation' paradigm originally developed by Chesbrough (2003) *(see section 2.1.)* and involves targeting KT & TT to occur through the different stages of development. This happened in both existing and/or new markets between different organisations. The AgorIP model is presented overleaf as *figure 2.23.*

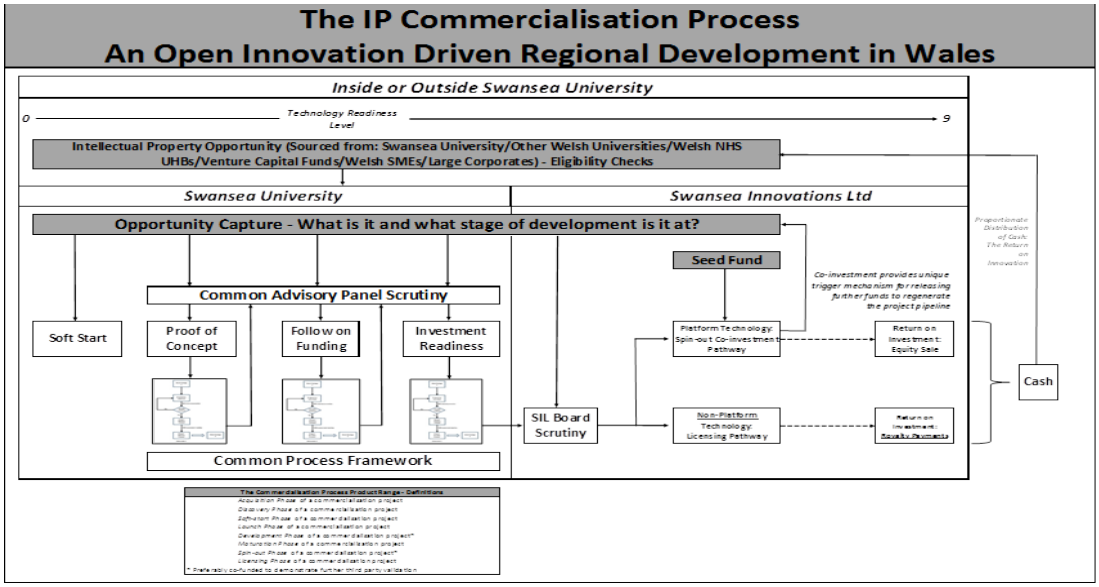


Figure 2. 23 Agor IP Model (SU, 2016)

The initiative has a collection of TT officers possessing a multitude of skills including; contract negotiation, market appraisal and project management (SU, 2016). The team also provides a

wider network of expertise that allows them to provide potential clients with investment and external sources, such as market research and regulatory advice (SU, 2016). AgorIP has also been subject to prior review (G. Davies et al., 2018; G. H. Davies et al., 2019), while there is an agreement that since the forming of AgorIP, the scope and scale have been widened through the AgorIP initiative (G. Davies, 2019a; G. H. Davies et al., 2019). This is also supported through interest from policymakers in Welsh Government HEFCW (2017) and the UK Government (UK Parliament Science And Technology, 2013).

2.5.2. SMART Expertise

SMART Expertise is a regional support programme that offers financial support to innovative collaboration projects that require expertise to solve Industry problems (BW, 2021). This is a continuation from policy objectives set out through SMART Specialisation (Foray et al., 2009; EC, 2014a). The programme will support 100% of the research organisations project costs, which cannot be over 50% of the total project cost. The Industry partner will provide the outstanding project costs (BW, 2021).

2.5.3. FLEXIS

FLEXIS programme is a multi-stakeholder programme, collaborating with Cardiff University, Swansea University, The University of South Wales, NPTCC and Tata Steel UK. This takes the triple helix approach of collaboration (Etzkowitz, 2003; R. Pugh, 2017; Cai & Etzkowitz, 2020). Below is a map to show where FLEXIS is based in relation to Port Talbot, the PTWEZ and other key stakeholders in the region. With three main aims to generate revenue for Welsh research, recruitment and development of clusters to support activity (FLEXIS, 2021). Recently FLEXIS was part of an initiative to develop a *"zero-carbon area demonstrator"* to support clean living (FLEXIS, 2021).

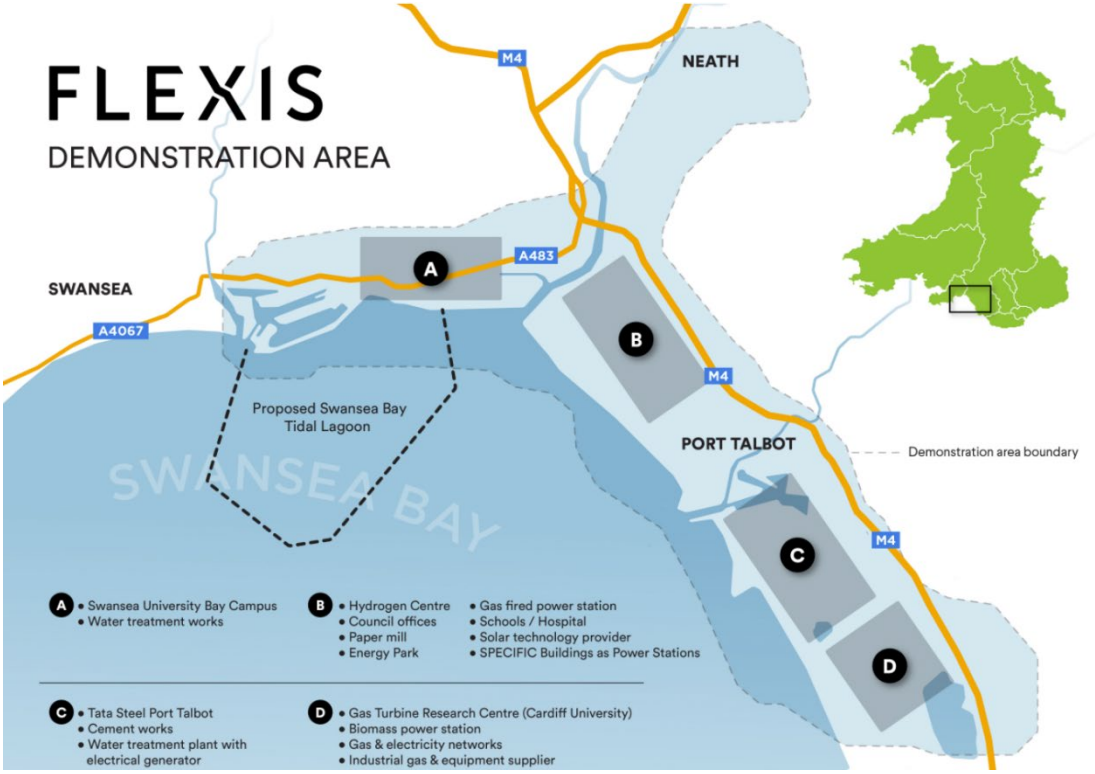


Figure 2. 24 FLEXIS demonstration areas (FLEXIS, 2021)

2.5.4. SPECIFIC

There has been a long-standing interest of SPECIFIC in the literature (Marques et al., 2019). While SPECIFIC has showed *"active buildings which can generate, store and release their own heat and electricity from solar energy"* (SPECIFIC, 2021). SPECIFIC was created by Swansea University in 2011 to support the commercialisation of a portfolio of functional, glass and steel *'smart coatings'*. This is done through capturing, storing, and releasing energy (SPECIFIC, 2021), while this technology allows for both new and existing buildings to become their own power stations . Considerable amount of funding has been granted to SPECIFIC by the UK research council, the Engineering and Physical Sciences Research Council (EPSRC), Innovate UK and WG (WG, 2019c). In a recent article by Marques et al. (2019) they go into detail about the progress SPECIFIC has made, stating they have benefitted from SPECIFIC being in line with recent Government goals for finding solutions to climate challenges. However, there were causes for concern with Swansea's ability to attract further private investment into the region to build the cluster (Marques et al., 2019).

2.6 Conceptual Model

This section summarises the two conceptual models that will be provided in this thesis. Based upon the literature review, the RIS model described by Trippl and Tödtling (2007) will be used in order to appropriately map the RIS of South West Wales. Justification of this model described later in the section, while the Triple Helix Model (Leydesdorff & Etzkowitz, 1998) will be used for the analysis of the key stakeholders in the RIS where KT&TT interactions occur between the key stakeholder of Industry, Academic and Government (Trippl & Tödtling, 2007). These conceptual models will be the basis to gather data on the drivers and barriers for KT&TT to occur.

2.6.1 Regional Innovation Systems (RIS)

Section 2.4 introduced NIS, together with RIS by key Academics in the field (P. Cooke, 1992; P. Cooke & Morgan, 1994; Bjørn T Asheim & Isaksen, 1997; Autio, 1998; P. N. Cooke et al., 2000; P. Cooke, 2004; Tödtling & Trippl, 2005; Huggins & Johnston, 2009; Martin et al., 2011). Subsequently, has led to the use of the RIS as part of the conceptual model for this thesis that was framed by (Trippl & Tödtling, 2007).

The RIS concept has been considered in the southwest Wales context (P. Cooke & Morgan, 1994, 1995; Bjørn T Asheim & Isaksen, 1997; Morgan, 1997; Bjørn T Asheim & Gertler, 2005) and has been significant in recent European policy highlighting the importance for areas to innovate (OECD, 2010, 2013, 2020). Hudson (2011) believes that regions that have built systems around the creation of knowledge to be capitalised will succeed the most. As a result, such areas will enable the production and faster use of more information, which can lead to the development of novel goods and procedures (Trippl & Tödtling, 2007).

The original model by Autio (1998) describes the two key areas for the RIS that are *'Knowledge Generation'* and *'Knowledge Exploitation' (See section 2.4.);* the main external influences of the RIS are described *'the policy instruments'* and '*National systems of Innovation'* (NSI) institutions. Tödtling and Trippl (2005) further evolves the RIS model by suggesting that there needs to be some level of autonomy in the system for this model to be

successful, with a consistent flow of KT to occur between key actors within the RIS. Tödtling and Trippl (2005) Afterward, modify the model to take into account the "regional policy dimension," which has gained importance since its inception Autio (1998).

This RIS Model was further developed by Trippl and Tödtling (2007) from the biotechnology cluster in Austria. They highlighted three key areas and add the *'socio-institutional factors'* to this model. *(See Figure 2.25).*

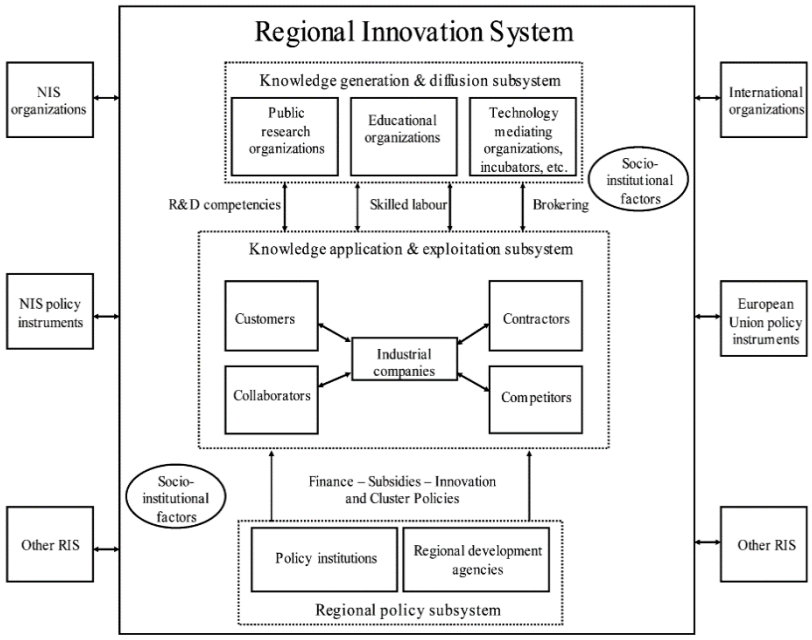


Figure 2. 25 Main structuring of Regional Innovation systems, original model (Trippl & Tödtling, 2007).

Breakdown of the regional Innovation system (Trippl & Tödtling, 2007) highlighted three key areas the RIS:

- *Knowledge generation & diffusion system:* This part of the model highlights the knowledge-based stakeholders in the RIS. This comprises all stakeholders that are creating and transferring knowledge, technology, and skills. They are then broken down into three subsections that are 'Public Research Organisations' (universities, research institutions, public laboratories, etc.), within South West Wales this consists of Swansea University, SPECIFIC; 'Educational Organisations' (universities, technical colleges, vocational training organisations, apprenticeships, etc.) consisting of the UWTSD, Swansea university; 'Technology mediating organisations, incubators, etc.'

(TT Offices, science parks, incubators, etc.). Within the context of South West Wales this would be AgorIP, ACCELERATE, and the PTWEZ.

- *Knowledge application and exploitation subsystem*: Describes the Industry in which the major participants operate, including the industrial, service, and tertiary businesses as well as their clients, suppliers, partners, and rivals. Typically, this refers to a cluster, which is an important component of the RIS. A Key organisation in the South West RIS system is Tata Steel.
- *Regional policy subsystem*: 'Policy institutions' and 'Regional development agencies' are two vital parts to RIS. Examples of this are the devolved Government in Wales and the Swansea Bay City Deal (SBCD, 2020). Previous works on innovation policy (P. N. Cooke et al., 2000; Bjørn T Asheim et al., 2003; Tödtling & Trippl, 2005) shows subsystems play a crucial role in developing the region's economic potential. More recent work by Bjørn T Asheim et al. (2011) supports this by stating the importance of regional policy.
- *Local flows of knowledge and skills*: to have an effective RIS, there must be suitable links between the RIS sections (Trippl & Tödtling, 2007). This is a vital component to the success of the RIS, which will lead to regional collective learning and systemic learning. Keeble and Wilkinson (2000) separated collective learning into three categories that include new firm spin-offs, labour market recruitment and labour mobility and networks. Subsequently, Tödtling et al. (2006) gave a more detailed categorisation of this that include market links, formal collaborations, informal networking, and KS. This has been further developed over the years (Bjørn T Asheim et al., 2019). Examples of this relate back to KT&TT activities that will be discussed in section 2.4.4. (Leydesdorff & Etzkowitz, 1998; Leydesdorff, 2018; Leydesdorff & Cucco, 2018).
- *'Socio-institutional factors'*: this section signifies an area's routine, relationship and culture are set up. This varies greatly by location and must be well understood for RIS to be successful (Trippl & Tödtling, 2007). Also, this will have a significant effect on the relationship of the innovation actors and how these relationships are regulated (Gertler, 2004; Malerba, 2005). This aspect considers the factors that affect KT&TT occurring in the RIS.

Bjorn T Asheim et al. (2011) pointed out the absence of literature on the RISs' intrinsic failures, not merely to focus on their accomplishments, which creates an imbalance in awareness of the difficulties associated with RISs. The literature for RISs fails to analyse the importance of labour markets and human capital, compared to the importance of education, training systems, and R&D personnel and qualified staff (Bjorn T Asheim et al., 2011). Grillitsch and Asheim (2018) discusses the context of Trippl and Tödtling (2007) conceptual model as suited to RISs that have high technology companies, research, education and leading university hospitals. Nevertheless, there is a lack of local actors to absorb KT&TT activities, there is an assumption that the success of RIS is dependent on high levels of linkages between firms and Academia (Trippl et al., 2015).

This conceptual model sets out to answer the conditions required to optimise the linkages between the three key actors described (Leydesdorff & Etzkowitz, 1998). Additionally, this sets to outline similarities and differences between the RIS model described in the biotechnology cluster in Austria and the RIS of South West Wales.

2.6.2. The Triple Helix Model

The Triple Helix Model has shown to be a critical model in KT&TT activities (Etzkowitz, 2003; Huggins et al., 2008; Elias G Carayannis & Campbell, 2010; Geoghegan et al., 2015; Leydesdorff, 2018; Zhang et al., 2019; Yoda & Kuwashima, 2020). A key aspect of this model is the importance of the three key stakeholders of Government, Academia, and Industry see section 2.4.4 on Triple Helix Model. The KT&TT processes *(see sections 2.4.1 & 2.4.2.)* represent the respective roles of Industry and Academia, while RIS (section 2.4.) introduces the role of Government in creating the conditions and providing resources to support the economic development to a region. This model is therefore used in the design of the data collection, findings, and discussion (Leydesdorff & Etzkowitz, 1998). This sets out to understand the configurations that are used in South West Wales.

The two other variations of the Triple helix are described below. To the left is described as a ‘existing socialism’ where the Government often has control over Industry and Academia. On the right is a more rigid form of the Triple helix, where the key stakeholders are more independent of each other, with some linkages between them. This is shown in *figure 2.26* overleaf.

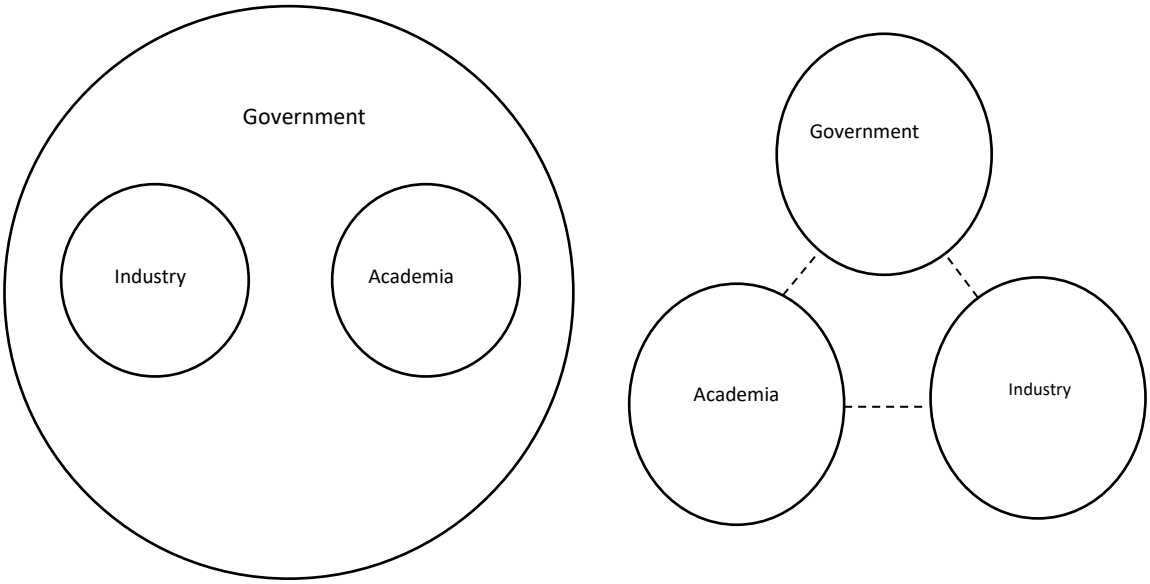


Figure 2. 26 presents the iterations Triple helix model I & II (Etzkowitz & Leydesdorff, 2000a).

Figure 2.27 shows the arrangement of the triple helix III considers strong linkages between the key stakeholders that would allow for 'Tri-lateral networks and hybrid organisations. The significance of the interactions between the players for the emergence of an innovative environment through spin-offs, knowledge-based economic development, and strategic alliances that are key components to the accomplishment of KT&TT operations (Warren et al., 2010; Huggins & Strakova, 2012) Below is the Triple helix model in *figure 2.27*.

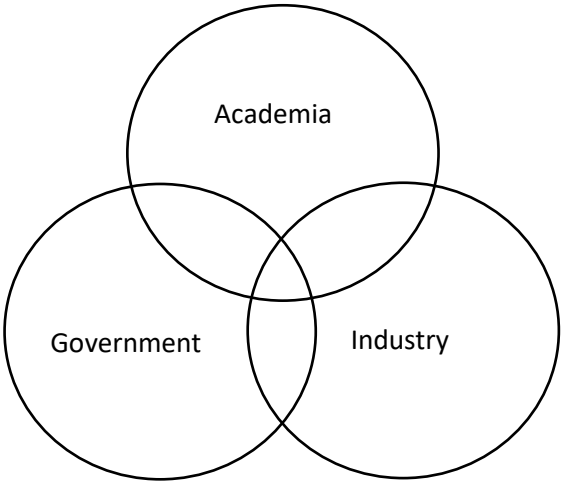


Figure 2. 27 presents the Triple Helix model III for conceptual model (Etzkowitz & Leydesdorff, 2000b).

Etzkowitz and Leydesdorff (2000a) brings together the above concepts, for firms of all sizes to collaborate together with Academic institutions of excellence, and Government laboratories (Etzkowitz & Leydesdorff, 2000b). Key literature has given the Triple Helix Model context to show how it can support innovation activity in a region(Huggins et al., 2008; Brannback et al., 2008; Geoghegan et al., 2015; R. Pugh, 2017; Lopes et al., 2018; Yoda & Kuwashima, 2020; Cai & Etzkowitz, 2020). Huggins et al. (2008) offered this particular backdrop to Wales and the interactions that take place between Government, Industry, and Academia, specifically to examine the extent to which universities are involved in regional development. This aims to expand on the Triple Helix by providing a study of South West Wales in context. R. Pugh (2017) further analysed this theory in relations to Welsh policy and found the oversimplification of the Triple Helix Model, because of the complex nature of Academic stakeholders. Tailored policy should be carefully considered to specific contexts through understanding the geographical, political, historical, social and cultural contexts (P. Cooke, 2004; R. Pugh, 2017). Using the Triple Helix Model and RIS model sets out a full understanding of the context of South West Wales.

2.7. Conclusion

These models will become the conceptual model. The next chapter introduces and explores the research question and sub research questions. This will also, discuss the methodology of the thesis, with a breakdown of the philosophical underpinnings, research design and analysis techniques used.

To conclude, the literature review discussed provides an overview of the key literature and economic context for the design of this thesis, while supporting the choice of conceptual models used in the next chapter. The exploratory nature of this thesis, which was influenced by the context of South West Wales, precluded a systematic examination of the literature. While research gaps have been highlighted with the potential to provide a context specific analysis of the RIS within South West Wales. Additionally, the literature has demonstrated that there is a dearth of studies that examine the elements that affect KT&TT in relation to Academia, Industry, though limited research on both Academia, Industry and Government. Finally, the analysis of the research has revealed gaps in the literature on EZs, which frequently examines economic aspects to demonstrate its effectiveness.

3. Chapter three: Research Methodology

3.1. Introduction

This chapter provides an overview of the research approach taken. The research question, in addition to the research aims and objectives, are presented in the first section, which aims to situate the study within the context of the PTWEZ. This involved consideration of elements identified in the literature review, such as established and emerging initiatives of AgorIP and Freeports. As significant potential components of the RIS, they were specifically incorporated.

The ontological and epistemological positioning of the study is then examined and a justification for the approach taken is provided. Finally, the research techniques used to gather and analyse the data for this thesis are discussed. Figure 3.1 summarises this chapter and is located below.

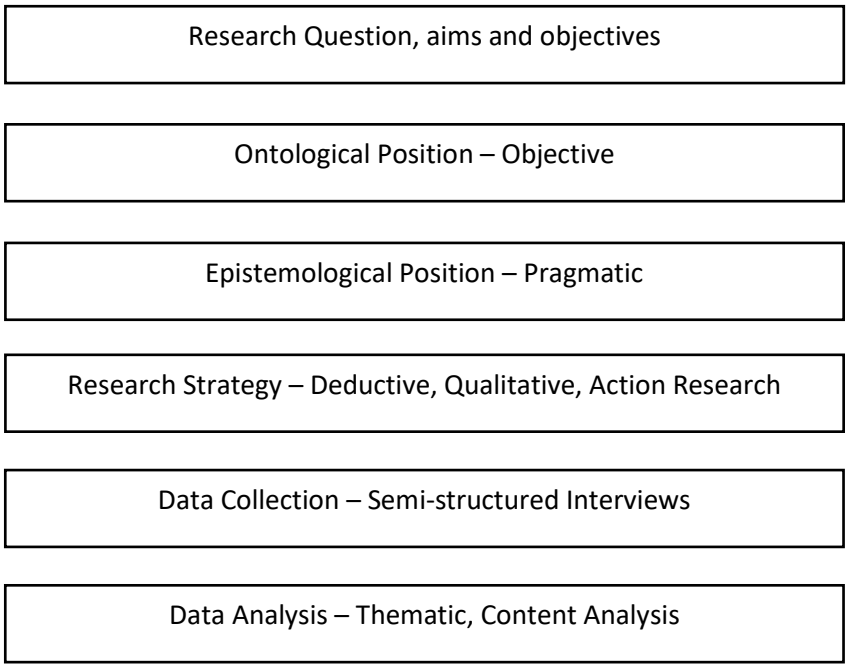


Figure 3. 1 Chapter three structure

3.2. Main Research Question

The overall direction of this applied piece of research is influenced by the research sponsors, PTWEZ and WG. The literature review highlighted the key themes associated with KT&TT that builds upon the conceptual models used of the Triple Helix (Leydesdorff & Etzkowitz, 1998) and RIS (P. Cooke, 1992; Trippl & Tödtling, 2007). This sets to appropriately map the context of South West Wales and the PTWEZ and acquire new understanding of how KT&TT can be maximised to support the regional ambitions. The primary research question is presented below.

> Q: "What are the drivers and barriers for knowledge and technology transfer within the context of the Port Talbot Waterfront Enterprise Zone?"

3.3. Research Aims

The Research aims were designed to explore the context of the PTWEZ and how it can supplement the main research question. The first aim sets out to understand how the PTWEZ maximises their innovative capacity. RIS Trippl and Tödtling (2007) suggests different actors need to work together, such that this asks how the PTWEZ can work in South West Wales to maximise innovative activities. The primary research aim is thus presented below.

- To understand how the PTWEZ can positively impact on innovation activities in the region

The second research aim sets to frame the dynamics of the main research question, which will base its understanding on the literature review conducted and then tested against the semi-structured interviews in phase two and three. This attempts to verify the conceptual model used of the Triple Helix Model (Leydesdorff & Etzkowitz, 1998). The second research aim is outlined below.

- Map the factors that impact KT&TT activities in the region

Finally, the third research aim sets to provide solutions of key issues gleaned from the findings by identifying means through which barriers may be reduced and transited into drivers. This is further developed to test against the literature of the key themes identified to affect KT&TT activities (Rossi, 2018; Ferreira & Carayannis, 2019; Hayter et al., 2020). The final research aim is presented below.

- Develop tools and/or initiatives that may support KT&TT activities in the region

Developing these studies attempts to validate the core research question by testing it against key topics in the literature, in addition to the conceptual models of the RIS and the Triple Helix Model(Leydesdorff & Etzkowitz, 1998; Trippl & Tödtling, 2007)

3.4. Research Objectives

To investigate the main research question and aims, set objectives must be achieved. The objectives support the development of the PTWEZ and its innovative capacity, while reflecting on key stakeholders in the region to support KT&TT activities. The objectives are summarised below:

- Identify key factors that impact KT&TT through the literature review and data collection cycles
- Develop a reference model and =describe how it relates to South West Wales
- Implement themes synthesised from key stakeholder within the innovation system
- Implement recommendations to support different innovation contexts in their KT&TT activities.

Table 3.1, which is presented overleaf, provides an overview of how each of the research objectives set out to achieve the main research and aims described above.

Table 3. 1: Research Questions v Research Objectives

Research question and aims	Research objectives
"What are the drivers and barriers for knowledge and technology transfer within the context of the Port Talbot Waterfront Enterprise Zone?"	Identify the key factors that impact KT&TT Implement themes synthesised to key stakeholder within the innovation system
To understand how the PTWEZ can positively impact on innovation activities in the region	Implement themes synthesised to key stakeholder within the innovation system
Map the factors that impact KT&TT activities in the region	Identify the key factors that impact KT&TT
Develop tools/initiatives that can support KT&TT activities in the region	Development of a reference model and how it relates to this context Implement recommendations to support different innovation contexts in their KT&TT activities.

3.5. Methodological Underpinnings

It is important to understand the epistemological and ontological positioning of the research in order to understand the research context. This section describes the methodological assumptions or philosophical positions which underpin the study.

3.5.1 Ontology

Ontology concerns itself with the "nature of reality" (Saunders et al., 2007). This asks what assumptions we have about how the world operates, and the commitments people have to views (Saunders et al., 2007). Ontology can be divided into realism and anti-realism. Realism is an ontological position which correlates to scientific enquiry as it supposes that phenomena exist independent of the human mind and can be objectively measured. *"The essence of realism is that what the senses show us as reality is the truth: and that objects have an existence independent of the human mind"* (Saunders et al., 2007) p.102. This provides insight that reality is in an individual's perspective, but also one that is independent of the mind. This suggests that personal insights gathered through the research collection should apply to the data for more valid results to be drawn upon (Scotland, 2012).

3.5.2. Epistemology

Epistemology is the concern of what source of knowledge is deemed acceptable in a certain field of Academia, while also understanding how we communicate with one another (Burrell & Morgan, 2017). There are two basic positions in epistemology: objectivism and subjectivism. Objectivism is when reality is seen as external to the individual and can be observed. Because reality can be observed, the objectivist approach suggests that reality can also be measured (Matthews & Ross, 2010). In contrast to the objectivist perspective, the subjectivist approach suggests that 'reality' is only what an individual perceives it to be. This experience therefore cannot be generalised (Matthews & Ross, 2010)

According to (T. R. Miller et al., 2008) epistemologies "*shape how researchers answer questions regarding the validity of knowledge (qualitative vs quantitative, etc.), the legitimacy of methods to produce knowledge (experimentation, induction, hypothesis testing, etc.), and the assumptions inherent in particular conceptualizations of the object of study and certain methodologies*". This emphasises how important it is to consider how a person's viewpoint on epistemology affects the type of data analysis used (quantitative or qualitative) and how the research question(s) are investigated. The combination of ontological and

epistemological positionings gives rise to several different philosophical paradigms. Key paradigms are discussed below.

Positivism: This philosophical approach is typically situated within the natural sciences. This assumes that *"working with an observable social reality and that the end product of such research can be law-like generalisations similar to those produced by the physical and natural sciences"* (Remenyi et al., 1998) p32. The assumption here is that reality can be measured, and that research undertaken is done in a value-free way (Gill & Johnson, 2002). A positivist researcher will likely follow a highly structured methodology that allows for replication of results (Klenke, 2008).

(Saunders et al., 2007; Scotland, 2012)*Interpretivism*: This philosophical position is underpinned by a subjective approach to epistemology. This standing focuses *"on the meaning rather than the measurement, of social phenomenon",* which is a common practice in the social science setting (Collis & Hussy, 2003) p.53. This is done through entering the real world whereby you study the subjects to gain understanding from their perspectives (Chowdhury, 2014). Interpretivist methodologies gain meaning through observations, through panel discussions, informal interviews, and focus groups (Scotland, 2012).

Pragmatism: This approach "is concerned with action and change and the interplay between knowledge and action" (Goldkuhl, 2012). In contrast to Positivist and Interpretivist paradigms, to which (Goldkuhl, 2012) describes as only observing the world, this approach focuses on outcomes. p*ragmatism cuts across this transcendental/empirical distinction by questioning the common presupposition that there is an invidious distinction to be drawn between kinds of truths." (Rorty, 1982).* According to this approach, there is no real truth because it corresponds to reality (Rorty, 1982) Pragmatists therefore hold the belief that there is no 'best way' to obtain knowledge (Houghton et al., 2012) and many approaches to collecting and analysing data are often used

(Saunders et al., 2007; Matthews & Ross, 2010)*Table 3.2* overleaf provides a comparison of the major philosophical paradigms and associated research methods to accompany the methodological underpinnings described above.

Table 3. 2: Comparison of the major qualitative paradigms adapted from (Klenke, 2008).

Paradigm	Ontology	Epistemology	Research Methods
Constructivism	Relativistic – reality is socially and experientially based, local and specific in nature	Knowledge consists of mental constructions about which there is relative consensus	Case sudies, Interviews
Interpretivism	Reality and researcher are inseprable	Knowledge is based on abstract descriptions of meaning and constituted through a persons lived experiences	Case studies, Interviews, Phenomenology, ethnography, ethnomethodlogy
Symbolic interactionism	Researcher and reality are intertwined	Knowledge is created through social interactions and the meanings that arise from them	Grounded Theory
Pragmatism	Reality is equivocal, but grounded in terms of language, history and culture	Knowledge is gained through experience; researcher as reconstructors of subectivity intended and 'objective' of the actions of others	Interviews, cases, surveys
Positivism	Reality is objective and apprehensable	Knowledge acquistion is value-neutral and stripped of moral content	Surveys, experiments, quasi-experments

Due to the applied nature of this research and it being sponsored by the PTWEZ and WG, the research described herein is positioned pragmatically. This is assumed due to the researcher being aware that when solving a complex problem, there is no best way to obtain such knowledge. Therefore, it is important to gain this knowledge through both the literature and action from the key stakeholders in the RIS of South West Wales. The epistemological position taken for this research study is in line with the pragmatist paradigm (Klenke, 2008). It involves observing and measuring reality (Matthews & Ross, 2010). The starting position of not having an explicit hypothesis as part of the inductive paradigm lends itself to the pragmatist approach. This also fits the approach of carrying out interviews to obtain the data required to answer the main research question and research aims.

3.6. Approaches of other key studies

Existing key studies examining Enterprise Zones have taken a predominantly quantitative approach when analysing the initiatives (Bondonio & Engberg, 2000; Neumark & Kolko, 2010; Ham et al., 2011). These studies have historical data for analysis. However, given that Enterprise Zones are more recent, and the complex nature of the questions that this paper sets so answer, greater emphasis is placed on qualitative methods, as it was deemed that quantitative analysis alone might not fully analyse the hypothesis. Below is *table 3.3,* which categorises the key EZ literature and defends the standpoint of this thesis in the literature (Brekhus et al., 2005).

Table 3.3: List of key literature on EZs

Title	Date	Author/s	Research Approach/Focus
Monitoring enterprise zones: Year three report	1984	Roger Tym & Partners	Quantitative analysis
Retail parks, enterprise zone policy and retail planning: a case study of the Swansea Enterprise Zone Retail Park	1987	Bromley	Qualitative - Case study approach
Enterprise zones and local employment: evidence from the states' programs	2000	Bondonio & Engberg	Quantitative analysis – local employment
UK enterprise zones and the attraction of inward investment	2000	Potter & Moore	Quantitative- Inward investment for economic generation
Enterprise zones and job creation: Linking evaluation and practice	2001	Boarnet	Quantitative – Job creation
Do local economic development programs work? Evidence from the federal empowerment zone program	2008	Busso & Kline	Quantitative analysis – economic factors
Do enterprise zones create jobs? Evidence	2010	Neumark & Kolko	Quantitative – Job creation

from California's enterprise zone program			
Do location-based tax incentives attract new business establishments?	2011	Hanson & Rohlin	Quantitative analysis – tax incentives for increased business activity
Government programs can improve local labour markets: Evidence from state enterprise zones, federal empowerment zones and federal enterprise community	2011	Ham, Swenson, İmrohoroğlu,	Qualitative analysis local labour markets
Enterprise Zones/Do they create or transfer value?	2012	Wainwright	Qualitative analysis – summary of historical EZs in the UK
Enterprise zone policy: developing sustainable economies through area-based fiscal incentives	2012	Granger	Quantitative – Local employment, wealth produced by indigenous wealth
Place-based policies	2015	Neumark & Simpson	Qualitative overview of policy initiatives
Enterprise zones, poverty, and labour market outcomes: Resolving conflicting evidence	2019	Neumark & Young	Quantitative – poverty, unemployment
Do Enterprise Zones have a role to play in delivering a place-based industrial strategy?	2019	Hooton & Tyler	Review of the evidence from previous case studies – review of the literature

Table 3.3 above points to the dominant use of quantitative analysis of EZs. This supports the approach taken for a qualitative study taken to address more complex issues and solutions that cannot be easily quantified.

3.7. Research Perspective

The study context presented in *table 3.1*., together with the applied nature of the research reflected in the central research question and objectives, leads to a pragmatic standpoint regarding an ontological and epistemological view, where every individual constructs a reality based on their environment and their social interactions. In addition to this, the researcher will have to take their own values and beliefs into account when analysing the data, as this will have an influence on the findings.

=The methodological standpoint of a pragmatism paradigm allows for knowledge to be attained through experiences. This will facilitate understanding of the organisational change paradigm, and perhaps better answer the question about how the PTWEZ can increase the potential knowledge technology from Swansea University to the PTWEZ. The remaining section will present and defend the research strategy and assigned methodology.

3.8. Data collection methods:

This section will discuss the methods of collection of primary and secondary data, which was facilitated through the sponsorship of this thesis, who provided unique access to key stakeholders involved with the PTWEZ.

3.8.1 Primary data

Primary data is a significant part of data collection for a specific question to be answered that uses certain procedures to fit the research problem (Hox & Boeije, 2005). The two core areas of primary data collection are quantitative and qualitative. This is reflected below in *table 3.4* overleaf, which is informed by (Hox & Boeije, 2005).

Table 3. 4: Examples of primary data collection, adapted from (Hox & Boeije, 2005)

	SOLICITED	SPONTANEOUS
QUANTITATIVE	Experiment	(Passive) Observation
	Interview Survey	Monitoring
	Mail Survey	Administrative Records
	Structured diary	
	Web Survey	
QUALITATIVE	Open Interviews	(Participant) Observation
	Focus Groups	Existing Records
	Unstructured Diary	

3.8.2. Quantitative Research:

Quantitative research is underpinned by positivist philosophical assumptions and uses numerical figures for statistical analysis (Bell et al., 2018) p.37, (Saunders et al., 2007). Here, some researchers adopt the approach of deductive testing that is used for pre-determined hypotheses (M. N. Marshall, 1996) although deductive techniques are often associated to quantitative techniques (Manna & Waldinger, 1980; Gallaire et al., 1989). (Saunders et al., 2007). In contrast to qualitative research, quantitative data sets typically rely on large sample sizes or data sets (Park & Park, 2016), compared to smaller data sets which are often then norm in qualitative research (Park & Park, 2016).

However, quantitative research has been seen as gathering data upon 'basic data sets', compared to the rich nature of qualitative research (Ansari et al., 2016). Also, this form of research has been considered as 'thin' abstraction and description (Brekhus et al., 2005).

3.8.3. Qualitative Research:

In contrast to the analysis of quantitative data, qualitative data analysis derives meaning from words and images (Howe, 1988). Sandelowski (2004) believed that qualitative research should generate knowledge grounded from human experience and is often associated with the interpretivism philosophy, because of the subjective nature of the collection of information from socially constructed meanings (Saunders et al., 2007) p. 568. Qualitative research is often seen as a holistic form of analysis, while exploring the similarities and differences associated of various social events (Park & Park, 2016). Here, questions regarding *'why'* and *'how'* phenomena occur are asked to study 'complex human issues' (M. N. Marshall, 1996). Critics have questioned the validity of qualitative research (Silverman, 1993)with some suggesting that qualitative research is relatively non-scientific (Denzin, 1994) qualitative research can be methodologically rigorous if the researcher is well informed and aware of their ontological and epistemological positionings.

3.8.4. Quantitative vs Qualitative Research:

The two defining methods of research are quantitative and qualitative, although mixed methods approaches exist as a hybrid option incorporating both (Saunders et al., 2007) p. 169. (Bell et al., 2018) An overview of these two types of research approaches is summarised in *Table 3.5.* overleaf, which highlights key comparisons between them (M. N. Marshall, 1996).

Table 3. 5: Methodological underpinnings of quantitative and qualitative research (M. N. Marshall, 1996)

	Quantitative	*Qualitative*
Philosophical foundation	Deductive, Reductionist	Inductive, Holistic
Aim	To test pre-set hypothesis	To explore complex human issues
Study plan	Stepwise, predetermined	Iterative, flexible
Position of researcher	Aims to be detached and objective	Integral part of research process
Assessing quality of outcomes	Direct tests of validity and reliability using statistics	Indirect quality assurance methods of trustworthiness
Measures of utility of results	Generalisability	Transferability

3.8.5. Mixed-Methods Research:

Historically, Bouchard Jr (1976) p.268 suggested that the convergence of findings from two methods "enhance our beliefs that the results are valid and not a methodological artifact". In this regard, Johnson et al. (2007)suggest that *"research is an intellectual and practical synthesis based on qualitative and quantitative research; it is the third methodological or research paradigm (along with qualitative and quantitative research)."*

Adoption of mixed-methods approaches have been growing in popularity in recent years (Johnson et al., 2007) Particularly in innovation studies Hong et al. (2012). Some critics argue that quantitative and qualitative should not be mixed (Howe, 1988). Park and Park (2016) suggest that the combination of quantitative and qualitative methodologies provides a complementary view of phenomena.

3.8.6. Secondary data collection

Secondary data collection is an important aspect of the generation of knowledge on a subject (M. P. Johnston, 2017). However, often when secondary data is analysed through summarised version of data in published papers (Church, 2002) this may only show part of the picture of the data collected (Church, 2002). Extensive research was carried out on Enterprise Zones across Wales and England and data was collected specifically to the PTWEZ to understand what companies were within the zone.

3.9. Pilot Testing

Before the start of the first phase of interviews, pilot testing was carried out on the semi-structured interview. Pilot testing or pilot studies are implemented to support the refinement of the information being shown to the target audience (Van Teijlingen & Hundley, 2001). Issues can arise with pilot studies when they are used as the main source of evidence in papers due to the small sample size, which can often misconstrue the data (Thabane et al., 2010). Van Teijlingen and Hundley (2001) signified the importance of carrying out tests on a small sample size before initiating the main study.

3.10. Data Analysis

This section will address the data analysis approaches used in the thesis, including the approach to qualitative data analysis adopted, the method of data collection, and the sampling technique chosen

3.10.1 Thematic analysis

A thematic analysis approach was taken to analyse data collected during semi-structured interviews, as outlined during *phase two* and *phase three* of the research design. This is a method *"for systematically identifying, organising, and offering insight into patterns of meaning (themes) across a data set"* (Braun & Clarke, 2012). Thematic analysis allows for large data sets to be analysed and was therefore chosen for use in the present study. (Braun & Clarke, 2012) This form of analysis takes an inductive approach (Braun & Clarke, 2012)and followed the steps to thematic analysis outlined below Javadi and Zarea (2016)

During the initial stages of thematic analysis, initial codes are generated from the data, while taking care in making sure all the data is treated equally for analysis (Boyatzis, 1998). As the researcher becomes familiar with the data, codes are created which reflect the data. These are then collated into larger themes (Braun & Clarke, 2012). Following this process, the initial codes and themes are reviewed before finalisation(Braun & Clarke, 2012).This form of analysis is a useful tool to find when theoretical saturation is (Braun & Clarke, 2021). Theoretical saturation describes when no new information codes, or themes can be synthesised from the data (Ekins & Newman, 1970) (*See section 3.13 for Theoretical saturation).*

3.10.2 Content analysis:

Content analysis has dated back to the 18th century and allows researchers to quantify their qualitative research (Berelson, 1952) offering a *"systematic and rigorous"* approach (White & Marsh, 2006). Content analysis adopts a similar approach to thematic analysis, although content analysis is seen to quantify qualitative data (Vaismoradi et al., 2013). This is done through measuring the frequency of different categories and themes (Vaismoradi et al., 2013). Content analysis was therefore undertaken in the present study, with this being supported by thematic analysis approaches during *phase three* of the research design.

3.10.3. Sentiment analysis

Sentiment analysis allows for data to be separated into positive and negative comments or sentiments (Prabowo & Thelwall, 2009). There are a variety of ways to carry out a sentiment, which are through the sentiment of words (Hatzivassiloglou & McKeown, 1997), subjective sentences (Pang & Lee, 2004) and through topics (Nasukawa & Yi, 2003). However, there are limitations due to the complexity of the English language and the subjectivity of deciding if the sentiment is positive or negative (B. Liu & Zhang, 2012).

(Medhat et al., 2014) provide an overview of the sentiment analysis that summarises the steps to appropriately analyse data in this form.

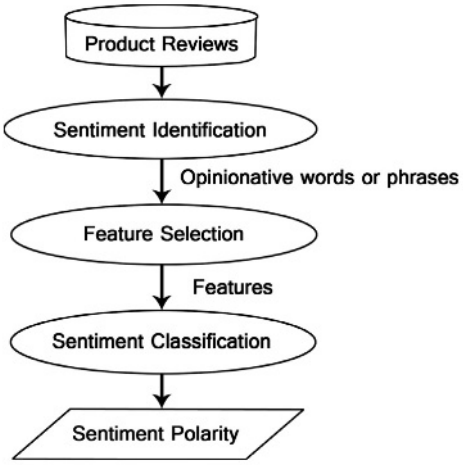


Figure 3. 2 Original model of sentiment analysis process original model (Medhat et al., 2014).

3.10.4. Nvivo Software

All interviews were fully transcribed and then coded using Nvivo software, which is a programme designed to support researchers to conduct qualitative research and offers many advantages for data analysis (Hilal & Alabri, 2013). This allowed for thematic analysis to take place, where main and sub themes were synthesised from the data that supports the approaches of content (White & Marsh, 2006; Vaismoradi et al., 2013) sentiment (Pang & Lee, 2004; B. Liu & Zhang, 2012) and thematic analysis (Braun & Clarke, 2012; Javadi & Zarea, 2016; Braun & Clarke, 2021). Other competitors to Nvivo include Microsoft Power, which provides data cross compatibility on mobile devices, and Tableau Desktop, which provides powerful data visualisation. However, it can be increasingly expensive. Nvivo was chosen because of its ability to perform several types of qualitative data analysis. (Phillips & Lu, 2018), while it is regarded as a powerful software for dealing with large volumes of data and categorising it (Alhojailan, 2012). Finally, Nvivo was chosen due to practicality reasons – with this being the sole software for qualitative analysis that is endorsed by Swansea University.

3.11. Semi-structured interviews:

Semi-structured interviews are considered a critical aspect of qualitative research (Schmidt, 2004) and comprise a technique commonly used by researchers within social sciences (Alsaawi, 2014). According to Saunders et al. (2007), managers are more likely to accept this form of interview, as opposed to a questionnaire or survey. However, this is generally only if the topic interests them and is relevant to their current work. Semi-structured interviews allow for an explorative form of data to be collected through open ended questions for complex problems (Schmidt, 2004), allowing for a richness of data to be collected (Bryman, 2016). However, appropriate consideration of the open-ended questions must be planned beforehand (Dörnyei, 2007). This entails the structuring of themes that will be asked from the literature, but also sets out as an explorative tool to understand more meaning of the question (Saunders et al., 2007).

3.12. Sampling

Sampling is a critical part of the data collection process and the technique employed must be appropriate to fit the research design (Taherdoost, 2016). (M. N. Marshall, 1996) describes three key approaches to qualitative data collection, which are described below.

- *Convenience Sampling* – This involves the least rigorous approach by picking participants that are easily accessible

- *Judgement Sampling* – Also known as *'purposeful sampling,'* this approach involves drawing on a calculated selection of the participants through a developed framework. This allows for the participants selected to have a high chance of answering the research question and research aims

- *Theoretical Sampling* - This type of sampling is carried out with the most amount of rigour and is informed by theory.

3.12.1 Snowball sampling

A further type of sampling is that of *'snowball sampling,'* which is whereby *"A random sample of individuals is drawn from a given finite population"* (Goodman, 1961). This technique is often taken when the target population is difficult to reach due to their seniority and busy work schedule (Brewerton & Millward, 2001).

3.13. Theoretical saturation

Theoretical saturation is considered the concept of constant comparison occurring in the analysis of data and the foundation to grounded theory (Glaser & Strauss, 2017) and should be considered when justifying the sampling of data in various forms of qualitative research (Glaser & Strauss, 2017). It is considered to be the point at which sampling becomes counterproductive because a level of saturation is achieved whereby further sampling would uncover no 'new' insights (Bowen, 2008). Theoretical saturation is also typically discussed in relation to thematic analysis (Braun & Clarke, 2021). However, O'reilly and Parker (2013) argue that the concept of theoretical saturation as a justification for the end of data collection is inappropriate. It is essential that the researcher properly addresses their research position before deciding on how or if they would apply theoretical saturation to their design (Caelli et al., 2003).

3.14. Action Research

Action Research (AR) was a term first used by Lewin in 1946 (Adelman, 1993). Since then, it has been widely referenced in management researcher (Thomas & Tymon Jr, 1982; Robert S Kaplan, 1998; Reason, 2006). This is a process that develops solutions to real life organisational problems through participating and collaborating with relevant key stakeholders (Coghlan, 2019). Saunders et al. (2007) define this according to five key themes: purpose, process, participation, knowledge, and implications.

Despite categorisation into these five key themes, AR is not a simple process as it requires continued support and collaboration with key stakeholders involved (Reason, 2006). Following concerns regarding the rigour of AR in Academic settings (Thomas & Tymon Jr, 1982), it has become an established method for Academic practice. This is depicted by Robert S. Kaplan (1998) in *figure 3.3* overleaf, which shows as the cycle of Innovation Action Research. This starts off with the '*base case'* to understand organisational context. From there, a cyclical approach is taken and throughout the process, more understanding is made that will lead to advanced implementation.

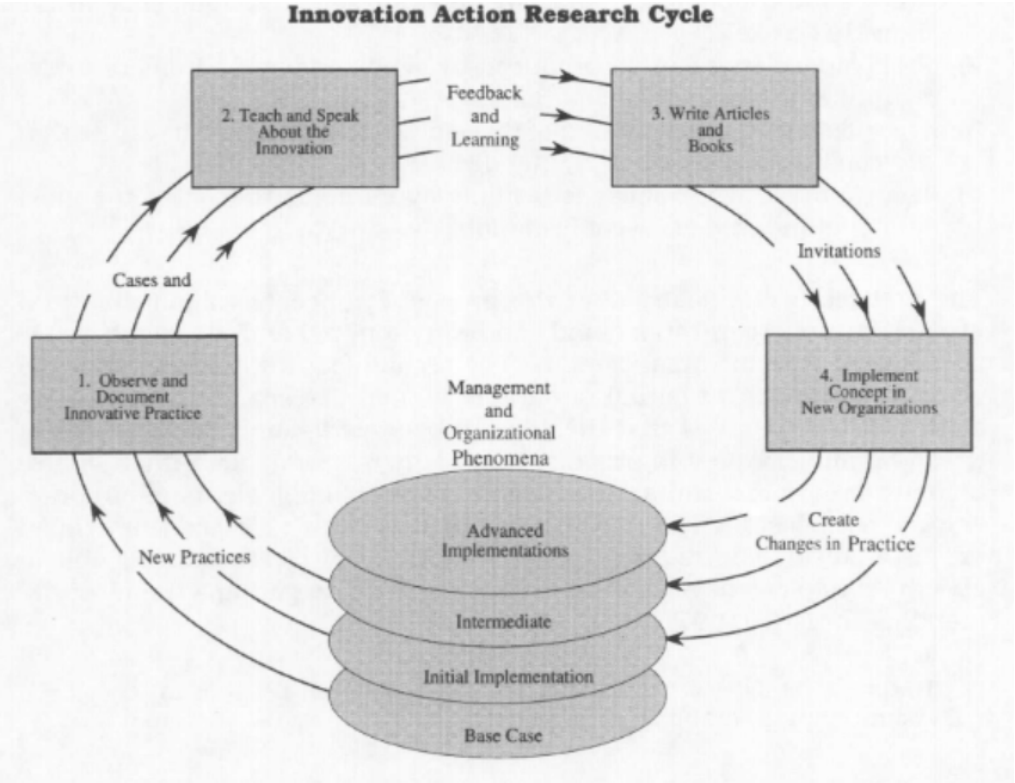


Figure 3. 3 Innovation Action Research Cycle (Original model) (Robert S. Kaplan, 1998).

AR has been used in organisational contexts to solve complex issues (Canterino et al., 2018). Furthermore, this form of analysis has helped to uncover and solve 'tacit' problems, through developing processes and practices in complexed organisational contexts (Ollila & Yström, 2020), while examples have given a contextual analysis of the university-Industry analysis (Guertler et al., 2020; Ollila & Yström, 2020).

3.15. Research Design:

The research design has thus taken an Action Research methodology that follows a phased approach for this thesis (Robert S Kaplan, 1998). An exploratory approach was started because of the complex nature of the research question and how context specific this is. Saunders et al. (2007) suggest that this process would clarify one's understanding of an issue, which can be done through a variety of ways, such as unstructured interviews with key actors within this context. However, a semi-structured interview style was utilised as an approach to qualitative data collection. This is further detailed in *table 3.6.* below, which provides an overview of the research design and outlines the four phases undertaken.

Table 3. 6: Summarises the research objectives and questions achieved in relation to the research phases.

Phases	Research Objective answered	Research question and aims answered
Phase One: Literature review, key themes, conceptual model	Identify key factors that impact KT&TT through the literature review and data collection cycles Development of a reference model and how it relates to this context	Q: "What are the drivers and barriers for knowledge and technology transfer within the context of the Port Talbot Waterfront Enterprise Zone?" Map the factors that impact KT&TT activities in the region
Phase Two: First phase of data collection	Identify key factors that impact KT&TT through the literature review and data collection cycles	Q: "What are the drivers and barriers for knowledge and technology transfer within the context of the Port Talbot Waterfront Enterprise Zone?" Map the factors that impact KT&TT activities in the region Develop tools/initiatives that can be developed to

		support KT&TT activities in the region
Phase Three: Second phase of data collection	Identify key factors that impact KT&TT through the literature review and data collection cycles Implement themes synthesised from key stakeholder within the innovation system	To understand how the PTWEZ can positively impact on innovation activities in the region Develop tools/initiatives that can support KT&TT activities in the region
Phase Four: Refinement and implementation of models	Development of a reference model and how it relates to South West Wales Implement recommendations to support different innovation contexts in their KT&TT activities.	Q: "What are the drivers and barriers for knowledge and technology transfer within the context of the Port Talbot Waterfront Enterprise Zone?"

3.15.1. Phase One: Literature review, key themes, conceptual model

Phase one of the research design was an exploratory phase to understand the innovation system in South West Wales, while delving into the topics of KT, TT, Open Innovation, etc. which are detailed in the literature review *(Chapter two).* This first phase sets out to answer the research objective, which is to "Identify key factors that impact KT&TT through the literature review and data collection cycles". This stage reflects the 'base case' described by (Robert S Kaplan, 1998).

The topic areas were researched through various online databases (Ifind, Google scholar, EBCSO etc.). Key phrases were used to refine the search results, while Chartered Association of Business Schools (CABS), Academic Journal guide (AJG) was used to validate the credibility of the articles referenced in the literature review. Key themes were identified from the KT&TT literature that supported the design of the questions used in phase two of the data collection *(see section 3.2 & 3.3).*

To support the research question and design, two conceptual models were drawn upon – including the RIS model designed by Trippl and Tödtling (2007) and the Triple Helix Model

(Leydesdorff & Etzkowitz, 1998). This sets out to achieve the research objective regarding the “Development of a reference model and how it relates to South West Wales”. Following completion of this phase, the second phase commenced, which sets out the research design as presented below.

3.15.2. Phase two: First phase data collection

Phase two began with semi-structured interviews with key stakeholders from the fields of Academia, Industry, and Government (Leydesdorff & Etzkowitz, 1998). The interview questions were informed by the aforementioned literature review, which primarily aimed to gather more information where gaps in the research occurred. The questions posed were drawn from the themes identified in the literature review. They were presented in a neutral manner to avoid any bias response and opening nature to support the expansion of answers. The objectives under investigation during the interviews were framed around the mapping of the RIS to further understand the relationships between these stakeholders. Finally, this set to answer how Government fund initiatives, such as the PTWEZ, may impact on the KT&TT activities. This allowed for data to be gathered on the drivers and barriers for KT&TT to occur within the context of South West Wales. Finally, this gave an opportunity to gather data on PTWEZ and their influence around this subject area.

An introductory email was sent to participants to highlight the research and provide material to supplement the interview questions. A consent form was attached to this so that they may agree of the interview being recorded and transcribed. This was in accordance with Swansea University's ethics policy, which is detailed in Appendix 3.1.

Initial piloting allowed for refinement of the interview and questions. Upon reflection of these initial interviews, some of the questions were adapted to gain deeper insights from participants on topics of interest. An example of a question that was added to the topic guide following the pilot testing was “What further steps could the Enterprise Zone undertake to attract and retain opportunities from your area of business?”. This directed the conversation towards the PTWEZ, which was an initiative that was not previously mentioned by participants when interviewed during the pilot testing stage. The amendment was introduced to the main study.

The sampling for the interviews was purposeful (M. N. Marshall, 1996) to fit the conceptual model of the Triple Helix Model (Leydesdorff & Etzkowitz, 1998). Once key stakeholders were identified, contacted (via email) and interviewed, one final question was asked, with that being whether they knew of any appropriate stakeholders who would consent to be interviewed on the topic. Thus, snowball sampling proceeded (Goodman, 1961).

The aim for this research design was to carry out two phases of data collection to achieve the research objectives of *"Identify the key factors that impact KT&TT through the literature review and data collection cycles".* The interviews were carried out either in person or virtually, depending on the location of the participant. A total of ten questions were asked of participants, with these starting broad, going from open, explorative questions to more specific closed questions as the interview proceeded, with the latter being informed by the literature *(see appendix 3.3).* The duration of the interviews ranged from 15 minutes to 90 minutes. All interviews were recorded, transcribed and then coded using Nvivo software. A total of 32 interviews were conducted, with eleven of these being with stakeholders from Academia, nine from Government and twelve from Industry partners. At this point, theoretical saturation was reached. Themes were generated using thematic analysis. Sentiment analysis was also undertaken, which indicated whether the themes were positive, negative, or neutral. However, because of the complexity of the answers, this method of analysis was subsequently disregarded. Content analysis was then carried out to quantify the number of times each theme was referenced per interview, which provided a percentage of times the theme was mentioned and an average per theme.

During this phase, a case study paper titled "Knowledge and Technology Transfer in the Port Talbot Waterfront Enterprise Zone" was written and presented at ECIE21. This allowed for immediate feedback from a blind peer review as well as from the audience to which it was presented, which aided in the refinement of the themes and recommendations. In addition, presentations were held with the sponsors PTWEZ and Swansea University's TTO, AgorIP. The discussions opened up a new theme and agenda for the UK Government of 'Freeports,' which will be raised in the second round of data collection.

This resulted in the PTWEZ incorporating the insight of the initial cycle, into its forward plan. A focus on regional strengths and an acknowledgment of challenges working with academic structures, were key features that reflected the other elements of change of practice. Greater collaboration with local universities through AgorIP and city deal projects became an emphasis of the next cycle.

3.15.3 Phase three: Second phase data collection

Following the completion of the first round of interviews, *Phase three* was initiated by the feedback provided to key stakeholders within the RIS of South West Wales. The synthesised themes were derived from the first phase of data collection and refined further in the second phase of data collection This set out to achieve the research objective *"Implement themes synthesised to key stakeholders within the innovation system".* Following these meetings, further themes were identified from the feedback that supported the development of the second round of interviews. This set out to further support the research objective to *"Identify the key factors that impact KT&TT".* The interview schedule hereby included closed questions, as this was deemed necessary to validate the themes synthesised from the first round of interviews (*see appendix 3.4 for further information)*.

The participant pool comprised of a mixture of previous interview candidates and new candidates. However, all participants were considered to be key stakeholders within the context of the PTWEZ and from fields within Academia, Industry, and/or Government (Leydesdorff & Etzkowitz, 1998). Purposive sampling was used for this phase to interview those with the most experience. Snowball sampling was not required due to the contacts established during the first two phases of the research design. The key themes synthesised were re-visited in greater depth, with enhanced understanding and exploration around solutions undertaken. A total of eleven interviews were conducted during this phase, which included interviews with two stakeholders from Academia, four from Government and five from Industry. At this point, theoretical saturation was considered to be achieved. The same methods were used from the first phase for the collection and analysis of the interviews.

A second case study paper titled "*The 'Freeport' dilemma in the Regional Innovation System of South West Wales"* was peer reviewed and presented at the ECIE21 for further refinement and insights of 'Freeports'. This allowed for further dissemination with key stakeholders to discuss freeports feasibility in South West Wales.

3.15.4. Phase four: Refinement and implementation of final model

After completion of the two rounds of interviews, the data gathered was deemed adequate for refinement of the conceptual models and for answering the main research question described in section 3.2. This concluded with a presentation of the final form of the RIS (Trippl & Tödtling, 2007) in relation to the Triple Helix Model (Leydesdorff & Etzkowitz, 1998). The recommendations provided supported the extension of the PTWEZ for a further year, with key insights disseminated to the PTWEZ board to maximise their ability to support in KT&TT activities. The PTWEZ stakeholders were also informed of the results of the Freeport paper in order to assist them in making judgments regarding whether to move forward with a prospective Freeport bid. Additionally, the findings influenced AgorIP's capacity at Swansea University by enhancing their visibility and offering new insights to help them become sustainable in subsequent iterations of the TTO. This finalises the last cycle of the AR approach. The road map for the thesis is described below.

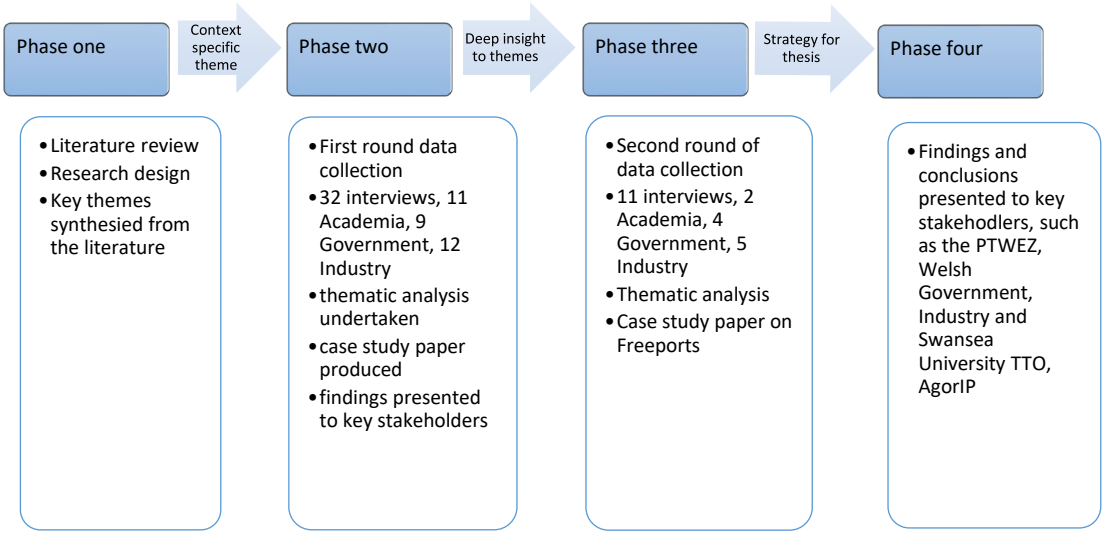


Figure 3. 4 Research design road map

3.16. Research Ethics

Research ethics received approval in line with the Economic Social Research Council (ESRC) framework for Research Ethics (see (ESRC, 2015)). The completed documentation for approval is attached in *Appendix 3.1.* The ethics form addresses the six key principles, which are:

- Quality and Integrity
- Informed Consent
- Respondent Confidentiality and Anonymity
- Voluntary Participation
- Avoid Harm to Participants
- Show Research us independent and Impartial

Participants engaged in the research on a voluntary basis and had the opportunity to withdraw at any stage during the research study.. Transcriptions were available to participants for member-checking and approval, with all data anonymised and held on secure encrypted platforms for analysis, as per the ethics form (*see Appendix 3.1).*

3.17. Chapter Conclusion

Chapter three has given an overview of methodological approach taken throughout the research study. This involved using a qualitative, Action Research approach to data collection, with the support of secondary data to further inform the findings. The ontological stance underpinning these methods is objective and pragmatic - observing and measuring reality objectively. Not having an explicit hypothesis in the inductive paradigm favours the pragmatic approach. This is fitting with the technique of conducting interviews to gather data for the key research question and study aims and objectives. The following chapter describes the findings from the two phases of data collection and interviews carried out.

4. Findings

4.1. Introduction

This chapter sets out to discuss the findings from the data collection carried out from this thesis. The following sections are made up of two rounds of findings, with each section categorised according to Industry, Academia, or Government. This framework is in line with the conceptual Triple Helix Model (Leydesdorff & Etzkowitz, 1998). Key themes will then be highlighted from the thematic and content analysis used and discussed. This will be followed by an overall analysis comparing the three stakeholder groups (Trippl & Tödtling, 2007). A total of four phases of research will be carried out, which will be shown below in *figure 4.1.*

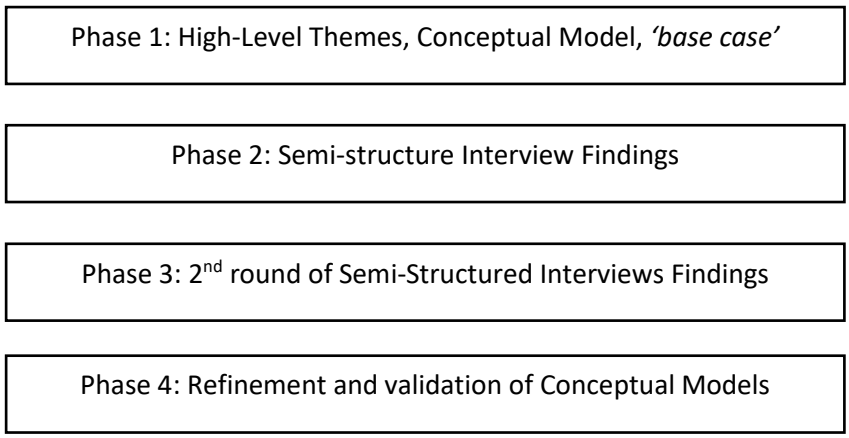


Figure 4. 1 Chapter four Structure

4.2. Phase one: Literature Review

Phase one builds upon the literature review and the themes concluded and the conceptual model discussed in *chapter two (figure 2.25 & 2.27).* Key themes identified from the literature review are shown in *figure 4.2.* They were identified because of their ability to answer the main research question and to validate the conceptual model of RIS (Trippl & Tödtling, 2007), while using the Triple Helix Model (Leydesdorff & Etzkowitz, 1998). RIS was used to identify how the key themes affect the context of South West Wales, while the Triple Helix Model was used as a framework tool for the interviews in Phase *two* and *three,* and to explore how they may interact with one another.

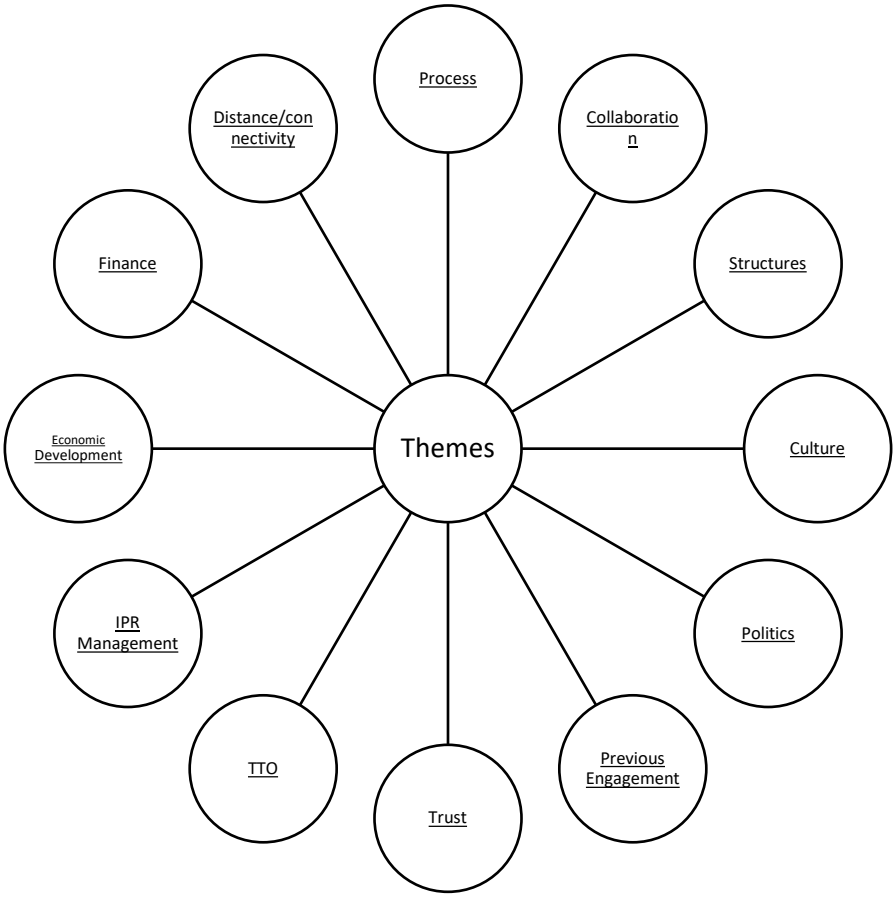


Figure 4. 2 *Key themes from Literature review*

The themes formed from the literature are the basis of the phase two primary research activity as described in the next section and set to answer research aims in *section 5.4.*

4.3. Phase two: Findings

The second phase, which were the interviews, comprised of 32 participants, including stakeholders from Industry (11), Academia (10), and Government (11). Purposeful sampling identified target participants that had experience of working on KT&TT activities and were active in innovation and in the RIS of South West Wales. This was followed by snowball sampling that aimed to get interviewees to identify participants that would best answer the interview carried out. Participants were often from senior positions, which arguably allowed them to provide more rounded answers. For a robust analysis, participants were also identified who held fewer senior positions to provide insights from both spectrums of the role hierarchy. Examples of participants identified were key stakeholders from WG PTWEZ, Swansea University, and Cardiff University.

This set out to be an explorative and explanatory form of interview, through a variety of questions set out from the literature review. The explorative part of the interview then looked at examples of KT occurring, where candidates then spoke about drivers and barriers to their examples. This allowed for data to be collected on specific examples, where themes were synthesised from this for each of the three key stakeholders.

4.3.1. Content analysis

A content analysis was incorporated throughout phase two and three of the findings. This provided a quantitative viewpoint to support the qualitative analysis, with information such as the percentage of people who mentioned the theme and the average times referenced by everyone in the different key stakeholders of Academia, Government, and Industry. However, there are limitations to this form of analysis. First, some participants may mention a theme more often than another, which would increase the average. Also, someone may talk about this a theme for a long period, but this may be only categorised as one reference, compared to someone speaking about it briefly, multiple times in an interview. This was resolved by analysing both the average times mentioned and the percentage of participants that discussed the theme, allowing for the most accurate representation of the key themes mentioned. This is shown in *appendices 4.1 – 4.18.*

4.3.2. Academia

Ten Academic participants were interviewed, with stakeholders holding varying roles within different departments. For example, some were heads of their respective departments, while others were lecturers. The specific background also varied from engineering, computational foundry, and other areas within the university who all have vast experience with KT&TT. This allowed for a bottom-up and top-down understanding of the topic in question. Some participants worked within Cardiff University, which is a research-led Russell Group University, while others were Academics from University Wales Trinity St. David (UWTSD), which is teaching-led university.

Definition:

When considering the term KT, the understanding amongst respondents often described TT activities in the same definition. A key aspect of Academic respondents thinking about KT was the link between the lecturer and student. An example of this was described by a Cardiff University lecturer, which would support the model associated with Russell group universities.

"I would say in the most general terms. In that form of words, I would include, you know, the traditional sort of technology transfer work that is done, but I'd also include, you know, whether or not it's the right word to use. But the production inverted commas of all our graduates and master students and post graduates. So knowledge transfer via walking legs." A10

There was also an appreciation of the TT&KT activities occurring between HEI and Industry. Here, an impact engagement officer from Swansea University stated:

"It means taking really good examples of research and getting them to a stage where we can transfer that to the benefit of Industry." A1

Both quotes demonstrate the complex terms of KT&TT and the various definitions that are attributed to these activities, which is dependent on the context.

Drivers

Drivers of KT & TT activity were broken down into the following subsections for the Academic stakeholder (*See table 4.1*). A content analysis was performed to support the thematic analysis, which supports the mixed methods approach. Linkage strength was calculated from the percentage of respondents that mentioned the theme. These were categorised according to strength, which varied from low (0%-20%), medium (30%-50%) and high (60%+). Table 4.1 below depicts the linkage strength for academic participants' drivers.

Table 4. 1: Linkage strength of Academic Drivers

Drivers	**Linkage strength**
Collaboration	Low
Economic Development	Low
Research	Medium
Technology Transfer Office (TTO)	Low

The overall linkage strength varied between 20-30% of respondents mentioning these drivers, which is relatively low. The themes synthesised from the thematic coding were separated into these categories, which is shown below in Table 4.2. *(See appendix 4.1 for content analysis).*

Table 4. 2: Key themes Academic Drivers

Theme – Description	*Example/s*
Collaboration; just 20% of applicants addressed this subject, averaging 1.5 references each interview. Working collaboratively can help attain the goal more efficiently and for everyone's benefit. A2 participant with Industry and Academic engineering experience underlined this topic.	*"Talking to a group of people and reaching a consensus, you generally get to a solution much more quickly." A2*
Economic Development; An impetus for KT&TT is the economic impact it can have on a region and the overall benefit to all parties involved. Economic relationship strength was 20%, which is weak. Academic participant (A7) noted the benefits to industrial and Academic stakeholders.	*"Ultimately pass on those benefits to consumers and to other Industry partners and create jobs and create wealth and increase productivity." A7*

Research; 50% of individuals mentioned 'Research' as a driver for Academics. This can further develop and test the research in real-life circumstances, according to a UWTSD professor (A4). These activities are vital to universities' overall goals. A Swansea University professor (A9) explained the benefits of the university's consultancy policy. Consultancy policy allows Academics to work with Industry while employed.	*"knowledge has enabled us to…Taken that further into other aspects of their own research and practice.* *"We have a well-defined consultancy policy that encourages this kind of knowledge exchange and transfer because it's good for both parties have done that." A9*
TTO; 20% of Academic participants cited Swansea's TTO as a KT&TT benefit. A participant at Cardiff University (A10) described 'AgorIP' as a successful tool. This was supported by a Swansea University stakeholder (A3) describing AgorIP as a success.	*"I think Swansea is actually a pretty good model of trying to get things done and trying to move things ahead." A10* "*In my time in the university… the projects will probably run into. Hundreds, I would've thought." A3*

The factors mentioned here demonstrate that research is the most significant factor for Academic participants (50%). This is not, however, conclusive because no theme had a particularly strong connection amongst the participants. To understand the primary drivers in phase three, more investigation is necessary.

Barriers

Complex problems are bound to incur obstacles, and these were explored in the interviews conducted with stakeholders working within Academia, which is shown in *table 4.3*. The participants' descriptions of obstacles they faced while engaging in KT&TT activities were used to synthesise the themes in an explorative manner, with further analysis conducted and displayed in *appendix 4.2.*

Table 4. 3: Linkage Strength Academic Barriers

Barriers	**Linkage Strength**
Communication	High
Culture	High
Financial	Low
IPR Management	High
Politics	Medium
Structure	High

Table 4.4. sets to expand in the previous *table 4.3* by describing the themes in relation to the data gained from the interviews carried out. This will show the percentage of participants mentioning each theme. See appendix 4.2 for a more detailed view of the content analysis.

Table 4. 4: Key themes Academia Barriers

Theme – Description	Example/s
Communication; 60% of KT&TT applicants mention this on average 2 times. Poor communication affects knowledge transfer and absorption. Academic communication breakdowns can hinder university research. Not explaining the benefits can be harmful (A2). Socially, Academics may communicate less with Industry representatives than others (A7).	*"Restrictions around what knowledge can be transferred depending on, uh, the transmitter and the recipient of the knowledge" A2* *"But if we're not communicating what the benefits of that are to who and when and making that a reality. So, I think we don't do a good enough job of maximising the impact of that research" A7*
Culture; This was a highly topical issue, expressing a potential for a "clash of cultures," with 60% of participants mentioning culture. This can lead to a different pace for KT&TT activities (A3), which must be understood during early encounters. The statement overlaps Academic structural difficulties. Time zone and language constraints can also affect how stakeholders communicate. This is a complicated subject (A7).	*"So, there's there's a clash of culture then in terms of pace sometimes." A3* *"there's a language barrier and a time difference barrier on a geography barrier." A7*
Finance; 20% linkage strength, 'finance' was mentioned the most, 2.5 times, of all the impediments. When negotiating IP and licencing with Industry stakeholders, universities sometimes overestimate their IP's value. This can harm their relationship with their industrial partner and discourage future collaboration. Swansea University engineering professor raised this concern (A11). A Cardiff University (A12) Academic noted that Wales may not receive as much funding to assist KT&TT initiatives as England.	*"University has to decide whether it wants to try and make money, or whether it wants to try and make a difference" A11* *"Yeah, it's just quite difficult to the university sector at the moment is financially challenged in Wales." A10*
IPR management; was mentioned by 70% of participants. Multiple stakeholders might lead to	*"Who owns the IP? What background IP is each partner*

legal complications, which can slow down the process. Also, IP can vary greatly between examples, adding to the complexity (A3). It's a hurdle, but it's necessary to protect the university's knowledge by helping Academics harness it (A1). A key Swansea University stakeholder (A6) indicated that institutions overvalue their IP, which demotivates Industry to engage with them.	*bringing to the to the relationship? The right rights around foreground, IP royalties and kind of what happens with the money when you make any money from it. So that can be an obstacle occasionally. So, we want to get it. But that's part of the business negotiation" A3* *"And Academics, particularly, I feel, get quite worried when you talk about intellectual property and anything. That's it that comes from that research." A1* *"unfortunately, most universities and most entities have an unrealistic expectation of what that value is" A6*
Politics; 20% of Academics mentioned politics. A10 from Cardiff University noted it in regard to Swansea's political concerns. A Swansea University participant (A7) supported this but didn't elaborate.	*"You know, the events that have unfolded in the last 12 months. I think I would be very surprised if they didn't have some impact." A10* *"Politics, networks, people's personal and what's the word, selfish kind drivers quite often are some of the biggest barriers" A7*
Structure; 90% of Academic applicants mentioned structure as the most important topic. We'll discuss different viewpoints on structure. Academics are sometimes viewed as more complex than Industry, which can affect the universities' capacity to perform KT&TT (A2). This is due to Academics' rigorous workload and teaching responsibilities. Delay in responding to market needs can diminish competitiveness. A Swansea University participant suggested there were not the right structures in place to protect Academics' IP (A1). Academics suggested that performing KT&TT activities hinders them from being promoted compared to writing papers. The Academics felt they could collaborate more. Universities can be tough to traverse to have these tasks done in accordance with Industry, too (A7). This also pertains to Academic workload, which might effect Industry structure (A10).	*"I think universities are far more complex than the Industry is in that respect…. taking the credit for the idea is very, very important to an Academic" A2* *"Knowledge that they have spent years and years and years developing going to be taken if the right structures aren't put in place for it to be protected." A1* "Universities are slow, and they are too complicated and they don't know where the access points are." A7 *"Structural barriers everywhere really in terms of workload." A10*

The fact that the barriers highlighted ranged in linkage strength from high to low indicates that participants were more in agreement with the hurdles that affect KT&TT, with Academic participants' most-discussed subject being 'Structure' (90%). According to some, universities are more complicated than their counterparts in business. IPR management was cited as a major impediment by 70% of respondents, with IP procedures being particularly complicated. Other important aspects included 'Communication' (60%) and 'Culture' (60%). Additionally, 'Politics' (20%), along with 'University Structure' and 'IPR Management', were a singular discovery that was brought up a few times and will be expanded upon in phase three.

Previous Engagement

Previous Engagement was a theme highlighted from the literature review and was directly asked to all participants. Table 4.5 below expands on the theme in relation to the data collected.

Table 4. 5: Previous Engagement from Academic participants

Theme – Description	Example/s
Previous Engagement; The literature review identified "Previous Engagement" as a prominent theme, and Academic replies on this theme all agreed that previous engagement has an impact on future connections. However, whether the initial encounter was fruitful still varies (A1). The topic of trust was then brought up throughout these responses; if a connection is effective, trust typically develops after the initial one. However, developing a relationship based on trust is a lengthy process that requires commitment from both parties to be effective (A5).	*"Yes, absolutely. Yes. If you build a really good relationship from day one and whatever your research project or your knowledge is of interest to that company going forward, they are more likely to trust you. They are more likely to want to re-engage with you to do additional work." A1* *"Oh absolutely, I mean every; relationships is a long process, it's a long winding process, people do business with people and so every interaction you have is building towards that relationship." A5*

There was an overwhelming agreement of the importance of '*Previous Engagement*' for KT&TT activities to be more successful. Also, '*Trust'* has a significant part to play with '*Previous Engagement,'* highlighting that these relationships take time to be built.

Trust

'*Trust'* was a significant theme found in the literature and was questioned to all Academic interviewees. *Table 4.6* sets to expand on this theme and how the participants found '*Trust'* affected KT&TT activities.

Table 4. 6: Trust from Academic participants

Theme – Description	Example/s
Trust; was a theme highlighted in the literature review and was directly asked in the interviews. The forming of partnerships depended heavily on trust. It's critical that trust be established early on in a relationship. When a relationship first begins, this can be created by achieving the goals that were initially agreed (A1). By settling on a shared objective, you can show respect for the person you are building a relationship with. It all boils down to whose employee you trust among these large organisations (A9).	*"I think it's really important when you are talking about building a new connection that you can trust." A1* *"a trust relation isn't with a company or organisation uses with teams of people." A9*

Academic participants believed '*Trust'* was significant to KT&TT activities and comprised an essential aspect in the early stages of a relationship. It was also suggested that '*Trust'* is built between the individual, and not the organisation.

Distance/connectivity

'*Distance*/*Connectivity'* was the final theme asked of, with this being salient within the literature. Below *table 4.7* shows the linkage strength of the three sub-themes found from *'Distance/Connectivity'* and how this impacts KT&TT activities. Further content analysis is shown in *appendix 4.3*

Table 4. 7: Linkage strength for Academic, Distance/Connectivity

Distance/ connectivity	**Linkage strength**
Proximity	High
Relationship	Medium
Technology	Medium

The linkage strengths shown below, found three sub themes that were all discussed by participants, with '*Proximity'* being the most agreed between Academic participants. Table 4.8. sets to expand on these sub-themes in detail and highlight the data.

Table 4. 8: Distance/connectivity themes expanded for Academic participants

Description	Example/s
Technology; was regarded as a theme that can break down the barrier of distance. Some respondents contended that if the relationship is strong enough, it doesn't matter as much. Communication has become less of a barrier as a result of technological improvements. A representative of AgorIP brought up this (A3).	*"I think in you know, in the you know, currently where we are with technology, I don't think distance geographically is is (sic) an issue." A3*
Proximity; The agglomeration of businesses through the formation of complementary Industry clusters was the subject of the opposing argument. A stakeholder working in SPECIFIC brought up a point that if people are brought together in an innovation hub, there can be many benefits (A7). There is still the idea that having face-to-face interactions provides advantages, such as more efficient ways to conduct KT and TT activities. An Academic in the Life Sciences Hub brought this up (A8)	*"So, I think for me that that connectivity piece is massive. If you can bring people together physically in a hub, you know, in the innovation space, that's where what happens is that if you don't, you can't plan innovation." A7* *"But if you're trying to catalyse it and get it started, it's easier to do close by, which is an argument for co-locating Industry, Academia and the NHS in our case." A8*
Relationship; Considering how strong the relationship is, is crucial when analysing the consequences of distance. According to a Swansea University student, the strength will determine how significant distance is as a barrier (A1).	*"I think that purely you've got to take that on a case-by-case basis. That's got to be assessed on the level of connection that you have felt with the partner, whether it be the Academic to the Industry or vice versa…. If that connection is strong enough, distance largely won't matter." A1*

Being in '*proximity'* of one another was seen as critical to the success of KT&TT activities. However, '*technology'* was seen to minimise the barrier of distance affecting KT&TT activities. Also, '*relationships'* comprised a factor with great potential to minimise the impact of distance.

Mitigating barriers

Academic participants were not agreed on how to reduce or mitigate the barriers described. However, they did allude to the solution on average more frequently that suggests that one solution may solve multiple barriers *(see appendix 4.4).* The linkage strength of the themes found from the thematic analysis is presented in *table 4.9* below.

Table 4. 9: Linkage strength for Mitigating barriers identified by Academic participants

Mitigate barriers	**Linkage strength**
Cluster	Low
Collaboration	Medium
Communication	Low
Financial	Medium
IPR Management	Medium
Structure	Medium

Table 4.10 below sets to expand on the themes highlighted above with reference to the data gathered from Academic participants. *See appendix 4.4* for further content analysis of the themes for mitigating barriers.

Table 4. 10: Mitigating Barriers expanded for Academic participants

Description	Example/s
Cluster; The development of cluster in and around Swansea will solve some barriers mentioned above, such as the distance and connectivity dilemma. However, only 10% mentioned this as a solution. This would provide benefits to industries situated there and the universities by having those available connections nearby. Because of the complexities associated with KT&TT activities, some suggest increasing these interactions to further develop the collaboration between key actors of Government and Industry. This is important to understand the key stakeholders within the region that will benefit one another.	*"My passion would be to get a number of clusters very near to the university because then I think you get the benefits of people just walking in or meeting up." A9* *"For any company or research project is to look at where your key stakeholders are and make sure you maintain the relationships because it's too easy to take for granted" A7*
Collaboration; had a medium level of discussion from participants to mitigate barriers (30%), through collaboration between the university and Industry, can increase the chances of a successful relationship to	*"So, a lot of the activity we've been doing has been trying to find the right companies with the right problems that can*

form and be sustained.	*actually do something about it" A7*
Communication; 20% of applicants suggested, is a solution to mitigate barriers. This is done through properly discussing what the individuals want to get out of the relationship by setting aims and objectives with shared goals (A2). Other protocols, such as a single point of contact and maintaining expectations are important factors in the relationship, so they are not disappointed when the relationship or activity ends (A4).	*"Um, discussing things through properly before contracts are signed. And sometimes in the end you find this when you you (sic) know, you start work." A2* *"The key thing is having good communication and having a single point of contact so that things don't get lost in translation. Then it's about being very clear about expectations because especially when you if it's if it's more pure research involved" A4*
Finance; can be a factor to help improve these processes (30%), through various schemes and co-investment from Government and Industry. Where a Swansea University stakeholder was quoted suggesting this idea.	*"I think where this co-investment from Government, co-investment from Industry and there's an expectation and Academia to put a contribution as well. So, knowledge transfer partnership" A3*
IPR Management; had a reference average of 1.5 times and received 40% of the mentions. T Two solutions were offered. First, establish protocols so you can give away IP, which will raise the IP's commercialization possibility and strengthen future stakeholder connections (A6). The other answer is to promote communication and transparency amongst Industry stakeholders. A Swansea University IP negotiator said this (A3).	*"Either allowing faculty if it's a spin off type thing, umm but have the simplest protocols for doing that, umm and if its companies, you will actually make more money in the long run by essentially giving way the IP, then you will by trying to negotiate some deal" A6* *"On IP. Well, it's just been very clear from from (sic) the beginning of the negotiations about what each party wants and opposing the end. That's compromise" A3*
Structure; was a theme brought up by 30% of the participants to reduce the hurdles indicated, which can	*"Mainly by setting up research teams or knowledge transfer*

be done by creating separate companies to quicken KT&TT processes. For Academia, this will essentially streamline the procedure. A USP is one protocol that should be in place so that Industry is aware of your goals and objectives from the start of the partnership.	*teams which are semi-independent of the Academic body" A4* *"I think we could be really clear on what the proposition is, what the USP is, what we're offering to do and why it's necessary." A7*

'IPR Management' was the most frequently mentioned theme among Academic participants, with 40% suggesting it to mitigate barriers. Other important topics derived from the interviews included *'Structure'* (30%), *'Collaboration'* (30%), and *'Financial'* (30%), all of which will be addressed further in phase three.

How can PTWEZ impact KT&TT

This section sets to identify themes regarding the impact PTWEZ can have on KT&TT activities in South West Wales. Generally, there was a lower rate of discussion across these themes, however, more themes and solutions were identified. Linkage strength is shown in *Table 4.11.*

Table 4. 11: Linkage strength for PTWEZ impact, Academic participants

PTWEZ Impact	Linkage Strength
Cluster	Medium
Communication	Low
Financial	Low
Infrastructure	Low
International	Low
Sustainability	Low
Collaboration	Low

A total of seven themes were found from the interviews carried out. The only theme that had achieved a level higher than low linkage was '*clusters.' Table 4.12* overleaf sets to expand on all the themes found and give refence to the data collected.

Table 4. 12: Themes Expanded for PTWEZ Impact, Academic participants

Description	Example/s
Cluster; A key theme highlighted was the EZs ability to form 'clusters' by working out industries of strength by getting the correct business to move in the region that was raised by a stakeholder from Swansea University based in the Engineering (A2). With support from Cardiff University Engineering department (A1). This had the highest average reference per person of four, with 30% mentioning this. There was an example of a potential cluster in minimising excess amounts of low-grade waste heat that could be an opportunity for businesses to harness that waste and turn it into energy.	*"We need to encourage businesses within the UK to either grow or me relocate to an area…. Well, actually, it's a simpler way of describing this clustering." A2* *"Look at the goals for the Welsh Government, look a bit like bringing in business that is actually going to make a difference to the locality." A1* *"And so, if you look at the proximity of the enterprise zone to Tata, for example, um, there's huge amounts of low-grade waste heat on the Port talbot site by low grade." A2*
Communication; In order to achieve the relevant goals, the PTWEZ has set, they need to improve their communication with key stakeholders in the region. This point was mentioned by Academic stakeholder in SPECIFIC (A7) due to them not being as aware of the strategy for the PTWEZ have criticised them by not know their aims, objectives and USP.	*So, is the one in Port Talbot really essentially about saving the manufacturing environment and Tata Steel, or is it for whichever of the local authorities are actually driving it? If it can't do everything for everyone and I think there needs to be a lot more transparency about what it's actually intended to do for who. And, you know, that's not going to please everyone, but at least if it has a clear focus." A7*
Financial; This was a brief theme mentioned by one individual, but they suggested the need for financial benefits associated within the PTWEZ.	*"I think there's gonna to be tangible financial benefits." A7*
Infrastructure; 20% of interviewers cited this as a factor to address. This is a key driver for companies to locate in a location, and if the infrastructures are in place, the company will likely stay. Statements have been made that corporations will only migrate to an EZ to take benefit of financial programmes and will move once they end.	*"Basics that companies look for from an investment perspective is access skills, access, logistics, transport, infrastructure. So, again, you know, if Enterprise Zone were focussing on, you know, making sure we had the electrification, me and she'll get Metro in place. So, there's some basic building blocks." A7*
International trade; (10%) was mentioned as a solution to maximise KT&TT activities in the	*"Have business that is able to export, not just work locally as well. Because*

region and globally. This was highlighted by a Swansea University employee who had experience working in KT partnerships (A1).	*I think there's a big driver for Welsh Government to have an increase in our exportation. After Brexit, this type of stuff. So, if there was industries that could be potential exporters to the world, great. I think that would potentially benefit the enterprise zone." A1*
Sustainability; (20%) was synthesised as a solution for the PTWEZ and how they can support the objectives set out by UK Government. A stakeholder within Swansea University with experience in Industry mentioned the sustainability aims and objectives (A7). This was also supported by an experienced Academic from Cardiff University (A10) to support the previous statement.	*"The sustainability goals are jumpstarting, passionate about being involved in this project." A7* *"Port Talbot enterprise zone was, you know, totally, you know, zero 2050" A10*
Collaboration; Findings from Academic participants suggested the need for collaboration between the PTWEZ and Academic stakeholders, to help with KT&TT activities, where an Academic stakeholder involved with collaborating with Industry was quoted saying:	*"And having that strong link to the Academic presence" A7*

'*Clusters'* was seen to be the biggest impact for the PTWEZ to develop to improve on KT&TT activities, while there was only a '*medium'* linkage from participants (30%), there was an average of three references per person who spoke of '*clusters'* (*See appendix 4.5).* How PTWEZ can impact upon KT&TT activities is addressed further in *phase three*.

4.3.3. Government

Ten Government representatives were interviewed as part of the initial phase of data gathering. This was different from Swansea and Cardiff's local and regional councils. The participants' experiences with KT&TT exercises provided a wide range of perspectives. This part intends to follow the same format as the Academic section.

Definition

When Government officials were asked to define the term 'KT,' they often described it alongside 'TT', although some provided interchangeable definitions while others described the difference between the two. The most appropriate definition for this context is presented below.

"You look at knowledge transfer, the Industry, I think would promote it, call it application. And primarily, although it's not restricted to two to a one-way relationship of primarily knowledge transfer, is gaining value from the research and understanding built in the Academic base and and (sic) enabling that to have a commercial outcome in Industry. So, a literal transplantation, I guess, of the knowledge and understanding that's developed in the research base into the right organisations who can create commercial gain from that knowledge and understanding and therefore growing economic growth" G5

Drivers

The drivers highlighted from the thematic analysis will be discussed in detail in this section. *Table 4.13* provides an overview of the linkage strength from Government participants.

Table 4. 13: Linkage strengths of Drivers for Government Stakeholders

Drivers	**Linkage Strength**
Collaboration	High
Communication	Low
Economic Development	High
TTO	Low

With only a total of four themes synthesised from the thematic analysis, Government stakeholders were in agreement of what the key drivers are for KT&TT activities to occur. Here, '*Collaboration'* and '*Economic Development*' were found to be the standout drivers. The following table (*table 4.14 overleaf)* sets to expand on the themes mentioned by Government participants.

Table 4. 14: Themes expanded of Drivers by Government participants

Description	Example/s
Collaboration; 60% of participants cite collaboration's benefits. Often, benefits aren't seen until collaboration occurs, proving that strength in numbers helps all parties. A G7 WG officer who works with patent protection emphasised collaboration. An Innovate UK (G2) employee backed this by demonstrating the benefits of collaboration.	*"It's a great example of synergy where neither party could do something on their own, but together they can interest further knowledge there the create something that wouldn't otherwise." G7* *"But we have published study that shows that when we fund the competition, when we have funded collaborative research and development with Innovate mission, if you like, which business let upper TRL stuff, if there is a university partner, there's higher impact. In fact, there's more than one university partner" G2*
Communication; has a low level of discussion (10%), though it was still mentioned as a driver for KT&TT activities. A Cardiff Government official was quoted highlighting communication as a driver.	*"Whether that involves technology or without technology, it's the communication and that's the way it communicated is particularly important." G6*
Economic Development; 70% of participants discussed 'Economic Development'. Cardiff Council can boost the financial gain from university expertise. This will help WG through increased economic gain and sustainable growth. An Innovate UK employee underlined the benefits of Academic knowledge to the Welsh economy.	*"The more knowledge transfer that takes place, the better, because that will hopefully lead to more sustainable employment, more sustainable jobs and better wages and higher skills, higher skills in our communities." G6* *"Gaining commercial value from that knowledge. So absolutely critical for for (sic) the Welsh economy. The UK economy. To foster knowledge exchange between businesses and research base." G5*
TTO; Also had a low discussion point (10%). However, an effective TTO can offer as a driver to support these KT&TT activities to occur, this was echoed by a regional WG official, quoted saying:	*"That was totally different to the typical technology transfer office, which actually wants to work with the Academics to encourage them to win more funding that will come back into the university rather than really commercialise." G10*

Drivers from Government participants indicated that '*Collaboration'* (70%) and '*Economic development'* comprise the key drivers for KT&TT to occur. This is further supported by appendix 4.6, which provides a detailed content analysis regarding the drivers. *Phase three* sets out to further test these findings and explore how they can be improved upon.

Barriers

This section sets to generate an understanding of the themes found from Government stakeholders that comprise barriers to KT&TT activities. An overview of the linkage strengths of the themes mentioned by Government stakeholders is presented in *table 4.15* below.

Table 4. 15: Linkage strength of barriers from Government Stakeholders

Barriers	**Linkage Strength**
Collaboration	Medium
Communication	High
Culture	High
Financial	High
IPR	Medium
Structure	High

Table 4.15 shows that a variety of themes mentioned by Government participants impact KT&TT activities, with four themes having a high linkage, including '*Communication'*, '*Culture'*, '*Financial*', and '*Structure'.* The following table (table 4.16) sets to expand on all themes identified by Government stakeholders.

Table 4. 16: Themes expanded of barriers by Government stakeholders.

Description	Example/s
Collaboration; (30%) It can constitute a hindrance to KT&TT activities if it is not done properly. Knowledge transfer cannot take place if the collaboration is ineffective, according to a Government official who works on commercialization out of institutions. A spokesperson from Innovate UK backed this argument by pointing out that universities don't always provide the same results as business.	*"It's all about collaboration. It's not about us paying them to do a piece of work. That's not what this is about. All of this knowledge transfer and collaboration, commercialisation is about working together. If you don't work together, then you just become a contract researcher." G8*
Communication; 70% of respondents said communication affects KT&TT. A G10 official with expertise dealing with colleges suggested that communication broke down on both sides, showing that neither party is to blame. An Innovate UK representative suggested that a language barrier between Industry and Academia affects KT&TT efforts (G5).	*"And then when the communication breaks down, it's a two-way breakdown of communication." G10* *"I think there is a language challenge to universities and business sometimes." G5*
Culture; An Innovate UK executive noted that cultural differences between Industry and Academia can cause misaligned aspirations and objectives. This can affect future relationships and activity effectiveness. 70% of people mentioned this. A WG official says an "old boy network" culture can hurt equal opportunity. This can develop to sexism, which causes problems and impediments.	*"Academics groups they are working with can be quite difficult because they're not really focussed on the industrial outcome" G2* *"As a woman that I think they're often, there's that one of the barriers can often be the old boy network type of thing" G7* *"Reluctant to share with each other unless they're encountering a common problem like, I don't know, a regulatory barrier." G2*
Financial; Recent funding cuts can hurt KT&TT initiatives, which need a lot of resources. Finance was cited by 80% of responders. Innovate UK employee said this (G5).	*"I don't think the right money is available for knowledge transfer are activities…But the money just doesn't exist to pay the research entities to properly engage with the businesses and the risk is too high on the business side." G5*

Increasing budgets isn't always the answer because it can create more barriers. Cardiff council endorsed this (G6). University and Industry sometimes mistake a linguistic barrier when finance is discussed (G5). An NPTCC official (G1) said it was due to a breakdown in communication about what the institution wants from the relationship.	*"Challenging environment now where they're going to have to go through in terms of budgets and financing. Could help in the process, could also hinder so." G6* *"I think there is a language challenge to universities and business sometimes." G5* *"Imbalance and the lack of clarity in terms of the message that's then communicated." G1*
IPR management; had 30% of the participants discussing this as an issue. A WG official (G7) observed this as a barrier when people do not understand the process or how it should be used properly. Only when proper education and training around the protocols it can be a useful tool for protection of knowledge. This was supported by a relationship manager within WG, quoting the IP issues the universities have (G9). One participant from WG questioned the charitable status of universities and how that can affect their ability to give IP away freely (G7).	"Intellectual property is often a barrier in that people don't understand it and they don't trust it…they think that they just don't understand how to use intellectual property to get what they want. They just think it's a massive wall in front of them, that's stopping them from getting what they want. They don't realise that it's like a ladder gets what you want. If you can understand it." G7 *"Sometimes the universities in Academia can be quite hard to deal with, from a business perspective on how you share the IP" G9* *"They don't like giving things away and they sometimes worry that they have a charitable because of their charitable status" G7*
Structure; 100 percent of interviewees reported structure as a barrier an average of 3.2 times. A WG (G8) participant who works on KT activities said 'bureaucracy' made it difficult to interact with Academia. An Innovate UK (G5) employee said it's tough to find the suitable Academic for the job, which slows down the process and hinders KT&TT activities. Neath Port Talbot County Council (NPTCC) official said it takes too long for Academia to complete KT&TT initiatives to fully benefit from the expertise (G1).	*"The universities, they're a I suppose that they are a bureaucratic nightmare…the Rice Department. Swansea, probably about five or six that I know of they work with. But yet. It's a difficult thing to do. Everybody's got to balance budgets. Everybody's fighting for money. The same pots of money." G8* *"Finding the right Academic can be a challenge" G5* *"unfortunately, the processes sometimes are too long" G1* *"Transition issue between spin outs coming out of the university" G1* *"I think one of the barriers that is probably on our side has been our compliance rules and regulations that have made it very difficult. It's*

This can impede institutions' ability to commercialise research. The issue isn't one-sided. A Research Development manager (G10) noted compliance standards and rules made KT&TT tough for Academia. This can slow the process or harm the parties' relationship.	*caused the big issue at the moment for me is that the university, the engineering department and the science department have dropped out of using smart expertise because of the perceived risks." G10*

Of the barriers discussed by Government officials, '*Structure'* was the most mentioned with 100% of participants raising this point as an issue. Other key themes such as '*Communication'* (70%), '*Financial'* (80%) and '*Culture'* (70%) were mentioned. *Phase three* sets to address the issue of structure in more detail and understand how this issue can be addressed. *See appendix 4.7* for further content analysis.

Previous engagement

Previous Engagement was a theme directly questioned to Government participants. The insights provided are shown overleaf in *table 4.17* that set to expand on this theme to give a detailed account by these participants.

Table 4. 17: Theme expanded on Previous Engagement for Government stakeholders

Theme - Description	Example/s
Previous Engagement; An Innovate UK (G2) official highlighted previous engagement as dependent on if the initial interaction was positive or negative. The first meeting is critical to the future of any relationship, and it is significant for KT&TT activities. This was echoed by a WG (G9) official describing the importance of first impressions.	"It's almost certainly I mean, that's that's (sic) human nature. Yeah…. Good or bad experience will dictate on whether someone is prepared to work with you again." G2 "Previous engagement, if you have delivered what you said you're going to deliver, it's going to be positive isn't it, I think umm we all work within large-scale organisations." G9

The findings show that the perceived importance of 'Previous Engagement' was unanimous amongst Government participants and that first impressions with a potential individual are essential to the successful development of KT&TT activities. Here, a bad experience will equally have a negative effect, showing how important 'Previous Engagement' is.

Distance/Connectivity

'*Distance/Connectivity'* was another theme found to be a critical element to KT&TT activities where participants were directly asked about this subject and how it impacts KT&TT. *Table 4.18* sets out the linkage strengths of 'Distance/Connectivity' of the sub-themes found.

Table 4. 18: Linkage strength of Distance/Connectivity for Government participants.

Distance	**Linkage strength**
Proximity	Very High
Technology	High

Proximity and technology were both critical themes raised by Government participants. *Table 4.19* sets to expand on the themes that were raised by the participants. See *Appendix 4.8* for further content analysis of distance/connectivity for Government participants.

Table 4. 19: Distance/Connectivity themes discussed by Government participants

Theme - Description	Theme
Proximity; There was consensus among Government stakeholders regarding the advantages of proximity and in-person interaction for maximising KT&TT and innovation efforts. A Government person with knowledge of IP management brought this up (G7) An employee at Innovate UK agreed with this (G9).	*"My Job is based in London for the Welsh Government. And the reason I'm in London is because there is an element of actually being there, of actually having to make. My job is engagements and engagement." G7* *"Innovation is a contact sport." G5*
Technology; However, there has been some argument that the advancement of technology has increased the distance between persons, making it less of a barrier if they are not as close. Though this is when a relationship is developed, and trust is established beforehand. This was raised by a regional WG authority (G9).	*"I think technology will allow that to widen, in terms of the geographical distance, but you still always need that trust and different cultures have different ways and means of doing things." G9*

Proximity was discussed by 100% of Government participants, who all agreed on the high level of importance of being in close proximity to one another to carry out KT&TT activities. '*Technology'* was seen as a solution to decreasing distance as a barrier for KT&TT activities.

Trust

Trust was the final theme directly questioned to Government participants of how it impacts on KT&TT activities. *Table 4.20* provides a detailed overview of what the participants discussed on the subject.

Table 4. 20: Theme expanded of Trust for Government participants

Theme - Description	Example/s
Trust; is a significant factor in the forming of relationships. A WG official who deals with IP, suggested that trust built over time and through previous experiences with individuals that have delivered on what was agreed at the beginning of the relationship. However, if trust is broken, it can be very hard, if not impossible to establish the connection previously attained. To minimise the risk of this happening, communication and transparency should be maintained throughout, which was mentioned by A WG official whose role is a relationship manager.	*"It's much easier to trust someone if you have some experience of working with them and you know how they behave in certain situations, because you need to be able to trust with trust". G7* *"If that trust gets broken down, it's broken you know a trust is and reputations are hard to gain and easy to lose and again it's about being transparent, if you can't do something, tell somebody you can't do it, umm but again you know." G9*

'*Trust'* was seen as significant to KT&TT activities, with this linking closely to the impact of previous experiences on '*trust'.* It was seen to be very difficult to build trust, and very easy to lose trust when communication and transparency were not being achieved in the relationship.

How to Mitigate barriers

This section sets out to discuss the Government participants responses on how to mitigate barriers in KT&TT activities. Below is *Table 4.21* that provides an overview of the themes and linkage strength.

Table 4. 21: Linkage strength of mitigating barrier for Government participants.

Mitigate Barriers	**Linkage Strength**
Clustering	Medium
Collaboration	High
Communication	Low
Financial	Medium
IPR Management	Low
Strategy	High
Structure	Medium
Technology	Low

Table 4.21 shows a total of eight themes that were discussed by Government Participants with a mixture of linkage strength. The key theme with a high linkage strength was 'Collaboration'. Next, table 4.22 sets to expand on these themes in detail. See appendix 4.9 for further content analysis.

Table 4. 22: Themes expanded of mitigating barriers for Government participants

Theme – Description	Example/s
Clustering; 40% of participants highlighted clustering as a solution to minimising the barriers suggested. One participant from Innovate UK (G2) described the recipe for a successful cluster to occur. To attract the correct companies for the clusters, it is important to understand the ratio of industries within the zone, which was highlighted by a relationship manager (G9). However, if there are not the correct resources in the region, there should be protocols set to find the most suitable Academic outside of the region, which was mentioned by an Innovate UK (G5) official.	*"Having a concentration of very similar sort of technology businesses is an area that really helps with that human capital because because (sic) ultimately without the skilled people, the cluster can't function" G2* *"From a clusters perspective it is understanding what analysis is being done of the businesses that are in that geographical zone, let's look at, where you know, how many engineering companies are there? How many IT companies are there? How many advanced manufacturing companies are there?" G9*

	"And although proximity is going, as I said, likely to drive a better outcome. If your specific need isn't served by the local research institutes, then you wouldn't go to local research. It's true, you would go to the rights Academic." G5
Collaboration; is also an essential aspect to reduce the barriers disseminated, with 70% of participants mentioning the point. This is through not only collaborating within the zone through clusters, but to be aware of the key stakeholders outside of the zone that will add value to those industries. A NPTCC official (G1) supported this. An Innovate UK (G2) official highlighted that if collaboration between a university is not optimised, then it is likely that Industry a business will relocate.	*"Better working collaboration between stakeholders perhaps actually external stakeholders realising maybe the market knowledge of the local state stakeholders is fairly valuable" G1* *"If there are no business collaborate business club races around the university, they will just go across the country to find them." G2*
Increased *communication* with the key stakeholders in the region is critical to mitigating the barriers highlighted, this will subsequently add to potential co-location of key stakeholders in the region. However, only 10% of participants mentioned this solution, which was by a Cardiff Government official.	*"To bring some of these guys down here. That's where communications are important. This shows the importance of co-location people one side or another. Yeah" G6*
Financial; 30% of participants mentioned increasing funding as a solution to mitigate the barriers above, through a continued amount of support for KT&TT activities, which was mentioned by a NPTCC official.	*"A consistent and sort of sustained offering of incentives because as it stands as I said it's that one incentive it isn't there's no other incentive available for an Enterprise Zone." G1*
IPR Management; Issues with IP need to be addressed on the university's side, where potential IP can be given away for free, if certain requirements so that it has a potential to grow. This was mentioned by 20% of the applicants with an average of 3 times mentioned per participant. A Government official who deals with patents was highlighted a IPR strategy.	*"People are having ideas all the time that actually you can't make the best use of. So, you might want to licence those ideas out to be used elsewhere, because it isn't." G7*
Strategy; was an important aspect with 60% of participants raising this as a solution. The PTWEZ should look elsewhere for the best knowledge and	*"Look for the best solution. Bring that knowledge back. To Wales." G8*

bring It to the region. A KT officer (G8) highlighted the need for a simplified strategy to support these activities. This was echoed by a NPTCC officer (G1).	*More and more straightforward clear processes to apply because that's that's (sic) the major downfall for everything." G1*
The *structure;* was a significant barrier highlighted, it was also suggested as a way to solving barriers. The idea of having an intermediary involved in the process to help the structural issues associated with these activities. This would allow for an impartial view for both sides of the relationship to maximise the potential for success to occur. Structure was only mentioned by 30% of participants, which was by an Innovate UK (G5) official.	"I think you need a third party that's interest is in economic growth within that region. Not the research aspects and not the business aspects. So, although we for our competition, we say either business or a university has to lead. I think some of the stronger bids have proposed a creation of a new entity or a third party that's interested only the economic growth because they are impartial.*" G5*
Technology; Developments of video conferencing technology (10%) can help minimise barriers such as distance, when people cannot be in the same room together, which was mentioned an WG official dealing with patents and engagement.	"It's just it's a bit like a video conference, extremely high resolution." G7

All of the aforementioned themes are critical to mitigating barriers, the standout themes were '*Collaboration'* (70%) both in the region and outside of the region to maximise KT&TT interactions; 'Strategy' (60%), which needs to be improved upon to support these activities in the region; and '*Clustering'* (40%), which has to be carefully planned to get the right stakeholders into the region. If there is not the right Academic locally, then these need to be sources from outside of the region. These themes will be addresses further in *phase three.*

How can PTWEZ impact KT&TT

This section provides an overview of what Government participants views were on how the PTWEZ can impact KT&TT activities. Below *Table 4.23* provides an overview of the themes discussed and the linkage strength for the participants.

Table 4. 23: Linkage strengths for PTWEZ impact of Government participants

PTWEZ Impact	**Linkage Strength**
Clusters	Medium
Collaboration	Medium
Financial	Low
Infrastructure	Medium
Strategy	Low
Mapping	Low

A total of six themes were raised, which had a low to medium spread of linkage from Government participants. This shows that there was not one theme that was more important than the other. *Table 4.24* sets to provide an expansion of the themes highlighted above. See *Appendix 4.10* for further content analysis.

Table 4. 24: Expansion of PTWEZ impact on KT&TT form Government participants.

Description	Example/s
Clustering; (30%) was a medium discussed topic from Government participants, where they described the need for a strategy around getting the correct industries to the region. An Innovate UK official raised this point and was quoted: This was supported a WG official (G9) stating the importance for EZs to develop effective clusters within the zones.	*"You want to have you want to stick to kind of a. A framework of kind of the type of companies that would benefit and another." G2* *"I think we really need to try and drive forward the cluster activities there, I think we need to look at how we can enhance events that are targeting companies within the zone." G9*
Collaboration: Despite receiving the highest average reference of 3.7, 30% of respondents raised the need for increased PTWEZ partnership. A Government	*"You need to sort of nexus to do that. So maybe an enterprise zone. Is the kind of place where*

official (G7) who works with engagement and believes the PTWEZ may influence these activities by establishing a 'nexus,' which is a premise within the zone that facilitates these interactions between key players. The concept of organising events to assist these activities has the potential to catalyse the early stages of KT&TT. This was reiterated by a relationship manager in WG (G9). For concepts like these to be successful, sufficient involvement with key stakeholders in the region is required. Additionally, the idea of using the EZ as a location to collaborate with Academia and Industry was suggested by Government participants, where a WG official (G9) was quoted saying:	*you could kick off an event like that. You know, you and you need you definitely need to arrange people in the room." G7* *"I think it's a proper engagement activity, I think it is about getting in there and it's about talking to the businesses that are in that location and understanding what we can and what we can't do for them" G9* *"We need to really up the communications around what's going on there, I think we really need to try and drive forward the cluster activities there, I think we need to look at how we can enhance events that are targeting companies within the zone." G9*
Financial; received some discussion with 20% mentioning this. A NPTCC official raised the issue around lack of finance, with a solution being a sustained offering to businesses to motivate them to relocate and stay.	*"A consistent and sort of sustained offering of incentives because as it stands as I said it's that one incentive it isn't there's no other incentive available for an Enterprise Zone." G1*
Infrastructure; was a factor raised for PTWEZ to consider, with 30% mentioning this. More specifically, to address the limited available property. This was an issue addressed multiple times. There is less of an issue to attract the business here because of most of the properties, incubators and laboratories being at full capacity. A NPTCC official was quoted supporting this. (G1)	*"you need physical property which we trying to address…. You can have a thousand spin outs coming up you're going to have to put them you're not gonna get any economic gain here because they're going to go elsewhere." G1*
Strategy; was mentioned 20% with an agreement of a good strategy. However, questions were raised to how they implement this by a Government official who deals with innovation and knowledge transfer. A necessary action plan should be implemented alongside this to support the aims and objectives of the Enterprise Zone.	*"So, although they've got a strategy, we need the action plan and we need to say, well, yeah, can we implement?" G10*
Mapping; To support this, necessary mapping (20%) of those key stakeholders and industries should be carried out to optimise the potential of the EZ. Also,	*"And then that mapping of strengths versus need can start to fill those additionality pieces*

this would involve understanding the strengths of the universities in the region and how they can link up those Industry strengths in the region.	*into the ecosystem, which means that that manufacturing site can evolve and can become. more value adds to the business and much harder to pull out from the local area". G5*

Key themes identified were '*Infrastructure'* (40%) that raised the importance for the PTWEZ to further develop the region to support KT&TT activities; '*Clusters'* (30%) to be developed that will support the Industry that is already there; and '*Collaboration'* (30%) to be raised by the PTWEZ acting as a '*Nexus'* to support the collaboration between Industry and Academia.

4.3.4. Industry

Twelve Industry stakeholders were interviewed for the first phase of data collection. Stakeholder were from a variety of professional backgrounds, ranging from consultants, multiple board members on EZs in Wales, Venture Capital (VC)'s, and companies inside and outside of the PTWEZ. This section sets out to provide a detailed discussion of the findings from Industry participants.

Definition

The most accurate definition described by Industry participants was by a VC, which reflects on the direction of commercialisation of IP from KT activities.

"Knowledge transfer means to me admitted specific to the university sector. Moving knowledge, which is normally valued in terms of IP and that should appear at some stage in copyright from the Academic sphere where commercialisation is not the primary focus. It is a focus at all to a commercial sphere for monetisation of the IP" I12

However, some participants referenced the definition to the knowledge aspect of transfer, which was also by a VC.

"Knowledge transfer? Uh, well, in simplest form, it's about, you know, ideas being taken, being ideas being disseminated to a wider audience." I3

Drivers

This section sets to discuss the drivers by Industry participants and provide a detailed overview of this. *Table 4.25* provides an overview of the themes identified from the thematic analysis and linkage strength between these themes.

Table 4. 25: Linkage strength of Drivers for Industry participants

Drivers	**Linkage strength**
Collaboration	Medium
Economic Development	Low
Infrastructure	Low
TTO	Low
Knowledge	Medium

There was a varied spread across the five themes identified for drivers described by Industry participants *(see Appendix 4.11),* with the highest being '*Collaboration'* (Medium), and '*Knowledge'* (Medium). *Table 4.26* gives a breakdown of the themes in detail and provides evidence from the interviews. See *Appendix 4.11* for content analysis for drivers.

Table 4. 26: Themes of Drivers from Industry participants

Theme – Description	Example/s
Collaboration; One of the key drivers for Industry participants was the opportunity to collaborate with universities locally and on a global level. This had 50% of participants discussing collaboration. It also allows for other individuals from different professions to get a different view of the issue trying to be solved. This was mentioned by an Industry stakeholder who is within the PTWEZ (I2). This was supported by a VC who has business in South Wales (I6).	*"To have access to equipment that we don't have here and brainpower that we don't necessarily have here to look at processes and products in different ways. It's allowed us to to (sic) think outside the box." I2* *"I find universities are very good at providing specific technical skills" I6*
Economic Development; The economic gain for these activities is critical to its success, with 25% suggesting this. If this can bring tangible benefits to the stakeholders taking part, then it will attract more organisations to want to participate. This was indicated by a VC in Wales.	*"if there are technology developments or ideas that are being developed within Wales, we obviously want to try and commercialise those and and (sic) see them as as (sic) widely successful as possible." I3*
Infrastructure; (8%) was described as a driver to support KT&TT activities where a Welsh EZ chairman described the need for infrastructure in these zones, where they were quoted:	"It's all about three things. Infrastructure and infrastructure and more infrastructure." I11

TTO; (8%) AgorIP was mentioned as an entity that had not worried the VC interviewee.	*"But I haven't heard horror stories. I have lots of horror stories from lots of universities. And I haven't heard any stories about Swansea. So, you know, hopefully that's a good sign." I6*
Knowledge; with 50% recognising this as another significant theme. An Industry participant that deals with Industry and Academic engagement within an EZ in Wales remarked that an Industry stakeholder (I2) within the PTWEZ must have the knowledge competence to deliver to Industry positioned within the zone and outside, which might add value to being there (I8).	*"certainly, benefited the business in terms of new opportunities to look at things in different ways"* I2 *"Absolutely crucial. Otherwise, we're just a property offer. If we can't get that to work, we might as well just go through to any other office in on the high Street or whatever? It's what sets us apart is really the ability to tap into That knowledge" I8*

Overall, the key theme of '*Collaboration'* (50%) suggests there is much opportunity to be had when industry collaborates with Academia on KT&TT activities, with '*knowledge'* (50%) being critical to the reasoning behind industry motivations to collaborate with Academia.

Barriers

This section provides an overview of the barriers highlighted by Industry participants, while *Table 4.27* provides a reference to the themes discussed in relation to the linkage strength.

Table 4. 27: Summary of themes for Barriers, discussed by Industry participants

Barriers	**Linkage Strength**
Communication	Low
Culture	Medium
Financial	Medium
IPR	Medium
Structure	High

With five themes discussed by Industry participants, Structure (*High*) was agreed upon as being the most significant barrier to KT&TT activities. *Table 4.28* provides a detailed expansion of the themes highlighted. See *Appendix 4.12* for further content analysis.

Table 4. 28: Discussion of the key themes of Barriers by Industry participants

Theme - Description	Example/s
Communication; was mentioned by 17% of Industry applicants. An Industry stakeholder who was a chairman of one of the EZ boards Language can act as a barrier on a global scale for KT&TT.	*"I would argue with you that whilst the world's language is an impediment. To economic development in many, many areas of Wales." I11*
Culture; 42% of interviews discussed the relationship between Industry and Academia. I11 said it was a bigger impediment than distance, and a Welsh EZ chairman agreed (I9). This statement highlights cultural disparities between universities and business, which a FLEXIS Industry stakeholder echoed. Culture has prompted Industry players to be hesitant to engage with Academics in the past; early planning and conversations are recommended.	*"The culture is more important than distance from my perspective." I11* *"It's an uphill battle to bring them along." I9*
Financial; 17% of participants cite a need for KT&TT funding. A PTWEZ stakeholder (I2) said the lack of resources and time was a hurdle. This is mainly due to the poor success rate of TT efforts, thus Industry stakeholders must not spend too much of their assigned resources.	*"Purely resource. Those are the barriers that we've we've (sic) experienced in allocating sufficient time." I2* "We've got to be careful of how much time people are spending on projects that may be going nowhere or adding very little value managing that." I2
IPR Management; 33 percent of participants cite IPR management as a barrier. A VC in Wales (I6) with expertise at numerous universities worldwide discussed this issue. Miscommunication with these stakeholders can erode confidence. This affects the relationship's duration and success. Universities' lack of IPR valuation knowledge causes discontent. A consultant in South West Wales echoed this (I7).	*"When universities act in ways that erode that trust by taking intellectual property, not crediting the people that came from, you know, arguing, you know, what value that the technical invention or the intellectual property has over a business when in fact businesses are valuable because they make sales, not because they have no underlying intellectual property, that that that may or may not have contributed to sales." I6* *"There is a lack of understanding often in Academia of the potential value of the outcomes that could be achieved from the research." I7*

Structure; 67 percent of participants mentioned this in the thematic and content analysis. Due to different skill sets, Industry and Academia have issues. An Industry participant with expertise dealing with Academia indicated that this could make it difficult to align corporate and Academic participants in KT&TT operations. A VC in Wales said this is because universities lack a competitive model for working with Industry partners. A Welsh VC said that it's 'impossible' to solve the fundamental issues between Industry and education. The goal, according to an Industry participant who is a member of an EZ board in Wales, is to get any information or profitable concept out of the institution as soon as you can. This maximises success. Similarly, Academic and Industry partners may have conflicting priorities, which can make it difficult to agree on a shared aim, as FLEXIS noted. One participant suggested that boundaries are necessary to test the information and technology's validity. Without these challenges, any concept may advance.	*"Universities are, by stereotype or definition, highly siloed." I9* *"There doesn't seem to be a standard model that doesn't even seem to be a competitive model." I3* *"Very difficult for them to steer the organization in any direction because of things like Academic integrity… But changing the inherent structure of university has proven to be impossible in every respect that I've ever come across." I6* *"So, a barrier is to get them out which means, having somewhere for them to go to and you can see we are trying to do something about that." I10* *"Because a professor wants to do X. We want to do Y. They're not exactly. Totally different." I9* *"If there were no barriers to innovation coming out of the universities, you would have an awful lot more companies set up and an awful lot more disappointed people, because there will be a lot more failures" I10.*

'*Structure*' (67%) was seen as the most significant barrier to KT&TT activities due to the inherent differences between Industry and Academia. They also stressed that it is almost impossible to change those structures to support KT&TT activities. Also, '*Culture'* was seen as significant (42%) to impact KT&TT activities, specifically between Industry and Academia, which caused hesitancy from Industry to want to collaborate.

Previous engagement

This section presents an overview of Previous Engagement, which was a question posed directly to Industry participants. Table 4.29 provides an overview of the responses.

Table 4. 29: Summary of Previous Engagement from Industry Participants

Description	Example/s
Previous engagement; It takes years to create a strong connection, yet one mistake might lead to its downfall. This was described by a participant who has worked with Academia (I8). This point was backed by a participant who works for FLEXIS (I9). I9 asserts the importance of first impressions and networking in person. Once this is established, the following session to discuss commencing any KT&TT activities will be far more productive.	*"Yeah, absolutely. We are we've got a thing here where we say we get one chance from Industry. And if we don't deliver, it makes the next engagement. So, so much more difficult. And that's why sometimes when Academics or universities don't deliver, its rather frustrating for us in the middle." I8* *"Yes, absolutely support Massively. That is why I try to network events as much as possible. Even if you just shook the hand and took the business card in person. Your next engagement when you want to go and have a more serious conversation is a thousand times more likely to happen" I9*

Participants unanimously agreed on the significance of '*Previous Engagement*', although this was dependant on having positive experience with the KT&TT activities. Additionally, participants suggested that increased networking supported the inception of '*Previous Engagement'.*

Distance/connectivity

When participants were asked about '*Distance/Connectivity*', the following themes were generated, with these being highlighted in *Table 4.30* along with their linkage strength.

Table 4. 30: Overview of themes from Distance/Connectivity by Industry participant.

Distance/connectivity	**Linkage strength**
Proximity	High
Technology	Medium

The two key sub-themes identified were '*Proximity'* (High) and '*Technology'* (Medium). *Table 4.31* now goes into detail about the sub-themes described in relation to the data collected from Industry participants. See *Appendix 4.13* for detailed content analysis.

Table 4. 31: Summary of the sub-themes of Distance/connectivity from Industry participants

Theme – Description	Example/s
Proximity; Different people have different opinions about the barrier of distance (75%). Some participants asserted that improvements in video technology services supported their claim that distance is not a barrier to communication. An Industry representative within the PTWEZ demonstrates this. Distance can be difficult, a participant in the Industry who runs a global business highlights the necessity of maintaining global connection in order to comprehend market trends across many continents. Distance is indicated to be a barrier when time zones are in existence, an individual from FLEXIS concurred.	"Nowadays we have opportunities to communicate through various mediums. I don't think distance is a big issue…We can have quite good communication with universities that are not locals." *I2* *"Distance can be a challenge in how regularly you communicate. But we source information from all of those markets on a regular basis, which impacts our investment decisions. So, it would be wrong to say there's no impact on on (sic) distance……So I would say even though it's difficult to maintain connectivity and it will when your you know, at greater distance, it's really important to do it because you need a view."* *"Oh, massively. Yeah. Yes, just absolutely it's just so much knowledge transfer is so much more effective and useful when it happens face to face." I9*
Technology; According to a participant in the sector, technology can reduce the obstacles caused by distance. But differing time zones can make communication more difficult. Others in the group considered this to be a major obstacle, particularly when it comes to carrying out these activities.	*"So, it's pretty tricky. Yeah, but we can we can (sic) talk to each other quite, quite (sic) regularly over Skype and share in video sharing. And all of those things work, but you can never over time zone differences." I1*

'*Proximity*' (75%) had mixed views regarding proximity being a barrier to KT&TT activities. Some believed these increased KT&TT activities, while others saw that being connected globally tended to be more beneficial for understanding market trends. Additionally, '*Technology'* was seen to minimise barriers of distance impacting KT&TT. However, differing time zones can cause this to become a barrier.

Trust

'*Trust*' was the last theme to be specifically asked to Industry participants, with an overview of their responses being shown in *Table 4.32.*

Table 4. 32: Overview of Trust from Industry participants

Theme – Description	Example/s
It can be challenging to build trust; it was a crucial component that Industry players agreed upon. Building that relationship requires a continuous period of time, as noted by a prior chairman of an EZ. Trust is important to KT operations, according to a VC participant (I4). KT cannot be implemented as successfully without confidence. Relationship success depends on trust, and the two are interdependent (I6).	*"Trust, well right, I think trust is building up confidence of working with one another and that requires stability of approach umm but also, umm personal relationships, umm so yea you can't, you got to work together over a period of time." I4* *"So so (sic) in my experience, knowledge transfer is an exercise in trust." I6*

'*Trust*' was seen as a significant factor to affect KT&TT activities, with it taking a long time for 'Trust' to be formed. This is also deemed as being essential to the forming of relationships when KT activities are carried out.

Mitigating barriers

The section sets out to detail the mitigating barriers identified by Industry participants. *Table 4.33* sets to provide an overview of this, along with the linkages from participants.

Table 4. 33: Overview of Mitigating barriers by Industry participants

Mitigate Barriers	**Linkage Strength**
Clusters	Low
Collaboration	High
Financial	Medium
Infrastructure	Low
Strategy	Medium

A total of five themes were identified as having the potential to mitigate barriers, with '*Collaboration'* having the highest linkage from Industry participants. *Table 4.34* below sets to provide an overview of the themes identified from the thematic analysis. See *Appendix 4.14* for content analysis.

Table 4. 34: Overview of mitigating barrier from Industry participants

Description	Example/s
Clusters; was only cited by 8% of the responders. A VC in Wales remarked that clusters will consolidate Industry, increasing the likelihood that KT&TT operations will take place (I3) Additionally, the concept of a cluster network across several EZs in Wales can be advantageous to one another by exchanging information and concepts (I3).	"*What about putting all of them in one place and in a large campus with with their involvement and have 200 people, 200 businesses, or also all clustered and working together to try and create products?" I3* *"And that doesn't mean just in Cardiff that could be across the entirety of South Wales." I3*
Collaboration; was significant to mitigate the barriers suggested previously, with 58% of participants discussing this. A business owner (I5) from outside the PTWEZ made the point that colleges should be actively interacting with enterprises there. Considering a plan to reduce this barrier is necessary because structure was such a large barrier. South Wales-based VC provided support for this (I6). The Technology Transfer Office (TTO), who act as a university's gatekeeper to the Academic community, must facilitate this partnership. By collaborating with as many Academics as possible, they may serve business by finding the suitable Academic. An individual with experience fostering partnerships between Industry and Academia repeated this (I8). A corporation in Swansea talked about how collaboration is a two-sided issue where both sides need to be as open as possible about sharing in order to benefit society and the area that they are in (I5).	*"Your Academics, you know, and then you have your businesses. It's almost like, well, it would be highly beneficial to have that communication much more open with Academics." I5* *"You know, basically be as permissive as possible and actively encourage Industry to come and talk to your researchers and encourage your researchers." I6* *"Exposing the University and the Academics to the opportunities and the businesses that we have here and that blown away when we do tell them what's available here and vice versa." I8* *"I think people need to be more open about sharing. I think, you know, I think we we as a society don't do that enough." I5*

Financial; Some financial incentives need to be in place, as it is considered a barrier, but not as significant as other barriers. With 25% mentioning this as a solution, an individual with experience working with Academia in TT activities was quoted:	*"Secure some funds, and I don't mean couple hundred thousand, I mean a significant amount of money, secure some funds." I10*
Strategy; 33% of participants suggested strategy as a way to lessen the hurdles brought up. Stakeholder from the Industry (I10) brought up this issue. An Industry representative from the PTWEZ (I2) emphasised how well the PTWEZ has managed to reduce the obstacles that come with KT&TT activities. They should have a plan that minimises the paperwork and "red tape" involved in working with Academics and managing KT&TT operations if they want to improve their Academic approach. A representative from FLEXIS concurred (I6). According to a consultant headquartered in South Wales, the assistance that business may provide to Academics will boost the likelihood of success for both parties (I7).	*"He came up with this thing, which he said look, until I can get them out of from the university, they don't have a chance." I10* *"So, more activity to boards that sort of improvement processes is happening and more strategic thinking is happening here is helping to mitigate the problem." I2* *"So administratively, if universities can make that a lot easier, not interfere with the individual professors that might want to take risk or researchers who might want to take risk with a business." I6* *"You've got to support them in that bit in articulating what the potential impact is but then also the business skills required to take those impacts and turn them into something that is real and that has the potential to support Industry." I7*
Technology; The developments of video communication technology will help minimise barriers associated to distance. This would allow to be interconnected to over EZs within Wales. However, only 8% of participants mentioned this as a solution, where an Industry representative from FLEXIS was quoted saying:	*"Skype, whatever you want to call it, is also great in its own regard. And I think we all need more of it being in Wales, being further west than in Cardiff." I9*

With '*Collaboration*' being significant to mitigating barriers, Industry participants raised the need for Academia to engage with Industry as much as possible. TTOs were identified as solutions to increase the accessibility of appropriate Academics for Industry to collaborate with. In addition, '*Strategy*' was seen as a potential solution to mitigate barriers. They saw an opportunity for the PTWEZ to support KT&TT activities by having strategy for this. Also,

having universities change the way that they deal with IP and spin-outs and allowing for them to get out of the university as quickly as possible was identified as a way of increasing the potential for success.

How can PTWEZ impact KT&TT?

This section provides an overview of Industry participants' perspective on how the PTWEZ can impact KT&TT activities. *Table 4.35* provides an overview if those synthesised from the literature, in addition to their linkage strength.

Table 4. 35: Linkage strength of PTWEZ impact on KT&TT activities by Industry participants

PTWEZ Impact	**Linkage Strength**
Clusters	Low
Collaboration	Medium
Financial	High
Infrastructure	Medium
Strategy	Low

Five themes were found to be key ways the PTWEZ may impact KT&TT activities, with the most salient one being Finance (*High*). *Table 4.36* provides a summary of the themes. See *Appendix 4.15* for content analysis.

Table 4. 36: Overview of themes for PTWEZ to impact TK&TT by Industry participants

Theme – Description	Example/s
Clusters; A limited percentage of Industry stakeholders (8%) discussed clusters as a strategy for the PTWEZ to assist KT&TT activities. This issue was brought forward by a major VC stakeholder (I3). This calls into question the need for a planned strategy to incorporate the right industries into a RIS.	*"But at least they should be considered as alternatives trying to force businesses to move to a location or creating an environment that they moved to a location solely for the benefit." I3*
Collaboration; The importance of the PTWEZ and other EZs in Wales to collaborate with Academia is vital to its success (33%). Also, it would increase the likelihood of businesses to stay within the region for a more sustained amount of time, which was supported by an EZ board member.	"I've been saying that we need to have an Academic presence, or we need to have a research presence there, because if not, it's just been not a food park. It's just another food park it…. Whereas if you have a research presence from one of the

	universities, it has a greater chance and it has a greater chance of success." I11
Financial; Finance was cited by 50% of participants as a potential area where the PTWEZ could influence these activities. The barrier is caused by the variance in financial incentives between Welsh and English EZs. According to a spokesman from the PTWEZ, English EZs are occasionally granted a several hundred million each as opposed to the thousands provided to Welsh EZs. A VC with South West Wales expertise advised that innovative efforts require a significant amount of capital to achieve commercialization. To support the various stages, this calls for an ongoing source of money. Building a partnership with VCs can help create a new financing source for these efforts. Otherwise, you run the danger that businesses that migrated to take advantage of those initiatives may just depart when the funding mechanisms from the Government are finished. As stated by a VC representative in another source:	*"That is one of the key problems with the sort of enterprise zones or whatever you want to call then university set up, not an enterprise Zone as such. But that has to be funding because it is the key driver behind any innovative system." I2* *"The businesses in that kind of economic zone need to understand the relationship with investors. Should they be attracting investment, which is really, really important to growing you economically." I6* *"And when that environment ends, a lot of them tend to leave. I mean, the most recent example is the grant that was paid Pinewood to create studios in Wales. That was for five years. Five years is expired. They are moving out." I3*
Infrastructure; 25% of respondents cited the development of infrastructure as being important to the success of EZs. Without it, companies are less inclined to relocate or remain there permanently. The transportation network needs to be improved with resources. As a result, the EZ and their current innovation system will be more connected. Where a VC backed this idea (I3). Some participants (I4) argue that the construction of infrastructure will keep enterprises there longer than financial incentives. Finally, a former EZ board member quoted the need for more property to be made available as a way to meet the demand of businesses looking to move to the PTWEZ:	*"But at least they should be considered as alternatives trying to force businesses to move to a location or creating an environment that they moved to a location solely for the benefit, but because they get economic support or grant doesn't. In my mind I intend to create a long-lasting reason to stay." I3* *"We need to get more available property, umm that means we need oven ready sites, sites which are free of development constraints but." I4*

Strategy; According to 17 percent of respondents, strategy is an area where the PTWEZ may have a greater impact. A former EZ board member recommended that any EZ's plan should fully comprehend the industries that will improve the site. The ensuing Industry ought to move to the area. An experienced VC in Wales echoed this when he said (I3)	*"Umm so you do have to reflect on what's right on the particular location and what's right on the particular economic profile of an area." I4* *is that generally they have to have a clear purpose. I3*

Overall, '*Finance'* (50%) was seen to achieve the highest levels of agreement regarding the PTWEZ impact on KT&TT activities. One impact was identified to be the disproportion of funding given to English EZs, compared to Welsh EZs, with the best way to support Welsh EZs being to match the funding structures – particularly since KT&TT activities require a lot of capital in order for the idea to be brought to market. '*Collaboration' (33%)* was also seen as a key factor to supporting KT&TT activities, with this increasing the chances for Industry to stay in the region if they can collaborate with Academia.

The next section will provide an overview of *phase three* of the action research, which will involve a further round of semi-structured interviews based upon the findings generated from *phase two*. The key themes identified are shown in *figure 4.3 overleaf*.

4.4. Sentiment Analysis

Throughout the first round of data collection, a sentiment analysis was attempted. This was accomplished using the Nvivo software, with a manual approach used to reference all codes. However, following examination of the statements provided by candidates, it was difficult to distinguish between 'neutral,' 'positive,' and 'negative' terms. Following that, an auto code was run across all of the references. However, after going through these scripts, it was discovered that the algorithm's choice was incorrect. This was thought to be due to the complexity of the participants' queries and answers. As a result, a decision was made to not include this in the study so as not to confuse the reader.

4.5. Phase Three: Findings

Following *phase two,* feedback of the findings was shared with key stakeholders within the PTWEX and South West Wales RIS. This confirmed most of the findings, although a key theme of 'Freeports' was highlighted from certain key stakeholders. The purpose of *phase three* was to verify and get a deeper understanding of how to answer the key issues highlighted in *phase two*. *Figure 4.3* gives an overview of the key themes discussed in *phase three.* Eleven interviews were carried out with 13 people, ranging from key stakeholders within Industry (5), Academia (2) and Government (4) in South West Wales. At this point, theoretical saturation was achieved. The sampling was purposeful and participants were chosen based on them being deemed knowledgeable from phase two – with all key stakeholders being involved in the RIS of South West Wales. The seniority of participants during *phase three* was generally higher and the questions asked of them looked at more complexed problems. This section will provide an overview of what the participants discussed from *phase three.*

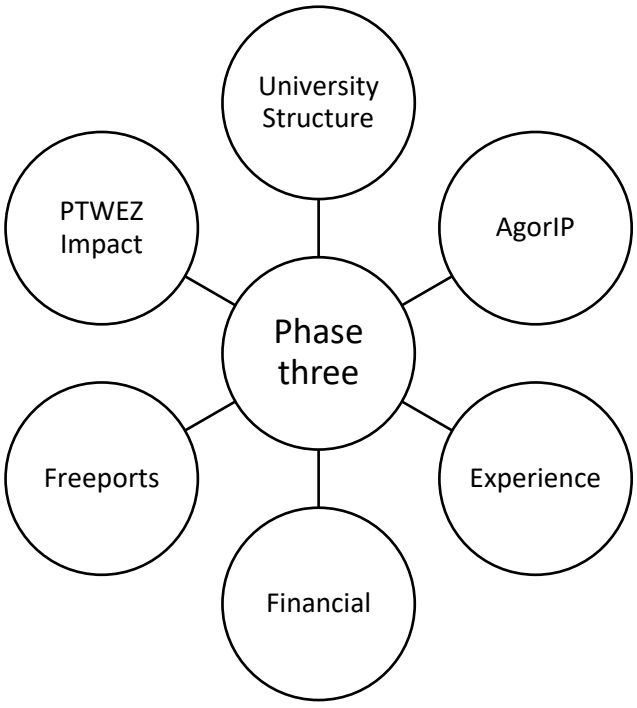


Figure 4. 3 Phase Three key themes

4.5.1. Academia

Two case study interviews were carried out for Academic stakeholders at Swansea University, with both having vast experiences of working with Industry. *Table 4.37* gives an overview of the key themes discussed with the linkage strength of each, with a content analysis shown in *Appendix 4.16.*

Table 4. 37: Core themes and linkage strength for Academic participants.

Themes	**Linkage Strength**
University Structure	High
AgorIP	High
Experience	Medium
Financial	High
Freeports	High
PTWEZ Impact	High

The correlation strength for each of the themes emphasised is high, as demonstrated above. This is because all participants were asked about these important topics, which resulted in a large skew for all of the issues covered. A summary of the conversation amongst Academic participants for phase three is shown in Table 4.38.

Table 4. 38: Overview of phase three findings for Academic participants.

Theme - Description	Example/s
University Structure; There was consensus about the progress universities are making with Industry engagement, with an average of nine references to university structures being made per participant. However, a Swansea University participant who had previously worked in Industry backed recommendations for enhanced curriculum embedding while developing these abilities in individuals to assist the KT&TT operations (2A1). Another Academic attendee reinforced the idea that Academics should work together more cohesively when it comes to commercialization efforts, given that Academics may be rather compartmentalised (2A2).	*"To the commercialization there is a gap and, obviously, there is a gap of launching in order to take off of the of the company and in again here is a lot of multidisciplinary aspects that make take into consideration and support." 2A1* *"Be more unified in the way that he approaches Community commercialization I think it's dealt it's dealt with on a faculty basis or maybe even on a departmental basis on those those (sic) relationships that are formed between.* Possibly

	individuals and Industry, possibly between departments and Industry." 2A2.
Focal Point; A crucial solution mentioned by a Swansea University participant was the creation of a focal point through which important stakeholders from various regional universities might work. This was expanded upon by highlighting the fundamental structural challenges that exist between Academia and Industry. This would boost the possibilities for KT&TT activities between Industry and Academia.	*"Through the Welsh universities, so what I would suggest is I think capability sharing facility sort of facility sharing and working collaboratively without whereas universities in the past have been I would say. Strength in collaboration is something that really needs to move forward without universities and re-join diversity, so if we if we consider. Individual benefits through through (sic) collaboration and as an example of that I'm currently in discussions with the University, UWTSD and Swansea university, with trinity." 2A2* *"A network that that just circulates the opportunities that are available and brings likeminded people together to maximize what those benefits could actually be done to the university." 2A2*
Decarbonisation; A Swansea University delegate emphasised the need of focusing on the decarbonisation agenda and how Swansea University can help these goals. The importance of major stakeholders within Academia supporting this is growing.	*"To sort of really energize the the (sic) ambitions of the sort of decarbonisation agenda, which obviously construction it contributes significantly." 2A2*
AgorIP; Participants at Swansea University who were questioned about AgorIP were unfamiliar with the topic. They did, however, agree that AgorIP is a strength for the institution in terms of supporting Academics through commercialization. Around AgorIP, an average of 6 referrals were made.	*"And what it's what its objectives are so you know that would be something that I would definitely be promoting the university to do more, of is. communicate and educate some of the the (sic). The staff members who have. Industry facing a commercialization activity as part of their role to be you know, to make sure that they are, they are, they are fully abreast of what." 2A2*

Process; Structural and procedural difficulties around AgorIP were raised, with a clear strategy and emphasis helping to improve the effectiveness of the relationship and KT&TT activities raised by 2A1. Another Swansea University participant (2A2) agreed, providing a simple way to improve commercialisation.	*"you need to start this is kind of a culture that forces this technology transfer OK… so if I is very bureaucratic so probably need to streamline this kind of process." 2A1* *"Because universities, is a is a convoluted beast and and (sic) pulls in all different directions, I think, having a simple strategy in terms of what universities position around commercialization is would certainly help." 2A2*
Communication; A delegate from Swansea University made the recommendation that AgorIP should do a better job of telling the important people about its successes so that more opportunities can be created from them. AgorIP may be able to serve as a bridge between Academics and the PTWEZ to aid with and facilitate KT&TT efforts, according to one suggestion. In order to facilitate possible commercialization, this strategy can potentially be replicated at other regional colleges.	*"I wasn't fully aware of AgorIP's remit and so maybe that's something that needs to be improved upon is is (sic) making sure that data information reaches the people that have responsibilities when it comes to looking at commercialization opportunities." 2A2* *"To demonstrate best practice and show how engagement between universities, via possibly a tech transfer office into an enterprise zone or or or (sic)…..You know the expansion of AgorIP to work across multiple institutions, you know would would (sic) then be something that could benefit the enterprise zone and wider initiatives that are happening within within within (sic) the regions and local authorities." 2A2*
Expand Model; The model AgorIP, which is being developed by other universities, can support TTOs that are having trouble maximising commercialisation.	*"You know the expansion of AgorIP to work across multiple institutions, you know would would (sic) then be something that could benefit the enterprise zone and wider initiatives that are happening within within within (sic) the regions and local authorities."2A2*
IP; When asked how AgorIP can improve the IPR management, there was little knowledge known on this subject.	*"I don't believe. I'm in a position to be able to provide an answer that*

	you can actually make use for that question." 2A2
Experiences; Swansea University Experiences associated with Government often highlighted some structural issues. This made it hard to find the relevant person who had enough authority to make decisions, though a positive relationship was still associated. This could be improved with a top-down approach to get the funding.	*"It doesn't make it easy for us to. To be able to. Engage with the relevant people that can have the the (sic) authority to to (sic) give us the the (sic) initial seedcon funding that we're looking for to kick start this project." 2A2*
Financial; Funding was an important aspect for commercialisation. Though it may be difficult for WG to be able to support in the way other stakeholders want. This opens the question around VC who can have a greater impact on funding opportunities, where an Academic participant was quoted:	*"I don't believe Welsh Government wanted to be the instigator for some of these opportunities, where, as a venture capitalist might see a different picture and have a different agenda and the different." 2A2*
Freeport; The Freeport debate had a mix response based on the knowledge that the participant had around Freeports. This reflected the on average of 2 references per participant. One Swansea University stakeholder was not familiar with this concept and the term needed to be explained. However, For the other participant that was familiar with Freeports, they believed there was an opportunity, Port Talbot was suited strategically for the location of a Freeport. This is a great opportunity for Port Talbot and the PTWEZ for its future, for regional and economic growth.	*"Port Talbot is one potential location in a given it's it's (sic). Geographical sort of location in South Wales it's ideal because Tata steel, as you know, one of the country's main employees, one of the region's main employers. You know within within within (sic) that region as well also opens up opportunities to to (sic) explore, but I would say, certainly something something (sic) you know, working with a free ports agenda to create possibly an expanded version of the enterprise zone." 2A2*
Focal Point; Applicants were asked about what should happen to the PTWEZ after its completion in June 2021. An average of 3 references made. The belief by the Swansea university participants (2A2) suggested that the PTWEZ gave benefits to the region, mainly to bring lots of companies into one area is a positive. This would act as a focal point for businesses, Industry and Government to link for these activities, while also acting as an anchor to attract businesses, the PTWEZ should continue as the benefits out way the costs associated (2A2).	*"I think we can only benefit in every aspect, because you haven't quite a lot of companies in the area, "To demonstrate best practice and show how engagement between universities, via possibly a tech transfer office into an enterprise zone or or or (sic) a similar entity can facilitate growth and can demonstrate local uplift in GVA and really and really show how collaboration, I think that that that's probably the key, the key word in*

	what I'm trying to say is oh how collaboration really does reinforce partnerships." 2A2 *"Organizations to remain within within (sic) regions to attract new business opportunities and having those links formalized between enterprise zones." 2A2*
Future; Academics suggested the PTWEZ should provide information on lessons learnt, with detailed explanation of what opportunities will follow its completion. With areas to carry on, for key stakeholders to affect this.	*"What additional opportunities exists, should there be you know different funding mechanisms and and (sic) opportunities and what will be very useful is some of the learning outcomes to be shared what worked what really." 2A2*

Reponses on '*University structure'* were generally positive with reference to positive Industry engagements. However, more could be done to embed this idea into the curriculum. One key solution raised was the idea of a *'focal point'* that can help bring together key stakeholders from Industry, Academia and Government. Furthermore, decarbonisation was cited as a key issue that should be addressed when looking at solutions for *'University Structure'.*

The TTO of Swansea University *'AgorIP'* was not very familiar with the participants that were questioned on the subject. However, they believed this was a strength for the university to support commercialisation activities. Often, process issues were raised about '*AgorIP,'* where a clear strategy should be implemented to support KT&TT activities. Finally, communication was key to the success of '*AgorIP'* and improving their links with stakeholders such as the PTEWEZ.

'*Financial'* factors were seen as a complex issue, with it being difficult for WG to provide the necessary funding to support KT&TT activities. However, VCs were referenced as a unique opportunity in supporting the types of activities that require lots of capital throughout the process.

The topic of '*Freeports'* sparked debate among Academic participants, which was partly due to the amount of knowledge that they had on the subject. The participants who were knowledgeable on the subject believed that they could bring a lot of opportunities to the region and could act as a focal point for economic activity if implemented correctly.

A key characteristic of the PTWEZ was its ability to become a '*focal point'* for economic activity among Industry, Academia, and Government, through attracting the correct Industry and providing them with the right resources. For the future of the PTWEZ, this was not certain. However, lessons learnt detail information for future consideration that should be followed by key stakeholders following its completion.

4.5.2. Government

A total of four interviews were carried out with six key stakeholders, which varied from local and regional Government members with experiences of working with the PTWEZ and Swansea University. *Table 4.39* below gives an overview of the themes discussed and the linkage strength from Government participants.

Table 4. 39: Themes and linkage strength for Government participants

Themes	**Linkage Strength**
University Structure	High
AgorIP	High
Experiences	High
Finance	High
Freeports	Medium
PTWEZ	High

The linkage strength for the themes is all relatively '*high,'* with this being due to these themes being asked directly to all participants. See *Appendix 4.17* for detailed content analysis for this section. Meanwhile, *Table 4.40* below gives a summary of the themes and sub-themes synthesised from the data analysis.

Table 4.40: Overview of phase three finding for Government participants

Theme - Description	Example/s
University Structure; An average of 4.5 references were made, which reflects the limited knowledge by Government officials regarding university structure, which was shown in the quote by a local Government stakeholder.	*"In terms of the university structure, obviously we're not terribly familiar with the university structure other than what we see from the outside" 2G1.* *"Commercialisation takes place outside the university, so the logic is get it outside*

A WG official who has extensive experience working with universities and Swansea University suggested the concept that IP and economic potential should be removed from the university as soon as possible.	*of the university as quickly as possible." 2G4*
Collaboration; Collaboration amongst the major regional institutions must grow in order to maximise the commercialization potential emanating from the universities. Other local Government stakeholders agreed that there was a need for cooperation, which was supported by this. But there is a gap between Academia that needs to be filled. The topics of SPECIFIC and FLEXIS were raised. Regarding their level of commercial production success, there have been some concerns raised.	*"Academic excellence role is to look at industrial opportunity, how we can make money out of that, then you know missing a trick, so you know I think that's somehow AgorIP." 2G2* *"And that's where I think we need to be, is really looking at markets and they need people to help them with that. I mean, they are getting better at commercialisation, but. You know, still, I think we're probably quite a long way off to some honest." 2G1* *"And I mean SPECIFIC, for example, which is spin off from Swansea, has done a lot of work over the last sort of 10 years. Commercially. Probably not a huge amount, and I may be doing them a disservice there, but, you know, certainly the sort of level of jobs that were being talked about with that level of investment never really materialised." 2G1*
Workload; was referenced as an issue that Government and university have. This can make it hard to find free time to increase the linkages between the stakeholders. This was supported by a Government participant stating the fact, due to teaching commitments and other roles within the university, make it very hard to prioritise collaboration between these stakeholders. This can have a subsequent effect on the timeline differences that Industry and Academia have.	*"These days and I assume it's the same in the university, but I don't know is that especially in local Government, we've got like a million jobs." 2G1* *"Work very, very hard and they don't just do do one thing, so they're asked to teach the rest of do research, and you know organized research undertake some research, you have their own." 2G4* *"Generally, when you when you're working with Industry, they want they want something quickly within a set timeline and they want it to be as easy as possible." 2G4*
AgorIP; T Regarding AgorIP awareness, there were differing opinions; some important Government players knew very little or nothing about AgorIP. Local Government	*"There's three people here who are working fairly closely in this world and never heard of it." 2G1* *"You know, it's exactly the thing that we are looking at you know we wanted to*

was quoted with an average of 6 references per interview. Those who were knowledgeable, however, were quoted as saying the following about AgorIP and the possible impact this TTO can have on the area.	*find a way where innovation could be translated back into an Academic environment and. I still think AgorIP is a great idea." 2G2*
Communication; Having AgorIP communicate more with key stakeholders can give them more chance for success. Followed by collaboration, this will improve the linkages and the issues highlighted above.	*"So, I think [AgorIP] need to reach out to local authority and other partners operating in the area to explain to us what they are, what they do and how they can help us by all working together…. And when we get a better understanding of what they do, then we can move forward. But at the moment, we are ignorant of their existence" 2G1*
Missed Opportunity; A Government participant mentioned if more could be done on their side to maximise commercial output coming out of the university. However, there was a disconnect between the Government expectations and the potential that AgorIP could bring to the table.	*I think whether it's because we failed to maximize on those opportunities or or (sic) because the the the (sic) actual university. Offering. isn't isn't (sic) as deep as it says is on the packet." 2G2*
Finance; was a debated topic, with an average of five references made per interview. Often, Government participants had negative experiences with offering capital and not seeing any substantial returns on their investment. This was also supported by another Government participant of the hesitancies around finance and how often there is any impact to the region. Having available property for these companies was believed to have more of an impact. Also, it reduces the risk of the Government not getting their returns on investment from grants. Finally, the suggestion for Government to offer loans instead would help with financial issues that they are having and still motivate companies to locate to a region, due to the low interest rates.	*"And I just say, you know, I think everybody's going to be going through a lot of money at companies that then disappear when things don't look quite so good." 2G1* *"It feels to me that most times and we're paying for the thinking and for anything that actually said it comes back out of that in the real world." 2G2* *"I think everybody's going to be going through a lot of money at companies that then disappear when things don't look quite so good. And and (sic) at least you've got the space left to give to somebody else if they go." 2G1* *"it's great that we've got it there, I think it's a really brilliant thing that you know within an enterprise zone area they offer the offer alone or 2% below base it's a really good incentive for a company working in the enterprise zone, and you know those companies that have." 2G2*

Venture Capitalist; A limited number of VCs in Wales, shows the limitation to gather finance for spin outs and commercial potential. Where there has not been much exploration of VC, this was quoted by a key stakeholder on the PTWEZ board (2G2). With local Government (2G1) suggesting there is an opportunity for VCs to get involved with development of property.	*"So, I think the main thing that we're lacking, certainly in Wales is is (sic) investment capital." 2G2* *"And then I think then there's an opportunity for venture capitalists to get involved in terms of developing sites and premises" 2G1*
Freeports; received an average of 3.5 references per interview. Often with Government stakeholders, there was slight concern with the concept of competing against other local Governments that was shown by local Government. Also, by regional Government who raised the issue of Freeports being UK Government-based policy, introduced in Wales. The issue made around 'obstruction' raises concerns in WG.	*"I think there's concerns that we don't we don't want to be competing against other parts of of (sic) Wales. We are a small nation, and we should all be working together. And we also don't want it to result in the loopholes that some Welsh Government officers believe it's going to result in." 2G1* *"And it's a UK Government policy, Welsh Government has as really articulated some of the concerns that we have about Freeports. And the potential for things like obstruction and that's a piece of work that my policy colleagues are working with with (sic) the UK Government to get a better understanding of the of the." 2G3*
PTWEZ future; received on average eleven references per interview, which was significant. Some Government stakeholders believed there should be something that takes its place, whether that's an evolution from the PTWEZ or a new initiative (2G4). The idea of an '*Innovation District'* to take its place that was suggested by a Government stakeholder on the PTWEZ board (2G3). However, some stakeholders who are involved with the decision making are yet to decide on the future (2G3).	*"Because I mean I've been very, very impressed in how they've managed to bring key stakeholders…Then nature doesn't like a vacuum so something else will fill it." 2G4* *"And for me, the concept of an innovation district, which is…. As an evolution. Would be definitely the way to go for an iteration of the next iteration of enterprise zones, if there is going to be one, it seems to me that's an enterprise zone as a concept is fine, but you're largely talking about sort of." 2G3* *"Where they will be when they do to come to the end of June, I couldn't comment on that at the moment I'm afraid." 2G3*
Resources; For the next iteration of EZs to go ahead a Government stakeholder (2G2) on	*"Either you have an enterprise zone which has teeth on can differentiate itself from*

the PTWEZ mentioned the need for increased support financially. There is plenty of support provided by WG, but it is about making stakeholders aware of this.	*the rest of the pretty good…. Infrastructure in Wales for business support is there, you know the you know I think this or not embarrassed by the level of intervention and support the Welsh Government offers." 2G2*
Focal Point; The idea of bringing together the key stakeholders from Industry, Academia and Government was seen as a benefit to the PTWEZ and the region, which was suggested by local Government (2G1). This was further supported by local Government (2G4).	*"But looking at Industry in that collaboration between Industry, Academia and Government is really important going forward." 2G1* *I think they're a focal point for gen generation of new ideas and the opportunity to bring together key they are bringing together key stakeholders. To focus on making the region more attractive to Industry and coming up with a plan avail there they actually want to interface with Academia." 2G4*
EZ board; was significant to its success throughout its tenure. This was referenced by multiple Government stakeholders (2G3). This was echoed by local Government (2G1).	*"Is absolutely the way that we should try and harness harness (sic) all those those (sic) potential opportunities that that come to us, but I certainly think our enterprise zone boards have been very successful." 2G3* *"Because unless they approach us for something else, we can't seek those people out. So, I think that's that's (sic) a major step forward. [The board] are genuinely interested in making a difference." 2G1*
Property; An important aspect raised by local Government is the delivery of available property for businesses to relocate to the region (2G1. This was also supported by board members within the PTWEZ (2G2).	*I think I think enterprise zones need. I cannot to say the same thing over and over again. We need to be there about delivering space premises and premises." 2G1* *"Buildings and property." 2G2*
Communication; There is still a need for increased dialogue between the key stakeholders and the PTWEZ to make them aware what opportunities there are, which was referenced by a PTWEZ board member.	*"The opportunity for a better dialogue between local authority and business and Welsh Government in providing focus on those on those opportunities." 2G2*

Based on their level of expertise dealing with Industry, Government participants' thoughts and opinions on *'University Structure'* were divided. Successful commercialization depends on universities releasing their intellectual property as soon as possible. Collaboration was also considered to be a crucial component in supporting KT&TT activities and minimising '*University Structure.*' Questions were asked about the success of initiatives like SPECIFC and FLEXIS as well as what could be done to strengthen the connections between Industry and Academia. The 'workloads' of university staff members with their obligations to educate as well as their pursuit of any potential partnerships with Industry and Government accounted for a significant portion of the inherent problems surrounding *'University Structure.'* Participants from the Government, however, emphasised that because of their own *'Workload'* issues, it was a failure at both ends.

'*AgorIP'* received similar conflicting opinions and views of the TTO in Swansea University. Some participants had little to no knowledge of them, even though they had experiences working directly with Swansea University. However, those that did were positive about the model, although there remained room for improvement. '*Communication'* was seen as a key aspect to improve '*AgorIP's'* ability to support KT&TT activities by being transparent with the activities that are being carried out. It was suggested that Governments expectations of '*AgorIP'* were too great, with this causing issues.

When '*Finance'* was discussed, Government stakeholders often had negative experiences with funding, especially when they had offered funding to businesses in the region and did not get any returns. Instead, participants suggested either giving interest free loans or property development for the business to locate to. There was a belief that the VCs would be a benefit to the region and to KT&TT activities, though it proved to be increasingly difficult to get the funding in place from these individuals.

Participants' *'Freeports'* replies were frequently of a political nature. Additionally, it was agreed that WG should select the region that would benefit Wales rather than competing with other regions in Wales for the Freeport. Participants did concur, however, that South West Wales would be a suitable location for a Freeport. However, there were concerns regarding the '*Freeports'* policy. There was admiration to the PTWEZ and the board for the work they had done over the past few years. There was a belief that there should be something to takes its place in the future, although the correct '*resources'* and infrastructure need to be in place. The idea of an '*innovation district*' can act as a '*Focal Point*' to support these KT&TT activities between Industry, Academia, and Government.

4.5.3. Industry

A total of five Industry stakeholders were interviewed for *phase three*. This varied from key stakeholders involved in the PTWEZ, VCs within the region, board members and consultants with experiences working with Industry and EZ's. *Table 4.41* below provides an overview of the themes and the linkage strength of each.

Table 4. 41: Themes and linkage strength for Government participants

Themes	**Linkage Strength**
University Structure	High
AgorIP	High
Experiences	Medium
Finance	High
Freeports	Medium
PTWEZ	High

All themes discussed received a medium or high discussion from participants, which was due to all the themes being asked directly. Below is an overview of the themes discussed shown in *Table 4.42.* See *Appendix 4.18* for a content analysis of this phase for Industry.

Table 4. 42: Overview of phase three for Industry participants

Theme – Description	Example/s
University structure; received 4.5 references per interview. A consultant (2I4) with experience working with key stakeholders raised the need of universities matching the pace of Industry to increase the success of the KT&TT activities. Another consultant (2I1) raised the need for businesses to be aware of what the universities and institutions of Academic excellence can offer them. However, others argue the university has a responsibility to provide social value, rather than just monetary value through commercialisation (2I4).	*"Industry will come closer to Academia and make use of this if they know that Academia can actually run at pace" 2I4* *"it's about also ensuring that you know businesses have access to any university where the special specialism lies so it's not about kind of only being able to engage with one institution." 2I1* *"So along they add value to society, so I see sort of a double thing there some of it is commercial side of It is, but this is a different way of looking at things to improve the." 2I4*

Communication; was critical to maximise commercialisation from universities, this was referenced by a consultant who had experience with Cardiff University (2I4).	*"Trying to get Academics to articulate the true value of of (sic) their research and there was a suggestion at the time that." 2I4*
Political; issues were raised regarding the previous issues from Swansea University that was believed to influence the potential for AgorIP (2I2).	*"Then there was that awful business with people being fired and and (sic) allegations of malfeasance"2I2*
AgorIP; received an average of 7.8 references per interview. There was a belief from participants of the potential AgorIP has. However, there were question marks over how successful they have been with the PTWEZ, which was brought up by a board member (2I2). The idea for Welsh Universities working together can benefit Wales collectively when there is potential for commercial gain coming out of universities. This was an idea brought up from a EZ board member, An increased focus on maximising the potential for IP to be commercialised would result from this (2I2). However, some Industry participants were less familiar with AgorIP as a concept and argued that adding another layer to these activities could affect the ability to commercialise IP, with an Industry representative (2I3).	*"I think it's up to me to try and re-establish very quickly. Those links before they become totally cold, so what I'm saying is there's not not (sic) much happening, and you could lay that well it's not my fault but I'm probably only one motivated to do something about it." 2I2* *"So, um my vision would be that that Welsh universities have some kind of of (sic) central team that that I may could do more than just commercial lines IP but maybe all the things they want to do it in in conjunction but but (sic) a team which commercialised is the IP for all universities." 2I2* *"If the assumption is there's another layer of bureaucracy responsible for doing that then nobody." 2I2* "They mostly get in the way" 2I3
Process; Where it was suggested by a VC with experiences in South Wales (2I3), is to get the IP out of university structures as fast as possible. To do so, it is important to make it as easy as possible for Industry to use that IP. Also, to have certain protocols that it stays locally, so that it can have a benefit to the surrounding region, both economically and socially.	*"So, so you know the the (sic) end conclusion is still the same you have to liberate the intellectual property from from (sic) the University and give it a chance to turn into a successful commercial entity… Giving it or making it extremely easy for a British commercial entity to take that and try to turn it into a business without the burden of a heavy upfront cost." 2I3*

Experiences; from Industry varied from each applicant. There were examples of working with postgraduate course to support entrepreneurship where a VC was directly responsible for this where they were quoted:	*"So, we we (sic) created formed in partnership at a master's level program to recruit. You know technology entrepreneurs who are recent grads they they (sic) learned; you know kind of an entrepreneurial." 2I3*
Finance; Per interview, the Industry received an average of three recommendations. Participants' knowledge of the effects of finance and the possibilities for business activity differed. A VC quoted a model used by West Canada to support local businesses. There was agreement of the financial opportunities that are already here by a consultant who has carried out reports on the region. The advantages associated with the influx of finance can only benefit these activities. However, this explained the necessity for the stakeholders to seize the chances.	*"As a very good one, where you know you subsidise early stage, investing you leave the investor make the decision and and (sic) put their money at risk. But there's a there's a there's you know tax incentive to to (sic) put the money into a qualified local company. "2I3* *"And I think it's more than just the availability of funds because money is is (sic) available. It's actually that drive and determination." 2I1*
Collaboration; This was supported by a key stakeholder situated in the region of the PTWEZ, which suggested the benefits rely on collaborating with businesses, more so than the finance.	*"So maybe maybe maybe (sic) you wouldn't even need any financial intervention say look, you know we're kind of trying to build these relationships with local businesses and we'll give you are kind of. You know, will have us kind of strategic review for free" 2I5*
Freeports; received mix responses from Industry participants. An average of 4.5 references were made per interview. Those participants that were knowledgeable often described as a great opportunity for South West Wales to achieve goals in the future generations act, where an experienced consultant in the region (2I4). The unique characteristics of a deep-water dock in Port Talbot make the location of interest for the Freeport agenda. This was supported by another experienced consultant (2I1).	*"But it has to be doing it, you know I would say this for any freeport and any enterprise, it has to drive this in the next socially acceptable and environmentally acceptable manner." 2I4* *"And we we (sic) had put forward kind of the concept of free port. Again, very much having land adjacent to a unique deep-water port." 2I1*

Politics; The subject of politics has been brought up countless times. Opinions diverge due to England and Wales holding different political philosophies. As a result, there is now a tribalistic attitude between the Governments (2I1). A significant participant in the PTWEZ described this as a chance to develop areas that require improvement. However, would not elaborate further on the matter (2I4). Less knowledgeable participants made no comments about this. When they learned about Freeports, though, they came to the conclusion that it can only be advantageous for a region if an experienced VC is already there (2I3).	*"I don't think now announcing 8 yeah. Cross well crossing and then, but then the implication being over there might be one in Wales and might be one in Scotland, not particularly kind of well thought through in terms of how best to manage that, in a strategic manner." 2I1* *"I'm not a politically driven animal or what I do see is a lack of progress and the lack of focus, because those things get in the way of of (sic) decision making by those that do take." 2I4* *Politically, quite a tricky question, I can give you. I think if I, from my point of view. You know, obviously we're keen on anything that helps. The development ports poor areas and the poor communities, we serve so. 2I5* *"It seems like a reasonable strategy to create economic activity" 2I3*
Future of PTWEZ; received the largest amount of discussion with an average of 9.2 references made per interview. The PTWEZs board were a significant benefit to the success of the tenure. The board's ability to bring together key stakeholders from Industry, Academia and Government was significant (2I1). Though in the future, suggestion of an improved strategy to increase how often they would come together for meetings should be considered, where it was quoted by an experienced consultant 2I1). With support from an experienced consultant of the potential for Port Talbot (2I1). The potential for the PTWEZ to be a 'focal point' for was raised numerous times. This would allow for the collaboration between the key stakeholders of Industry, Academia and Government to occur.	*"I think the enterprise zone. Because of the potential power of the boards networking capacity, I think is is is (sic) most important, and. Possibly not achieved that the big risk is that the board members come once a quarter review some papers make some comments, develop a strategy" 2I1* *"I think the location, the area has enormous potential it's more than just whether it's an enterprise zone or innovation area or whatever." 2I1* *"Stronger linkage and, as we said, between Academia, Industry and economic development functions in terms of sort of marketing and promotion." 2I1*

This was supported by key stakeholders within the PTWEZ suggesting the zone as an opportunity for spin-outs to locate (2I5).	*"It in theory, the enterprise zone would give it would be a good place for any kind of spin off commercial activity that comes out of the university to land, you know be somewhere, for it to go and somewhere, for it to be." 2I5*
Property; However, there was agreement for the need of more available property for these spin-out companies to locate and companies to relocate to the region (2I1).	*"The other kind of issues, I said really is about ensuring we've got ready availability of sites and premises, the property side." 2I1*
Collaboration; Though there is still a need to look outside of the region to collaborate with Industry, due to the benefits it can bring to the local area that was supported by a VC with experience present in the region (2I3).	*"Anything that teaches the local population to do business outside their area. You know, has a has a doubling effect of economic activity, because it's it's (sic) dollars from elsewhere coming into your region and then those dollars recirculate within your region, whether it's." 2I3*
Innovation District; The idea of an 'Innovation District' was suggested by Industry participants that worked closely with the board in the PTWEZ, where a key Industry participant supported this (2I2)	*Innovation district, which is defined by land, which is as good access can be developed as an appetite to develop it if you can find that land, then you start migrating university." 2I*

Participants' views on '*University Structure'* raised concern for some, while others highlighted the importance of collaborating with universities to provide support in areas such as social value. To perform KT&TT activities effectively, the appropriate '*Communication*' must occur between Industry and Academia.

'*AgorIP'* received positive responses from participants regarding their potential to support commercialisation activities. However, there were questions about their success thus far and especially between the PTWEZ. Further developments need to occur to maximise *'AgorIP'* potential for success. One solution to this is to ensure that IP is transferred out of the university as quickly as possible. This may increase its chances of success.

'*Finance'* was seen as critical to the success of KT&TT activities, although motivation is needed from all stakeholders to take advantage of these potential opportunities. However, the importance of 'collaborating' was seen as more significant than '*finance'*. Often, the difference in funding mechanisms between England and Wales is responsible for causing competition between the two countries.

Participants views on the '*Future of PTWEZ'* was believed to be important for an evolution of this, with the need for a 'focal point' to be established for KT&TT activities to occur. The idea of an *'Innovation District'* was seen as the appropriate model to take the PTWEZs place. This would allow for the *'Innovation District'* to be appropriately positioned according to the key industries within South West Wales; supporting them to maximise their potential for KT&TT activities to occur. However, the correct infrastructure and '*property'* must be in place to support these activities. Finally, a fundamental part of the success of these activities is commitment from all key stakeholders who wish to collaborate.

The next section provides a summary of the secondary data collected to support the findings from the primary data.

4.6. Secondary Data

This section sets to analyse all EZs within the UK, using the English and Welsh EZs as areas of focus to understand similarities and differences. Additionally, this section sets to detail a deeper contextual overview of the PTWEZ sectors of focus, including the companies that are situated there currently.

Data on EZ UK

Secondary data gathering highlighted the similarities and differences in EZs that exist in England and Wales, with *table 4.43* below providing a breakdown of what the English EZs have to offer in comparison to Welsh EZs. The data collected unearthed information regarding links to Academia, the availability of a deep-water docks, their location (I.e., whether they are based in a city) and their sector of focus. From this information, it is clear that the English EZs most similar to the PTWEZ include Great Yarmouth, Tees Valley and Solent EZ (See *Appendix 4.19* for an overview of the English EZs). However, the PTWEZ remains unique due to Tata Steel being a significant stakeholder within the zone.

Table 4. 43: Welsh EZs

Location	Sector focus
Anglesey	Low Carbon emissions projects
Cardiff Airport and St Athan	Aerospace and transportation
Central Cardiff	Grade A office rentals
Deeside	Advanced manufacturing in innovation
Ebbw Vale	Manufacturing, skilled work force with links to Academia
Haven Waterway	Energy heritage with diverse range of sectors, links to education
Port Talbot Waterfront	Manufacturing heritage with unique, well-connected location
Snowdonia	Military heritage which looks for low carbon ventures, ICT and aerospace

Overleaf is a breakdown of the EZs that are based in a city, between English and Welsh EZs. This is due to the inherent differences between EZs within a city. These are shown as figure 4.4.

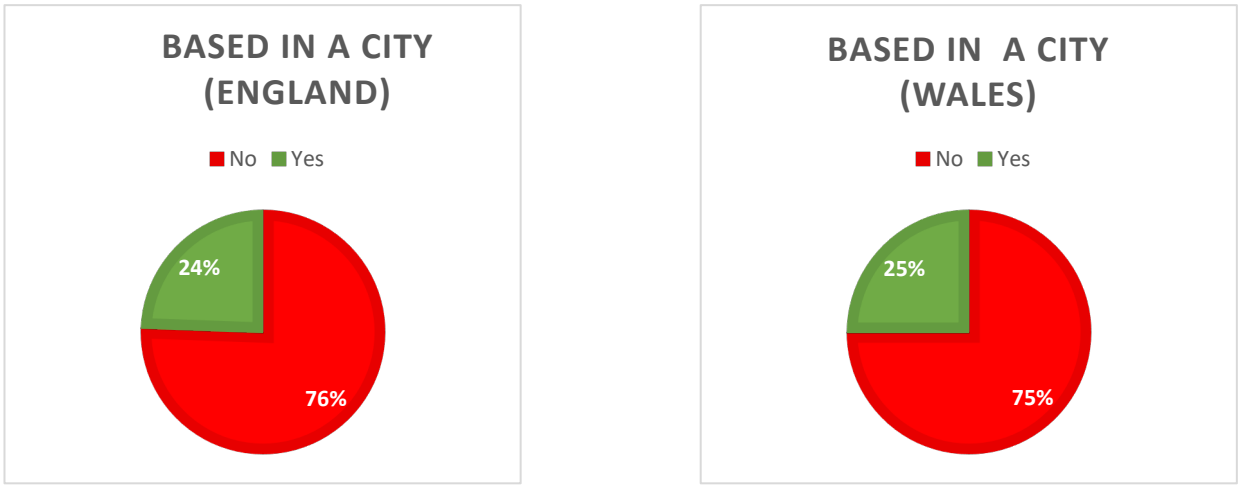


Figure 4. 4 Pie chart that demonstrates the percentage of EZs based in a city.

The data shows the similarity in the proportion of EZs that are within a city, which serves to inform comparisons about how they are integrated with key stakeholders in their respected region. A key feature of the PTWEZ is its access to a deep-water dock. The figure below breaks down the proportion of Welsh and English EZs that have access to a deep-water dock. (See *Figure 4.5)*

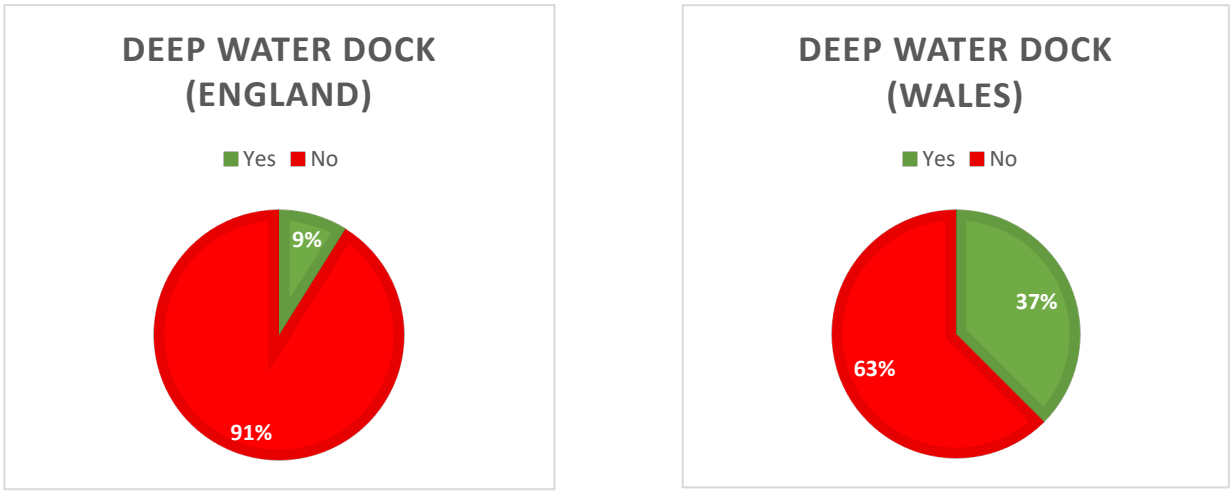


Figure 4. 5 Percentage of EZs that have a deep water dock

Only 9% of English EZs were found to have access to a deep water dock, with these including Great Yarmouth and Lowestoft Enterprise Zone Extension, Oceanside Plymouth, Solent, Tees Valley Enterprise Zone Growth Extension. These are similarities that can be compared to the PTWEZ regarding how they utilise this key feature. That is, 37% Welsh EZs were found to have

access to a deep-water dock, with this being a greater proportion compared to English EZs. These EZs are Anglesey, Haven Waterway, PTWEZ. Another considered factor is whether an EZ is made up of multiple sites. This is an important factor considered for proximity between sites for dissemination of KT&TT activities. This is shown in Figure 4.6 below.

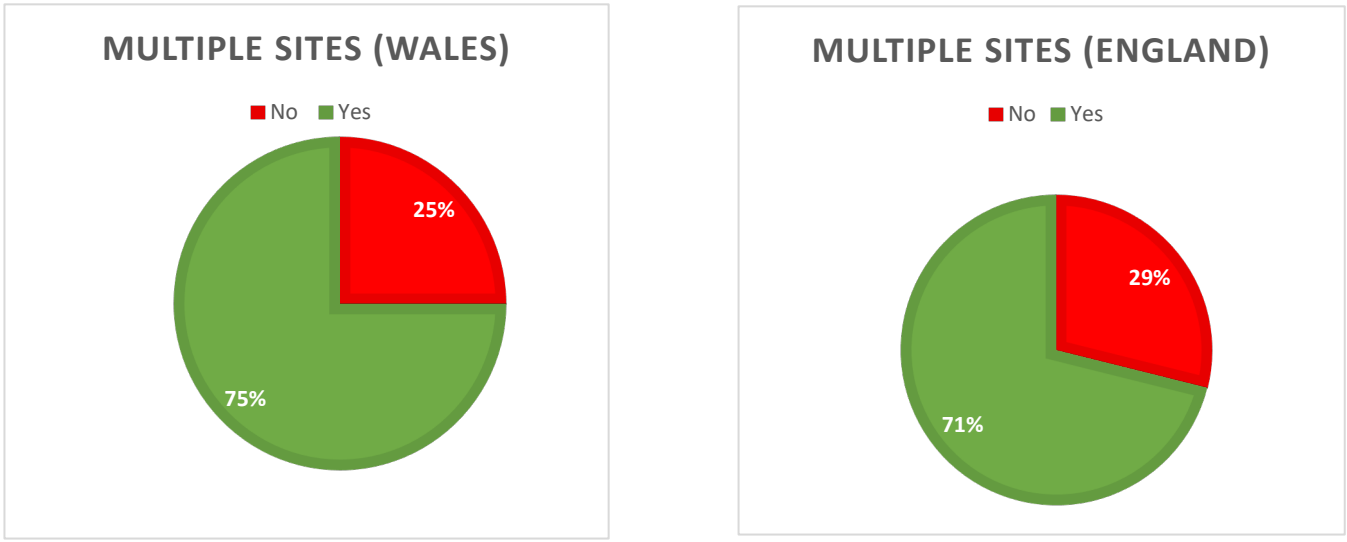
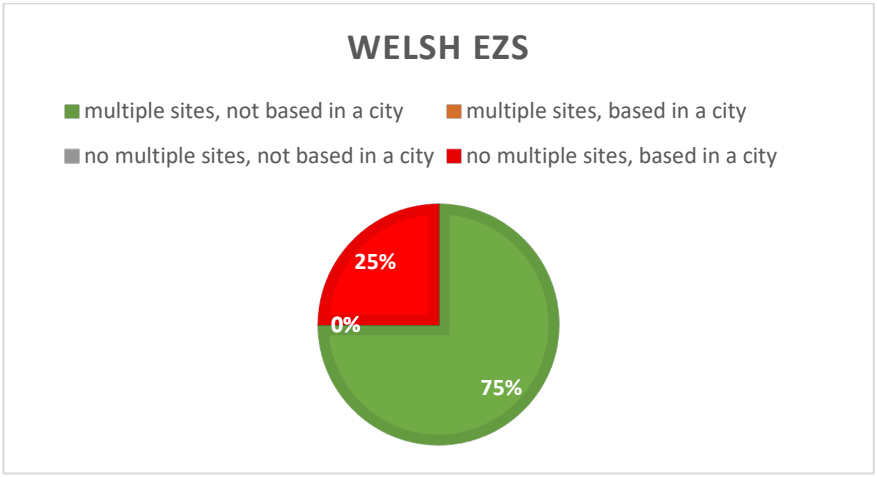


Figure 4. 6 Percentage of EZs that have multiple sites

Both the English and Welsh EZs have a similar proportion of EZs that have multiple sites. However, to get a better understanding of the comparisons to the PTWEZ, further analysis was conducted to explore the proportion of Welsh and English EZs that have multiple sites and that are not based in a city. This is shown in figure 4.7 below.



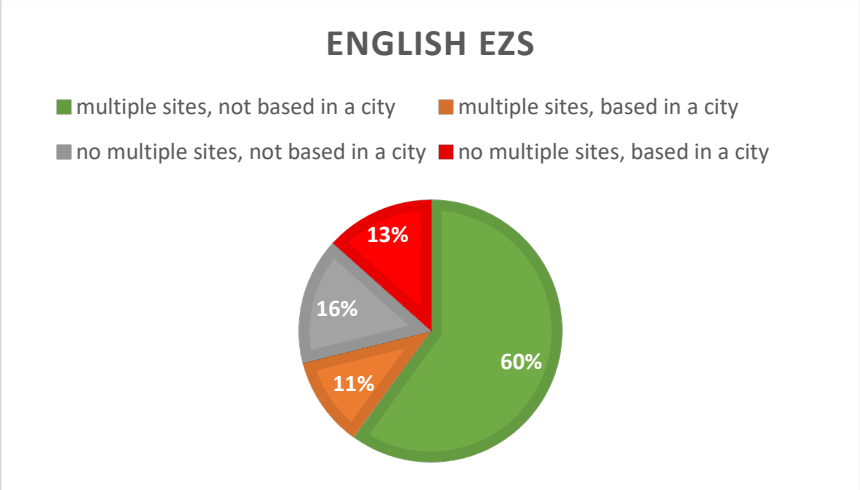


Figure 4. 7 Summary of EZs as a pie chart

There is further support of the comparisons Welsh and English EZs have with multiple sites and outside of the city. However, English EZs have more variations of factor for EZs as shown in *Figure 4.7.*

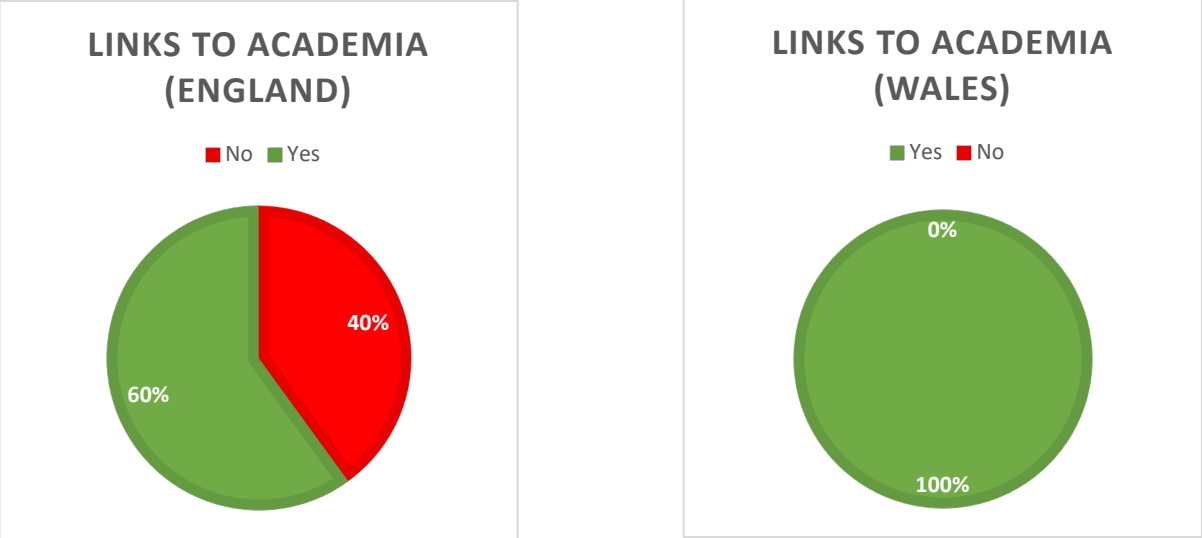


Figure 4. 8 percentage of EZs linked to Academia

It is shown in *Figure 4.8* that Wales specifically sets out to link with Academia in all their EZs, compared to 60% of English EZs. However, the reduced percentage of links to Academia in England suggest that they are more Industry-led initiatives. This is also due to England having a UEZ initiative, which is direct at collaborating with Academia, compared to Wales EZs being multifunctional for Industry and Academia.

Table 4. 44: University Enterprise Zones (UEZ)

UEZ University	**Description of Sector Focus**
Birmingham City University	STEAM (Science, technology, engineering, arts and maths)
University of Bristol	Life Sciences % broader science-based businesses
University of Cambridge	Digital Health & MedTech
Cranfield University	Aerospace
Durham University	Photonics, surface science, energy biosciences, satellite application 7 data intensive research
University of Essex	Digital & Creative
University of Falmouth	Digital/Games
University of Hertfordshire	Broad sector focus
Keele University	Data Analytics
Lancaster University	Advanced manufacturing and digital health
University of Lincoln	Food
Oxford Brookes University	Artificial intelligence & Data Analysis (for the service sector, Creative industries, social scientist & law, also applicable for HR & Lifesciences
Queen Mary university of London	Life Sciences
Sheffield Hallam University	Health & Wellbeing
University of Southampton	Futures towns Innovation
Staffordshire University	Advanced materials & manufacturing
University of Sunderland	Digital/Media
Teesside University	Digital
University College London	Third Sector

Data on businesses situated with the PTWEZ

The data discussed was gained through the Neath Port Talbot County Council, who have first-hand knowledge of bringing in the new companies into the PTWEZ area. The two sectors predominately in the region are manufacturing and construction industries, both of which support strategic plans set out by (BW, 2019; Hatch, 2018). These two sectors make up 108 companies (49.7%) out of the total 217. Bourne et al. (2020) provides an analysis of the data, which is set out in the conference paper (see Appendix 4.1).

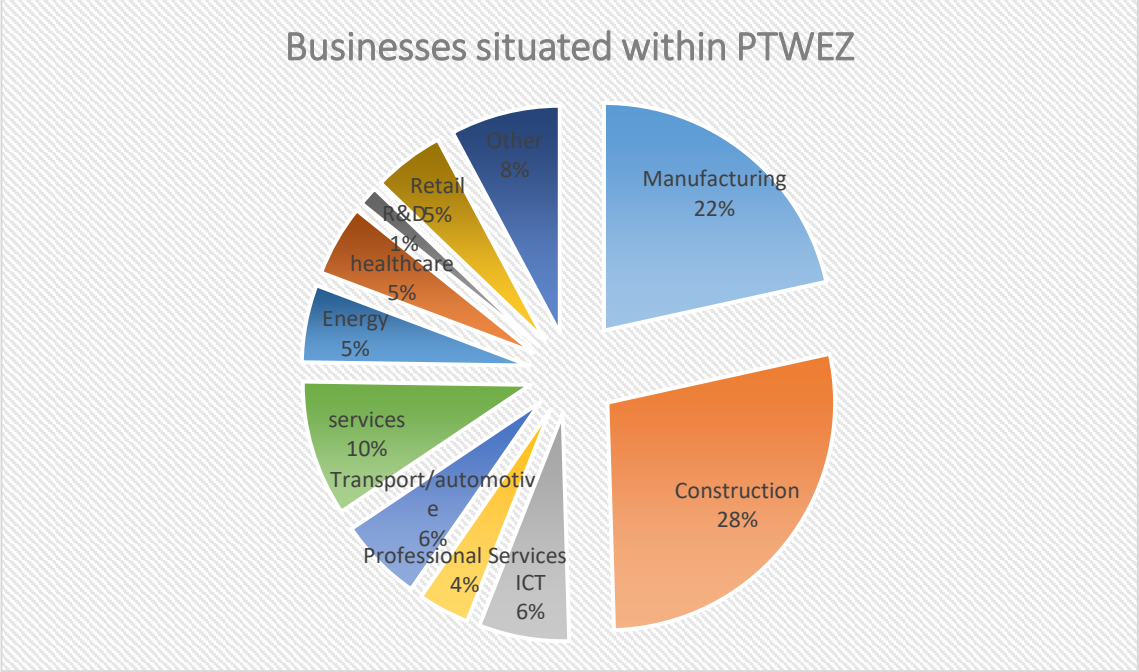


Figure 4. 9 Businesses within the PTWEZ by sector.

AgorIP Outputs

Following a study conducted by G. H. Davies et al. (2020) where data was collected over a 27-month period from its initial pilot phase in 2016 to March 2018, a total of 234 opportunities occurred. *Figure 4.10* below provides an overview of the opportunities by sector.

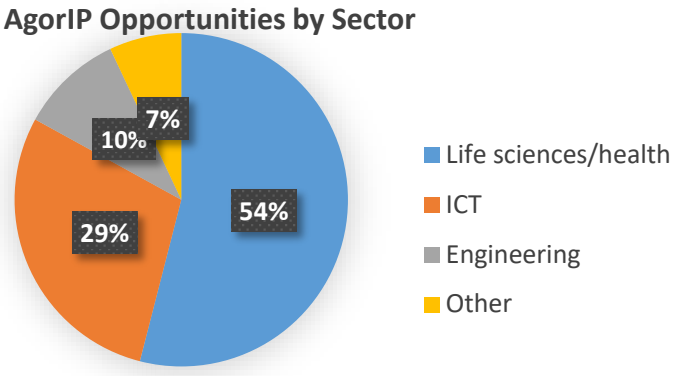


Figure 4. 10 AgorIP opportunities by sector

Of the portfolio, 89 TT activities achieved one of the four AgorIP objectives, which include:

- Soft start: The creation of a spin-out to support and develop IT, for the purpose of attracting investment and exploration of market opportunity
- Hard Start: Creation of a spin-out with investment arranged from the beginning, with the ambition to initiate a market opportunity
- License: Providing IPR identified with involved partners for their exploration and return of royalties
- Open Source: Making IP available to a large audience of potential users in the hope that it becomes successful without conferring any particular advantage or receiving financial benefit

Overall, 19 of the spin-outs achieved IP and investment, which equates to 8.1% of all the opportunities. *Figure 4.11* below breaks down the opportunities and their direction of focus.

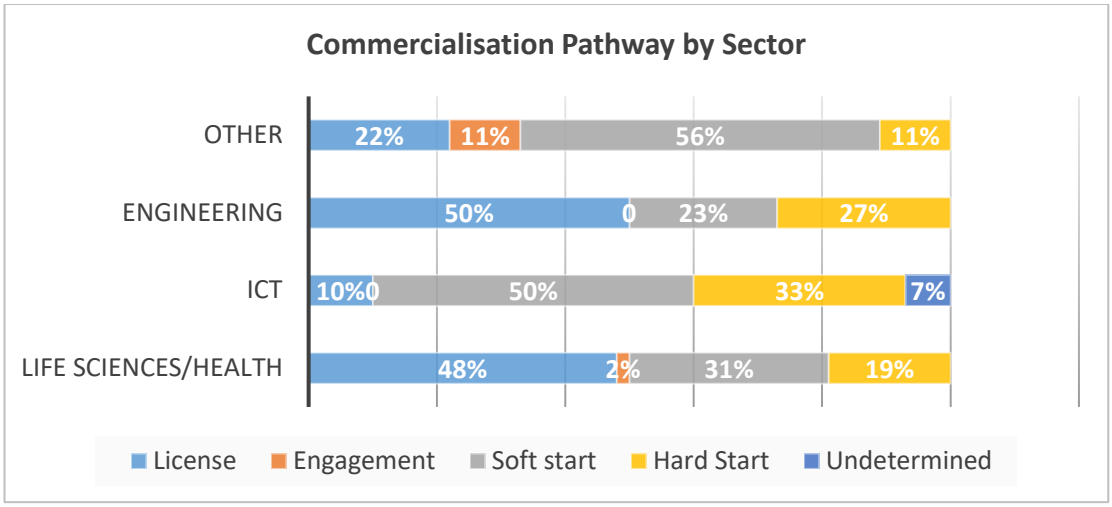


Figure 4. 11 Commercialisation Pathway by Sector

Figure 4.11 shows the key areas that AgorIP work on in TT activities and how the industries have achieved the four objectives discussed above.

4.7. Conclusion

The insights collected during the two phases of the action research described in this thesis sets to provide valuable insights regarding KT&TT activities, EZs and RIS. The action research undertaken to achieve this included both primary and secondary data collection carried out over two phases of semi-structured interviews, with a total of 45 insightful interviews and two case study papers. Unique insights have been uncovered in critical areas, ranging from variables that influence KT&TT, the impact EZs can have on a RIS and how to mitigate the identified significant hurdles. Secondary data obtained on English EZs and Welsh EZs also gave substantial insights for comparing EZs for key PTWEZ features. This was supported by secondary AgorIP output data, while challenges affecting these activities have been identified, all three stakeholder groups have shown a desire to increase their KT&TT operations. Secondary data from AgorIP's outputs signify the ability that this initiative possesses to support TT activities, with the PTWEZ having the potential to play a key role as a facilitator for these activities to occur more effectively. *Chapter five* will set to give context to these findings in relation to the literature review carried out in *chapter two.*

5.0. Chapter 5: Discussion

5.1. Introduction

The purpose for this section is to provide a discussion of the findings from *chapter 4* against the research question and research aims in the context of the literature review in *chapter 2.* This chapter will begin by revisiting the main question and, and how the phases of data collection have set to answer these. Following this is an overview of the findings and how these offer an answer to the main research question in relation to the literature review carried out in *chapter two.*

5.2. Main Research Question

The main research question sets out to answer in the thesis, with support of the conceptual models of RIS and the Triple Helix Model is stated below:

"What are the drivers and barriers for the successful transfer of knowledge and technology transfer within the context of the Port Talbot Waterfront Enterprise Zone?"

5.2.1 Research Aims

To support the main research questions, the research aims were designed to segment the main research question into multiple phases which are discussed in this section. The research aims are described below:

- "To understand how the PTWEZ positively impact on innovation activities in the region"
- "Map the factors that impact KT&TT activities in the region"
- "Develop tools/initiatives that can support these KT&TT activities in the region"

5.3. Phase one: Literature Review

Phase one provided an overview of the literature which is discussed in *chapter two.* The main themes that were identified, are shown in *Figure 5.1*. Other key areas the literature review addressed were '*Freeports', 'EZs', 'The PTWEZ',* and *'Clusters'* etc. The conceptual models of RIS the Triple Helix Model were designed to help answer the main research question and research aims by a framework. The themes identified were the foundation to *phase two* of the research design *(See Figure 4.3)* and to answer the research aim "*Map the factors that impact KT&TT activities in the region?".*

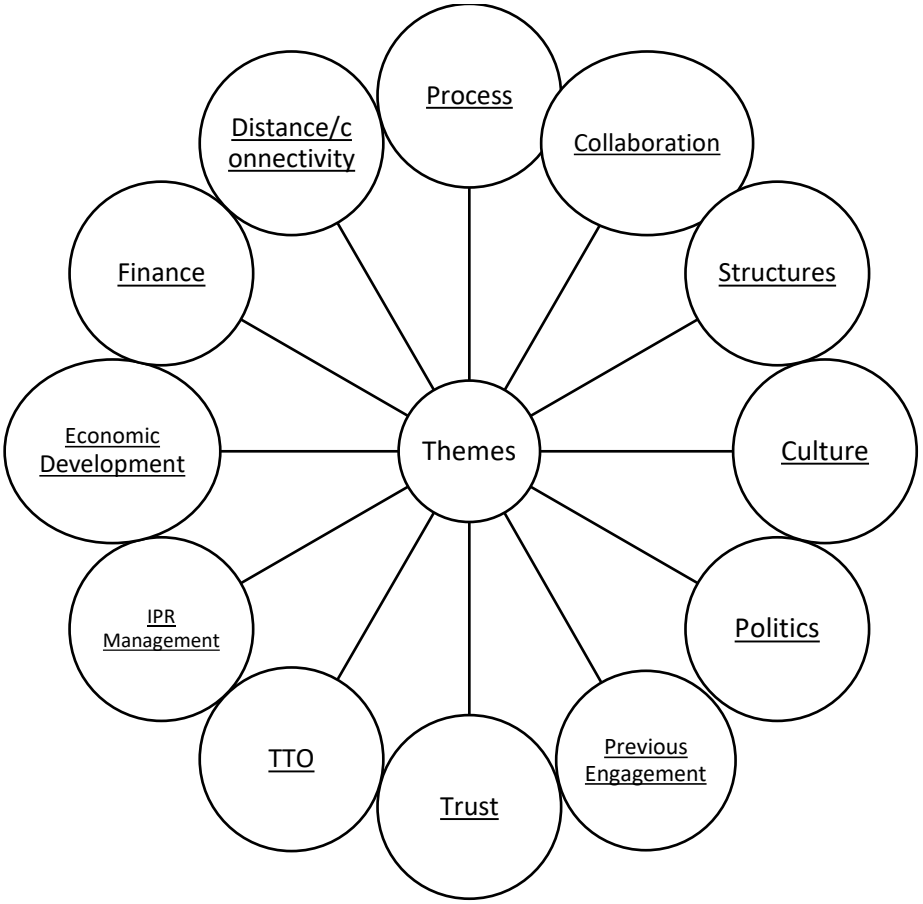


Figure 5. 1 Overview of key themes from Findings

5.4. Phase two: Discussion

This section will now discuss how this phase answers the research aims discussed above within the context of the literature review in *chapter two.* The following sections will split out in reflection of the findings and the Triple Helix Model used as the conceptual model (Leydesdorff & Etzkowitz, 1998). The review of these findings sets to build upon the conference paper produced by (Bourne et al., 2020) that looks holistically at the drivers and barriers for KT&TT to occur from the PTWEZ (*see Appendix 5.1).*

5.4.1. Academia

This section will provide a discussion of the findings and literature review for the Academic Stakeholder. Firstly, it will set out to answer the research aims of "Map the factors that impact KT&TT activities in the region" followed by "Develop tools/initiatives can be developed to support these KT&TT activities in the region". Finally, the research aim "To understand how can the PTWEZ Positively impact on innovation activities in the region".

Drivers

Table 5.1 gives a breakdown of these drivers and the alignment to the literature, with detailed discussion in the remainder of the section. This sets to answer the aim of "Map the factors that impact KT&TT activities in the region". Overall, there was a low response rate from Academic interviewees for drivers, with the highest reference *'Research'* (50%).

Table 5. 1: Main themes and alignment to the literature for Academic Participants.

Drivers	**Alignment to the Literature**
Collaboration	Agrees
Economic Development	Agrees
Research	Agrees
Technology Transfer Office	Disagrees

Collaboration

Collaboration was a theme highlighted by Academic participants. It was considered a factor that impacts KT & TT activities in a positive way that is supported in the literature (Adler &

Kwon, 2002; Albert N. Link et al., 2007; Ankrah et al., 2013; Ankrah & Al-Tabbaa, 2015). This suggests the importance for Academics to collaborate with Industry.

Economic Development

Furthermore, Economic Development has a positive effect for collaboration (Ankrah et al., 2013; Perkmann et al., 2013; Tartari et al., 2014). Tartari et al. (2014) supports the findings found by Academics regarding the self-motivation to perform these activities over external regulations, while Perkmann et al. (2013) highlighted the responsibility universities have to develop *'social capital'* of the regional economy. This should incentivize Academics and Industry to collaborate on KT & TT as this appears to drive economic benefits and increased productivity to all parties involved.

Research

Findings by Academic respondents suggest benefits associated to their research with 50% of participants mentioning this as a driver, this supports the findings by D'este and Perkmann (2011). This suggests that Academics that participate with Industry in some capacity, can further their Academic career.

In addition, to '*Research'* a driver for KT&TT activities was the policy developments by Swansea University to support Academics working with Industry in their *'consultancy policy'*. But the research frequently points out that this presents a considerable impediment (Francis-Smythe, 2008). It demonstrates the literary nuance of a real-life case scenario, which illustrates that Swansea University has the know-how to support Academics staff in KT activities. Secondary data findings surrounding Welsh EZs with experience of collaborating with Academia support this (See section 4.6).

Technology Transfer Office

Applicants from phase two mentioned the TTO in Swansea University as a successful model for KT&TT activities. TTOs' effectiveness contradicts the literature on their obstacles (Hertzfeld et al., 2006; Siegel, Veugelers, et al., 2007; Belitski et al., 2019; Holgersson & Aaboen, 2019). Secondary findings on AgorIP output show Swansea University's progress on making on KT&TT activities *(See figures 4.10 & 4.11).* This shows how AgorIP supports commercial activity.

Table 5. 2: Overview of Drivers for Academic participants

Academia	Themes	Linkage strength	Alignment to the literature
	Collaboration	Low	Agrees
	Communication	Nil	Nil
	Economic Development	Low	Agrees
	Infrastructure	Nil	Nil
	Knowledge	Nil	Nil
	Research	Medium	Agrees
	Technology Transfer Office	Low	Disagrees

Table 5.2 shows that of all the drivers discussed by Academia, Industry and Government, only four were mentioned. Also, there was a relatively low linkage strength discussed by the interviewees. However, all the themes discussed agreed with the literature, apart from '*TTO'* that disagrees with the literature.

Barriers

Below, *Table 5.3* describes the alignment between the literature and each of the barriers synthesised from the data collected. This further contributes to addressing the research aim "*Map the factors that impact KT&TT activities in the region".*

Table 5. 3: Alignment of barrier to the literature for Academic participants

Barriers	Alignment to the literature
Communication	Agrees
Culture	Agrees
Financial	Agrees
Intellectual Property Rights	Agrees
Politics	Agrees
Structure	Agrees

Overall, the barriers highlighted all agree with the literature found. The response rate for the barriers was relatively high, which is shown in *chapter four, figure 4.3.* The following section will go into detail of the main themes.

Communication

Communication was the subject of much discussion from Academic interviewees. However, there is limited existing research focused upon this element as noted by Vick and Robertson (2018) in their literature review. Noted in this area of the literature, it has been highlighted in other literature that the development of communication can support KT&TT activities (Plewa et al., 2013; Ankrah & Al-Tabbaa, 2015; Estrada et al., 2016). This was highlighted in the findings (see section 4.3.2.). This is reflected in the Link et al. (2015) showing the complexity and bidirectionality of interactions in KT and TT activities. This was interpreted as a breakdown in Academic-Industry dialogue. We conclude that increased communication and transparency are essential for success.

Culture

Culture between organisations was noted as a potential barrier amongst Academic responses, often linked to the difference in pace between Academia and Industry(Francis-Smythe, 2008; Malik, 2013; Ghauri & Rosendo-Rios, 2016). The study findings also suggested barriers associated with differing languages between Academia and organisations, this supports the observations of Malik (2013). Responses indicate a knowledge of the cultural differences between Industry and Academia, which can help minimise future conflicts.

Financial

Academic stakeholders' responses show universities must decide how they execute KT&TT operations, whether the aim is to make money or to positively impact society (Alexy et al., 2009). Concerns were also raised about Wales' finance infrastructure and its ability to support these activities. This supports Reid (2018) who suggests improvements of quality research funding. The literature emphasises the necessity of having the proper financial infrastructure in place to support KT&TT initiatives (Hughes & Kitson, 2012; Kitagawa & Lightowler, 2013; Rodríguez-Gulías et al., 2018) yet only 20% of interviewees mentioned it.

IPR management

Academic participants (70%) considered IPR difficult, which is corroborated by the research (Siegel & Wright, 2007; El-Ferik & Al-Naser, 2021). Other Academics believed that it is more beneficial to give the IP away in the chance it can benefit the region and society (Alexy et al., 2009; Peters et al., 2013; Holgersson & Wallin, 2017; Holgersson & Aaboen, 2019). Though IPR management is seen as a critical part of the literature (Alessandrini et al., 2013). Therefore, it is recommended that organisations like AgorIP rectify these IPR issues in subsequent cooperation. This is consistent with the research on IPR-related difficulties and should be appropriately addressed by AgorIP in subsequent partnerships.

Politics

There is little research on this subject, it was discovered that the complexity of internal organisation politics was a barrier to KT&TT activities. However, Hughes and Kitson (2012) found that there is a concern with Academics around the bureaucracy within universities. Bureaucracy is inherently difficult to identify and solve. However, you could bypass this issue, by taking the IP out of the university as quick as possible (Holgersson & Aaboen, 2019) and link it to the PTWEZ as a support mechanism. This theme is a sensitive topic and requires the appropriate measures to minimise politics as a barrier.

Structure

Organisation structure of universities was discussed extensively by interviewees (90%) and was raised as a significant barrier to KT&TT activities. The literature supports the inherent structural barriers associated between Industry and Academia (Albert N Link & Siegel, 2005b; Galan & Plewa, 2016; Ghauri & Rosendo-Rios, 2016). Not having the correct structures in place can adversely affect the university's ability to protect IP (Abreu & Grinevich, 2013). The

issues with the difference in timescales support the findings by Ghauri and Rosendo-Rios (2016). Both the literature of the findings supports the significance of university structure effecting KT&TT activities.

Table 5. 4: Overview of barriers for Academic participants

Academia	Themes	Linkage strength	Alignment to the literature
	Collaboration	Nil	Nil
	Communication	High	Agrees
	Culture	High	Agrees
	Financial	Medium	Agrees
	Intellectual Property Rights	High	Agrees
	Politics	Medium	Agrees
	Structure	High	Agrees

Table 5.4. shows that Academic participants highlighted most of the themes synthesised from the literature review except for collaboration being a barrier for KT&TT activities. Also, there was a high linkage strength across the themes with all the findings agreeing with the literature.

Previous engagement

The findings regarding previous engagement from Academics support the literature (Plewa et al., 2013; Wallin et al., 2014; Ghauri & Rosendo-Rios, 2016; Steinmo & Rasmussen, 2018). There was agreement that if the collaboration has performed well, it will have a positive effect on future relationships (Wallin et al., 2014; Steinmo & Rasmussen, 2018). This emphasises the significance of developing those initial informal encounters with Industry partners since, following a successful engagement, the likelihood that the relationship will develop into more formal collaborations improves. In order to connect Academics with business partners, the PTWEZ can be extremely helpful.

Trust

The participants identified Trust as a significant factor in KT&TT activities, which supports the literature (Inkpen & Tsang, 2005; Plewa et al., 2013; D'Este et al., 2013). Trust was identified as a significant part of forming the relationship (Plewa et al., 2013). This was agreed by the literature and the findings of the importance of '*Trust*' in the beginning of a relationship.

Findings found that '*Trust'* is built with the individual, not the organisation. *'Trust'* is built over time and is lost in a second, which makes it complicated process. The university has a requirement to be as transparent as possible to Industry stakeholders and fulfil the goals agreed when these KT&TT activities occur. There is also a requirement from the Industry side to build trust. This is a novel finding which makes a new contribution to the knowledge of 'Trust' in this area of research.

Distance/Connectivity

Distance was a key theme questioned in the interview, which sets to answer research question; *"What factors impact the KT&TT activities*?". This section discusses its relation to the literature. Below is *Table 5.5* shows the alignment to the literature of the themes highlighted in the findings.

Table 5. 5: overview of Distance/Connectivity with alignment to the literature for Academic participants.

Distance/ connectivity	**Alignment to the literature**
Proximity	Agrees
Relationship	Disagrees
Technology	Agrees

Three key themes were identified when interviewees were questioned around '*Distance/Connectivity'.* All three agreed with the literature with details of this to follow.

Proximity

'*Proximity'* was signified as critical by Academic Interviewees. Some participants argued the importance of proximity, which would maximise the chances for KT&TT activities to occur, this is supported by (Van Wijk et al., 2008; Rogers, 2010). Also, the importance of clusters to support KT&TT activities and regional growth (Reve, 2011; Bottazzi & Dindo, 2013) Both the literature and the findings from the primary data support the need for proximity when carrying out KT&TT activities.

Relationship

Academic participants highlighted the significance of a good relationship and its ability to minimise distance as a barrier, which contradicts the findings by Morandi (2013) who found that the experience with a firm does not change distance as a barrier. Moreover, Laursen and Salter (2014) found that a firm's absorptive capacity can minimise distance as a barrier. Yet, there are differences between the literature and the findings, similarities can be drawn upon when distance becomes a factor in the relationship. The effects of COVID-19 have forced individuals to communicate online and from great distances.

Technology

The developments of technology, has reduced the effects of '*Distance'* as a barrier (Renato Garcia et al., 2018). This illustrates that Academic interactions can be short or long distance, but the closer the person is to the university, the better. PTWEZ can reduce distance by connecting with Academics and Industry to assist KT&TT activities.

Table 5. 6: Overview of Distance/Connectivity for Academic participants

Academia	Themes	Linkage strength	Alignment to the literature
	Proximity	High	Agrees
	Relationship	Medium	Disagrees & adds
	Technology	Medium	Agrees

Of the themes discussed above, '*Proximity'* and '*Technology'* tends to agree with the literature. The finding on 'Relationship' disagrees with the literature but also sets to add as new findings for affects that can decrease distance as a barrier.

Potential to Mitigate barriers

The following section discusses themes to mitigate barriers in relation to the literature review by answering the research aim "*Develop tools/initiatives that can support these KT&TT activities in the region". Table 5.7* shows the alignment of the key themes synthesised.

Table 5. 7: Themes to mitigate barriers and alignment to the literature

Mitigate barriers	Alignment to the literature
Cluster	Agrees
Collaboration	Agrees
Communication	Agrees
Financial	Agrees
IPR Management	Agrees
Structure	Agrees

Intellectual Property Rights Management

There were suggestions by Academic participants that giving away IP could improve the potential for successful commercialisation to occur, which is supported in the literature (Alexy et al., 2009; Holgersson & Wallin, 2017). In addition, to improve the relationship between the key actors when dealing with IP, our findings suggest that clear communication and transparency is critical to its success, which agrees with the literature (El-Ferik & Al-Naser, 2021). This supports secondary data collected on AgorIP outputs and Welsh EZs regarding the potential linkages between TTOs and EZs *(See section 4.3.10.).*

Structure

Structure sets to agree with the literature for the need to improve relations between Industry and Academia through the development of KT teams (Kotha et al., 2013; K. Miller et al., 2018). The PTWEZ can support this in offering a location to bridge the gap between these entities by becoming a focal point.

Clusters

The role of clusters in overcoming the barriers has been a recurring theme. This aligns with the literature, where clusters have been found to benefit Industry, Academia, and Government (Reve, 2011; C. F. Kim et al., 2012; W.-H. Liu, 2013; Diamond, 2016; Reid, 2018; Valero & Van Reenen, 2019). The PTWEZ can act as a key area to support formation of *'Clusters'* in areas such as manufacturing, clustering and green energy. Secondary data collected on a sector within the PTWEZ suggests that the main clusters should be built within manufacturing and construction sector as they make up 49.7% of all the businesses. However, opportunities are emerging within the energy sector (5%) with investment being

pledged, most recently of the announcement for a £1.7 billion tidal lagoon to be built in Swansea (SQW, 2014; Swansea Council, 2021) *(See figure 4.9).*

Communication

The potential for improvements in communication was raised by Academic participants to minimise associated barriers. Increased clarity from the outset for Industry partners expectations can minimise associated barriers (Plewa et al., 2013; Malik, 2013; Ankrah & Al-Tabbaa, 2015; Estrada et al., 2016). These findings agree with the literature which describe the r importance of clear dialogue and complete transparency in performing KT&TT activities while maintaining expectations.

Financial

Specific funding to promote and facilitate KT&TT activities was suggested to help develop levels of activities and success (Feldman et al., 2002; Hughes & Kitson, 2012). However, Lawson (2013a) argued that private funding can affect the researcher's ability to patent, compared to it being public funding. When AgorIP accepts private funding, it is important that the correct agreements are in place to minimise any issues with the researcher to any issues and potential disputes over IPR and ownership.

Collaboration

Collaboration, as suggested by Academic participants, can help mitigate the barriers shown in *Table 5.4.* This is supported by Ankrah and Al-Tabbaa (2015) with collaboration being described as a significant part of the KT&TT activities. Developing the right collaborations through aligning the right Academic and Industry can maximise the chances for success. The PTWEZ can play a role in putting forward Industry that want to collaborate with Academia that relates back to focal point concept (Youtie & Shapira, 2008; Reve, 2011).

Table 5. 8: Overview for mitigating barriers for Academic participants

Academia	Themes	Linkage strength	Alignment to the literature
	Cluster	Low	Agrees
	Collaboration	Medium	Agrees
	Communication	Low	Agrees
	Financial	Medium	Agrees
	Intellectual property Rights	Medium	Agrees
	Structure	Medium	Agrees
	Technology	Nil	Nil
	Strategy	Nil	Nil

All interviewee themes match the literature. The lesser apparent linking strength across these topics may be due to confusion about how to mitigate barriers. Two themes were not discussed that were '*Technology'* and *'Strategy'*.

How can PTWEZ impact Knowledge Transfer & Technology Transfer

The following section presents discussion as to how the PTWEZ can impact on the KT&TT activities in South West Wales. *Table 5.9* below presents how the key themes align with the literature. This seeks to answer the research aim "To understand how the PTWEZ positively impact on innovation activities in the region", recognising the existing and potential contribution made through these activities (Potter & Moore, 2000; GOV, 2012; Hatch, 2018; WG, 2019a; BW, 2019). Low linkage strength and a variety of themes indicate that Academic participants had alternative answers to the main research question posed.

Table 5. 9: PTWEZ themes and alignment from Academic participants

PTWEZ Impact	**Alignment to the literature**
Cluster	Agrees
Communication	Agrees
Financial	Adds to the literature
Infrastructure	Disagrees
International	Adds to the literature
Sustainability	Adds to the literature
Collaboration	Agrees

Clusters

The development of *'Clusters'* were mentioned by participants as a way the PTWEZ can impact KT&TT activities within the region of South West Wales. This idea aligns with the policy-driven approach to move Industry into a region (Y.-S. Su & Hung, 2009; Swords, 2013). However, Swords (2013) criticised the impact of forced clustering. There is successful evidence for the impact of policy driven initiatives to support clusters (Heikkila & Xu, 2014). The formation of clusters around EZs are significant in economic growth (Gazel & Schwienbacher, 2019; Hatch, 2020). This highlights the importance of the PTWEZ to have clusters developed within the zone to support Industry. This is further supported by secondary data collected on businesses within the PTWEZ showing a focus on interrelated manufacturing and construction activities, with investment being pledged into the renewable energy sector (SQW, 2014; Swansea Council, 2021) *(See figure 4.9.).*

Communication

Academic participants saw *'communication'* as a way to improve KT&TT efforts. (Plewa et al., 2013; Ankrah & Al-Tabbaa, 2015; Estrada et al., 2016). Trippl and Tödtling (2007) found that a key component to a successful RIS is through good communication networks. This supports findings by Hatch (2020) for further development of communication in the context of UEZs. The literature and findings suggest the need for the PTWEZ to have a clear direction and to communicate effectively with key stakeholders within the RIS of South West Wales.

Financial

Funding was suggested to help the KT&TT activities by Academic participants (Y.-S. Su & Hung, 2009; Kitagawa & Lightowler, 2013). Y.-S. Su and Hung (2009) highlights the benefits associated to policy led clusters that often have financial support. However, Lawson (2013a) argued that private funding can impact the researchers ability to patent, compared to it being public funding. Through the support of AgorIP and their funding schemes, they can advise researchers with their desire for commercialisation.

Infrastructure

Infrastructure was seen by Academic participants as an area of focus to be developed within the PTWEZ (WAG, 2010). This contradicts findings by Hatch (2020) of the benefits UEZs bring

for infrastructure opportunities. Also, some of the key targets aimed by EZs and Welsh EZs were the development of infrastructure support (BW, 2019). The findings disagree with some of the main aims set out by EZ policy in Wales that is an area to address going forward. However, it is noted that only 20% of participants raised this as an issue.

International

Academic participants' findings add to the knowledge on improved foreign commerce from Welsh EZs post-Brexit. Industrial distance and national language can be barriers if PTWEZ wants to promote international business, according to the literature. (Kotabe et al., 2003; Malik, 2013). Other factors such as differing in culture can impact these activities as well (Gertler, 2004; Gopalakrishnan & Santoro, 2004; Ahammad et al., 2016). PTWEZ should link industries to the global market, but distance, cultural, and language barriers should be minimised.

Sustainability

A unique finding, in an ever-growing topic, is the direction of sustainability. This finding by Academic participants sets to support the idea of key initiatives that are set out for a decarbonisation agenda (SPECIFIC, 2021; FLEXIS, 2021) which can address UK Government objectives of being net zero by 2050. Increased collaboration between SPECEFIC, FLEXIS, and the PTWEZ can provide opportunities for new ideas to be developed and supported.

Collaboration

Findings from Academic participants suggested the need for increased collaboration between the university and the PTWEZ. This supports findings by Hatch (2020) around the benefits associated with universities collaborating with the EZs, while also supporting the literature for collaboration effecting TK&TT (Friedman & Silberman, 2003; Ankrah et al., 2013; Tartari et al., 2014; Ankrah & Al-Tabbaa, 2015). The PTWEZ plays a critical role in facilitating the collaboration between Industry and Academia by being a non-biased entity with the goals of regional and economic development.

Table 5. 10: Overview for PTWEZ impact for Academic participants

Academia	Themes	Linkage strength	Alignment to the literature
	Cluster	Medium	Agrees
	Collaboration	Low	Agrees
	Communication	Low	Agrees
	Financial	Low	Agrees
	Infrastructure	Low	Adds
	International	Low	Adds
	Mapping	Nil	Nil
	Strategy	Nil	Nil
	Sustainability	Low	Agrees

Overall, though the themes discussed did not exhibit a high linkage strength, the findings provided some anecdotal evidence to support and add to the literature of infrastructure and international trade. Two themes that were not mentioned by Academic participants were '*Mapping'* and '*Strategy'*. The following section will provide discussion of the literature and how it will set to answer the main research question and Research aims

5.4.2. Government

The following section will provide a summary of the Government's perspective in relation to the literature and the research questions. Firstly, it will set out to answer the research aim of *"Map the factors that impact KT&TT activities in the region"* followed by *"Develop tools/initiatives that can support these KT&TT activities in the region".* Finally, the *research aim "To understand how the PTWEZ positively impact on innovation activities in the region".* These findings from the Government interviewees add a unique perspective in the literature of KT&TT activities between university and Industry, while providing information on how the Government in Southwest Wales supports the key stakeholders of Industry and Academia.

<u>Drivers</u>

Drivers discussed will refer to the literature and answer the aim *"Map the factors that impact the KT&TT activities in the region".* Below *Table 5.11* summarises the themes and the alignment to the literature.

Table 5. 11: Driver's alignment to the literature for Government participants

Drivers	**Alignment to the literature**
Collaboration	Agrees
Communication	Agrees
Economic Development	Agrees
Technology Transfer Office	Disagrees

Government's views and objectives usually aligned with the literature shown above. Although '*TTO'* was seen to disagree with the literature. There was a mixture of themes that had a high prominence, compared to others where it was relatively low for '*Communication'* and '*TTO'*. The following section will discuss the key themes.

Economic Development

Findings from Government participants suggest the benefits associated to KT&TT activities to economic development. Ankrah et al. (2013) highlighted the economic benefits associated with KT&TT activities. This was also supported in the RIS literature of the benefits associated with collaboration (Trippl & Tödtling, 2007; Bjorn T Asheim et al., 2011). This shows that Government representatives see an opportunity and benefits from Industry and Academia collaboration.

Collaboration

The benefits associated with collaborating were agreed upon by Government interviewees. This is in support of the literature outlining the benefits associated with collaborating (J. D. Adams et al., 2005; Albert N. Link et al., 2007; Ankrah et al., 2013; Ankrah & Al-Tabbaa, 2015). Financial gain is also attributed to the benefit of collaborating with one another (Adler & Kwon, 2002; Ankrah et al., 2013). Enhancing the collaboration with the key stakeholders in the RIS of South West Wales is critical to maximising KT&TT activities.

Communication

Government officials seeing communication as a driver for KT&TT activities, supports the literature (Plewa et al., 2013; Ankrah & Al-Tabbaa, 2015; Estrada et al., 2016). Both the literature and findings support the importance of '*communication'* and the affects it can have on KT&TT activities.

Technology Transfer Office

Having an effective '*TTO'* such as AgorIP is critical to the success and output of TT activities. However, the literature often suggests they are more a hindrance than help (Siegel, Veugelers, et al., 2007; Belitski et al., 2019; Holgersson & Aaboen, 2019). This can be seen as an opportunity for AgorIP to support the Academics in fulfilling their goals and support the transfer into the market and the PTWEZ. Secondary data collected shows the outputs AgorIP has achieved, which has shown from spin-outs achieved through IP and investment (*see figures 4.11 &4.12).*

Table 5. 12: Overview of Drivers for Government participants

Government	Themes	Linkage strength	Alignment to the literature
	Collaboration	High	agrees
	Communication	Low	Agrees
	Economic Development	High	Agrees
	Infrastructure	Nil	Nil
	Knowledge	Nil	Nil
	Research	Nil	Nil
	TTO	Low	Disagrees

Table 5.12 shows that there were a mixture of themes and linkage strength of these. The themes discussed, all agreed with the literature, except '*TTO'* that gives new insights to the literature. Themes that were not mentioned by Government participants were '*Infrastructure'*, '*Knowledge'*, and '*Research'.*

Barriers

This section will discuss the themes in the findings, while addressing how they fit into the literature. This section sets to answer the main research question "What are the drivers and barriers for the successful transfer of knowledge and technology transfer within the context of the Port Talbot Enterprise Zone?" and research aim "Map the factors that impact the KT&TT activities in the region". Below Table 5.13 summarises the alignment to the literature for barriers.

Table 5. 13: Overview of Barriers alignment to the literature from Government participants

Barriers	**Alignment to the literature**
Collaboration	Agrees
Communication	Agrees/ adds to the literature
Culture	Disagrees
Financial	Agrees
Intellectual Property Rights	Agrees
Structure	Agrees

Structure

Structural issues were a significant barrier mentioned by Government participants describing the issues around 'bureaucracy' and how it effects on the ability for Government to support these activities. This supports the literature of the impacts of structure to support KT&TT activities (Hughes & Kitson, 2012; Abreu & Grinevich, 2013; Ghauri & Rosendo-Rios, 2016; Galan & Plewa, 2016; K. Miller et al., 2018). The workload of university stakeholder is overwhelming at times that can limit their ability to collaborate.

Also, Government participants suggested Universities can be too slow in these activities, which supports the literature around the differing in time available for these activities (Galan & Plewa, 2016). The complexities of universities can cause confusion to potential collaborations as they cannot find the right person for the problem.

Financial

The lack of funding for Academic entities to take part in collaborations with Industry was highlighted in the literature (Hughes & Kitson, 2012; Kitagawa & Lightowler, 2013). Hughes and Kitson (2012) found that Industry often lack the resources to fund KT&TT activities with Academia, which adds to these findings. However, Kitagawa and Lightowler (2013) have suggested that the funding is lacking for KT activities. The findings and literature show that issues around lack of funding can impact on KT&TT activities.

Communication

'*Communication*' was a highly discussed topic by Government interviewees. A two-way breakdown of communication between Academia and Government stakeholders was suggested, which contributes to the literature as it often discusses communication concerns implicitly and does not explain how (Liyanage et al., 2009; Plewa et al., 2013; Estrada et al., 2016). In addition, Government participants found that there can be a language barrier between these stakeholders, which supports findings by (Malik, 2013). It is shown that it critical to communicate in a way that is understood from both sides of the relationship so that it can achieve the aims and objectives of the activity.

Culture

Culture also had high discussion from interviews (70%), of it being a barrier to KT&TT activities. With the literature supporting the issues around culture (Francis-Smythe, 2008; Ghauri & Rosendo-Rios, 2016; Sapuarachchi, 2021). This suggests from the findings and literature of the issues occurring when agreeing on outcomes in the KT&TT activity.
The literature suggests bureaucracy can occur between Industry and Academia when they are working together (R. McAdam et al., 2011; Belitski et al., 2019). The evidence from the literature and findings shows the issues that can occur during the KT&TT activity.

Intellectual Property Rights management

IPR management was highlighted among Government participants. They commonly described IP concerns, such as lack of expertise and improper management, which is supported in the literature (Alessandrini et al., 2013; Tartari et al., 2014; El-Ferik & Al-Naser, 2021). This highlights the complexities associate with IP and the skills required by '*TTO's* to appropriately deal with the IP process.

There was a suggestion by Government participants, that even though universities are charitable by nature they should give IP away (Alexy et al., 2009; Peters et al., 2013; Holgersson & Aaboen, 2019). Both the findings and literature support the approach of giving more IP away hoping it can have societal benefits to the region if it becomes successful.

Collaboration

Inadequate collaboration can pose difficulties, according to Government participants and the literature (Albert N. Link et al., 2007; Ankrah & Al-Tabbaa, 2015; HOC, 2017). The need for collaboration is essential of the KT&TT activities and needs to be carried out regularly.

Table 5. 14: Overview of Barriers for Government participants

Government	Themes	Linkage strength	Alignment to the literature
	Collaboration	Medium	Agrees
	Communication	high	Agrees & adds
	Culture	High	Agrees
	Financial	High	Agrees
	Intellectual Property Rights	Medium	Agrees
	Politics	Nil	Nil
	Structure	High	Agrees

The overview shows Government spoke about many of the themes and with a high linkage strength provides good direction as the main issues that impact KT&TT activities. All the themes discussed agree with the literature, while communication also sets to adds to the literature. However, '*Politics'* was not discussed.

Previous Engagement

Previous engagement sets to answer the research aim; "Map the factors that impact the KT&TT activities in the region". This was agreed by Government participants as a critical part to a long-lasting relationship, dependant on the success of the initial relationship, supports the literature (Plewa et al., 2013; Wallin et al., 2014; Ghauri & Rosendo-Rios, 2016; Steinmo & Rasmussen, 2018). Government participants said for 'Previous Engagement' to be successful, what was agreed upon must be delivered (L. Johnston et al., 2010; Ghauri & Rosendo-Rios, 2016). Academia and Industry must deliver what was agreed upon when the partnership was founded to enhance future collaborations.

Distance/Connectivity

Distance/Connectivity was a significant theme discussed in the literature (Tödtling & Trippl, 2005; Trippl & Tödtling, 2007; Ambos et al., 2008; Acs et al., 2013). (D'Este et al., 2013; Morandi, 2013; Helmers & Rogers, 2015; Sapuarachchi, 2021). *Table 5.15* summarises the themes alignment to the literature. This section sets to answer the aim; *"Map the factors that impact KT&TT activities in the region".*

Table 5. 15: Distance/Connectivity alignment to the literature for Government participants

Distance	**Alignment to the literature**
Proximity	Agree
Technology	Agree

Two themes were found from this area, with both findings agreeing with the literature. The next section provides a detailed summary of the themes synthesises from the analysis.

Proximity

Government participants saw proximity as important for innovation. This supports the literature on the significance of proximity (Van Wijk et al., 2008; D'Este et al., 2013; Helmers & Rogers, 2015).(Reve, 2011; Rissola & Sörvik, 2018; Venturini, 2019) The findings and the literature support the need for proximity with key stakeholders so they can benefit from each other when performing KT&TT activities.

Technology

Technology has shown to be a factor to minimise distance as a barrier when performing KT&TT activities (Renato Garcia et al., 2018). It is suggested that Trust is a vital part of the relationship.

Table 5. 16: Overview of Distance/Connectivity for Government

Government	Themes	Linkage strength	Alignment to the literature
	Proximity	Very High	Agrees
	Technology	High	Agrees
	Relationships	Nil	Nil

Findings and discussion support the importance of Distance/Connectivity for KT&TT activities, with the key factors of proximity and Technology reducing the effects of Distance as a barrier. '*Relationships' was not* discussed as a theme.

Trust

Government participants found that '*Trust*' was instrumental in the forming of relationships, where once '*Trust*' is formed, the effectiveness of relationships is increased substantially (Plewa et al., 2013; Ankrah & Al-Tabbaa, 2015; Vick & Robertson, 2018; de Wit-de Vries et al., 2018). However, participants argued that once '*Trust*' is lost, it is very difficult, arguably impossible to repair, which adds to the literature. Full transparency must be applied when collaborating with the various Academics and Industry stakeholders, this will increase the chances of a successful interaction, which builds '*Trust*'.

Potential to mitigate barriers

The following section sets to answer the research aim; *"Develop tools/initiatives that can support these KT&TT activities in the region".* By addressing what Government participants views were on mitigating barriers compared to the literature. *Table 5.17* summarises the themes and alignment with the literature.

Table 5. 17: Mitigate barriers alignment to the literature for Government participants

Mitigate Barriers	**Alignment to the literature**
Clustering	Agrees
Collaboration	Agrees
Communication	Agrees
Financial	Adds to the literature
Intellectual Property Rights Management	Agrees
Strategy	Agrees
Structure	Agrees
Technology	Agrees

It is shown in table 5.17 that most of the themes synthesised agree with the literature, except for '*Financial*' and '*Strategy*' that add to the literature. The following section will provide a summary of the findings in relation to the literature review.

Clustering

Findings by Government participants found that clustering is an important aspect to mitigate barriers. This is supported in the literature (Cheng et al., 2014) regarding the benefits associated with policy driven clusters. Though planning must take place to get the right businesses and skilled people to support the clusters. However, it disagrees with some of the

literature around the effectiveness of policy led clusters (Swords, 2013). The PTWEZ can access some benefits associated with policy led clustering by providing a growth in industries such as green energy, manufacturing, and construction.

Collaboration

Collaboration had a high level of discussion among Government participants, with it being a significant factor in mitigating the barriers. This was supported in the literature on the importance of collaboration between Industry and Academia (Albert N. Link et al., 2007; Bozeman et al., 2008; D. P. Leyden et al., 2008; Ankrah & Al-Tabbaa, 2015). The findings and literature support the importance of collaborating with key stakeholders within the region.

Communication

Communication had a low (10%) level of discussion, though it is still an aspect for improvement. Where, it was supported by Plewa et al. (2013) of the significance of communication in mitigating barriers. The importance of communicating to key actors is significant to development on potential KT&TT activities.

Financial

Financial had a medium level (30%) of discussion from Government participants. The literature highlights the importance of finance (Tödtling & Trippl, 2005; Trippl & Tödtling, 2007; Hughes & Kitson, 2012; Kitagawa & Lightowler, 2013). However, participants suggested an improvement of incentive offerings from Welsh EZs, would increase the chances for companies to move there and stay there, which adds to the EZ literature. This was supported through secondary data collected on EZs showing a disconnect between financial offerings of English and Welsh EZs *(See section 4.6) (GOV, 2012; WG, 2018).*

Intellectual Property Rights Management

IPR management had a low level of discussion from Government interviewees. However, it was still mentioned as an area to mitigate those barriers. The idea of offering licenses out to companies to improve their chances of success echoes the literature as a strategy (Alexy et al., 2009; Peters et al., 2013; Holgersson & Wallin, 2017; Holgersson & Aaboen, 2019). This suggests that TTOs should give away more licenses that will maximise the potential for the success of these activities.

Strategy

Strategy received a high level (60%) of discussion from the participants to mitigate barriers. Where improvements should be made to make the process streamlined between Academia and Industry. This idea sets to agree to the literature and Government objectives for increased strategy in their approaches (Martin & Sunley, 2003; Huggins & Kitagawa, 2012; HM Government, 2017). Ensuring Academic stakeholders such as AgorIP and the PTWEZ have a coherent strategy that achieves their common goals from each is critical.

Structure

Participants' discussion of the structure accounted for 30%. Participants suggested the idea of a third party to instigate the relationship between Industry and Academia. This can be seen as a way of impartially seeing both sides of the discussion to get the best result for all parties involved (Youtie & Shapira, 2008; Reve, 2011; Rissola & Sörvik, 2018). Having a location for Academic and Industry stakeholders to collaborate can offer to solve some of the '*Structural barriers'* highlighted from the findings and the literature.

Technology

Technology (10%) had a low discussion for it to mitigate KT&TT barriers. Though video conferencing technology can support barriers associated with distance (Renato Garcia et al., 2018), it cannot take its place of the importance of being in the same room as the individual. However, if there were key stakeholders further away, then technology can play a critical part in creating a relationship and maintaining this.

Table 5. 18: Overview of Mitigating barriers for Government participants.

Government	Themes	Linkage strength	Alignment to the literature
	Clustering	Medium	Agrees
	Collaboration	High	Agrees
	Communication	Low	Agrees
	Financial	Medium	Agrees
	IPR Management	Low	Agrees
	Strategy	High	Agrees
	Structure	Medium	Agrees
	Technology	Low	Agrees

The overview of *table 5.18* of themes shows Government highlight all the potential themes from this section. With most of the themes agreeing with the literature, 'Financial' sets to add new insights to the literature. This goes a long way to answer the research aim *"*Develop tools and/or initiatives that may support KT&TT activities in the region".

How can PTWEZ impact Knowledge Transfer & Technology Transfer

This section sets to discuss the main themes synthesised, compared to the literature. Below table 5.19 depicting how the key themes compare to the literature. The research aim set to be answered is; *"To understand How the PTWEZ can positively impact on innovation activities in the region".*

Table 5. 19: PTWEZ impact Alignment to the literature for Government participants

PTWEZ Impact	**Alignment to the literature**
Clusters	Agrees
Collaboration	Agree
Financial	Adds to the literature
Infrastructure	Agrees
Strategy	Agrees
Mapping	Agrees

Clusters

Cluster received some discussion from Government participants. They supported the need for clustering as a way for EZs to improve on KT&TT interactions within the region. (Cheng et al., 2014; Heikkila & Xu, 2014). However, a report by Hatch (2020) suggested it may be difficult for UEZs to cluster around the zones being quite new to an area. This shows further development needs to be taken to establish the PTWEZ within a region.

Collaboration

Collaboration had a medium amount of discussion among participants. The idea of 'Nexus', supports the literature around an 'innovation hub' for collaboration between Academia and Industry (Youtie & Shapira, 2008; Reve, 2011). A 'Nexus' situated in the PTWEZ would minimise some of the barriers mentioned earlier, by providing a location for likeminded Academic and Industry practitioners. This would allow individuals to develop relationships in the hope that it will lead to KT&TT activities. This was supported through secondary data showing links to Academia for Welsh EZs *(See figure 4.8).*

Financial

Academic Participants suggested the need for *'Financial'* incentives to maximise the success for the PTWEZ and Welsh EZs. These findings add to the literature around the need for financial incentives (Tödtling & Trippl, 2005; Trippl & Tödtling, 2007; Hughes & Kitson, 2012; Kitagawa & Lightowler, 2013). With more financial offerings, the PTWEZ will compete with English EZs. The business then decides on the location based on the resources and infrastructure available.

Infrastructure

The need for availability of physical property was raised by Government participants. This would allow for companies to relocate and spin-out from the surrounding universities, these findings support the literature (Henrekson & Rosenberg, 2001; Trippl & Tödtling, 2007; McKinsey, 2014). Development of these infrastructure mechanisms will make the PTWEZ more enticing to businesses wanting to locate here and for them to stay long term.

Strategy

Strategy had a low discussion by Government participants. However, there was suggestion that proper implementation of the strategy developed, which supports Government objectives for improved strategy (Hatch, 2018; Reid, 2018; Hatch, 2020). This will help give direction and understanding of the key aims and objectives of the PTWEZ so that universities can align with their strategy.

Mapping

Mapping recommendations links to '*Clusters'*, though it had a low discussion point. Appropriate planning needs to be undertaken to understand the strengths and weaknesses of the EZ, so that the correct industries are targeted (Kowalski & Marcinkowski, 2014). The development of mapping will support the theme for clusters. This will give direction to the PTWEZ in the key industries that should be developed (Foray, 2018). Secondary data collected gives mapping of the PTWEZ showing Manufacturing (22%) and construction (28%) *(See figures 4.9).* This can help support Government and policy makers for a suitable strategy for relocating the right Industry to the region.

Table 5. 20: Overview of PTWEZ Impact for Government participants

Government	Themes	Linkage strength	Alignment to the literature
	Clusters	Medium	Agrees
	Collaboration	Medium	Agrees
	Communication	Nil	Nil
	Financial	Low	Adds to the literature
	Infrastructure	Medium	Agrees
	International	Nil	Nil
	Mapping	Low	Agrees
	Strategy	Low	Agrees
	Sustainability	Nil	Nil

The themes discussed in this section, provided supporting evidence to answer the research aim "To understand how the PTWEZ can positively impact on innovation activities in the region". Financial was the only theme that didn't agree with the literature but provided new insights. The key themes that were not discussed by Government were '*Communication'*, '*International'*, and '*Sustainability'*.

5.4.3. Industry

This section sets to summarise Industry participants in *phase two* of the research design. Also, the main research question; "What are the drivers and barriers for the successful transfer of knowledge and technology transfer within the context of the Port Talbot Enterprise Zone?"; the research aims of "What factors impact the KT&TT activities" followed by "Develop tools/initiatives that can support these KT&TT activities". Finally, the aim "To understand how the PTWEZ can positively impact on innovation activities in the region". Findings from the Industry perspective attempts to add to the ever-growing body of literature of KT&TT, RIS, Clusters etc.

Drivers

Table 5.21 provides a summary of the alignment to the literature. This section sets to answer the aim *"Map the factors that impact the KT&TT activities in the region"*

Table 5. 21: Driver's alignment to the literature for Industry participants

Drivers	**Alignment to the literature**
Collaboration	Agrees
Economic Development	Agrees
Infrastructure	Agrees
Technology Transfer Office	Disagrees
Knowledge	Agrees

For the themes discussed in this section, all the themes set to agree to the literature, except for 'TTO' that will disagree with the literature found on the area. The following part of this section will provide a detailed summary of the findings in relation to the literature review.

Collaboration

Collaboration received a moderate amount of discussion from Industry participants. When collaboration is successfully accomplished, you have the highest chance to maximise KT&TT activities, this supports the literature (J. D. Adams et al., 2005; Albert N. Link et al., 2007). This suggests the importance for Academic stakeholders collaborating often with Industry partners. Further data collected on Welsh EZs show the desire for collaboration between EZs and Academic institutions *(see figure 4.8).*

Knowledge

Knowledge received a moderate amount of discussion from interviewees. This would benefit Industry participants by looking at problems differently (Perkmann & Walsh, 2007; Trippl & Tödtling, 2007) (Ankrah & Al-Tabbaa, 2015). Industry participants also valued the university's knowledge base, which confirms the research on "knowledge spillover" and the benefits of KT initiatives (Trippl & Maier, 2011). This opens an avenue for Industry within the PTWEZ and in the surrounding regions they can benefit from being involved with Swansea University.

Economic Development

Benefits associated with '*Economic Development'* were referenced by Industry interviewees. Specifically, Industry representatives described the desire to take advantage of Welsh companies and keep them in the area for maximum benefit to the region and country. This supports findings by Ankrah et al. (2013) regarding the importance of KT&TT activities to economic development (Leydesdorff & Etzkowitz, 1998; G. Davies, 2021). To minimise businesses from leaving the area, the correct resources and infrastructure should be in place to keep these businesses. There should be constant dialogue between AgorIP and the PTWEZ to make use of any resources the university offers to Industry.

Technology Transfer Office

TTOs also received a low level of discussion from interviewees. However, it was suggested AgorIP were not considered a barrier to KT&TT activities in the eyes of the interviewees. This supports the notion that they may be considered a driver to support KT&TT activities. This disagrees with the literature that TTOs are often perceived as a barrier. Data on AgorIP output shows the benefits associated with the TTO of Swansea University and their ability to perform KT&TT activities. Specifically, they have been able to achieve 19 spin outs with IP and investment *(See figures 4.10 and 4.11).*

Infrastructure

Infrastructure had a low level of discussion. However, it was still seen as a driver for KT&TT activities. The findings support the literature of the benefits associated with the correct infrastructure (Henrekson & Rosenberg, 2001; Trippl & Tödtling, 2007; McKinsey, 2014). With the focus for the PTWEZ to develop property for spin-out and business to move too.

Table 5. 22: Overview of drivers for Industry participants

Industry	Themes	Linkage strength	Alignment to the literature
	Collaboration	Medium	Agrees
	Communication	Nil	Nil
	Economic Development	Medium	Agrees
	Infrastructure	Low	Agrees
	Knowledge	Medium	Agrees
	Research	Nil	Nil
	Technology Transfer Office	Low	Disagrees

Overall, all the themes agree with the literature except for '*TTO*' that disagrees with the literature. There were two themes that were not mentioned by Industry interviewees, '*Communication*' and '*Research*'. Also, this section has achieved to answer the research aim *"Map the factors that impact the KT&TT activities?"*

Barriers

This section highlights the main themes collected in relation to the literature against the findings from *phase two* of the research. This is supplemented with *Table 5.22* which shows the alignment to the literature for barriers. The research aim sets out to answer *"Map the factors that impact KT&TT activities".*

Table 5. 23: Barrier's alignment to the literature for Industry participants

Barriers	**Alignment to the literature**
Communication	Agrees
Culture	Agrees
Financial	Agrees
Intellectual Property Rights	Agrees
Structure	Agrees

The table above shows that all the themes discussed in this section align to the literature. The following part of the research will summarise the findings and the literature review carried out for each theme.

Structure

Structure received a high level of discussion by Industry participants. They describe universities as '*siloed*' which makes them difficult to work with on these activities (Francis-Smythe, 2008; Ghauri & Rosendo-Rios, 2016). It was also suggested that they are structurally impossible to change to the demands of Industry, this supports the literature of the differences between Academia and Industry (Hughes & Kitson, 2012; Galan & Plewa, 2016; K. Miller et al., 2018). Both the findings and literature highlight the difficulties associated with KT&TT activities occurring between Industry and Academia.

Communication

Communication had a low level of discussion by Industry participants. They suggested that there was sometimes a barrier to differing in languages and this would effect on their ability to achieve the desired goals in the KT&TT activities, which agrees with the literature (Malik, 2013). This suggests that when Industry is dealing with international companies, they need to be appropriately prepared if they are dealing with companies in a foreign language.

Financial

Barriers relating to financial had a low amount of discussion from Industry participants. They referred to not having enough resources to collaborate with university stakeholders. This supports the literature around organisations having difficulties in funding KT activities (Feldman et al., 2002; Hughes & Kitson, 2012; Huggins & Kitagawa, 2012). Finance is considered as a component in the literature, with references from Industry interviewees.

Culture

Industry participants discussed '*Culture'* in a moderate level (42%). Issues arise when they are forming relationships with Academia over common goals. The literature supports the view around the difficulties associated to differing in cultures (Francis-Smythe, 2008; Ghauri & Rosendo-Rios, 2016). Some claim that cultural barriers to these activities are greater than geographic ones. *Also; "It's an uphill battle to bring them along." I9* The findings and literature show there is hesitancy involved when Industry wants to collaborate with Academia.

Intellectual Property Rights

IPR had a medium amount of discussion by Industry interviewees that often referred to the breakdown in '*Trust'*, through bad relationships with IP and overevaluation experienced. Also, there were issues mentioned around the difficulties to appropriately evaluate the IP coming out of the universities, which can de-motivate Industry stakeholders (Siegel, Veugelers, et al., 2007; Lockett et al., 2008; El-Ferik & Al-Naser, 2021). A consultant within South West Wales echoed this; *"There is a lack of understanding often in Academia of the potential value of the outcomes that could be achieved from the research." I7.* However, the barriers were not referenced to AgorIP, but generally.

Table 5. 24: Overview of Barrier for Industry participant

Industry	Themes	Linkage strength	Alignment to the literature
	Collaboration	Nil	Nil
	Communication	Low	Agrees
	Culture	Medium	Agrees
	Financial	Medium	Agrees
	Intellectual Property Rights	Medium	Agrees
	Politics	Nil	Nil
	Structure	High	Agrees

From the table shown above, all the themes discussed agree with the literature presented in *chapter two.* Yet most of the barriers were not that prominent in the interviews. Also, two themes were not discussed were '*Politics'* and '*Collaboration'*. This could be because they were not considered barriers.

Previous engagement

Previous engagement sets to answer the aim "Map the factors that impact the KT&TT activities in the region". This was agreed unanimously as a significant factor in KT&TT activities. Specifically, the face-to-face interaction is critical to forming a relationship, that in the future, potential KT&TT activities can be agreed upon (Wallin et al., 2014; Steinmo & Rasmussen, 2018). A critical part is hosting regular networking sessions between Industry and Academic stakeholders, which can have long-term benefits to those involved.

Distance/connectivity

This section answers the aim *"Map the factors that impact the KT&TT activities in the region".* Distance has shown to be a significant theme to impact KT&TT activities, RIS and Knowledge Spillovers in the literature (Tödtling & Trippl, 2005; Trippl & Tödtling, 2007; Ambos et al., 2008; Acs et al., 2013). Table 5.24 summarises the themes and their alignment with the literature.

Table 5. 25: Distance/Connectivity and alignment to the literature for Industry participants

Distance/connectivity	Alignment to the literature
Proximity	Agrees
Technology	Agrees

Of the two themes synthesised, both themes agree with the literature review from *chapter two*. The next part will compare the findings against the literature.

Proximity

Industry participants found 'Proximity' to be significant within 'Distance/Connectivity'. However, Industry participants had conflicting views on the importance of this. Some argued that distance is not as much of a barrier because of the ease of communication (Reagans & McEvily, 2003; Laursen & Salter, 2014). This is an important aspect that Industry and Academic stakeholders should consider towards understanding global markets and getting the most suitable collaboration.

However, others argue the importance of proximity, describing KT activities as much more effective when it is carried out in person (D'Este et al., 2013; Helmers & Rogers, 2015). Being in proximity, can have many advantages for both sides of the relationship. However, it is important to have both close relationships and globally.

Technology

Industry participants believed that *'Technology'* can play an important part in reducing distance as a barrier, which supports findings of Renato Garcia et al. (2018). However, different time zones can complicate Industry's ability to achieve these activities (Malik, 2013). When involved in cross-time zone interactions, proper planning and discussion should begin with all parties involved to find a mutual time that works.

Table 5. 26: provides and overview of Distance/Connectivity for Industry participants

Industry	Themes	Linkage strength	Alignment to the literature
	Proximity	High	Agrees
	Technology	Medium	Agrees
	Relationships	Nil	Nil

This overview shows the themes discussed by Industry interviewees agreed with the literature. However, there was no discussion of the impact of relationships that suggests Industry discuss this area in a more transactional way.

Trust

Trust was a significant theme found in the literature, with this being agreed between the Industry participants as significant to the KT&TT activities (Van Wijk et al., 2008; Plewa et al., 2013; Howard et al., 2016; Estrada et al., 2016; Vick & Robertson, 2018). The following section sets to answer research aim "Map the factors that impact KT&TT activities". Trust is formed over time, and it is important that everyone is transparent with what they can give to achieve the goals agreed (Plewa et al., 2013; Vick & Robertson, 2018). *This creates trust over time, allowing both parties to realise their aims.*

Potential to mitigate barriers

The section sets to answer the aims; “Develop tools/initiatives that can be support these KT&TT activities in the region” by providing information on the findings and the literature review. Below is *Table 5.27.* giving a summary of the theme’s alignment to the literature.

Table 5. 27: Industry alignment to the literature for mitigating barriers

Mitigate Barriers	**Alignment to the literature**
Clusters	Agrees
Collaboration	Agrees
Financial	Adds to the literature
Strategy	Agrees
Technology	Adds to the literature

Table 5.27 shows that a selection of themes adds to the literature are ‘*Financial*’, *Strategy*’ and ‘*Technology’* along with the other themes. The next part will give an overview of the findings and literature review.

Collaboration

Collaboration had a high amount of discussion from Industry participants. The PTWEZ was suggested as an initiative that can support the linkages between Academia and Industry, where this supports the literature in a variety of ways (Trippl & Tödtling, 2007; Youtie & Shapira, 2008; Reve, 2011; Rissola & Sörvik, 2018). Albert N. Link et al. (2007) found that collaboration benefits both the Academic and Industry stakeholders participating. This suggests the idea of a *‘focal point’* point for the PTWEZ to bring together key stakeholders from Industry, Academia, and Government.

Financial

Industry participants discussed finance at a moderate level. They suggested a need for finance to support Industry, which can keep the Welsh EZ competitive. This finding sets to add to the literature. This could be supported by local Government redirecting some funds that are already in place and the potential to involve VCs within the zone.

Clusters

Clusters received a low amount of discussion of Industry participants (8%). The PTWEZ can be a hub for businesses across South West Wales, this supports the literature on the significance of clusters (Reve, 2011; Heikkila & Xu, 2014; BW, 2019).

Strategy

Strategy was discussed moderately by Industry interviewees. Interviewees suggested that the university should get spin outs to leave as soon as possible to give them the best chance for success (Alessandrini et al., 2013; Holgersson & Wallin, 2017; El-Ferik & Al-Naser, 2021). This finding agrees with the literature regarding the importance of commercial potential to leave the university quickly.

Technology

Technology had a low discussion point by Industry. However, they suggested that video communication tools can enhance their communication to key stakeholders locally and globally that supports the literature (Renato Garcia et al., 2018).

Table 5. 28: Overview of Mitigating barriers for Industry

Industry	Themes	Linkage strength	Alignment to the literature
	Clusters	Low	Agrees
	Collaboration	High	Agrees
	Communication	Nil	Nil
	Financial	Medium	Agrees
	Intellectual Property Rights	Nil	Nil
	Strategy	Medium	Agrees
	Structure	Nil	Nil
	Technology	Low	Agrees

All the themes synthesised were agreed upon with the literature, with '*Collaboration'* having high prominence, agreeing with the literature as the most agreed way to mitigate barriers. Industry did not discuss '*Communication'*, '*IPR'* or 'Structure' in mitigating barriers.

How can PTWEZ impact KT & TT

This section discusses how the PTWEZ can affect the KT&TT activities in the region by answering the aim *"To understand How the PTWEZ cam positively impact on innovation activities in the region".* To achieve this, the section will give an overview of the findings and literature review from this thesis. *Table 5.28* will summarise the themes and their alignment with the literature.

Table 5. 29: Industry Alignment to the literature for PTWEZ Impact

PTWEZ Impact	**Alignment to the literature**
Clusters	Agrees
Collaboration	Agrees
Financial	Agrees
Infrastructure	Agrees
Strategy	Agrees

Clusters

Clusters were mentioned by Industry stakeholders as a way for the PTWEZ to increase their ability to perform KT&TT activities. However, this only received a low amount of prominence. This concept supports the literature of the benefits clusters bring for economic development (Cheng et al., 2014; Heikkila & Xu, 2014; Hatch, 2020). Secondary data collected on this suggest the biggest proportion of Industry that is within the PTWEZ is Manufacturing (22%) and Construction (28%) (*See figure 4.9).* Though other areas such as Energy (5%) have been an area of focus in the region recently, with the net carbon goals Wales wants to achieve. This gives support of the idea of developing clusters that will benefit the region and its industries.

Collaboration

Collaboration had a medium amount of discussion by Industry. They suggested the importance of collaborating with as many key stakeholders as possible (Reve, 2011; Ankrah & Al-Tabbaa, 2015; Terroir, 2019). This also agrees with the idea of including key stakeholders in one location (Youtie & Shapira, 2008; Reve, 2011; R. E. Pugh, 2014; SQW, 2014). Including key stakeholder from Academia into the PTWEZ can bring benefits to all stakeholders by improving KT&TT activities.

Financial

Increasing funding was discussed among Industry interviewees (50%). They suggested that there is an indifference in funding mechanisms between English and Welsh EZs that can have an impact of the effectiveness of Welsh EZs. Finance is a key theme discussed in the literature (Tödtling & Trippl, 2005; Trippl & Tödtling, 2007; Huggins & Kitagawa, 2012; Hughes & Kitson, 2012). This highlights the need for increased and consistent funding to effectively carry out KT&TT activities.

Infrastructure

Industry interviewees raised '*Infrastructure'* as a solution to support KT&TT activities. The development of infrastructure to the region, such as property, increases the chances for businesses to relocate and stay in the region. However, compared to offering financial incentives, if the business leaves, you still have the asset of the property to offer to other businesses. Infrastructure is a theme highlighted in Government reports as an advantage to locate to an EZ (Ward, 2016; JLL, 2016; WG, 2019a). The findings and literature highlight the importance of '*Infrastructure'* developments.

Strategy

'Strategy' had a low amount of discussion by Industry. However, it was suggested by participants of need for a clear '*Strategy*' on what Industry they want to bring to the area (Peter F. Drucker, 2002; Foray et al., 2011; JLL, 2016; HM Government, 2017; BEIS, 2017; WG, 2019a). To have an effective EZ, the strategy should take place to understand what Industry is best suited to the region.

Table 5. 30: Overview of PTWEZ impact for Industry

Industry	Themes	Linkage strength	Alignment to the literature
	Cluster	Low	Agrees
	Collaboration	High	Agrees
	Communication	Nil	Nil
	Financial	Medium	Agrees
	Infrastructure	Medium	Agrees
	International	Nil	Nil
	Mapping	Nil	Nil
	Strategy	Low	Agrees
	Sustainability	Nil	Nil

The standout theme discussed by Industry was Collaboration with a high linkage strength agreeing with the literature. Other key factors discussed were 'Clusters', 'Financial', 'Infrastructure', and 'Strategy' that all agree with the literature. However, the themes that were not discussed were 'Communication', 'International', 'Mapping', and 'Sustainability. The following section will summarise all the themes from the key stakeholder of Industry, Academia, and Government.

5.4.4. Summary of Phase Two Discussion

This section will set to conclude the *phase two* the AR design of the key themes discussed and synthesised. This will provide information on the similarities, differences and what was not mentioned by the three key stakeholders. This sets the method taken to conceptualise the Triple Helix Model (Etzkowitz & Leydesdorff, 2000a). The themes synthesised in this section will be the basis for *phase three* of the AR. This will set out to achieve the Main Research question *"What are the drivers and barriers for the successful transfer of knowledge and technology transfer within the context of the Port Talbot Enterprise Zone?".*

Drivers

This section will discuss the key insights attained from *phase two for '*Drivers*'*. See table *5.2, 5.12 & 5.22* for overview of the themes discussed. '*Collaboration*', '*economic development*' and *'TTO'* were the three key themes synthesised from the analysis of the semi-structured interviews. All these themes were discussed from the three key stakeholder; '*Collaboration*' had the highest prominence and agreement to the literature (M. E. Porter, 1998; Leydesdorff & Etzkowitz, 1998; Gibson et al., 2007; Trippl & Tödtling, 2007). Second was *'Economic Development'*, though there was varying prominence from Industry (Medium), Government (High), and Academia (Low) (Trippl & Tödtling, 2007; Bjørn T Asheim et al., 2011; Ankrah et al., 2013). Finally, 'TTO' was a standout theme from the findings given all the stakeholders had disagreed with the literature. However, the linkage strength was low across the stakeholders, while all stakeholders disagreed with the literature on TTOs thus adding a new insight to the literature (R. McAdam et al., 2011; Holgersson & Aaboen, 2019; Belitski et al., 2019). Academia and Industry stakeholders rarely discussed 'communication'. Academia and Government did not stress the need of supporting 'infrastructure' Compared to Industry, this was a low-linkage driver. The data collection highlights the benefits to support KT&TT activities. However, there were on average less discussion of drivers to support these activities, then barriers that occur. It has been shown that these themes discussed are interchangeable between drivers and barriers depending on the experience of KT&TT activities.

Barriers

This section will discuss '*Barriers'* from phase two. *See tables 5.4, 5.14 & 5.24 for an overview of the conclusion.* The key themes mentioned by all three of the stakeholder groups, were '*Structure'*, '*Culture'* and '*Financial'.* 'Structure' was a significant barrier for these activities, with high prominence across all three stakeholders (Abreu & Grinevich, 2013; Kotha et al., 2013; Galan & Plewa, 2016). Second, was 'Culture' that had high amount of linkage strength in Academia, Government and medium from Industry (Francis-Smythe, 2008; Malik, 2013; Ghauri & Rosendo-Rios, 2016). Third, 'IPR Management' had a similar amount of linkage strength discussed that contradicts TTOs being mentioned as a driver (Tartari et al., 2014; SU, 2016; El-Ferik & Al-Naser, 2021). Finally, finance was a unique insight that all three stakeholders mentioned as a barrier, although there was on average lower discussion of this theme with Government (high), Industry (Medium), and Academia (Medium). A theme that was not mentioned by Government and Industry was '*politics'*, while it was discussed on a medium level by Academia. Also, collaboration was not suggested as a barrier by Industry and Academia stakeholders, though it was by Government. This insight may suggest a lack of understanding that this is an issue between Industry and Academia.

Distance/connectivity

This section summarises the applicant's response to distance and connectivity. *(See table 5.6, 5.16 & 5.26 for overview).* All key stakeholders mentioned 'proximity' and 'technology' when discussing 'Distance/Connectivity'. These findings support the literature of the varying views of Distance/Connectivity affecting KT&TT activities (D'Este et al., 2013; Laursen & Salter, 2014; Renato Garcia et al., 2018; Sapuarachchi, 2021). Though proximity was discussed, different parties had varied ideas on how big a barrier it was. Industry saw proximity less of a hurdle than Government and Academia due to worldwide ties. Distance between stakeholders was a major challenge for KT&TT. Academia had various views on whether distance impeded these activities. Relationships weren't a Government or industrial theme. The greater the bond and previous experience, the less distance is a barrier, according to Academia.

Previous Engagement

'Previous Engagement' was agreed unanimously of the impact that it has on KT&TT activities. Whether that is a positive or negative interaction, this supports the literature (See chapter 2) (L. Johnston et al., 2010; Wallin et al., 2014; Ghauri & Rosendo-Rios, 2016; Steinmo & Rasmussen, 2018).

Trust

'*Trust'* was agreed as a significant factor in the relationship that is being built, while it was found that '*Trust'* takes a long time to build in a relationship, if '*Trust'* is lost, then it can be very hard to rebuild that. Finally, 'Trust' was significant to KT&TT activities to be carried out effectively. The findings set to agree in the literature. *(See section 2.4.6.) (Plewa et al., 2013; Ankrah & Al-Tabbaa, 2015; Estrada et al., 2016; de Wit-de Vries et al., 2018; Vick & Robertson, 2018).*

Potential to mitigate barriers

This section summarises how to mitigate the barriers within this context. *(See tables 5.8, 5.18, 5.28 for overview).* The key themes discussed by all three key stakeholders were '*Clusters'*, '*Collaboration'* and '*Financial'*, although stakeholders were less agreeable on the solution to the barriers discussed. '*Collaboration'* was the most agreed and prominent theme with Academia (Medium), Government (High), Industry (high) that supports the literature of the importance of collaboration to mitigate the barriers highlighted above (A. B. Jaffe, 1993; Acs et al., 2013; Tartari et al., 2014; Ankrah & Al-Tabbaa, 2015; EC, 2019a; G. H. Davies et al., 2020). Forming '*clusters'* was a significant move to support Industry and Academia in KT&TT activities. However, prominence from the stakeholders were relatively low with Academia (low), Government, (Medium), Industry (Low) (Trippl & Tödtling, 2007; Reve, 2011; Kowalski & Marcinkowski, 2014; SQW, 2014; Lu et al., 2018). Finally, 'Financial' was a key theme discussed by all stakeholders to mitigate barriers, with Academia, (Medium), Government, (Medium), Industry (Medium) (Huggins & Kitagawa, 2012; Kitagawa & Lightowler, 2013; Ghauri & Rosendo-Rios, 2016; Galan & Plewa, 2016). Key issues in finance were additional funding and making existing money more available to KT&TT collaborators. Participants in the Industry recognised 'Structure' as an obstacle to be overcome. There was a widespread feeling that this could not be changed and had to be accepted. Industry didn't propose IPR to lessen hurdles, while Academia didn't offer 'technology' as a method.

PTWEZ Impact

This section summarises the PTWEZ effects and main stakeholders' topics. (See tables 5.10, 5.20, and 5.30). *'Finance'*, *'collaboration'*, and *'clusters'* were agreed upon by the three key stakeholders. *'Finance'* was crucial to strengthening the PTWEZ and Welsh EZs' efficacy, through increased funding and financial offerings to Welsh EZs, because KT&TT activities demand a lot of capital (Trippl & Tödtling, 2007; GOV, 2011; Hughes & Kitson, 2012; Martin et al., 2016; Hatch, 2018). However, the prominence for '*Finance'* was relatively low, Academia (Low), Government (Low), Industry (Medium). '*Collaboration'* was a key factor for the PTWEZ to support KT&TT activities, with Academia, (low), Government (Medium), and Industry (high) prominence. The PTWEZ can be viewed as a "hub" or "focal point" to bring together important players from Industry and Academia, with Government assistance, by acting as the facilitator to support these activities. (Youtie & Shapira, 2008; Reve, 2011; Geoghegan et al., 2015; Rissola & Sörvik, 2018). Also, '*Clusters'* were a theme highlighted from all the key stakeholder groups that draws comparisons to the '*Collaboration'* theme for increasing activity between different individuals. However, there was a lower discussion from this theme; Academia (Medium), Government (Medium), Industry (Low). A key theme not mentioned by Industry and Government was '*Communication' (Trippl & Tödtling, 2007; Plewa et al., 2013; Ankrah & Al-Tabbaa, 2015)*. This could mean that there is already enough communication going on between Industry and Government. However, not as much with Academia, which suggests a need for increased '*Communication'* with key Academic stakeholders.

The following section will set to provide more insights into the themes found in *phase two* that will be set on semi-structured interviews, with few people but more directed questions to achieve the Main research question and research aims.

5.5. Phase three Discussion

Phase three of the discussion details the findings synthesised from the semi-structured interviews in *chapter four*, while comparing this to the literature review in *chapter two*. Figure 5.2 summarises the key themes that were addressed during this stage of data collection. These themes were built upon *phase one* and *phase two* of the thesis and subsequently refined from the analysis in *phase two.* Also, the case study paper 'Knowledge and Technology Transfer in the Port Talbot Waterfront Enterprise Zone' supported in the generation of the key themes for phase three of the AR cycle. *The* same approach was taken to gather the data, although the style of questions was directed to get a solution to the problems raised in *phase two.* The main aim was to address the main research question "What are the drivers and barriers for the successful transfer of knowledge and technology transfer within the context of the Port Talbot Waterfront Enterprise Zone?".

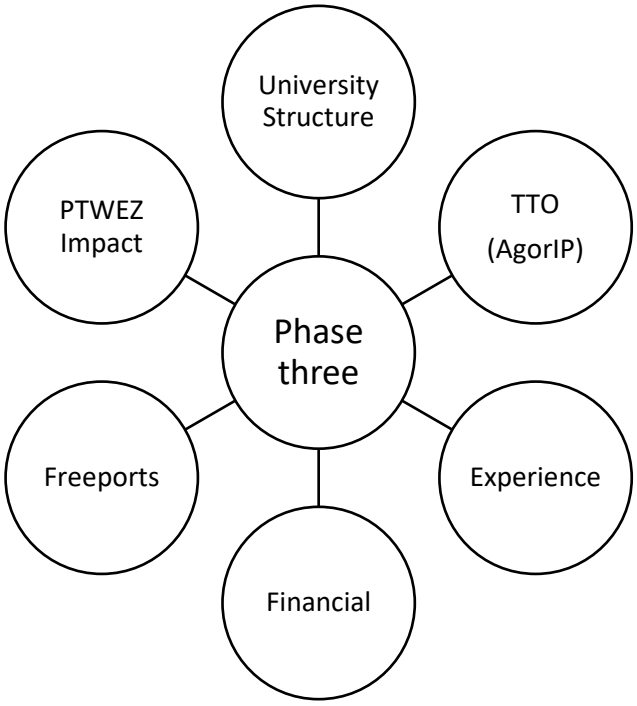


Figure 5. 2 Summary of key themes for phase three

The following section will be split into the key stakeholders of Industry, Academia, and Government that is in line with the Triple Helix model used as the template. A key addition to *Figure 5.2* is '*Freeports'* that was mentioned between *phase two* and *phase three* of the research design by multiple stakeholders. Subsequently, this will be one of the key themes addressed in phase three of the AR.

5.5.1. Academia

This section provides an overview of the findings and literature review carried out in *phase one and phase two.* Aim is to answer the research aims "To understand how the PTWEZ can positively impact on innovation activities in the region" and "Develop tools and/or that may support KT&TT activities in the region". *Table 5.31* summarises the key themes and their alignment with the literature.

Table 5. 31: Phase three alignment to the literature for Academia.

Themes	**Alignment to the literature**
University Structure	Agrees
AgorIP	Agrees
Experience	Adds to the literature
Financial	Agrees
Freeports	Agrees
PTWEZ Impact	Agrees

Of themes discussed from Academic interviewees, all the themes set to agree with the literature, with the exception of 'Experiences'. The following part of this section will go into detail on each of the themes highlighted above.

University Structure

To maximise commercialisation potential from Academia into Industry, Academics suggested to integrate KT&TT into the syllabus to increase awareness to students. This finding sets to add to the literature on maximising KT&TT. Additionally, there was a discussion by Academics of being '*siloed'* which can make it difficult to collaborate with Industry. This supports the literature on the differences effecting KT&TT (Galan & Plewa, 2016; K. Miller et al., 2018). A Swansea University Academic with experience in the Industry suggested; The multidisciplinary aspect raises the importance of having people with varying skills and experiences to optimise the universities' ability to collaborate with Industry.

'*Collaboration'* was suggested as an approach to minimise the barriers associated with university structure. The idea of a *'focal point'* would allow for key stakeholders from Industry, Academia and Government who want to partake in these KT&TT activities. The PTWEZ can act as the mediator for these interactions to occur, through a non-biased approach. This supports the literature around the idea of an 'innovation hub' to support Academia and Industry (Youtie & Shapira, 2008; Reve, 2011; Rissola & Sörvik, 2018). Collaborating through a *'Focal Point'* can be the approach taken to solve *'University Structure'* issues that have been a significant barrier raised from *phase two.*

AgorIP

There were a variety of replies from the Academic participants when asked about AgorIP. This shows that AgorIP is not effectively communicating what they can provide for Academics, and it adds a crucial lesson for 'TTOs' like AgorIP that they should be more open and upfront about what they can provide for Academic help (Belitski et al., 2019; Holgersson & Aaboen, 2019; El-Ferik & Al-Naser, 2021). Academics proposed AgorIP can bridge the gap between Academia and Industry, with the support of the PTWEZ to increase potential commercialisation opportunities. By having the strategy in place, it can allow stakeholders to make best of opportunities to successfully support Academics and Industry in KT&TT activities.

Participants from the Academic community advised extending this concept to other local universities in order to boost the commercialisation of information by universities. This is consistent with the literature on creating and working together to support KT&TT activities. (Trippl & Tödtling, 2007; Perkmann & Walsh, 2007; Albert N. Link et al., 2007) Expanding the

AgorIP model, can allow for collaboration to occur fluidly across regional Universities and Industry.

Experiences

They raised the interactions with Government based on Academics' experiences working on KT&TT operations. They specifically stated that it was difficult to locate the appropriate Government official with the authority to decide on financing support. This sets to add to the literature on issues around Government intervention on KT&TT activities.

Financial

Funding was suggested as an important aspect by Academic participants. However, they argue WG may not be willing to take that much risk on certain commercialisation opportunities. The literature raises the importance of VCs within a cluster to support potential TT (Powell et al., 2002; P. Cooke, 2004; Y.-S. Su & Hung, 2009). This opens suggestions of introducing VCs to the region to support these activities financially. By introducing VC's investment to the region can support commercial activity and support Government investment in the in the area.

Freeports

Participants from Academia responded to "Freeports" in a variety of ways. Despite being in favour of Freeports, one individual had little familiarity with the notion. The other thought Port Talbot, where it might increase economic activities there, was the place for it strategically. This information expands the body of knowledge on freeports, particularly those that might be located in Wales. It can also be used in conjunction with the PTWEZ because they both have advantages (Millett & Lassen, 2018; Bourne et al., 2021). The benefits associated with having a '*Freeport'* in the region can have many benefits associated and should not be overlooked.

Future of PTWEZ

Academic participants said the PTWEZ would benefit from a ‘focal point’ that brought together key players from Industry, Academia, Government, and investors. This would remove many of the constraints that Industry and Academia face when collaborating on KT&TT activities. This lends weight to the literature on 'innovation clusters' and the benefits they provide. (Youtie & Shapira, 2008; Reve, 2011; Rissola & Sörvik, 2018).

Participants from the Academic community held the opinion that when the PTWEZ is scheduled to be completed in June 2021, lessons should be learned from the experience and how it can be improved in the future. By understanding what opportunities should be taken from the PTWEZ, should be properly documented so in the future not the same mistakes are made again.

5.5.2. Government

This section will discuss the findings and literature review from *chapter two* for the Government perspective. Below *Table 5.32* will summarise the key themes and their alignment with the literature. The section will set to answer in more detail *"To understand how the PTWEZ can positively impact on innovation activities in the region"* and *"Develop tools/initiatives can be developed to support these KT&TT activities in the region".*

Table 5. 32: Government themes alignment to the literature.

Themes	**Alignment to the literature**
University Structure	Adds & agrees
AgorIP	Adds, agrees & disagrees
Financial	Adds & agrees
Freeports	Adds
PTWEZ Impact	Agrees & adds

The table shows the unique insights from Government perspectives will add to the literature on areas that are involved with TT activities.

University Structure

'*University Structure*' was a key theme found in the 1st round of interviews. Government interviewees had varying knowledge on '*University Structure'* and how it can be improved. Suggestions that any potential commercialisation should be taken out of the university. This is suggested that to maximise the potential for success, then AgorIP should maximise opportunities with the PTWEZ to spin out companies into the vicinity. This theory adds to the literature on improvements to TT activities and supports findings from *phase two.*

'*Collaboration'* was a key part of improving the structural differences between university and Industry (Ankrah et al., 2013; Tartari et al., 2014; Ankrah & Al-Tabbaa, 2015). This presents opportunities for Academic and Governmental advancement, as well as for prospective commercialisation. This information adds to the body of knowledge regarding local Government's obligation to assist the university in these TT operations.

Differing in workloads was a key area that affects the difference in '*structures'* and the universities' ability to keep up to pace with the requirements of Industry (Trippl & Tödtling, 2007; Plewa et al., 2013; Ghauri & Rosendo-Rios, 2016; Estrada et al., 2016). This can be

improved on by increased transparency of limitations in the beginning of the relationship and open dialogue from the beginning of the relationship.

AgorIP

Government responses were mixed on their amount of knowledge of AgorIP. Key stakeholders from NPTCC were less familiar with the TTO of Swansea University. This highlights some of the inherent issues associated with TTOs (Siegel, Veugelers, et al., 2007; El-Ferik & Al-Naser, 2021). However, those that were familiar spoke highly of the model. AgorIP's architecture is facilitating more effective KT&TT activities. The results contradict the literature on the obstacles related to TTOs (Siegel, Veugelers, et al., 2007; Holgersson & Aaboen, 2019; El-Ferik & Al-Naser, 2021).

To improve on potential outputs into the region and the PTWEZ, '*communication'* was seen as a solution to improve linkages between AgorIP and NPTCC. This supports findings by El-Ferik and Al-Naser (2021) to start the dialogue between TTOs and key stakeholders as early as possible in the relationship. Also, it signifies the importance of collaborating between the Industry and Academia.

Financial

Government interviewees often referenced negative experiences associated with offering funding Industry to stakeholders. Instead, the suggestion to develop property was seen as a better option (JLL, 2016). The development of these properties will support businesses moving and others leaving the university to go into the competitive market.

However, funding was also seen to support these activities by Government stakeholders. Specifically, VCs, where they can support KT&TT activities (Powell et al., 2002; P. Cooke, 2004; Y.-S. Su & Hung, 2009). A range of funding choices gives important stakeholders more reasons to want to support local enterprises. This supports findings by Kitagawa and Lightowler (2013) regarding the lack of funding to support these activities. Also, highlighting the need for increase private investment into the South West region.

Freeports

Responses by Government stakeholders on the potential '*Freeport'* were of hesitation. There was concern over the validity of the policy and how impactful it may be and minimise competition between other regions in Wales (Bourne et al., 2021). This outlook by local Government can affect the chances of a Freeport being located here. Mainly because of the Government requesting that local Governments must make a bid for the Freeport in the area. This insight adds to the literature on Freeports in South West Wales.

However, an alternative approach instead of a 'Freeport' is the idea of an '*Innovation District'*. This model will be an adaptation from an EZ, but would tailor around a region that would benefit the strengths that already are there (Foray, 2014), which support the theory of smart specialisation. This also adds to the literature on Freeports in Wales and how the policy would affect the country.

Future of PTWEZ

Government participants had good feedback on the PTWEZ and the impact that they had on the surrounding region. This insight adds to the EZ literature of added benefits they can provide to the region (Ward, 2016; Givord et al., 2018; Neumark & Young, 2019; Hooton & Tyler, 2019). Specifically, from the board member, who could increase networking between Government, Industry and Academia. Though this is not tangible proof of to success, this is a key motivator for a future development of the PTWEZ in some capacity.

Because of the PTWEZ ending June 2021, question marks were raised about what should take its place. Suggestions made by a PTWEZ board member mentioned the idea of an '*Innovation District'* has (Foray, 2014). This idea would be tailored around the RIS of South West Wales and mapping strengths to the region.

The idea of a *'focal point'* was suggested by Government stakeholders to support KT&TT activities between university and Industry (Youtie & Shapira, 2008; Reve, 2011). The development of a *'focal point'* will increase potential TKT&TT linkages between Industry, Academia and Government. This insight agrees with the literature of the benefits associated with a hub to support innovative activities.

5.5.3. Industry

This section summarises the Industry's Perspective for *phase three* by providing an overview of the findings and literature review. This section aims to answer in more detail the research aim *"To understand how the PTWEZ can positively impact on innovation activities in the region"* and "Develop *tools and/or initiatives that may support KT&TT activities in the region". Table 5.33* will summarise the themes and alignment to the literature.

Table 5. 33: Phase three Industry alignment to the literature

Themes	**Alignment to the literature**
University Structure	Adds & agrees
AgorIP	Adds & agrees
Financial	Adds
Freeports	Adds & agrees
PTWEZ Impact	Adds & agrees

The table above shows that these findings provide unique insights to the literature by adding to the key themes shown above. The following part of the section will provide a summary of the findings and the literature review carried out in *chapter two.*

University Structure

Industry stakeholders raised the importance to improve on the structural differences between Academia and Industry (Trippl & Tödtling, 2007; D'Este et al., 2013; Malik, 2013; Tartari et al., 2014; K. Miller et al., 2018). This opens up suggestion that Industry is more willing to work with Academia on KT&TT activities, which sets to add to the literature on the Industry perspective of KT&TT motivations.

There was an indication by Industry interviewees of the need to collaborate with multiple universities and stakeholders that offer them the correct solution (Tödtling & Trippl, 2005; Trippl & Tödtling, 2007; Trippl & Maier, 2011; Ankrah et al., 2013; Ankrah & Al-Tabbaa, 2015; Steinmo, 2015; Bjørn T Asheim et al., 2019). This insight supports the findings by Ankrah and Al-Tabbaa (2015) of collaboration for these KT&TT activities. This suggests that linkages should be made to all regional universities to understand what they can offer to Industry.

Finally, *'communication'* was an approach to minimise the structural differences between Academia and Industry. This supports the literature for the importance of communication (Plewa et al., 2013; Estrada et al., 2016). The support of AgorIP would help Academics find the true value of the Knowledge or technology they are offering.

AgorIP

Industry participants saw great potential with AgorIP but questioned how successful it has been to this point (O'Kane et al., 2015; Holgersson & Aaboen, 2019). This was a two-way breakdown between the PTWEZ and AgorIP. However, there is still ambition to grow the relationship. This relationship can grow over time through continued communication and transparency from both sides. This insight adds to the literature of the significance of Academia and TTOs in the success of EZs.

Industry interviewees supported the idea of getting the IP and commercialisation potential out of the university as quick as possible, (O'Kane et al., 2015; El-Ferik & Al-Naser, 2021). The findings signify the importance of getting IP out of the structures of university and into Industry as soon as possible. This will give the highest success for technology to be successful.

Financial

Finance was a solution to improving KT&TT activities by Industry stakeholders. A VC with experience globally and within South West Wales, mentioned a model used in Canada to support Spin-outs; *"As a very good one, where you know you subsidise early stage, investing you leave the investor make the decision and and (sic) put their money at risk. But there's a there's a there's you know tax incentive to to (sic) put the money into a qualified local company." 2I3.* This solution can subsidise companies and help increase the chances for businesses to stay in the region. This insight sets to add to the literature for solutions to increase KT&TT activities within a region.

However, Industry highlighted that it is not just about funding opportunities, but motivation from all parties wanting to participate in these activities (Gopalakrishnan & Santoro, 2004; Jane Zhao & Anand, 2009; Marcos & Denyer, 2012; Perkmann et al., 2013). The importance of other motivations was critical to obtaining a healthy relationship between the key

stakeholders. This adds to the literature on motivations for Industry to work with Academia in KT&TT activities.

Freeports

These findings build upon the conference paper by (Bourne et al., 2021). Industry participants had varying amount of knowledge on Freeports. Those that were knowledgeable believed that it was suited to Port Talbot. However, they were down to socially and environmentally driven factors. This suggests that the FGA should be a factor in the designing of the Freeport policy in Wales (WG, 2015).

However, some argued that the policy direction was not properly delivered in line with the English Freeports. This shows the lack of communication and relationship between the English and Welsh Government. This is a novel finding and adds to the literature on Freeports in Wales and the UK.

Future of PTWEZ

A big factor raised by interviewees was the success the PTWEZ had in creating an opportunity for the informal links between Industry, Academia, and Government. This shows the unique capabilities that the board members have to build relationships. This unique insight adds to the literature of benefits associated with EZs.

The idea of a '*focal point*' was echoed by Industry participants (Trippl & Tödtling, 2007; Youtie & Shapira, 2008; Reve, 2011; Rissola & Sörvik, 2018). Specifically for spin-outs to move into the PTWEZ. This suggests that there are opportunities between the regional universities and the PTWEZ to develop these potential KT&TT activities. This supports the literature of spin-outs being a key area of focus. Though this insight adds to the literature for support mechanisms for spin-outs.

Finally, '*Innovation District*' was mentioned by Industry participants as well (Foray, 2014; Morgan, 2015). The idea strengthens the EZ's concept to one that would work within a specific location, which supports the literature by Foray (2014) regarding smart specialisation and regional policy (Morgan, 2015).

5.5.4. Summary of Phase three Discussion

This section summarises the discussion from the three key stakeholders of Academia, Industry, and Government from phase three of the AR design. Key insights will be highlighted with evidence given to support the main research question and aims.

University Structure

It has highlighted 'U*niversity Structure'* as a complex issue to solve, this was first raised in the phase two of the Action Research cycle as a key theme highlighted by interviewees. This was further examined and questioned in the third phase of the Action Research. Though there were varying responses on the amount of knowledge on university structure. A key part of solving some barriers was by increased and continued collaboration between Academia and Government to support these KT&TT activities. Increased communication with key stakeholders in local Government and Industry can support these activities. A suggestion that was mentioned in *phase two* and *phase three,* is to get the technology out of the confines of the university as quick as possible to give the spin out a chance for success.

AgorIP

AgorIP has a critical role to play in bridging the gap between Academia and Industry. Though the participants questioned had varying knowledge on AgorIP that was based upon whether they have had experience working with them. This irregular knowledge of TTOs reflects the issues highlighted in the literature (Demil & Lecocq, 2010; O'Kane et al., 2015; Holgersson & Aaboen, 2019) This opens opportunities for AgorIP to build their network with key stakeholders from local Government and Industry within the PTWEZ. AgorIP has been seen as the ideal model to maximise commercialisation from Swansea University and other regional universities (SU, 2016). Though there is some need for increased transparency and communication between the key stakeholders involved in the RIS of South West Wales (Trippl & Tödtling, 2007; Plewa et al., 2013; Ankrah & Al-Tabbaa, 2015).

Finance

Finance has been a continued theme discussed throughout the interview process. This was further supported in phase three of the significant of finance, funding mechanisms and VCs. An additional key aspect to finance is to increase direct funding in supporting infrastructure developments such as property for Industry and spinouts to locate there (Hughes & Kitson, 2012; Huggins & Thompson, 2013; Lawson, 2013a). Also, improved strategy can be

introduced for finance that can be done through increased loans and grants so less capital is risked for high-risk industries (Galan & Plewa, 2016; K. Miller et al., 2018). VC funding has been an insight into how Industry and Academia could further these commercialisation opportunities (Rodríguez-Gulías et al., 2018). This further supports suggestions that finance has been lacking to support these activities, while VC offers another avenue for funding to support potential spin-outs coming out of the university.

Freeports

Freeports is a new theme highlighted between *phase two* and *phase three* of the AR cycle and was develop in the form of a case study '*The 'Freeport' dilemma in the Regional Innovation System of South West Wales'*. Findings suggest differences in opinions on the initiative (Lavissière & Rodrigue, 2017; Bourne et al., 2021). However, there was agreement among the participants that Port Talbot would be strategically a good location for a Freeport to be positioned in Wales. Issues arise when it came down to the politics of the initiative and it being a central Government policy, compared to that of WG. This issue has replicated itself from the EZ initiatives a few years back (GOV, 2020; Webb & Jzepa, 2021). This highlights a key aspect that needs to be addressed in the future, particularly with cross-Governmental initiatives. Therefore, increased '*communication'* and dialogue must be carried out to properly implement these initiatives so certain countries, such as Wales, Scotland and Northern Island, do not get left behind to England (Trippl & Tödtling, 2007; Plewa et al., 2013; Ankrah & Al-Tabbaa, 2015).

PTWEZ Impact

Because of the PTWEZ set to have been completed in June 2021, a key question asked is *'what should happen after?*' There was an agreement of the intangible successes that the PTWEZ brings to the region and the key stakeholders. Specifically, the PTWEZ board's ability to network with key stakeholders is invaluable to Academia, Government and Industry (Hatch, 2018; WG, 2018, 2019a; HOC, 2020). For the future, there was also agreement that something should take its place to further develop these networks and connections. For example, the idea of an *'Innovation District'* was mentioned multiple times as its successor (Youtie & Shapira, 2008; Foray et al., 2009; Foray, 2014; Marlow & Richardson, 2016; Rissola & Sörvik, 2018). The concept of this '*Innovation District*' would be an evolution from an EZ, though it would be further implemented into a RIS such as South West Wales by playing to the strengths of a region. This draws upon Academic such as Foray (2018) and Morgan (2013) on the concept of Smart Specialisation and regional development. This concept would take

advantage of the initiatives that are already in place and support by understanding the industries strengths and weaknesses of the region.

5.6. Phase four: Refinement and Validation of Conceptual Model

This phase sets to provide the final refinement and validation of the conceptual model used of RIS as the conceptual model for the research design. This will be presented below following the discussion of the refinements made. Following the completion of the *phase three* of the research design, has allowed for refinement of the RIS model described in *chapter two* and *chapter three*. Some key areas will be addressed to validate this model and refined this for the context of South West Wales which are:

- Refinement required to consider private investors and VC in their support in the RIS and KT&TT activities, due to all stakeholder discussing finance within both phases of the data collection. The new node '*Private Investment Community' (PIC)* will sit on the border of an RIS that suggests the stakeholder can both be within the geographical context or outside from a further distance. This development of the model reflects the literature of the importance of this stakeholder to support KT&TT activities (Brannback et al., 2008; Rodríguez-Gulías et al., 2018)
- Validation of the *'Knowledge generation & diffusion subsystem'* reflects the Academic organisations within the South West Wales context. The design for the sub-systems also fits South West Wales with the key areas of *'Public research organisations',* '*Educational Organisations'* and '*Technology Mediating Organizations'. These will comprise Swansea University, USW and UWTSD*
- Validation of the *'Knowledge application & exploitation subsystems'* that describes Industry stakeholders in the region. The significance of these stakeholders has been verified in the findings and the literature in KT&TT and University-Industry *(see 2.4.2. & 2.4.3.)* (Kogut & Zander, 1992; Bloedon & Stokes, 1994; Gopalakrishnan & Santoro, 2004; Ulhøi et al., 2012; Hewitt-Dundas, 2012; de Wit-de Vries et al., 2018; Rossi, 2018; Li et al., 2019; Bourne et al., 2020; Shi et al., 2020; Guerrero et al., 2021)
- Validation of *'Regional Policy subsystems'* that in this context is the PTWEZ (Ward, 2016; WG, 2019a; GOV, 2019; HOC, 2020) acting as a geographical location that situates these elements together. This would also reflect the Freeport if it were to

be established in the region (Sunak, 2016; GOV, 2020; Webb & Jzepa, 2021; Bourne et al., 2021)

Figure 5.3 below gives the final form of the RIS conceptual model used for the thesis. With the rationale for the final form of RIS.

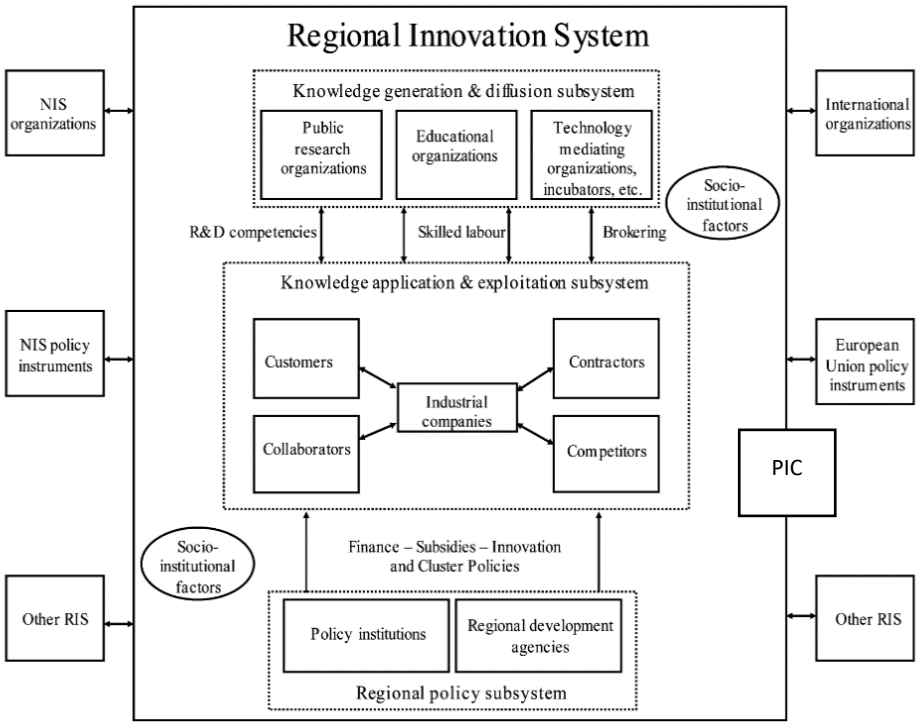


Figure 5. 3 Refined Conceptual model of RIS adapted from (Trippl & Tödtling, 2007).

5.7. Summary of Research aims

The following sections set to summarise the aims and how the primary data collected sets to answer these questions.

5.7.1. "To understand How the PTWEZ can positively impact on innovation activities in the region"

The data collected from *phase two* and *phase three,* has shown opportunities for the PTWEZ to become more integrated within the RIS to support KT&TT activities. The keyway that this can be done, is through the PTWEZ becoming a *'Focal Point'* for innovation and KT&TT activities to occur. This reflects the literature on the development of a 'hub' to support KT&TT activities (Reve, 2011; Sunak, 2016; Reid, 2018; Rissola & Sörvik, 2018; GOV, 2020). The unique advantage is that they have access to key stakeholders in Industry, Academia and Government to bring people together who want to collaborate in these activities (Leydesdorff & Etzkowitz, 1998; Etzkowitz & Leydesdorff, 2000a; Leydesdorff & Cucco, 2018). However, there have been question marks regarding the long-term strategy for the region, given that the PTWEZ was concluded in June 2021 (Martin & Sunley, 2003; OECD, 2010; HM Government, 2017; BEIS, 2017). However, the PTWEZ had funded for a strategy to be developed for the zone (Hatch, 2018). Though, the ambition is for something to take its place, with the aim of an *'Innovation district'* or a potential '*Freeport'* into the region to support economic development. 'Clusters' have seen to be a recommendation that was synthesised from phase two of the AR, that highlights the importance of developing clusters to support KT&TT activities in the region, where this supports the literature of the advantages of *'Clusters'* and policy led clusters (M. E. Porter, 1998; Sölvell et al., 2003; Trippl & Tödtling, 2007; W.-H. Liu, 2013; Valero & Van Reenen, 2019). Furthermore, Distance/Connectivity was a key theme discussed in phase two of the AR design. There was agreement in the findings regarding the importance of key stakeholders being in proximity of one another whereby if they are situated close to the PTWEZ, then this can provide benefits to them, which reflects the literature (Rosanna Garcia & Calantone, 2002; Trippl & Tödtling, 2007; W.-H. Liu, 2013; D'Este et al., 2013; Helmers & Rogers, 2015).

5.7.2. "Map the factors that impact Knowledge Transfer & Technology Transfer activities in the region"

The second aim sets to provide a detailed understanding of the key themes that impact KT&TT within the context of South West Wales. These are the key themes that were synthesised from *phase two* and *phase three* of the AR. *(See sections 5.4.4. & 5.5.4)*. *Figure 5.4* summarises the key themes identified to support these activities.

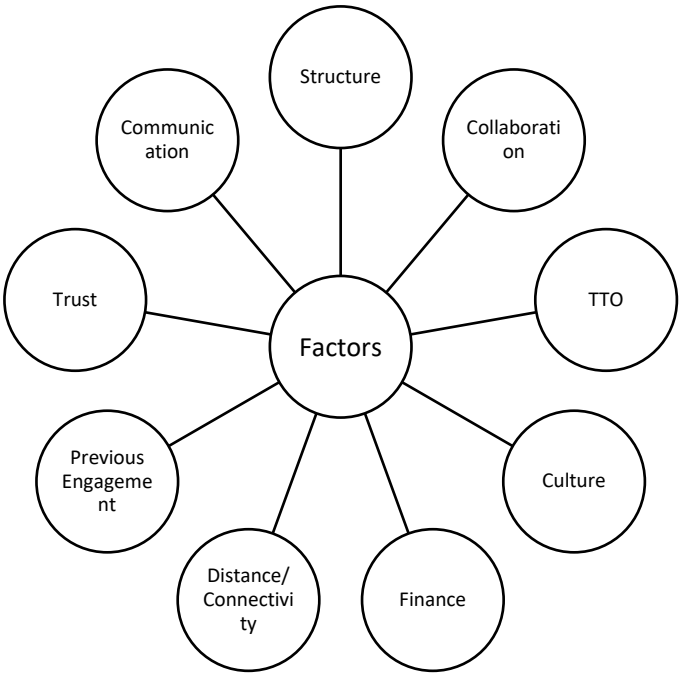


Figure 5. 4 Factor that impact KT&TT activities.

'S*tructure'* was the most referenced theme throughout both rounds of interviews. This was often seen as the most significant barrier that affects KT&TT activities. This was directed at the inherent structural issues of Academic institutions and their ability to collaborate with Industry. Examples of these issues were workloads for Academics, differing in pace (Galan & Plewa, 2016; Ghauri & Rosendo-Rios, 2016; Sapuarachchi, 2021) and the bureaucracy that affects Academics (Francis-Smythe, 2008; R. McAdam et al., 2011; Hughes & Kitson, 2012). Furthermore, it has shown in the literature that commercialisation from start to finish can take 15-16 years, thus emphasising the patience required for these activities (Lu et al., 2018). In addition, another key barrier synthesised was '*Communication'* and the importance of

having a continued dialogue with key stakeholders from Industry, Academia and Government (Trippl & Tödtling, 2007; Plewa et al., 2013; Ankrah & Al-Tabbaa, 2015; Estrada et al., 2016). Finally, '*Culture'* was a significant barrier that impacts KT&TT activities (Francis-Smythe, 2008; Ghauri & Rosendo-Rios, 2016). '*Finance'*, was seen as a critical theme to affect KT&TT activities, specifically based upon the lack of funding (Hughes & Kitson, 2012; Kitagawa & Lightowler, 2013) and the availability mechanisms in place to offer funding.

Drivers that were synthesised from the findings highlighted the significance of '*Collaboration'* and the positive effects it can have when properly carried out (Leydesdorff & Etzkowitz, 1998; Albert N. Link et al., 2007; Trippl & Tödtling, 2007; Ankrah & Al-Tabbaa, 2015). Moreover, TTOs were an opportunity to support KT&TT activities, with the positives of this initiative describes support for the development and progress of AgorIP. This appears to add to the literature and disagree with the inherent issues that surround TTOs (Siegel, Veugelers, et al., 2007; Holgersson & Aaboen, 2019; Belitski et al., 2019). Also, *'Distance/Connectivity'* was significant to KY&TT activities, with stakeholders being in proximity to one another as a key driver (D'Este et al., 2013; Helmers & Rogers, 2015; Sapuarachchi, 2021). However, there were varying views in Distance affecting these activities from Industry, Academia and Government. Academia, and Government saw proximity key to KT&TT, where Industry did not see this as much of a barrier, with benefits associate with individuals in proximity and from a distance. '*Technology'* was key to minimising distance as a barrier and was highlighted by all the key interviewees (Renato Garcia et al., 2018).

'Trust' was another significant factor to impact KT&TT activities, both from the findings and the literature (Van Wijk et al., 2008; Bruneel et al., 2010; Estrada et al., 2016; de Wit-de Vries et al., 2018). The findings raised the significance of the early stages of a relationship for 'Trust'. '*Trust'* can take a long time to grow and a second to lose (Plewa et al., 2013). '*Trust'* is built through good '*Communication' (Malik, 2013; Plewa et al., 2013; Estrada et al., 2016)*, full transparency and delivering on what was agreed in the forming stages of the relationship (Bruneel et al., 2010). Finally, *'Previous engagement'* was significant to KT&TT activities, with all interviewees agreeing on the significance of this, both a positive and a negative experience can have a significant impact on future relationships (Wallin et al., 2014; Ghauri & Rosendo-Rios, 2016; Steinmo & Rasmussen, 2018).

5.7.3. "Develop tools/initiatives that can support Knowledge Transfer & Transfer Technology activities in the region"

The final aim sets to synthesis the finding from phase two and phase three of the AR design by addressing what solutions there are to minimise the barriers and how to improve the effectiveness of South West Wales' ability to perform KT&TT activities. Figure 5.5 summarises the key themes that will provide solutions to support KT&TT activities.

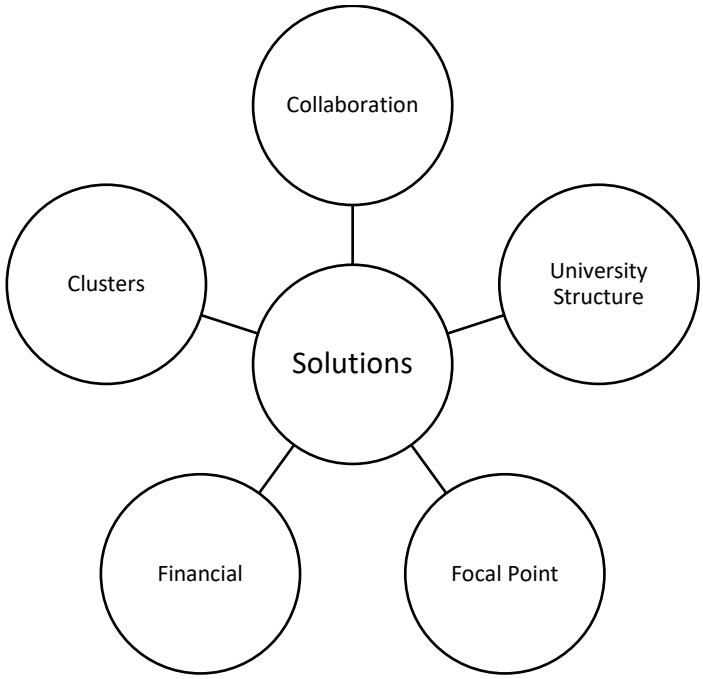


Figure 5. 5 key tools/initiatives to support KT&TT activities.

One of the key solutions to support KT&TT activities is the increased *'Collaboration'* across Industry, Academia and Government (Leydesdorff & Etzkowitz, 1998; Trippl & Tödtling, 2007). This was further supported by the idea of 'Clusters' as a mechanism and tool to support innovation and KT&TT activities (Trippl & Tödtling, 2007; Reve, 2011; SQW, 2014; BEIS, 2017). Furthermore, the literature of the positive impacts that policy-led clusters can have on a region are significant, while it was highlighted the positive impact of Academic involvement can have on clusters (Sölvell et al., 2003; Breznitz et al., 2008; Lu et al., 2018; Speldekamp et al., 2020). To coincide with this, is the recommendation raised by interviewees of introducing a *'Focal Point'* to support KT&TT activities (Siegel, 2003; Youtie & Shapira, 2008; Reve, 2011; Rissola & Sörvik, 2018). A significant part of these solutions is

the importance of Smart Specialisation to support with planning for increased success of '*Collaboration'* and '*Clusters'.* This supports the growing literature and policy objectives set out for increased economic activity (Foray et al., 2009; Foray, 2013; Morgan, 2013; Foray, 2014; R. E. Pugh, 2014; G. Davies, 2019a).

Furthermore, '*Finance'* was highlighted in both *phase two* and *phase three* as a significant theme to support KT&TT activities. Specifically, the idea of increased integration of the PIC was suggested in *section 5.6*. that supports the literature of the significance of this stakeholder in these activities (Lawson, 2013b; Rodríguez-Gulías et al., 2018). Also, the suggestion by interviewees for universities to be more open when dealing with IP between Industry and Academia can improve the chances of success. This was highlighted in the literature as a key area that can support commercial activity in a region (Alexy et al., 2009; Peters et al., 2013; Holgersson & Aaboen, 2019).

5.8. Summary of research question: "What are the drivers and barriers for knowledge and technology transfer within the context of the Port Talbot Waterfront Enterprise Zone?"

A detailed summary of the research aims, has provided sufficient support to answer the Main research question; *"*What are the drivers and barriers for knowledge and technology transfer within the context of the Port Talbot Waterfront Enterprise Zone?" The findings highlight the main factors that impact KT&TT activities, while also showing that all the factors can be seen as both a barrier and a driver. This has given a much-needed insight to the PTWEZ on how they can positively impact KT&TT activities in the region of South West Wales, while also providing insights to key stakeholders within Academia and Industry.

5.9. Limitations

As with any research activity, this study has its limitations. Due to the complex nature of the research questions and the nature of activities involved, this often involves answers becoming clearer over the longer-term. This is in tension with the comparatively short-term nature of a PhD study and availability of existing relevant historic data, necessary to answer these questions more comprehensively. This highlights the importance of a long-term goal, which needs to be integrated into Policy. Also, with the research being context specific to the South West Wales RIS and the unique characteristics such as the presence of the major steel works, unique smart specialisations and other factors may limit the insight that this research can transfer to other contexts.

The methodological approach itself brings certain limitations as well as the advantages exploited in this work. A thematic analysis is subjective in synthesising themes, which means researchers can have different opinions on this based on their methodological underpinning. This can allow for slightly differing conclusions and views, while AR and its cyclical nature can allow for evolving conclusions could cause contradiction in the findings.

Most of this thesis was completed through the COVID-19 pandemic. This caused disruption to the Action Research phases and the data collection. Most notably phases one and phase two of the AR were pre-COVID-19 and phase three was post-COVID. When phase three were carried out, travel restrictions and lockdowns were in place that meant that they had to be carried out over video conferencing software, which made it more difficult to arrange semi-structured interviews. The requirements of working remotely during the second half of the thesis, caused a change in working behaviour.

A further limitation is considered of the participants interviewed, as even though saturation was achieved there remains possibility of further insight being untapped. Also, as previously noted, Industry participants were more difficult to arrange interviews with, specifically Industry participants within the PTWEZ.

Also, it should be noted that the rapidly changing policy context that makes it hard to implement the findings from the thesis, as the initial phase of the PTWEZ formally ended in June 2021. This has been a repeating cycle with other policy initiatives such as the Technium programme and the potential Freeport, whereby longer-term potential is lost to planning cycles far shorter than the relevant time horizon for the original ambition.

5.10 Conclusion

This chapter has provided a detailed overview of the findings found in this thesis in relation to the literature review carried out in *chapter two.* Additionally, it has supplied conceptual models with validation and refinement in the context of South West Wales as a result of the AR technique throughout the phases of data collecting. Finally, the main research question and aims have been answered and insights have been provided to support the PTWEZ and the future initiatives to support KT&TT activities that occur between Industry and Academia. The following chapter will provide the conclusion for the thesis.

6.0. Conclusion

This section presents the study conclusions through summarising the response to the research question, and research aims, set in the AR context. Subsequently, the study's contributions to Academic research, practice, and policy are described. This is done alongside the research limitations before the final concluding remarks are presented.

6.1. Research context

The PTWEZ provided a specific context to this study, combining regional/national Government, local Academia and an evolving industrial base in a post-regional context of South West Wales. With key involvement from key actors in the PTWEZ and AgorIP provided unique and rich insights in the literature for KT&TT activities. Also, with this AR approach, allowed for a high-level of access from both practitioners, policymakers, and Academic stakeholders with key experiences in the region. This provided significant evidence to map the RIS of South West Wales. To support this, substantial secondary data had been carried out on English and Welsh EZs that drew comparisons from the different approaches *(See section 4.6),* while gathering data specifically on the PTWEZ and AgorIP. This was built upon from the conference paper produced by Bourne et al. (2021) of the context of South West Wales and the PTWEZ.

6.2. Methodology

The thesis and research involved factors that affected the method taken for the Action Research approach. A significant factor of this method was the engagement required across Academic, Industry and Government. Also, the immense support from the sponsors within the PTWEZ allowed for significant access to key stakeholder in Government and Industry with critical experience in this area. However, greater effort was required to access the suitable Industry stakeholders. Specifically, within the PTWEZ this proved challenging to secure engagement from key Industry stakeholders, compared to Government and Academia. Through excellent support from the supervisory teams, this provided support along with

contacts of key Academic stakeholders who have experience in KT&TT activities. The validity of the approach was verified through the research design and gaining the adequate data to answer the main research question and research aims. This provided a depth of insight from stakeholders in the region to give a rich amount of data within KT&TT activities. However, this area of research often benefits from more longitudinal data collection to be undertaken, because of the time that is required to have success commercial activity from start to finish (Lu et al., 2018).

6.3. Research aims

The research aims supported the main research question and the complex nature of that question needed to be separating to answer the question. The following section will discuss the research aims and how this research study has answered them.

6.3.1. "To understand how the Port Talbot Waterfront Enterprise Zone can positively impact on innovation activities in the region"

As summarised in *Section 5.7.1.,* key answers were synthesised of how the PTWEZ can positively impact upon innovation in the region. One of the key insights was for the PTWEZ to implement a '*Focal Point'* in the zone to support innovation to occur in the region, through increased *'Collaboration'* with Academia, Industry, and Government. This also supports the views of the development of '*Clusters'* in the zone to support the industries that is are already there. *Section 4.6* provides a high level mapping of the PTWEZ and the key areas of Industry that are in the zone are '*Construction'* (28%) and '*Manufacturing'* (22%) as shown in Bourne et al. (2020) for further discussion of the mapping. Finally, the potential introduction of a '*Freeport'* has grown in relevance during the duration of the research that highlights the fast pace of such strategic initiatives. '*Freeports'* received mixed responses, depending on interviewee brings some debate in its potential effectiveness to the region, though remain germane in Academic and practitioner discussion.

6.3.2. "Map the factors that impact Knowledge Transfer &Technology Transfer activities in the region"

Section 5.7.2 summarised all the key factors that affected KT&TT activities, whereby one of the most critical themes discussed throughout the interviews, was '*Structure'* and *'University Structure'.* Often mentioned negatively, this was believed to be one the greatest impediments to KT&TT, whereby suitable planning and preparations must occur to minimise this barrier. However, Industry participants described this barrier as near impossible to address. The key driver agreed between the three key stakeholders was '*Collaboration',* that when KT&TT activities are successful, it is down to the key individual collaborations across Industry, Academia, and Government. Significant to this thesis, this provides new insights into '*TTOs'* by adding to the literature of the positives they can bring by supporting these activities for increased success in commercialisation. Furthermore, *'Distance/Connectivity'* was a significant factor, with proximity significant to increased success of KT&TT activities, although Industry participants highlighted the need for collaborations and KT&TT activities to occur across the globe.

6.3.3 "Develop tools/initiatives that can support Knowledge Transfer & Technology Transfer activities in the region"

As summarised in *section 5.7.3*., the key tools and initiatives that can support KT&TT activities are the integration of a *'Focal Point' and 'Clusters'* in the PTWEZ to maximise the potential for KT&TT to occur. This provides potential to minimise the most significant barrier highlighted '*Structure'* by taking any potential opportunity out from the University as quickly as possible so that any potential '*collaboration*' and commercialisation can grow from the support of the zone. A key factor found to support this is the increase in funding mechanisms to support these activities by either Government grants and loans or integrating PIC to support potential commercial activity and spin-outs coming out of the university.

The above sections justify that the research aims, and objectives have been met, which will provide evidence and justification to answering the main research question, *"What are the drivers and barriers for knowledge and technology transfer within the context of the Port Talbot Waterfront Enterprise Zone?"*

6.4. Central research question

The central research question was formed following the completion of the literature review, framed in response to the PTWEZ ambitions. This set out to understand the RIS of South West Wales, through the key stakeholders of Academia, Industry and Government to maximise the innovation capabilities. It draws upon the insight provided in response to the sub-questions presented in the preceding sections.

6.4.1. "What are the drivers and barriers for knowledge and technology transfer within the context of the Port Talbot Waterfront Enterprise Zone?"

Two phases of in-depth interviews with Government, Academia, and Industry found similar drivers and barriers within the PTWEZ context, while providing detailed overview in relation to the research aims. The themes that were of particular importance included *'University Structure'* that was noted as a key driver, while 'Collaboration' was described as a positive response to the barrier of '*Structure'. 'Structure'* relates directly to the PTWEZ as a solution to solve this barrier with the potential to bypass *'University Structure'* through the development of a key 'Focal Point' to support all KT&TT activities across Academia, Industry and Government. Furthermore, a key barrier highlighted was *'Finance',* however, this was also described as a key factor to mitigate barriers. A unique insight was the driver of 'TTO' that was seen to positively impact KT&TT activities, but 'IPR' was highlighted as a barrier that affects KT&TT activities. AgorIP has a responsibility to address IPR issues with measures, so this key theme can become a driver to support KT&TT activities. The findings show the interchangeable nature of the terms described for drivers and barriers that highlight the potential for any barrier that was described to become a driver.

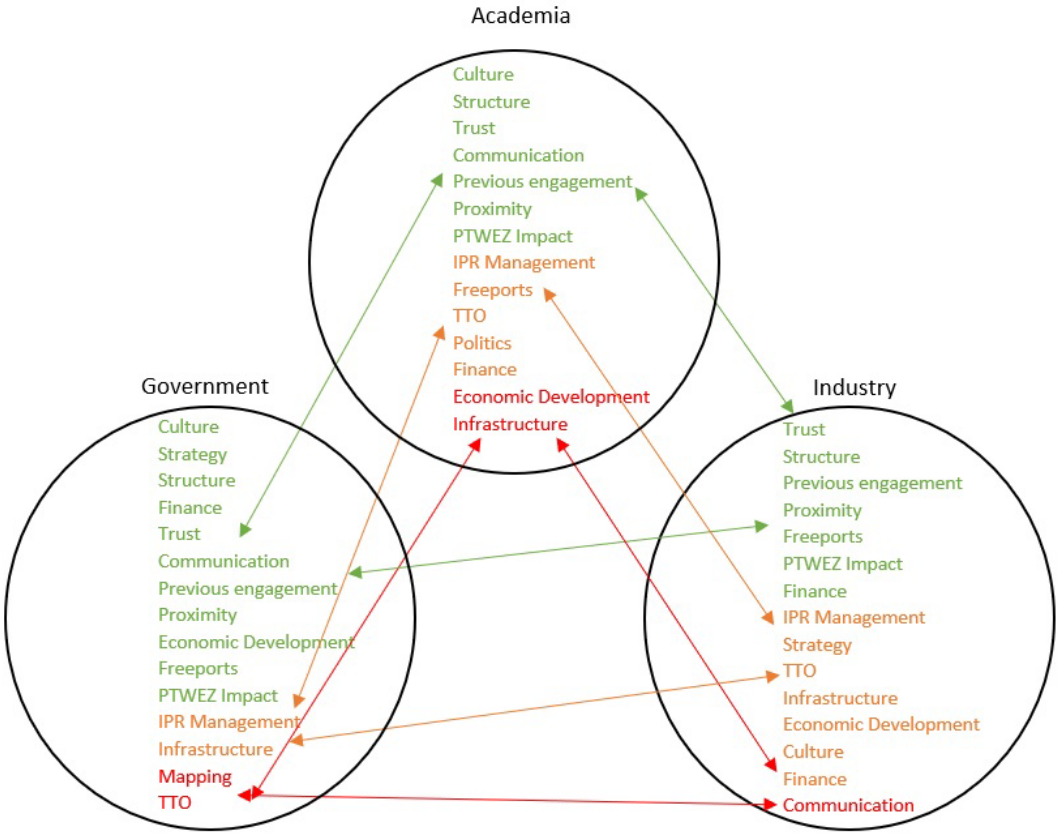


Figure 6. 1 Key themes of alignment between Academia, Industry and Government

The figure above summarises the interrelationships drawn from the analysis presented in the previous sections. It presents interactions for potential focus in future research and practice. Further consideration of these interactions is beyond the scope of this research but offers a foundation for PTWEZ and other regions to support their KT&TT activities. The strength of linkage is denoted by the colour of the line, giving potential prioritisation to factors that affect multiple stakeholders.

6.5. Contributions to Knowledge

The following sections set to provide insights to the contributions to theory and contributions to practice and policy.

6.6. Contributions to Theory

This research adds to the literature on KT&TT and its enablers and barriers to the successful collaboration and the impact of Government led initiatives such as the PTWEZ that is answered in the main research question. The Triple Helix Model attempts to understand the interaction dynamics between Industry, Academia and Government in South West Wales. A conference paper supported this part of the research contribution at the European conference of Innovation and Entrepreneurship 2020 (ECIE20) title *"Knowledge and Technology Transfer in the Port Talbot Waterfront Enterprise Zone." (Bourne et al., 2020) (See Appendix 5.1).*

The research also tested the relevance of the RIS concept and how for KT and TT it relates to a regional context with the attributes of South West Wales. This contributed to the literature by the examination of a post-industrial region of which there are many in northern Europe and other developed nations. These findings set to add to this body of literature as an important aspect of the innovation process through proper mapping of the key stakeholders within a region. Furthermore, findings and the literature suggest the importance of integrating the financial community into the RIS to support KT&TT activities that Government cannot. Private investors will take greater risk in TT activities that will provide the vital finance needed to further develop. This element did not feature in prior theory and is therefore a contribution to this work. Recognising other important variables that affect KT&TT, supporting literature on distance/connectivity, trust, and previous engagement, as well as expanding the body of information on the significance and effectiveness of TTOs in a setting like South West Wales. This supports theories on smart specialisation to understand the strengths a region can offer (Foray, 2014; Morgan, 2015). Furthermore, the work also adds to literature on cluster theory and the importance of this in Government led policy (Trippl & Tödtling, 2007; R. E. Pugh, 2014; SQW, 2014). The specific KT&TT focus of this thesis presents

how the theory of smart specialisation relates, thereby creating a connection between the areas of research.

Finally, this thesis sets to add the evolving UK Freeport literature by having a context specific region analysed (Sunak, 2016; Lavissière & Rodrigue, 2017; GOV, 2020; Bourne et al., 2021). The findings suggest that this initiative can support innovation within the region, on the condition that the key stakeholders within the RIS of South West Wales properly implemented and supported it. This was also supplemented with another conference paper at the ECIE21 titled *"The 'Freeport' dilemma in the Regional Innovation System of South West Wales."(Bourne et al., 2021) (See Appendix 5.2.).* Freeports was a key theme synthesised from the AR cycles, where this paper gave a detailed analysis of this theme.

6.7. Contributions to Practice & Policy

The research carried out sets to contribute to the WG initiative on the Welsh EZs and the PTWEZ. This provides insight for the further development of these Government-led initiatives. For example, this research has provided information for Mott MacDonald on an ongoing feasibility report for the PTWEZ identifying infrastructure opportunities. The findings also supported assertions of Reid (2018) & Diamond (2016) highlighting the importance of collaboration and the development of 'Industry-led innovation hubs'. Specifically, the PTWEZ can harness this suggestion by using the new 'Bay Technology Centre' that can act as a focal point for key stakeholders from regional universities (AgorIP), NPTCC and Industry wanting to collaborate (WAG, 2010; SQW, 2014).

The importance of the availability of Finance was a key finding from the research, where it was critical to KT&TT activities. The supply of capital required to maximise the success of these activities. This should be supported through public and private funding. WG offers a range of funding avenues for businesses to collaborate with Academia. However, Industry stakeholders presented limited knowledge of this. There is an opportunity for Government to make Industry more aware of potential funding mechanisms and initiatives. These findings will hopefully support the planned innovation report for Wales, with unique insights on a specific context of South West Wales.

6.8. Potential future research and practice agendas

Future research agenda has great potential for a longitudinal approach. This would give further insight beyond the complex nature of the research question, while further data collection and analysis would help support the policy led initiatives over a longer period more generally. As such, further development of data collection should be carried from Industry partners within the PTWEZ to maximise the robustness of the findings from their perspective.

The importance of finance as a missing component of many RIS models offers a rich vein of potential research, connecting areas of regional economic development, TT and new venture formation. Furthermore, the region perspective of PTWEZ presents potential for comparative studies to test these findings and other questions. The transition to net zero in itself offers a new context, where this smart specialisation of PTWEZ may be of particular interest to scholars and practitioners.

The depth of this thesis will allow for opportunities for additional local and international study to be done to comprehend the RIS and KT&TT elements between Academia, Industry, and Government. Data could also be collected from other EZs in Wales and England to allow for further comparisons and contrasts to how each EZ runs in relation to their respected RIS, while potential research can look at KT&TT factors and the interrelationship between Academia, Industry and Government for other EZs, with the potential for a mixed-methods or quantitative analysis to support the qualitative findings of this research. Alongside this, there is also scope for further analysis and exploration of city and growth regions, that can be compared to Swansea and South West Wales.

6.9 Concluding Remarks

This research has emphasised the need for advanced collaboration between Academia, Industry, and Government stakeholders, with the present research outlining motivations across these key stakeholders to partake in KT&TT activities.

The PTWEZ and other EZs have found to be a critical tool in bridging the gap between Industry and Academia. This can be achieved through further integration of the zone and the development of a 'Focal Point' to catalyse collaboration between Industry, Academia, and Government. The importance of a tailored RIS is critical to understanding the key stakeholders within a regional context, where a '*one size fits all*' approach is too simplistic for the questions being asked in this thesis. The findings described herein also highlight the need for the development of private investment companies to be established in the region to support KT&TT activities. As such, Government can draw learning for improved integration of initiatives such as the PTWEZ in the RIS of South West Wales by fostering increased collaboration and communication among key stakeholders from Academia and Industry.

From the opportunities and challenges identified in this thesis, there is clear potential for South West Wales to foster greater levels of innovation through KT&TT to benefit the immediate region and beyond. There have been barriers identified for working with the key stakeholders within the South West Wales context, they are all interchangeable and can all transform into drivers, and thereby optimise conditions for KT&TT activities in the PTWEZ and wider region.

Appendices

3.1 Ethics Form

SCHOOL OF MANAGEMENT, SWANSEA UNIVERSITY

FIRST STAGE ETHICAL REVIEW FORM

To be completed for all research involving human subjects OR datasets of any kind OR the environment

Name of PI or PGR Student	James Bourne
Staff Number or Student ID	[redacted]
Supervisors*	Dr. Gareth Davies, Prof. Michael Williams.
Date Submitted	17/01/2021
Title of Project	What are the drivers and barriers for the successful transfer of Technology and knowledge transfer on the context of the Port Talbot Enterprise Zone?
Name of Funder / Sponsor*	Swansea University / WG
Finance Code / Reference*	MSR1054
Duration of Project	3 years

Aim of research project (*250 words*):

- To explore the Innovation system of South West wales and the lineages of knowledge and technology transfer between academia, industry and government. This will look to further examine the drivers and barriers between these stakeholders and how the relationships are positioned when it comes to commercialisation potential coming out of universities.
- To Examine how the Port Talbot Enterprise Zone is perceived between these stakeholders and the impact this initiative has had on the surrounding region and how the Enterprise zone can help with the further development of knowledge and technology transfer to occur more effectively

* *Complete if appropriate*

***Risk evaluation**: Does the proposed research involve any of the following?*
✓ ***Tick** those boxes for which the answer is **YES***
✗ ***Cross** those boxes for which the answer is **NO***

Participants

x Will the study involve recruitment of patients or staff through the NHS or the use of NHS data or premises and/or equipment? If this is the case, the project **must** be reviewed by the NHS. Please see the following NHS online tools for help with this http://www.hra-decisiontools.org.uk/research/ and http://www.hra-decisiontools.org.uk/ethics/

x Does the study involve participants aged 16 or over who are unable to give informed consent? (e.g. people with learning disabilities: see Mental Capacity Act 2005. All research that falls under the auspices of the Act **must** be reviewed by the NHS)

- x Does the research involve other vulnerable groups: children, those with cognitive impairment or in unequal relationships? (e.g. your students). This **may** require NHS review, and will typically require the researcher to get **Disclosure & Barring Service (DBS) clearance** (formerly CRB checks).
- x Will the research harm or pose any risk to the environment? (e.g. research in environmentally sensitive areas (e.g. SSSIs); permission needed to access field sites; transport of samples between countries (e.g. soil); sampling of rare or hazardous material (e.g. invasive species) that could deplete or endanger)

Please describe the participants involved in your research (if no participants, state 'none'): *max 250 words.*

The participants for this research study are selected from three main areas, which include academics, industry professionals and government officials. The applicants selected have either had direct experience with knowledge transfer and technology transfer activities within the region of South West Wales. Their area of profession will not be a barrier for them to be interviewed.

These individuals are adults and therefore they can independently agree or disagree to participate in the study.

Recruitment

- x Will the study require the co-operation of a gatekeeper for initial access to the groups or individuals to be recruited? (e.g. students at school, members of self-help group or residents of nursing home?)
- x Will it be necessary for participants to take part in the study without their knowledge and consent at the time? (e.g. covert observation of people or use of social media content)
- x Will the research involve any form of deception? (e.g. misinformation or partial information about the purpose or nature of the research)
- x Will financial inducements (other than reasonable expenses and compensation for time) be offered to participants?
- x Does the research involve members of the public in a research capacity? (e.g. participant research; participants as co-producers or data collectors)

Please explain the recruitment of participants involved in your research (if no participants, state 'none'): *max 250 words.*
Participants of this study will be recruited through email messages sent to them. These contacts will be acquired through contacts suggested from the supervisors. Following this, recommendations by the participants will allow for a snowballing effect to take place to acquire additional participants for this study.

Research Design

x Will the study discuss sensitive topics or require the collection of sensitive information? (e.g. terrorism and extremism; sexual activity, drug use or criminal activity; collection of security sensitive documents or information)

x Could the study induce psychological stress or anxiety or cause harm or negative consequences beyond the risks encountered in normal life?

x Is pain or more than mild discomfort likely to result from the study?

x Will the study involve prolonged or repetitive testing?

x Are drugs, placebos or other substances (e.g. foods or vitamins) to be administered to study participants, or will the study involve invasive, intrusive or potentially harmful procedures of any kind? (If any substance is to be administered, this **may** fall under the auspices of the Medicines for Human Use (Clinical Trials) Regulations 2004, and require review by the NHS)

Please summarise your methodology in detail and provide reflective comments with regards to the design of your research: *max 250 words.*

The study methodology includes a semi-structured interview to gather data form the research participants. The interviews carried out will be align with all COVID-19 measurements to ensure the safety for all participants.

The action research approach will allow appropriate initial interviewees to be approached, while those who agree and are interviewed will be asked for recommendations of further potential interviewees to be approached in the same manner. This will be reviewed to support selection of diverse viewpoints and interviewees, while also working towards theoretical saturation. Transcripts will be provided back to all interviewees with the option to withdraw at any time.

All data gathered will be used in a purely anonymised manner with sufficient number of interviewees involved from each group to help protect this. These steps will be made clear as part of the informed consent for all prospective interviewees.

Primary data collection from these interviews will analysed through coding to identify relevant themes and sentiment. be triangulated with secondary sources to inform findings used to develop a second round of interviews that will also be conducted in the manner presented above.

Findings from the second cycle will be the main contribution to knowledge, which will be used to inform the research output (papers) and practitioner resource (PTWEZ strategy). These will only include the anonymised themes and findings. A copy of this will be provided back to all interviewees.

x Will tissue samples (including blood) be obtained from participants? (This would fall under the terms of the Human Tissue Act 2004. All research that falls under the auspices of the Act **must** be reviewed by the NHS)

Data Storage and anonymity

✓ Will the research involve administrative or secure data that requires permission from the appropriate data controllers and/or individuals before use?

x Will the research involve the sharing of data or confidential information beyond the initial consent given?

x Will the research involve respondents to the Internet or other visual/vocal methods where respondents may be identified?

Please describe how you will store your research data and for how long, and, if appropriate, how you will ensure anonymity of your data subjects: *max 250 words.*

The information that the researcher intends to collect may not be confidential, due to the style of the interview. However, the interviews will only be carried out by the researcher so that anonymity will be kept for the participants. All information will be held securely on password-protected system. No personal information will be retained beyond the PhD candidature.

The interviews will be recorded for analysis to be carried out appropriately; all recordings will be stored safely and securely to protect the identity of the participants. The recordings will be kept until the mark is awarded for the dissertation. After which all the recordings will be deleted from the device. The device is password protected for added security for these files.

Safety and Risk

✓ Has a risk assessment been completed?

x Is there a possibility that the safety of the researcher may be in question? (e.g. in international research: locally employed researchers)

x Will the research take place outside the UK where there may be issues of local practice and political or other sensitivities?

x Could the research impact negatively upon the reputation of the University, researcher(s), research participants, other stakeholders or any other party?

x Do any of the research team have an actual or potential conflict of interest?

x Are you aware of any other significant ethical risks or concerns associated with the research proposal? (If yes, please outline them in the space below)

Please describe the health and safety considerations in relation to both participants and researchers (*250 words max): If there are significant concerns an appropriate risk assessment and management plan must be attached.*

The heath and safety for all participants is paramount. The researcher will also not be at risk, by taking the precautions of any and all contact with participants to be carried out over email, phone and/or video conferencing platforms. This made even more significant, due to the current COVID-19 pandemic.

Other significant ethical issues or concerns: (If None, then please state 'None')

NONE

*If any answer to the questions above is **YES**, then a **Second Stage (Full) Ethical Review MAY** be required.*

*If the project involves **none of the above**, complete the **Declaration**, send this form and a **copy of the proposal** to **Amy Jones the School of Management Research Support Officer: amy.e.jones@swansea.ac.uk**. Research may only commence once approval has been given.*

***Declaration:** The project will be conducted in compliance with the University's Research Integrity Framework (P1415-956). This includes securing appropriate consent from participants, minimizing the potential for harm, and compliance with data-protection, safety & other legal obligations. Any significant change in the purpose, design or conduct of the research will be reported to the SOM-REC Chair, and, if appropriate, a new request for ethical approval will be made to the SOM-REC.*			
Signature of PI or PGR Student			By Email
Signature of first supervisor (if appropriate)			[redacted]
Decision of SOM-REC			Approved
Ethical Risk Assessment	Green ☒	Yellow ☐	Red ☐
Signature of SOM-REC Chair or SOM-REC deputy Chair			[redacted]
		Date	20/01/2021
SOM-REC Reference number (office use only)			SOM-REC PGR 056

3.2. Consent form

Consent form

What are the drivers and barriers to the successful localisation of technology and knowledge transfer in the context of the Port Talbot Enterprise Zone.

James Bourne, first year PhD student at Swansea University

	Please initial box
1. I confirm that I understand what the research is about and have had the opportunity to ask questions.	☐
2. I understand that my participation is voluntary and that I can withdraw at any time without given reason.	☐
3. I agree to take part in the research.	☐

	Please initial box	
	Yes	No
4. I agree to the interview being audio recorded.	☐	☐
5. I agree to the use of anonymised quotations in publications.	☐	☐

Name of participant: …… Signature: ……

Researcher's name: …… Signature: ……

Date: ……

3.3 1st phase of interview questions

Semi-structured interview

1. So, please tell me a little bit about your professional background and what you do (within the context of EZ)?
2. What does knowledge transfer mean to you?
3. Would you please describe your knowledge transfer experience, particularly any involving EZ?
4. How beneficial to you are Knowledge Transfer activities, and how so?
5. What barriers have you experienced during this process?
6. What does trust mean to you?
7. Does the distance/connectivity between parties impact upon your engagement in transfer of knowledge?
8. From your experience, how does previous engagement effect potential for future relationships?
9. What would your recommendations be to improve the transfer of knowledge based on the barriers that you highlighted on earlier?
10. What further steps could the Enterprise Zone undertake to attract and retain opportunities from your area of business?

Additional comment: is there anybody else I should interview regarding this area?

Prompts for the interviews

Tell me your thinking behind that?

How did that make you feel?

Tell me a bit more about that

What do you mean by that?

How did you come up with that approach?

3.4. 2nd stage Interview questions

2nd Phase Interview questions

1. Could you give a brief summary of your professional background and context?

Prompts:

South wales industrial cluster work

Department for commercialisation

- What are your experiences working with government, Industry, and academia?

2. What changes on university structure should there be to maximise potential for commercialisation?

Prompts:

- What can the technology transfer office help facilitate this?
- How can the Enterprise Zone help?
- How might clustering impact this?
- What could be the impact of a free port in this area?

3. What do the regional universities need to have to offer to industry?

Prompts:

- How can welsh government/EZ help?
- How does technology impact this?
- How do you create opportunities between industry and academia?

4. What financial intervention would you suggest being used to help facilitate these activities?

Prompts:

- What financial gaps are there currently?
- How can welsh government and the EZ facilitate this?
- How can VC's and other investors help in this process?

5. IPR management was a theme highlighted, how should the Technology transfer office evolve to the opportunities of industry?

Prompts:

- What interventions should be considered with this?
- What role can industry play in this?
- What role does the PTWEZ play?

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6. What would be your thoughts for the future of the Port Talbot water front enterprise zone beyond its completion?

Prompt:

- Export led opportunities?
- Agglomeration of industries?
- Other initiatives?

7. Do you have anything you would like to discuss?

4.1 Content analysis, Drivers for Academia

Drivers	references	% Mentioned	people	average reference
Collaboration	3	20%	2	1.5
Economic Development	4	20%	2	2.0
Research	5	50%	5	1.0
TTO	5	20%	2	2.5

4.2 Content analysis for Academic participant barriers.

Barriers	references	% Mentioned	people	average reference
Communication	13	60%	6	2.2
Culture	12	60%	6	2.0
Financial	5	20%	2	2.5
IPR	11	70%	7	1.6
Politics	2	20%	2	1.0
Structure	19	90%	9	2.1

4.3 Content analysis, for distance/connectivity Academia

Distance/Connectivity	references	% Mentioned	people	average reference
Proximity	16	70%	7	2.3
Relationship	6	40%	4	1.5
Technology	5	50%	5	1.0

4.4 content analysis for 'Mitigate barriers'

Mitigate barriers	references	% Mentioned	people	average reference
Cluster	3	10%	1	3.0
Collaboration	5	30%	3	1.7
Communication	5	20%	2	2.5
Financial	4	30%	3	1.3
IPR Management	6	40%	4	1.5
Structure	4	30%	3	1.3

4.5 Content analysis PTWEZ impact Academia

PTWEZ impact	references	% Mentioned	people	average reference
Cluster	12	30%	3	4.0
Communication	7	20%	2	3.5
Financial	1	10%	1	1.0
Infrastructure	4	20%	2	2.0
International	1	10%	1	1.0
Sustainability	2	20%	2	1.0
Collaboration	2	20%	2	1.0

4.6 Content analysis drivers Government

Drivers	Reference	% Mentioned	People	Average referenced
Collaboration	10	70%	7	1.4
Communication	1	10%	1	1.0
Economic Development	10	70%	7	1.4
TTO	1	10%	1	1.0

4.7 Content analysis Barriers, Government

Barriers	Reference	% Mentioned	People	Average reference
Collaboration	5	30%	3	1.7
Communication	10	70%	7	1.4
Culture	9	70%	7	1.3
Financial	22	80%	8	2.8
IPR	8	40%	4	2.0
Risk Adverse	1	10%	1	1.0
Structure	35	90%	9	3.5

4.8 Content analysis Distance/connectivity Government

Distance	Reference	% Mentioned	People	Average Reference
Proximity	24	100%	10	2.4
Technology	6	60%	6	1

4.9 Content analysis Mitigate barriers, Government

Mitigate Barriers	Reference	% Mentioned	People	Average Reference
Clustering	6	40%	4	1.5
Collaboration	11	70%	7	1.6
Communication	2	10%	1	2.0
Financial	4	30%	3	1.3
IPR Management	6	20%	2	3.0
Strategy	7	60%	6	1.2
Structure	6	30%	3	2.0
Technology	2	10%	1	2.0

4.10 Content analysis PTWEZ Impact, Government

PTWEZ impact	Reference	% Mentioned	People	Average Reference
Cluster	4	30%	3	1.3
Collaboration	11	30%	3	3.7
Financial	3	20%	2	1.5

Infrastructure	4	40%	3	1.3
Strategy	5	20%	2	2.5
Mapping	5	20%	2	2.5

4.11 Content analysis, Drivers, Industry

Drivers	References	% Mentioned	People	Average reference
Collaboration	7	50%	6	1.2
Economic	4	25%	3	1.3
Infrastructure	1	8%	1	1.0
Knowledge	9	50%	6	1.5
TTO	1	8%	1	1.0

4.12 Content analysis, Barriers, Industry

Barriers	References	% Mentioned	People	Average reference
Communication	2	17%	2	1.0
Culture	10	42%	5	2.0
Financial	8	17%	2	4.0
IPR	8	33%	4	2.0
Structure	25	67%	8	3.1

4.13 Content analysis, distance/connectivity, Industry

Distance	References	% Mentioned	People	Average reference
Culture	1	8%	1	1
infrastructure	1	8%	1	1
Proximity	15	75%	9	1.7
technology	7	33%	4	1.8

4.14 Content analysis, Mitigate barriers, Industry

Mitigate barriers	References	% Mentioned	People	Average reference
Clusters	3	8%	1	3.0
Collaboration	12	58%	7	1.7
Financial	3	25%	3	1.0
Infrastructure	1	8%	1	1.0
Strategy	6	33%	4	1.5
Technology	2	8%	1	2.0

4.15 Content analysis, PTWEZ Impact, Industry

PTWEZ impact	References	% Mentioned	People	Average reference
Clusters	1	8%	1	1

Collaboration	6	33%	4	1.5
Financial	9	50%	6	1.5
Infrastructure	6	25%	3	2.0
Strategy	3	17%	2	1.5

4.16 Content analysis, 2nd phase, Academia

	references	**% Mentioned**	**people**	**average reference**
University Structure	18	100%	2	9
AgorIP	12	100%	2	6
Experiences	7	50%	1	7
Finance	7	100%	2	3.5
Freeports	5	100%	2	2.5
PTWEZ	11	100%	2	3

4.17 Content analysis, 2nd phase, Government

	references	**% Mentioned**	**people**	**average reference**
University Structure	18	100%	4	4.5
AgorIP	18	75%	3	6.0
Experiences	11	100%	4	2.8
Finance	21	100%	4	5.25
Freeports	7	50%	2	3.5
PTWEZ	44	100%	4	11.0

4.18 Content analysis, 2nd Phase, Industry

	references	**% Mentioned**	**people**	**average reference**
University Structure	18	80%	4	4.5
AgorIP	31	80%	4	7.8
Experiences	7	60%	3	2.3
Finance	15	100%	5	3
Freeports	18	40%	4	4.5
PTWEZ	46	100%	5	9.2

4.19 English EZs

Location	Sector Focus
Aero hub Extension	Advanced Manufacturing/Engineering, Aerospace, Energy, ICT, Transport
Alconbury Enterprise campus	Advanced manufacturing/ Engineering, ICT, Industrial biotech, low carbon Industry
Aylesbury Vale	High tech performance, space, food and human health
Bristol Temple Quarter and Bath and Somer Valley (Extension)	regeneration project for social benefits
Black Country	Advanced Manufacturing/engineering, Aerospace, automotive, low carbon Industry
Blackpool airport	Wind, Nuclear, waste to energy
Birmingham Enterprise Zone Curzon Street (Extension)	Finance, ICT, creative Industries and Digital media expansion
Cambridge Compass	business opportunity with a high skilled workforce
Carlisle Kingmoor Park	Nuclear Engineering, Energy, Advanced Manufacturing
Ceramics Valley	Advanced Materials, Energy and Power Generation, Engineering, Business and Professional Services, Warehouse and Distribution
Cheshire Science Corridor	Life Sciences, Energy and Nuclear, Environmental Technologies, Advanced Manufacturing and Engineering, Automotive
Corridor Manchester	Life Sciences, Health Innovation, med-tech, ICT
Discovery Park	Agri Food, Business Services, Energy, Industrial biotech, Pharmaceuticals, healthcare
Didcot growth Accelerator	Big data, advanced materials and energy-related tech
Dorset Innovation Park	Advanced engineering, manufacturing, Aerospace, marine, energy, defence
Enterprise M3 EZ3	Digital ICT, Business and professional service, high tech manufacturing, sustainable tech
Exeter and East Devon EZ	Innovation Digital, Business and professional service, low carbon Industry, advanced manufacturing

Hertfordshire Enviro-Tech	Focus on new enterprises with a high knowledge content in environmental technologies
Great Yarmouth and Lowestoft Enterprise Zone Extension	Growing on energy related businesses and high skilled jobs
Harlow	Advanced manufacturing/Engineering, Life Sciences
Hereford	Advanced Manufacturing, Engineering, Agri Food, Business Services. Construction inc. Defence and Sec.
Hillhouse Chemicals and Energy	target sectors are chemical, polymer manufacturing, renewable and advanced manufacturing
Humber enterprise Zone Extension	Agri food, Energy, Retail & Logistics, Transport
Lancashire	Advanced Manufacturing/Engineering, Aerospace, Automotive
Leeds City Region - M62 Corridor	Advanced Manufacturing/Engineering Automotive, Construction inc. Pharmaceuticals & Healthcare
Loughborough and Leicester	Advanced Manufacturing/Engineering, Energy and Low Carbon, Life Science, professional and financial services, Software and Space
Luton Airport	aerospace, advanced manufacturing, associated leisure, hotel and catering
Manchester	Advanced Manufacturing/Engineering, Aerospace, Business Services, Industrial Biotech, Pharm & Health
Mersey Waters	Advanced Manufacturing/Engineering Automotive, Business services, Energy, Pharmaceuticals & Healthcare
MIRA Technology Park	Advanced Manufacturing/Engineering, Automotive, ICT, Low Carbon Industry, Transport
North East	Advanced Manufacturing/Engineering, Automotive, Low Carbon Industry, Transport
North East Round 2	vehicle manufacturing, subsea offshore technology, life sciences, creative and digital software
New Anglia (Space to Innovate)	Agri-Tech, Offshore Energy, The Green Economy, Digital and Creative

Newhaven	Advanced Manufacturing & manufacturing; Clean, Green and Marine, Environmental and services
North Kent Innovation Zone (Extension)	Healthcare and Medical Technologies, Advanced manufacturing, Engineering, Digital and creative industries
Nottingham and Derby Infinity Park	Advanced manufacturing/Engineering, creative Industries, Energy, Industrial Biotechnology, Pharm & Health
Northampton Waterside	Advanced Manufacturing, Automotive, Construction inc. built Environment
Oceangate Plymouth	Marine
Royal Docks	Energy
Sci-Tech Daresbury	Advance Manufacturing/Engineering, Aerospace, Energy, ICT, Pharm & health
Science Vale UK	Advance Manufacturing/Engineering, Aerospace, Energy, ICT, Pharm & health
Sheffield City Region	Advanced Manufacturing/Engineering, Aerospace, Creative Industries, Low Carbon Industry, Pharm & Health
Solent	Advanced Manufacturing/Engineering, Aerospace, Transport
Tees Valley Enterprise Zone Growth Extension	Advanced Manufacturing/Engineering, Chemicals, Creative Industries, Energy
York Central	Professional and business service, digital and creative, high-tech engineering and rail, education

5.1. **Knowledge and Technology Transfer in the Port Talbot Waterfront Enterprise Zone.**

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[redacted]

Abstract

This case study paper examines the Port Talbot Waterfront Enterprise Zone (PTWEZ) and its efforts to maximise its economic contribution to the region involving knowledge transfer (KT) and technology transfer (TT). This study includes consideration of KT and TT initiatives such as AgorIP. The study highlights literature regarding Regional Innovation Systems (RIS), including specifically KT and TT literature.

This paper examines the PTWEZ portfolio and draws insight from semi-structured interviews with key triple helix actors, along with first-hand accounts from PTWEZ stakeholder engagement.

Findings from this paper reinforce the importance of KT/TT between PTWEZ entities. The importance of a PTWEZ focal point to support the interactions between PTWEZ, while increasing scope and collaboration with AgorIP and relevant industries such as advanced manufacturing and renewable energy.

Keywords: Technology Transfer, Knowledge Transfer, Regional Innovation Systems, Triple Helix.

1. Introduction

There has been increasing interest in the significance of 'knowledge' and its impact on the economy and regional growth. (Cooke, 2002; Asheim et al, 2011; Davies, Roderick, & Williams, 2018). This particularly interests post-industrial regions such as south-west Wales, which have become particularly challenged over recent years. (Pugh, MacKenzie, & Jones-Evans, 2018). which has led to a greater emphasis on creating a knowledge-based economy in the south-west Wales region. Morgan (2001) described the need for this following the decline of the heavy Industry markets and inward investment; coinciding with introducing devolution in the UK in 1999. Devolution was then followed by the forming of the Welsh Assembly Government (WAG). WAG embarked on the delivery of new policies focused upon knowledge-based activity. This attracted a notable level of Academic interest (Cooke, 2004; Huggins & Strakova, 2012). For example, Pugh et al. (2018) describe problems with the 'Technium' knowledge-based initiative, including not learning from the original Swansea Pilot before expanding the initiative., Davies (2019) built upon the work of Huggins and Kitagawa (2012) to further understanding of this initiative inter alia. This echoed points from Pugh et al. (2018) noting that evaluating the question of time horizons for such initiatives. Besides this, Gibson et al. (2007) provided a more Industry perspective issue to this domain, highlighting a lack of deals flow between the private sector and Academia. These issues are germane in the region's context's plans, such as the Swansea Bay City Region (SBCR) Internet Coast City Deal (SU, 2017); where it looks to enhance the 'Regional Innovation System' (RIS), as per the concept, was set out by Cooke (1992) to

support the economic development of a specific area. This model works with the processes of KT & TT and its importance in the production of knowledge and innovation between Academia and Industry (Bercovitz and Feldmann 2006; Mowery and Nelson 2004). Perkmann & Walsh (2007) highlighted the need for partnerships to form between Academic and Industry contexts. This paper will look at the barriers and drivers for the successful localisation of KT&TT in South West Wales. While also provides a mapping of the RIS through the Triple helix model (Leydesdorff & Etzkowitz, 1998).

2. Knowledge Transfer – Technology Transfer

One established definition of 'knowledge' by Drucker (1998) describes it as the catalyst to bring about a potential change to something or somebody, allowing individuals or institutions to improve the capability of operative actions. Ankrah et al., (2013) defines knowledge transfer by "any activities aimed at transferring technology or knowledge to help either the company or university to further pursue its activities"; this adds to the importance of recognising both KT & TT as a collective.

Conversely, there is much discussion about how interchangeable the terms KT and TT are (Gopalakrishnan & Santoro, 2004; Martinelli, Meyer, & Tunzelmann, 2008; Ankrah & Al-Tabbaa, 2015). The two should be a combined activity. Nonaka & Takeuchi (1995) defined knowledge transfer between 'tacit' and 'explicit', which backs the argument of the similarity in definitions.

Battistella et al., (2016) provide an in-depth literature review. This looks into both entities. This literature coincides in the broader context of the University-Industry Engagement, which is an integral part of the Academic contribution (Tornatzky & Association, 2000).

A subsequent literature review has been produced which tests the university-Industry relationships (Perkmann et al., 2013). The driving catalyst for this relationship to form was through the Bayh-Dole Act in the US (Henderson, Jaffe, & Trajtenberg, 1998). In the UK reports produced by Lambert (2003) and additional Government documents by (HOC, 2013, 2017) and regional Welsh Government (WAG, 2004). Where they also challenge the issues highlighted by the Academics earlier on.

KT & TT is a two-way process; a succinct exchange between Academia and Industry (Abreu et al, 2009). Kitagawa and Lightowler (2013) discuss the term 'Knowledge Exchange'. There is a collective agreement that this process is bi-directional; this is contrary to the original belief of a unidirectional process; (Gopalakrishnan & Santoro, 2004; Ulhøi, Neergaard, & Bjerregaard, 2012). Bjørn T Asheim et al. (2011) refers to the mechanisms required for knowledge transfer to take place; including human capital and local labour markets and to improve the understanding of local and non-local sources of knowledge.

In the past two decades, TT between Government, Academia and Industry is considered being of immense importance in enhancing regional economic growth and social development. Known as 'the triple helix model' (Leydesdorff & Etzkowitz, 1998).

There is much discussion about how effective this model is in practice and whether it has reached the expectations for innovation, employment and GDP potential (B. T. Asheim & Coenen, 2005; McAdam et al, 2011). It is paramount that this process is developed further to solve these issues; this can be done through including a fourth entity, as described by Carayannis and Campbell (2009), includes the societal based innovation user for the quadruple helix model to exist. This is also

supported by Bozeman, Rimes, and Youtie (2015) that discusses how society needs to have some input into the TT process.

In North America and Europe, there has been a significant development in public policy regarding innovation (EC, 2013). Since 2010, the UK has seen a reduced growth in development relative to the USA (OECD, 2016). This has then emphasised the issues for post regional regions, such as South West Wales and its ability to have a production RIS. (Isaksen, Martin, & Trippl, 2018)

3. Port Talbot Waterfront Enterprise Zone (PTWEZ)

The PTWEZ is a Government-led industrial zone, made up of three areas; Baglan Energy Park, Port Talbot Docks, and Baglan Industrial Estate. These makeup 120.86 Ha of potential real estate for companies ranging from technology start-up to heavy Industry and specialise in advanced manufacturing and materials, energy and environment, and construction. This was formed from a direct response to the decline of the steel Industry and Tata Steel. (BW, 2019). Below is an image to highlight the mentioned areas of the PTWEZ as fig. 1.

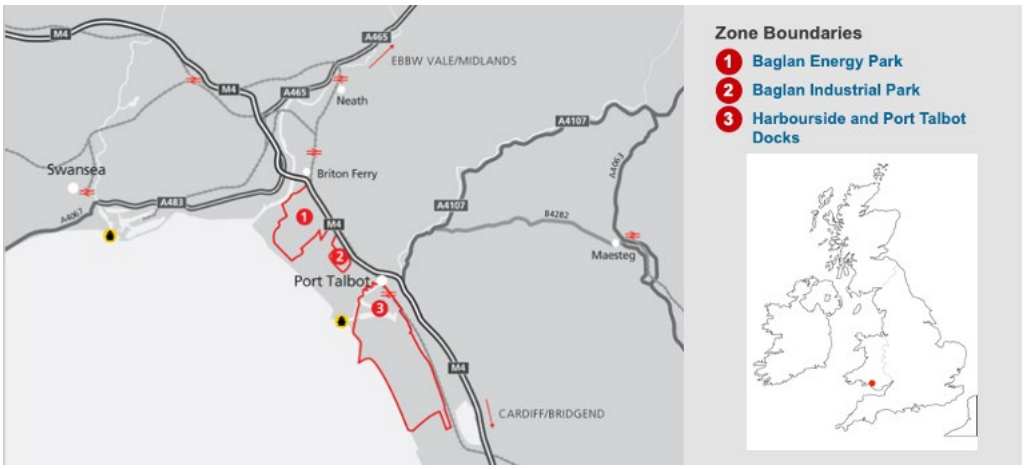

Figure 3 – Areas and sites in Port Talbot Waterfront (BW,2019).

Swansea Bay City Deal announced in January 2020, allocating £58.7 million to the Neath Port Talbot area SBCD (2020) to further the PTWEZ initiative in its ambition for regional economic development. There are 111,900 people employed in the region of Neath Port Talbot according to (WG, 2020). This initiative has recently been associated with the Swansea Bay City Region deal (SU, 2017).

The Welsh Government describes Enterprise zones as: “where we create the best possible conditions for your business to thrive”. (WG, 2019) The incentives offered includes infrastructure support and Business rate support; this allows businesses to offset up to a maximum of £55,000 against their business rates incurred during the previous year’s financial year or their rates bill paid, whichever is lower. In addition to that, they offer enhanced capital allowance to claim a 100% first-year allowance for capital cost of investment for plant and equipment.

The strategic aims and objectives have been set out by Hatch consulting are as follows;

- “Strengthen and diversify the South Wales economy, building resilience for the longer-term future.

- Stimulate a cluster of advanced manufacturing, energy and engineering companies by providing a well-connected, competitive business environment.
- Work with Welsh Government and other partners to encourage investment and innovation in the steel sector and wider supply chain to ensure a long-term future".

- "Champion and facilitate commercialisation of local R&D innovation through investment in property and business to help anchor prototyping, testing and production at PTWEZ.
- Differentiate the commercial market offer and unlock key development sites through investment in infrastructure and buildings to capture business expansion and growth.
- Raise the visibility of the unique development potential of PTWEZ through pro-active marketing".

(Hatch, 2018)

There are however no (SMART) objectives set out in the Hatch Consulting report.

Compared to the strategic plan produced by Business Wales, its aims and objectives provide (SMART) objectives (BW, 2019). Below shows a model set out by Hatch Consulting which briefly summarises the PTWEZ model. fig. 2.

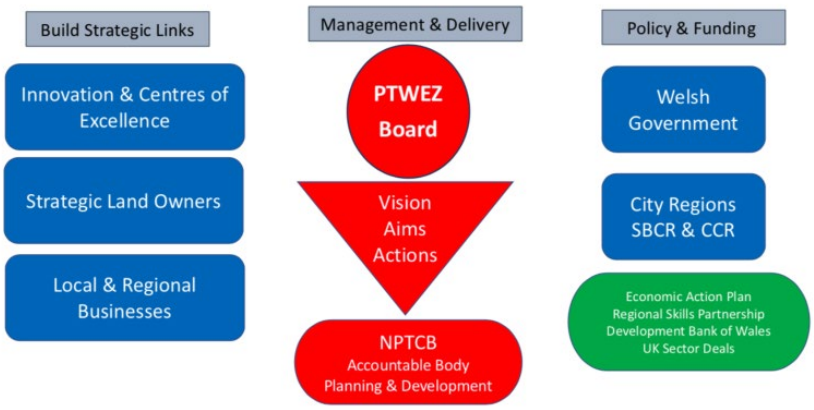

Figure 2: PTWEZ model (Hatch, 2018)

The model above describes its aims and objectives, which are closely coordinated with Welsh and local Government. Its policy and funding are closely aligned to the SBCR deal.

Morgan (2015) provides relevant literature on SMART specialisation in the South West region, also a review of a recent initiative 'SPECIFIC' which falls in the PTWEZ zone. (Marques et al, 2019). These strategic aims are closely aligned with the AgorIP university TT initiative in their vision, whereby the two working alongside one another can mutually benefit through aims and objectives. More recently, the PTWEZ have invested 250k into the AgorIP initiative, which was aimed to support "early growth EZ based businesses linked to AgorIP" (BW, 2019)

4. AgorIP

The AgorIP, which is Welsh for 'open' IP. Is an initiative, which was developed in partnership with Welsh Government and Industry to commercialise Intellectual Property from university and health board research output. This, similar to the PTWEZ, follows the 'triple helix' model produced by

(Leydesdorff & Etzkowitz, 1998). The AgorIP model claims a unique 'zero-waste' approach, whereby it allows these opportunities to progress to give the best opportunities for success (SU, 2016).

The initiative adopts the 'Open Innovation' paradigm originally developed by Chesbrough (2003) and involves targeting KT & TT to occur through the different stages of development. This happened in both existing and/or new markets between different organisations. The AgorIP model is presented below as fig.3;

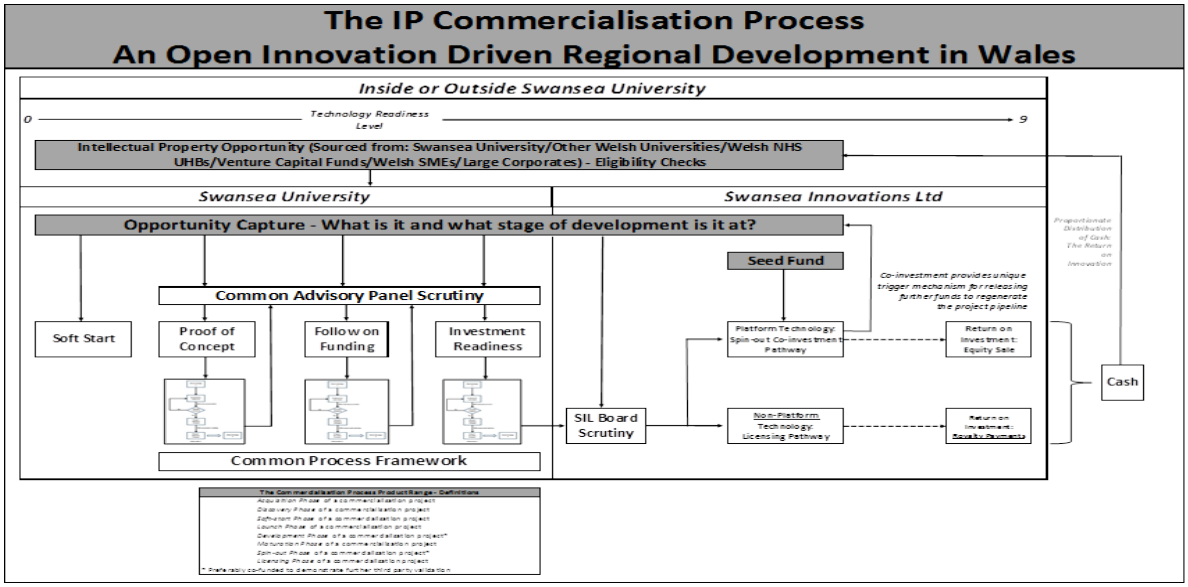

Figure 3: Agor IP Model (SU, 2016)

AgorIP involves 5 Technology Transfer Officers (TTO) possessing a multitude of skills including; contract negotiation, market appraisal and project management. The team also provides a wider network of expertise, which allows them to provide potential clients with investment and external sources, such as market research and regulatory advice. AgorIP has also been subject to prior review (G. H. Davies, Jones, Williams, & Joyce, 2019; G. H. Davies et al., 2018). There is an agreement that since the forming of AgorIP, the scope and scale have been widened through this initiative. This is also supported through interest from policymakers in Welsh Government HEFCW (2017) and the UK Government (RSM, 2018).

5. Approach

The approach for this case study has been developed drawing upon the approach pioneered by Stake (1995).

The research carried out for this paper comprised three parts. This includes the PTWEZ project documentation and portfolio, which provides data on the businesses are within the EZ. Second, the existing analysis of SBCR and PTWEZ project. Primary data collected from semi-structured qualitative interviews; comprising 32 interviews from key actors in the Government, Academia and Industry, which support the 'triple helix' framework (Leydesdorff & Etzkowitz, 1998).

A rapid thematic form of coding was undertaken to synthesise the interviews carried out. Themes and codes identified were then cross-referenced to the PTWEZ project information for the businesses within the PTWEZ.

This will look into how AgorIP can impact on this for the added inclusion of Swansea University, being closely associated with the PTWEZ; the data collected can then act as guidance to both support the TTO at Swansea University and the PTWEZ. This data can also act as a bridge between the two, to open up new avenues for potential KT & TT to take place.

6. Results and discussion

6.1 Academia

Participants from universities cited examples of working with Industry, including collaborative research, working as a consultant for an industrial partner, or creation of a university spin-out company. From the interviews carried out, there were proportionately fewer examples described of spins-outs, which could be partly because of the specific experience of the participants.

However, it is important to emphasise that significant spin-outs are a relatively rare phenomenon and can take up to 10-15 years to become financially viable, emphasising that KT & TT can happen through a variety of other ways, such as patenting, licensing, and joint ventures in the more explicit side of transfer, but also 'tacit' forms of movement for this process to happen (Alexander & Childe, 2013).

The structures of universities are so different from Industry that it makes it challenging for Industry to adapt their timescales do not align proactively, which echoes observation of (Demil & Lecocq, 2010). Industry participants also noted the structural differences between organisations, for example, "you know, that they're structured in such a way that, you know, they just cannot impose that kind of change on the majority of the staff".

There was an agreement to the importance of trust and how it influences relationships in KT & TT (Howard, Steensma, Lyles, & Dhanaraj, 2016) this was supported by the interviews. When exploring participants' experiences with the EZ, few had much experience with the EZ and those that did, with limited impact. It was sometimes believed that the EZ had impractical expectations and that its USP compared to other locations was unclear. This comes back to the importance of SMART specialisation (Foray, David, & Hall, 2009).

6.2 Industry

Views on the effectiveness of universities varied significantly amongst participants. Negative reviews often related to difficulty in finding the individual to help them with their problem. A Government official was quoted; "exposing one another to each other".

Academics have agendas, such as publication of papers and securing research grants, which then brings about the debate of the 'publish or patent dilemma' (McAdam et al., 2011). This was also backed by an interview with an Industry representative describing this. "We used to say fame and fortune. So, they need exposure. They need papers being cited by other researchers and they need their papers to be published in not in high-ranking journals and to win awards. And then the fortune

is they need to secure research money to keep their research centre going to employ their staff and employ more staff because they will want to grow their research centres".

This is being mainly for Academics being measured on this for performance and promotions, rather than upon their collaboration with companies. It was also perceived that that university may, to some extent, be losing sight of their mission and charitable status which should concentrate more on the economic and social development of the region.

There were differing views on proximity being as much of a barrier as is often perceived. Where some did not see this as a barrier where others did, which supports the work by (Malik, 2013). However, when delving deeper into the answers, the overall consensus is that it is required to be in proximity for the initial contact with an individual so that a relationship and trust can be formed. Once this has happened, then the challenge of distance becomes less of a barrier which can add to the literature in this area as this has not been suggested in this way. This was agreed upon, though some individuals highlighting that there will always be the barrier of distance. For example, the distance between London and Swansea was cited as forcing companies to re-locate from the region to increase their chances of receive funding.

6.3 Government

Governments, both national and local, have an important perspective on KT & TT because of their working with both universities and Industry. Interviewees echoed the view that the way universities are structured often makes it hard for Industry to align their timelines to that of activity within universities (Demil & Lecocq, 2010). This was described as being because of Industry having problems that they need sorting as soon as possible, which does not align with concurrent Academic imperatives. However, there were many examples cited of successful relationships between universities and Industry, addressing collective problems and contributing to the regional economic development, while also taking into consideration the recent importance of the Future Generations Act, which is described as "*improve the economic, social, environmental and cultural well-being of its area by contributing to the achievement of the well-being goals.*" (NAW, 2015)

The main reason for success, which was highlighted through the interviews was where universities are transparent with what they can do to help and are effective in managing the expectations of Industry partners and to implement this process appropriately, which is supported in the literature by (De Toni, Nonino, & Pivetta, 2011). Success was also noted as being contributed to by a range of Welsh Government schemes, such as the Strength in Places Fund, Smart Cymru and Open Innovation programmes. There is a limited amount of research that looks into the Government side of this process of KT & TT. This paper can then lead to more insight into this point of view.

6.4 Emerging themes

The interviews presented several emerging themes, including;

- Potential for greater collaboration between Academia, Industry and local and national Government institutions, with a focus upon key strengths aligned across Industry and Academia across the region
- Proximity and frequency of engagement matter in identifying, developing and sustaining collaboration
- Opportunity for a focal point within the Enterprise Zone which would allow for co-location of businesses, universities, funders and related actors to be situated to allow for greater levels of KT.

- Design of appropriated facilities is important for the success of this idea. The characteristics of this will be to have an open plan communal area to allow for the minimal friction flow of knowledge and ideas to pass. Also, separation of workspaces and labs for protecting IP and sensitive information.

7 PTWEZ portfolio

The data discussed was got through the Neath Port Talbot County Council, where they have had a first-hand account in bringing in all the new companies into the PTWEZ area. The two sectors predominately In the region are manufacturing and construction industries, both of which support strategic plans set out by (BW, 2019; Hatch, 2018). These 2 sectors make up 108 companies out of the total 217 (49.7%).

fig. 4 provides a breakdown of all the businesses within the PTWEZ.

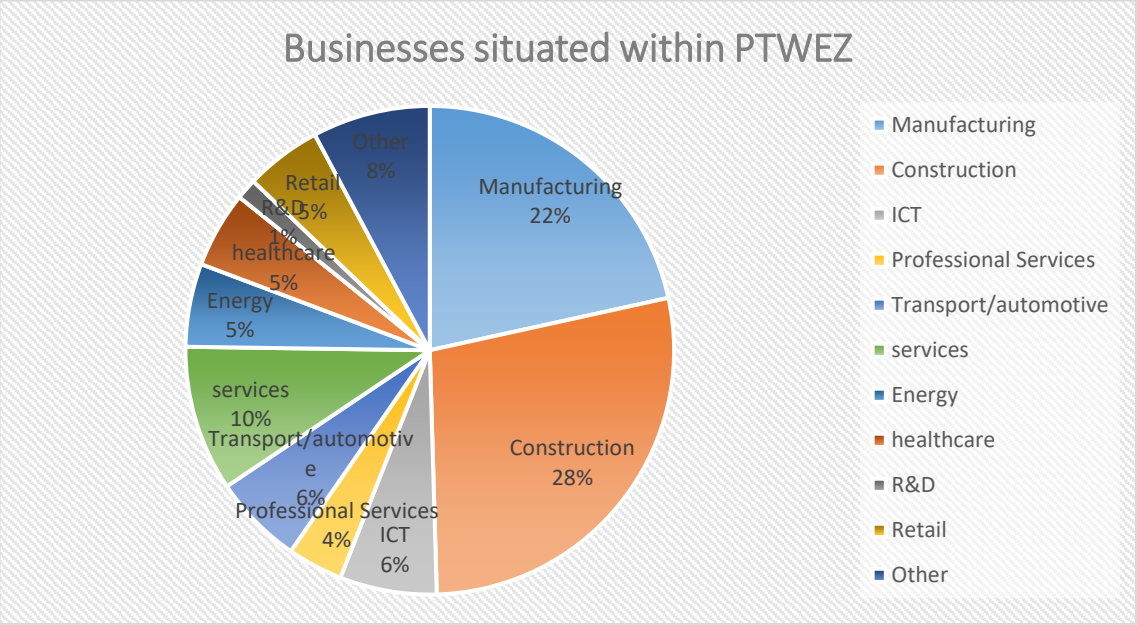

Figure 4 – Pie chart depicting types of businesses within the PTWEZ.

This is supported by the correct labour force within the area, which echoes observations of (Foray, 2014; Morgan, 2015) SMART specialisation. Recent emphasis has pushed towards Energy and ICT companies forming their clusters. During one interview with a Government official, the emergence of an ICT cluster was highlighted in the Port Talbot region; This initiative has recently been associated with the Swansea Bay City Region deal (SU, 2017). Also, energy and renewables have moved recently, which further supports the aims and objectives of the strategic plan.

8 Conclusion

This study has highlighted several well-established issues being apparent within the PTWEZ context; this relates to the theory that follows an increased demand for innovation to be supported by Academic institutions (Guerrero et al., 2016). This emphasises the complex nature of KT & TT; this being hard to measure its true impact between unique entities, such as Academia, Industry, and

Government. It is important to acknowledge that KT rarely happens quickly, and that there has to be a process and adequate infrastructure in place to allow for this to happen naturally. To facilitate this between Swansea University and the PTWEZ, stakeholders identified the potential for there to be a focal point for ease of communication, between the two parties, which is backed in the literature by (Van Wijk, Jansen, & Lyles, 2008). A good example of a successful model in this area is the 'Sheffield University Enterprise Academy'.

With Academia, the participants have the ability, motivation and capacity to facilitate this. Vice versa, Academics who do not have an interest in this process, are not obliged to partake. Conversely for practitioners, they need to be directed to the people, due to the individuality of Academics and their specialist research. This would be a point for AgorIP to consider in developing interactions between the two parties, as KT & TT is a two-way process.

This case study paper has gained a unique opportunity in gathering data on this EZ and how it can have a direct impact on the region in KT & TT process. This then can add to an additional strand to the literature from this context to provide teachings which then can be translated to other EZs across the UK.

It is important to understand and appreciate that this process can take a long time and all entities should maintain patience; more so for policymakers and critics, for much of the criticism of these initiatives in past years, was because of the premature nature of the evaluation of these KT initiatives and to give it ample time before such evaluation can take place.

The PTWEZ case has highlighted considerations that would be of relevance to regions with similar challenges and contexts, including the opportunity to draw upon well-established learning embedded in concepts such as Smart Specialisation and Open Innovation.

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5.2. The 'Freeport' dilemma in the Regional Innovation System of South West Wales.

The 'Freeport' dilemma in the Regional Innovation System of South West Wales.

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Abstract

This case study examines the potential benefits and barriers of the 'Freeport' initiative within the context of South West Wales and the impact it could have on the Regional Innovation system (RIS), while also achieving policy potential for Smart Specialisation. In addition, this paper adds to the existing cases relating to RIS Theory and how this initiative can facilitate in the activities of Knowledge Transfer (KT) and Technology Transfer (TT). Also, this further contributes to the existing literature relating to Regional Innovation policy in this specific region. Furthermore, it expands examination of Smart Specialisation, with a review of this post-industrial region in the emerging BREXIT context. Smart Specialisation is an EU policy, while the 'Freeport' initiative is a post BREXIT UK Government led policy within a devolved region. It poses a question for its orchestration in a developing multi-level governance. Additionally, this supplements the literature around the 'Freeport' movement and how it can support a region such as South West Wales, which can open additional avenues for international

trade. This examines the impact of University-Industry collaboration and its importance to regional development. The data comprises semi-structured interviews involving key stakeholders from Industry, Academia, and Government. To conclude, there are many similarities between that of the Enterprise Zone (EZ) and the Freeport initiative, which questions if the constant progression of these initiatives takes away from the previous one and not allowing for them to have enough time and resources to make a notable and long-lasting difference. However, it was unanimously agreed of the importance of such initiatives like the Port Talbot Waterfront Enterprise Zone (PTWEZ) and the potential Freeports.

Keywords: Freeports, Regional Innovation Systems, Smart Specialisation, Knowledge Transfer, Technology Transfer.

1. Introduction

Now in the age of post BREXIT, the UK Government has reconsidered its international trade approach, which questions the evolution of the devolved region, including Wales. Since devolution in 1999 the Welsh Assembly Government's (WAG) main aims has been to develop Wales into a 'knowledge economy' Abbey et al. (2008) and to carry out the interests of the collaboration between Universities and Industry (Perkmann & Walsh, 2007; Banal-Estañol et al., 2018). More recently, Freeports have been on the agenda of UK Government policy with the recent announcement of eight Freeports to go ahead in England, and at least one more in Wales and Scotland (Webb & Jzepa, 2021). The freeports announced in England are: East Midlands Airport; Felixstowe & Harwich; Liverpool City Region; Plymouth and South Devon; Solent; Teesside; Thames. These are depicted in the image below as Figure 1.

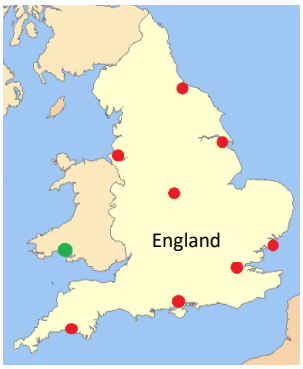

Figure 1. *Depicts the eight freeports in red and the location of South West Wales in green.*

The main objectives set out by UK Government for Freeports is to "create hotbeds of innovation" Webb and Jzepa (2021) and the desire to work with Academic institutes and centres of excellence (GOV, 2020). For these objectives to be achieved, KT&TT must be considered and recognised, which Ankrah et al. (2013) defined by "any activities aimed at transferring technology or knowledge to help either the company or university to further pursue its activities".

This case study paper then looks at the Region of South West Wales, which has significant interests in innovation, with the PTWEZ being a location of interest for this potential initiative. With limited research on Freeports, most of the literature looks at the conditions for success and its challenges associated with this (Susman & Schneider, 2008; Farole, 2011). This paper aims to supplement the field and explore how the concept may relate to region and its potential relationship to Smart Specialisation, which is defined by "a process addressing the missing or weak relations between R&D and innovation resources and activities on the one hand and the sectoral structure on the economy on the other" (Foray et al., 2011; Morgan, 2017). Because of the unique nature of the data available to this study, this will provide insights from the perspectives of Academia, Industry and Government, fitting the triple helix model (Leydesdorff & Etzkowitz, 1998). To coincide with the potential arrival of

a Freeport to South West Wales, is the completion date of June 2021 for the PTWEZ ending. This paper will set out to look what the future holds for the PTWEZ what configuration should follow this.

2. Freeports

Freeports, which are also called Free trade zones (FTZ) are defined by a geographical area which sits outside the legal customs territory of a nation (Jayawardena, 1983). More recently the UK Government has defined this as: Goods can be imported, manufactured, or re-exported within the Freeport incurring no customs duties or taxes; these fees are only paid once the good enters the domestic market (Sunak, 2016). However, compared to the definitions by the world bank Akinci and Crittle (2008) define freeports as similar to FTZ, but define this being a large area and cover a wide range of activities to support economic development and trade. Freeports are not a new phenomenon, they have been around for thousands of years. They were first used by the Triremes of the ancient Mediterranean, which allowed respite from import tax for ships carrying various goods, such as wines and olive oils. Since then, freeports have multiplied consistently throughout the globe for many years, with approximately 50 Free Trade Zones (FTZ), employing 66 million people across 135 countries, while there is not one in the UK (Sunak, 2016).

Freeports exist because of their ability to reduce the barriers often associated with international trade, such as boundaries and differing regulatory regimes (Lavissière et al., 2014). However, this raises one of the key arguments against this initiative, the displacement of jobs (Serwicka & Holmes, 2019; Webb & Jzepa, 2021). Concerns were raised by the Welsh Government (WG), because Freeports have been announced in England before agreeing with Wales and Scotland. This presents a lack of joint decision making between UK Government and the devolved regions (Webb & Jzepa, 2021). A GOV (2020) report details a step-by-step breakdown of how these freeports will be adapted to the UK. Most notably, they will be set up in a unique model to cover three objectives:

- Establish Freeports as national hubs for global trade and investment across the UK
- Promote regeneration and job-creation
- Create hotbeds for innovation

The boundary set out for the Freeport will range between 25-45km, where the main location should be near a port. Proposals outside of these boundaries will also be on a case-by-case basis (GOV, 2020; Webb & Jzepa, 2021). This has raised questions about how the devolved nations should react to this and the potential location of a Welsh Freeport. This paper sets to shine some more light on Freeports and the affects it may have on RIS of South West Wales, if the Welsh & UK Government decides on South West Wales.

A key finding found in the consultation report by Webb and Jzepa (2021) concluded that respondents believed that including Academic institutions to freeports were of great importance. While many local authorities highlighted the importance of linking in Freeports to the local ecosystem “like UKRI catapults” (GOV, 2020). The importance of Freeports has risen globally, directly impacting on Foreign Direct investment (FDI) invested in these zones (Farole, 2011).

While there are variations of Freeports globally, Lavissière and Rodrigue (2017) designed a model to best depict Freeports in its most versatile form. Though this model is comprehensive, it does not consider one of the main objectives, to provide a “hotbed for innovation” (Sunak, 2016). This proposes an evolution from the final prospective model by Lavissière and Rodrigue (2017) and that it should consider how it fits in to the collaboration of Academic institutions, science parks and centres of Academic excellence (GOV, 2020).

Data collected has been undertaken on the prospects of Freeports in the UK, with limited opinion on devolved regions, which this paper sets to answer. The table below fig 2. depicts the overview of Freeports policy levers in Wales, which are important aspects to consider when designing a prospectus for the Devolved regions.

Policy area	Wales
Customs	Customs policy is reserved by UK Government, with few exceptions including sanitary and phytosanitary control, which are mainly devolved
Taxation	Some tax policy is reserved by UK Government. However, some aspects, such as Business Rates and Stamp Duty and Tax, are devolved.
Planning	All planning policy is devolved
Regeneration	Regeneration policy is in part devolved
Innovation	Innovation policy is part-reserved by UK Government, part-devolved. The Freeports innovation measures are reserved, except as stated otherwise.

Figure 2. *Overview of Freeport policy lever in Wales, retrieved from (GOV, 2020).*

The Freeport consultation report then raised the importance of planning these under local economic and infrastructure strategies (GOV, 2020; Webb & Jzepa, 2021). In a Welsh context, this should support the perspective of the Future Generations (Wales) Act (H. Davies, 2017) as well as recent WG policy prioritisation of Smart Specialisation (Foray et al., 2011; R. E. Pugh, 2014; Morgan, 2015; Marques & Morgan, 2018). Therefore, this sets out to look at the views of key stakeholders in Government, Academia, and Industry in South West Wales; to understand if this is a suitable location for a Freeport to be located, while also considering the local economic and infrastructure strategies that are already in place.

3. Freeports within a Regional Innovation System (RIS)

RISs were first developed by P. Cooke (1992) who defined it as a mapping of a regions innovation capacity. The RIS approach has signified the importance of geographical proximity for KT.

Due to complex nature and regional setting of Freeports and their proposed 'innovation hotbed role' they could be considered against the RIS (P. Cooke, 1992, 2004; M. McAdam & Debackere, 2018). They may present a factor for consideration within such models, to help maximise its potential and to achieve Government's goals for innovation to occur. RIS has been a frequent topic in European policy objectives (OECD, 2013; EC, 2014a; OECD, 2020). Therefore, the importance of Freeports within the RIS is essential to achieve its optimal potential. Wales has developed into a key centre of high quality, highly skilled workforce, with recent devolved policy agendas for decarbonisation, innovation centres and energy positive buildings to support start-ups and spinouts from Academia (JLL, 2016; SBCD, 2020; WG, 2020).

The most suitable model that depicts the RIS is by Trippl and Tödtling (2007), whereby they recount all the key actors involved. For the RIS for South West Wales, will be broken down into its key components:

First, the key stakeholders involved in the knowledge generation and diffusion system are the three main universities, Swansea University, University of Wales Trinity St David (UWTSD), and University of South Wales (USW). They respectively have their various incubators and Technology Transfer Offices (TTO). AgorIP is the TTO for Swansea University and the incubator of significance is FLEXIS, which is partly based within the PTWEZ. Followed by SPECIFIC, which is based within Bay campus of Swansea University. Recently FLEXIS was part of an initiative to develop a "zero-carbon area demonstrator" to support clean living (FLEXIS, 2021). While SPECIFIC have demonstrated "active buildings which can generate, store and release their own heat and electricity from solar energy" (SPECIFIC, 2021).

Second, local knowledge flows and skills are the mechanisms and resources that are in place within the RIS to help with the collaboration of formal and informal links for KT (Tödtling et al., 2006). The PTWEZ is a key stakeholder that was designed for the purpose of linking Academia into Industry. The Freeport initiative is also an example of performing KT&TT activities.

Third, Socio-institutional factors that describes how the various actors work together and the differing in cultures. Bourne et al. (2020), found that there are still cultural and structural differences associated with Academia, Industry, and Government because of the "patent or publish" dilemma (R. McAdam

et al., 2011). However, with the RIS, there are many examples of collaborations between Academia and Industry, most notably in the life sciences and engineering department (G. H. Davies et al., 2020).

Bjørn T Asheim and Isaksen (2002) concluded in their study of the importance of KT&TT when firms are within RISs, as this is one of the key drivers for companies to be within a certain location. Huggins and Kitagawa (2012) support these findings who state the importance of Academic institutions in KT activities. This then supports the objectives set out in the Freeports policy of including Academic institutions, to establish operating laboratories, testing facilities, translational research centres and business incubators to help drive new opportunities (GOV, 2020).

4. Approach

The case study paper is to question how the Freeport would be situated within RIS of South West Wales. This approach has been developed, drawing upon the approach pioneered by (Stake, 1995).

Research carried out for this paper comprised three parts. Bibliographic literature review, primary data collected from semi-structured qualitative interviews, and secondary data on the statistics on Freeports, comprising 12 interviews with key actors in the Government, Academia, and Industry.

A rapid thematic form of coding was undertaken to synthesise the interviews carried out. Themes and codes identified were then analysed with the knowledge of the Freeports that have already been chosen and for what reason.

These results will be related to the policies of Smart Specialisation and RIS, to understand and give insights for policy implications. This will investigate how AgorIP can support the ongoing development of the PTWEZ, in relation to the potential Freeport agenda. Furthermore, this data can also act as a bridge between the two, to open new avenues for potential KT & TT to take place.

5. Findings & Discussion

The results are presented in three sections reflecting the triple helix model, within the context of South West Wales (Etzkowitz & Leydesdorff, 2000a). This method was based upon previous work by Bourne, Davies and Williams (2020) who discussion and analysis separated it into these three sections. These are a continuation of an initial data collection, that was set out to understand the drivers and barriers for successful KT&TT within the context of PTWEZ. Main themes were synthesised though semi-structured interviews of key stakeholders within Academia, Industry, and Government (Bourne et al., 2020). This work sets to understand the evolution of the Enterprise Zone and how it might work in an international context. Presented below are quotes and themes emerged from the rapid thematic analysis.

5.1 Academia

Limited knowledge was held by Academics regarding the Freeport initiative, where participants either knew nothing about the initiative, or they were quite familiar with it. In relation to the 'innovation hotbed' dimension of RISs, there was a consensus for a lack of joined up approach between the TTO in Swansea and the PTWEZ for the potential of spinouts and commercialisation.

"So, there is external support and there is the enterprise zone that they do require support, but it's not that apparent really the whole embeddedness like that."

Conversely, With the consensus for the future of the PTWEZ, it was agreed that proper investigation must be undertaken. However, there was an overall agreement that it can act as key component between the KT&TT activities. Also, this initiative has been seen to only be beneficial to the key stakeholders of the Triple helix in the area. Where an Academic was quoted:

"The area, I do not know a lot, but it's quite nice to see so many companies happening in certain areas, as I say quite close as well to Swansea directly, this can only be a benefit. For the local community."

There was limited discussion of tangible benefits associated with the PTWEZ. However, there was a level of belief in non-tangible benefits, including an overall social benefit to the surrounding region. Also, this supports the literature around the importance of creating the linkages between Industry, Academia and Government that may not have been achieved without this (Zhang et al., 2019; Bourne et al., 2020). Moreover, the basis for the PTWEZ naturally forms clustering of industries and companies within a region that can only be seen as beneficial, while also supporting the literature (Bramwell et al., 2008; Valero & Van Reenen, 2019).
In addition, this supports the idea of incorporating various stakeholders for when a freeport is formed to optimise innovation activities (GOV, 2020).

5.2 Government

Given the conditions and resources the PTWEZ had during its tenure, there was great admiration of what the board had done in the collaboration between these key stakeholders within the region. Where a Government official was quoted saying:

"you know, I think that the enterprise zone has operated quite effectively as a mechanism for building trust between partners."

Furthermore, this is supported through all the Government officials' interviews, that they had achieved more than expected, given their budget of £40,000. When asked of what should take the EZ's place once it completes in June 2021, there was an agreement that an evolution of the EZ should occur, but only on the condition that more resources are given to the initiative. However, there was not a general agreement of what should take its place, whether that is a continuation of the PTWEZ, or a possible "Innovation District" quoted by a Government official:

"It is too soon to stop it at this moment. Then I made that comment that nature hates a vacuum; something else will fill the void, but it may not be right."

In Port Talbot the port was raised as an important stakeholder and resource to help support the strategic objectives set out by the PTWEZ.

"Associated British port, there is an opportunity there."

This key stakeholder gives another argument to a Freeport being situated here. Port Talbot has a deep harbour port for bulk materials, which makes it unique to the markets that it can offer. Where Government officials believe that strategically, Port Talbot is best situated to have a Freeport for the overall benefit of Wales.

However, there is still some trepidation regarding the Freeport debate, where WG have raised some issues regarding "Obstruction", which should be addressed before the WG begin deciding on where this Freeport should be. Furthermore, there is a desire for more analysis to understand the true benefits that these freeports can bring, where a Government participant quoted:

"Clearly, and then in the right way, with the right policy approach and the right set of interventions and they could be a very useful tool for driving the economy of a region, but there are potential downsides if it's not done properly."

Together with the Academic respondents, the importance of including Academic institutions was unanimous amongst Industry participants, which backs reports by Sunak (2016) and GOV (2020), supporting the notion of the 'Innovation hot bed'. Coupled with the importance of involving key

stakeholders such as ABP and St Modwen who have large amount of influence within the region. This adds to the port that is already there, which can be utilised with the EZ and supports the idea of a 'supercharged Freeport' which links a freeport and EZ such as the PTWEZ (Millett & Lassen, 2018). Conversely, there was slight concern over the amount of analysis that has been carried out over the potential benefits of the Freeports, which echoes comments made in the report by Webb and Jzepa (2021) where WG highlighted the issues around the joined up approach between main Government and the devolved regions. In addition, the hesitancy raised by Government officials, relates back to the literature around displacement of jobs (Serwicka & Holmes, 2019; Webb & Jzepa, 2021).

5.3 Industry

An Industry participant was directly quoted in the potential for a Freeport to be in South West Wales and in Port Talbot, where they argued from a strategic point of view that to get the most out of a Freeport, the key stakeholders of Academia, Industry and Government should be part of the process of this initiative. However, it comes back to potential political issues because of the Freeport being a UK Government led initiative, compared to this being an initiative led by the devolved region of Wales, where they were quoted:

"We should be able to look and create an opportunity that is bringing together, Academia, public sector, private sector, third sector, to a certain degree. To create something that is different and differentiated at port talbot, which also has sustainable import, export capability. So, I see, there is a potential there, but I see political problems."

When describing the PTWEZ, participants emphasised the importance of Academic institutions and how they collaborate with local Industry. While taking advantage of Intellectual Property (IP) and spin outs coming out of the main universities around Swansea, that are Swansea University, UWTSD and USW, where an Industry participant was quoted:

"One of the things that came out of our zoom meetings board meetings was that we should try and get someone from the University thinking about how the university can contribute to this process of creating wellbeing, wealth and opportunity."

However, there was a great enthusiasm to collaborate with the TTO in Swansea University 'AgorIP' and their exciting model, which would maximise potential for commercialisation of IP and spin outs. But there seems to be a disconnect between what the university is doing and what the PTWEZ sees. This was argued that personnel changes within the university, meant it was hard to build momentum.

"To let me know who is currently looking for finance and who might be looking for finance that's coming out of research over the next 18 months or two years I need to know those things, and that has slowed down."

IP is territorial in nature, which poses the question as to how that may manifest in the proposed innovation hotbed Freeport initiative. Also, the desire described from Industry proposes the output of AgorIP for spin outs and commercialisation potential. This supports the objectives stated by Webb and Jzepa (2021) consultation report regarding using key stakeholders within a location, such as Academic institutions. However, inherent issues associated with working with Academia were raised and questioned regarding the joined-up approach between key stakeholders (R. McAdam et al., 2011; Mascarenhas et al., 2018). Similarly, Industry respondents echoed, one of the main objectives from the Sunak (2016), which relates back to the opportunity of developing "hotbed for innovation". Disagreement on the effectiveness of these area-based initiatives working, with a report carried out by WWC (2016) who found the EZ's didn't consider displacement In their evaluations, where analysis that did, often found displacement occurring.

6. Conclusion

In conclusion, this case study offers several insights for researchers and practitioners. First, there was unanimity over the importance of Academic institutions being essential to the success of the Government led initiatives such as the PTWEZ and Freeports, through KT & TT.

Following the completion of the PTWEZ, there was an opportunity noted for something to succeed it to promote innovation activity. This proposes the idea of an 'Innovation district' with the potential addition of a Freeport in the vicinity.

The above points should be considered in the complex policy dynamics acknowledged between main UK and WG that should be resolved to progress these policies. There are similarities between Freeports and EZ's, which asks if this is just the same idea but labelled as a new initiative. What differs is the Freeports added benefits for customs relief on international trade, that may bring displacement of jobs around the UK. However, since eight freeports have already been announced, it should be in WG's best interests to decide where a Freeport may go for the optimal benefit of the country. Otherwise, there is a potential for displacement to happen from Wales into England and a risk for new international business being situated elsewhere that can have a long-term effect on the development of Wales.

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Glossary

Action Research – A philosophy of research used in applied research to provide transformational change by providing action
Agglomeration – the impact of companies and individual locating near to each other
Amorphous – a form that lacks clarity or a defined clear structure
clustering – grouping a set of objects that are like one another
construction – Industry that sets to produce items and materials
Enterprise Zones – a geographic area that encourages economic growth through infrastructure incentives and tax support
European Regional Development Fund – supports social cohesion across Europe through funding mechanisms
focal point – a central location that establishes linkages to other geographic areas
Freeport – Government led programme to increase economic activity to a region
Global Innovation Index – provides as an annual ranking of countries' ability to innovate
Gross Value Added – is the measure and value of goods and services produced in an area of sector
Heterogenous – describes a phenomenon that is diverse
Higher Education Institutions – comprises Universities, Colleges, and Institutes of Technology
House of Commons – an elected body in the lower house of Parliament
infrastructure – production of facilities and systems to support a location
Innovation – the practical implementation of ideas and produce goods and services
Intellectual Property – is a category of property that described tangible property of human
knowledge – is the awareness of something or someone
Intellectual Property Rights – the rights given to an individual when they create intellectual property
Knowledge Spillover – is the exchange of ideas between individuals
Knowledge Transfer – purposeful sharing of information between individuals
Manufacturing – processing of raw materials into finished goods
National Innovation Systems – flow of information and technology among people
Open Innovation – supports the promotion of innovation across boundaries
Organisation for Economic Co-operation and Development – economic body found to stimulate growth among countries
Private Investment Community – Private companies that are support commercial activity
Public Research Institutions – High research-intensive establishments that Government have established to promote innovation
Regeneration – the process of renewal and restoration of a system that is damaged
Regional Innovation System – the support of economic activity through the rapid diffusion of knowledge between individual and organisations
Research and Development – innovative ideas undertaken by organisations to develop new services and products
Small Medium Enterprise – businesses that are in the category of a certain amount of staff
Social Innovation - production of new services and products to support the development of individuals sustainably
Spin out – is when a company is formed and becomes separate from the original company
Sub Questions – a more specific question that supports the main question
Technology Transfer – transferring technology from an individual or organisation to another entity
Technology Transfer Office – an establishment that supports technology transfer activities
UK Research and Innovation – a public body that directs research and innovation funding

University Enterprise Zone – specific geographical entities to support economic activities from universities
Venture Capital – private equity financing that supports start-ups and emerging companies

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