

Medium-size Me! - Qualitative Perspectives on Open innovation in Welsh medium-sized enterprises

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1. Introduction

“Innovation and infrastructure, can unleash dynamic and competitive economic forces that generate employment and income. They play a key role in introducing and promoting new technologies, facilitating international trade and enabling the efficient use of resources.” UN Sustainable Development Goal 9 (United Nations, 2015)

Innovation as a global instrument of growth is important in today's economy, as expressed by the UN Sustainable Development goal described above, as it was when Schumpeter (1911) established the initial relationship between these two factors. The majority of innovation literature focuses on the successes of Western economies. But the global inequalities across national states and the importance of understanding the influence of innovation on less-successful economies is crucially important for a post-

Covid-19 world that seeks to “level-up” (Department Business and Strategy, 2020) to ensure a move towards socio-economic equality.

In researching these less-prosperous economic areas, also referred to as the periphery (Lee and Brown, (2016), observed innovative firms in the periphery are more likely to apply for both overdrafts and loans than normal firms. This economic inequality means there are less opportunities for companies in this region to innovate. The Global Innovation Index (Toyo University, 2019) indicates the prevalence of European developed nations, ranked using 60 indicators, as the innovation powerhouses of the global economy with Iceland, Sweden, Switzerland, and the UK featuring in the top ten. However, this indexed top 10 also features developing economies such as Singapore, Ireland and Estonia which indicates not only the innovation potential of less-developed nations, but also the necessity in understanding and exploring national contexts, such as the Welsh economy, which receive reduced attention in the literature.

The use of open innovation, which is a process of exploiting internal research and development with external partners (Chesbrough, 2003), within the national context of Wales also receives less attention from empirical studies (Rhisiart *et al.*, 2014). This study seeks to understand the part that open innovation can play in this peripheral economy and how companies of a specific size use this innovation method to generate economic growth.

1.1 Welsh Policy Context

Welsh Government has also reacted to the need to catalyse innovation activity through both a combination of funding and business support to combat this with the SmartCymru (Welsh Government, 2020c) programme funding across the research and development landscape in Wales, and Covid-19 Resilience Innovation Project Support (Welsh Government, 2020a). Recent focus on policy in Wales is driven by the Prosperity for All: Economic Action Plan (Welsh Government, 2017) which centres on the socially-driven Foundational Economy (Bentham *et al.*, 2013) and its tenants of supporting foundational sectors such as care and health services, food, housing, energy, construction, tourism and retailers. Structural interventions have also followed with the Foundational Economy Challenge Fund (Welsh Government, 2020b) providing £4.5m to engage the private and public sector in innovation activity around Foundational Economy themes.

Linked with the foundational economy from a Welsh Government perspective is the growth of Medium-Sized Enterprises (MSE) who employ 50-249 people. In announcing the Foundational Economy Challenge Fund, Lee Walters, Deputy Minister for Economy and Transport said;

“We want to increase the number of grounded firms in Wales and establish a firm base of medium-sized Welsh firms which are capable of selling outside Wales but have decision making rooted firmly in our communities.” (Welsh Government, 2019).

This area of both the Welsh economy, and the published body of research is underexplored (Federation of Small Businesses, 2017; Nikos Kapitsinis, Munday and Roberts, 2019) and understanding how these firms innovate to generate increased economic benefits is important for current and future economic policy in Wales.

1.2 Literature Review: Open Innovation in Medium-sized enterprises

Open innovation (OI) is defined by Chesbrough (2003, p.35) as developing increased research and development (R&D) activity to “commercialize internal ideas through channels outside of their current businesses to generate value for the organization”. This method of innovation is specifically being experimented with by the Welsh Government through its OI Development Awards in 2015 and the more recent SMARTCymru OI Feasibility call (Business Wales, 2018)). This allows businesses to explore the feasibility of conducting this form of externalised research and development activity. Therefore, this paper seeks to gain a better understanding of the business impact of OI practices within the Welsh context. More generally, it is widely accepted that successful innovation is often a collaborative and non-linear exercise, involving a range of public and private sector actors and institutions in a network of mutually reinforcing knowledge exchange (Cooke et al., 1997; Thissen et al, 2013).

There is also a wealth of literature on how small businesses and start-ups use and benefit from OI to drive R&D activity (for example, Park, 2018 and Santoro et al.,

2018). However there is a limited literature on the use of OI and its particular applicability for medium-sized firms (Lichtenthaler, 2008) and thus related policy implications. Exploring OI for this size of business and in Wales represents a new contribution.

Existing literature on OI focuses, in the main, on the two areas in terms of size; namely SMEs as a collective entity, and large organisations (Chesbrough, 2003; Chesbrough and Crowther, 2006). This is potentially problematic in the case of generalisation of SMEs as a collective. There are distinct differences in resource, staff, innovation diffusion, and absorptive capacity between a micro or small enterprise with only 2-49 staff, as compared with a medium-sized enterprise which can have between 50-249 staff. Several authors have outlined the gaps in knowledge as there is “*relatively limited research on OI in SMEs*” (West *et al.*, 2014, p. 809). Van de Vrande *et al.* (2009) puts this down to a lack of market need in this business demography as SMEs have a “*lack of financial resources, scant opportunities to recruit specialized workers, and small innovation portfolios so that risks ... cannot be spread*”. This generalisation describes the issues for smaller employers although studies such as Park (2018) and Santoro *et al.* (2018) have since challenged this theoretical hegemony. But suitably sized medium-sized enterprises have the resource and innovation portfolios to reduce these barriers and require further exploration of the opportunity within the research environment.

Ahn et al. (2016, pp. 1023–1024) also identifies the commercial opportunity of OI for medium sized enterprises ; “*medium-sized firms rather than small firms can take a more open attitude towards OI.*” A limited number of studies (Laursen and Salter, 2006; Keupp and Gassmann, 2009) have explored the relationship of perceived OI success and integration with business size. Keupp and Gassman’s study of Swiss innovation structure indicates that small technologically intensive firms are less open to external collaborators and that the level of innovation restriction is dependant on how “*large a portion of the overall value they strive to appropriate*”(Keupp and Gassmann, 2009, p. 338). Their findings do illustrate that firm size is a predictor of OI “*breadth*” (number of knowledge sources) and “*depth*” (level of collaboration with external sources), but they do not differentiate the number of employees per organisation to accurately illustrate the difference of application (Keupp and Gassmann, 2009, p. 332). The study does however suggest that regional structure provides no correlation with OI which would be an interesting hypothesis to test in Wales.

Podmetina et al. (2011) find that firm size is “*not a significant factor*” in the uptake of OI (p. 313). This hypothesis will be tested in relation to Welsh medium-sized businesses as part of this study. The focus on size and openness is also surveyed as part of Ahn et al. (2016) study, which indicates specifically that medium-sized firms are proportionally over 10% more open to innovation than larger firms. The opportunity to study in the diverse economic and social terrain in Wales is both novel and important for policy and practice relating to innovation and medium sized firms in Wales.

1.3 The ‘missing middle’? The Mittelstand to the Canol

The German economy has long been seen as a bastion of family owned, medium-sized, enterprise success, also referred to as the ‘mittelstand’ (Law, 2011). The success stories of companies such as Bosch (Schaefer, 2011) and Koenig & Meyer (Bayley, 2017) has led the European aspiration to emulate the German achievement (Pahnke and Welter, 2018). The so-called ‘Brittlestand’ (Thompson, 2014; Walker, 2014) describes the British variant on this growth model. The Chartered Business Institute (CBI) has long been advocating the development and investment in medium-sized business. The report, ‘Future champions: Unlocking growth in the UK’s medium-sized businesses’ (CBI, 2011, p. 4) illustrates that medium firms represent “22% of economic revenue and 16% of total employment” and they are “often neglected by policymakers”. In exploring the innovation-powered growth potential of medium-sized firms, or ‘Canol’ in Welsh, and gathering reflections on these results from policymakers in Wales this study should ensure a clearer understanding of this neglect.

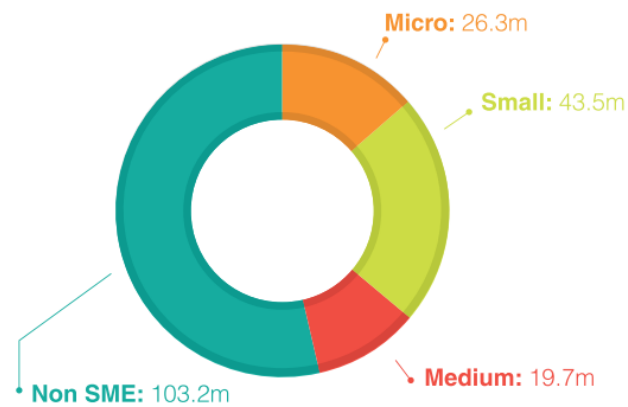
The Federation of Small Business (FSB) (2017) more recently looked at the issue of the under-development of medium-sized firms in Wales, leaving the responsibility firmly at the door of Welsh Government who expel energy and financial resources on attracting Foreign Direct Investment (FDI) while ignoring “domestic economic growth through the generation of sustainable middle-sized firms” (Federation of Small Businesses, 2017, p. 6). The report also indicates the lack of headquartered

large organisations in Wales which leads to a deficit in private capital and research investment and the lack of publicly-funded innovation.

However, a recent report from the Economic Intelligence Wales (Kapitsinis et al., 2019) also highlights the deficit of larger enterprises in Wales, alongside a lack of growth from medium-sized enterprises. The report questions the notion of the missing middle as a particularly Welsh problem, citing parity with the UK picture while raising potentially Wales-specific issues (such as branch-plant operations and a lack of local strategic decision-making). The analysis of business demography in this report highlights that in terms of number of enterprises and proportionality that Wales aligns with the UK, but analysis of innovation funding by the Welsh Audit Office and Innovate UK illustrates a different picture.

Localised data provided by the Welsh Audit Office (The Wales Audit Office, 2018) of financial support provided by Welsh Government based on the size of business, shown in the Figure 1 below, illustrates that business support which includes innovation funding is disproportionately funding non-SMEs and small enterprises. Medium-sized enterprises actually receive the least funding despite their relative capacity to develop new products, processes and services and the need to encourage their progression towards larger firm status (N Kapitsinis, Munday and Roberts, 2019).

Figure 1. Commitments for financial support for business between April 2014-March 2017



(The Wales Audit Office, 2018) Note - Figures exclude open access funding;

Innovate UK, Welsh Economic Growth Fund and the Growth and Prosperity Fund

Although Nikos Kapitsinis, Munday and Roberts (2019) thorough and in-depth analysis of Welsh MSEs illustrates that the concept of the ‘missing middle’ in Wales is incorrect in terms of the number of businesses compared with the UK average. However, what the Welsh Audit Office, and Innovate UK data (Innovate UK, 2020) over the same period, illustrates that there is a missing-middle, or at least a deficiency, in terms of publicly-funded innovation and Welsh Government support for medium-sized enterprises. Exploring why MSEs don’t engage with these structural funding mechanisms is a key contribution that this study can make to the debate, and understanding of how to create growth within this business class and contribute to the ‘levelling-up’ of Welsh medium-sized enterprises within the UK economy (Forth *et al.*, 2020).

2. Research Questions and Methodology

From the discussion above the following broad research questions were identified:

RQ1: How does Welsh Government funding for open innovation incentivise Welsh medium-sized enterprises to innovate?

RQ2: What are the observed barriers and enablers to open innovation in Welsh medium-sized enterprises.

In order to respond to the research questions a series of interviews were conducted with innovation stakeholders within Welsh medium-sized enterprises. These stakeholders had previously identified, through a previously circulated questionnaire, that they engaged in closed and open innovation to develop new products, processes and services. The population of medium-sized firms in Wales was drawn from the FAME database (Bureau Van Dijk, 2019) which uses

Companies House data of registered businesses that return accounts on an annual basis. In order to select this total population, the following criteria was used:

- All active companies (not in receivership nor dormant) and companies with unknown situation
- Number of employees: >50, <250
- Year: 2017 (01/01/2017 – 31/12/2017)
- Registered address: Wales
- Registered email address and contact

At the time of the search, the total accessible population of medium-sized enterprises recorded on the FAME database in Wales was 971, and of this number 580 had a published email address enabling contact under General Data Protection Regulation legislation, which formed the accessible population. A survey was then distributed via email with follow-ups sent over the course of a 3-month period in 2019 with 60 responses received. From the 60 respondents, a total of 13 agreed to be interviewed for the purpose of the research. This represents a suitable number of interviews to achieve coverage of the proposed research questions in line with guidance provided by Kuzel (1992); Marshall (1996); Francis *et al.* (2010); Saunders (2012) to capture a number in the range of 5-60 interviews.

The study employed a semi-structured interview method, as structured interviewing would have ensured the reliability of the results but restricted the exploration of

concepts and ideas that participants offer as part of the process. The semi-structured interview process offers a balance between the reliability of the structured interview with the creativity and experimentation of unstructured interviewing. This provides a space for a “*higher degree of confidentiality, as the replies...tend to be more personal in nature*”(Easterby-Smith *et al.*, 2018, p. 185). The use of this approach allows the researcher to explore the subject allowing “*opinions to emerge*” and gain greater insight (Saunders, M.N.K., Lewis and Thornhill, 2019, p. 375). The question bank for the interviews was formed through a combination of theory, drawn from the literature review, and the findings of the previous quantitative (Barker, Clifton and Loudon, 2020) and (Barker, Clifton and Loudon, 2018) ethnographic study.

In order to ensure the quality of the question A small-scale pilot completed with 3 business owners. Feedback was incorporated into the questions to ensure clarity and understanding before invitations to participants were circulated. Interviews were then completed with 13 organisations in-person, via the telephone, and by video-conference due to both the impact of Covid-19 and the pragmatism of seeking reduce extensive and costly travel.

2.1 Sample

The sample was self-selecting and formed from respondents to the qualitative survey who indicated that they were willing to be interviewed for the project. This approach was also selected due to practical reasons as respondents to the survey

indicated willingness to be interviewed and therefore available to be contacted under GDPR legislation. The sample was formed through a purposive sampling strategy in that participants were also selected based on meeting criteria relating to the method of innovation that the company used to ensure broad coverage between companies using open and closed innovation.

In order to establish a level of saturation and broad coverage of companies using differing methods of innovation certain areas of the sample were targeted specifically to ensure coverage in particular companies using only closed innovation who made up four of the participants willing to be interviewed. The summary table presented below illustrates the variance within the sample. Interviewees' identities have been anonymised (as in Participant 1,2,3 etc.) as illustrated in Figure 21.

Table 1. Summary Sample Table

Company Name	NUTS2	Industry/Commerce	Employee Number	Employee Number Category	Business-2-Business (B2B)/ Business-2-Consumer (B2C)	Innovation Method
Participant 1 - Manufacturing - (PT1M)	East Wales	Industry	73	50-99	B2B	Both open and closed innovation
Participant 2 - Financial Services (PT2FS)	West Wales	Commerce	183	150-199	B2B	Both open and closed innovation
Participant 3 - Manufacturing (PT3M)	East Wales	Industry	212	200-249	B2B	Both open and closed innovation
Participant 4 - Education (PT4E)	East Wales	Commerce	157	150-199	B2C	Both open and closed innovation
Participant 5 - Construction (PT5C)	West Wales	Industry	142	100-149	B2B	Both open and closed innovation
Participant 6 - Manufacturing (PT6M)	West Wales	Industry	55	50-99	B2C	Both open and closed innovation
Participant 7 - Manufacturing (PT7M)	East Wales	Industry	190	150-199	B2B	Both open and closed innovation
Participant 8 - Manufacturing (PT8M)	West Wales	Industry	122	100-149	B2B	Both open and closed innovation
Participant 9 - Information and communication (PT9IC)	East Wales	Commerce	126	100-149	B2B	Closed innovation
Participant 10 - Manufacturing - (PT10M)	West Wales	Industry	215	200-249	B2C	Closed innovation
Participant 11 - Education (PT11E)	East Wales	Commerce	82	50-99	B2C	Open innovation
Participant 12 - Education (PT12E)	East Wales	Commerce	74	50-99	B2B	Closed innovation
Participant 13 - Manufacturing (PT13M)	West Wales	Industry	248	200-249	B2C	Closed innovation

The respondent population, indicated in Figure 21, illustrates a broad geographic spread between companies in the East and West of Wales, alongside representation from industry and commerce. Various sizes, based on number of employees, of medium-sized enterprises are also broadly covered alongside the sales model that they use (B2B/B2C). Also, it should be noted that the sample indicates a bias towards medium-sized enterprises in the manufacturing sector, which is representative of the largest sector in Welsh economy for medium-sized enterprises (Nikos Kapitsinis, Munday and Roberts, 2019), but this is an influence on the results.

3. Data Analysis

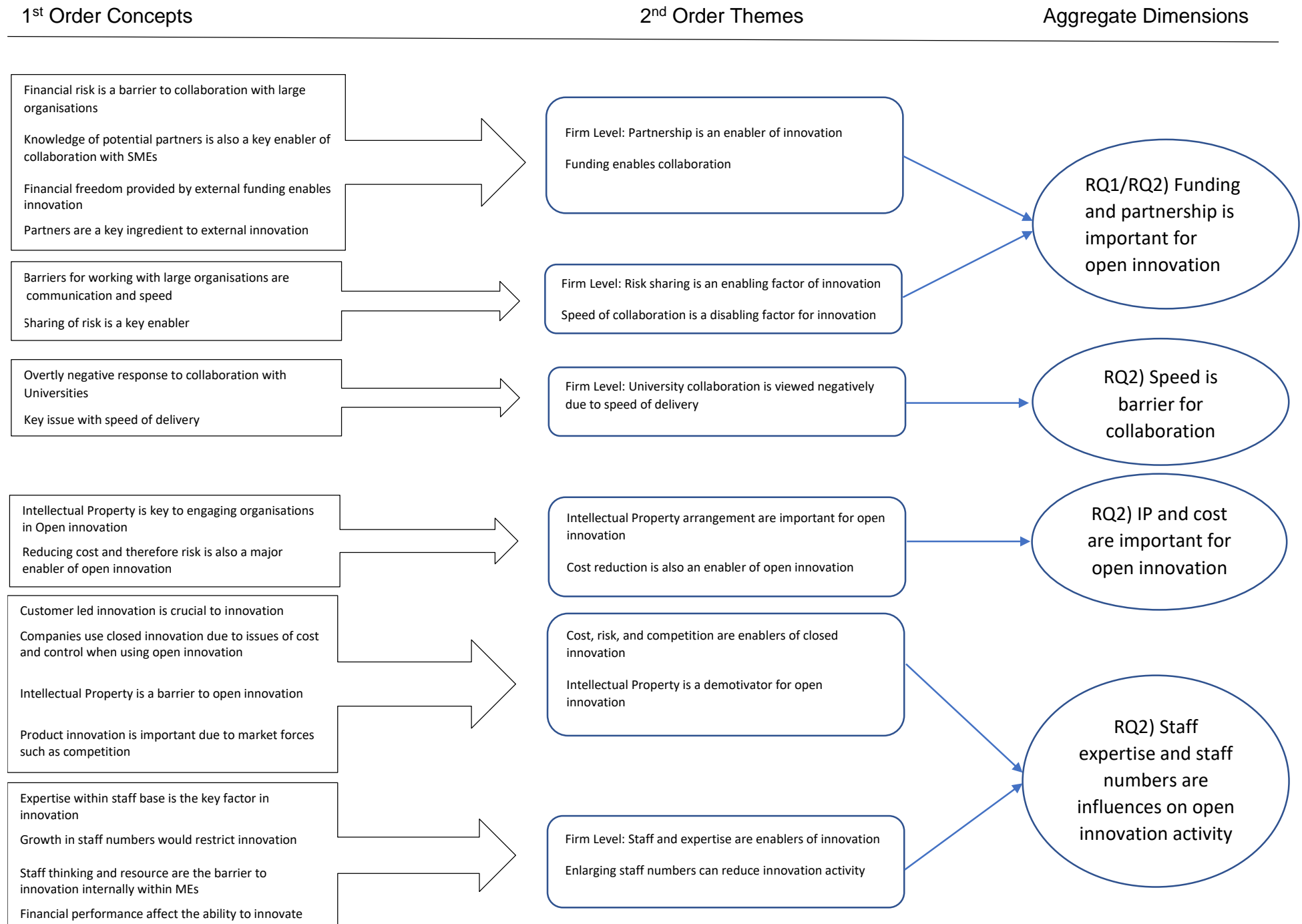
In order to analyse the semi-structured interview data thematically, the study utilised Corley and Gioia's (2004) framework for analysis by theming the data in the first instance into 1st Order Concepts which are descriptive collections of the main themes of the interviews, then broader '2nd Order Themes' which amalgamate the descriptive content into concepts. Then finally 'Aggregate Dimensions' are formed by grouping the thematic data again to form a "*a process that eventually reduces the germane categories to a more manageable number*" (Gioia, Corley and Hamilton, 2013, p. 20). This manageable number of aggregate dimensions have been created within the nVivo software systems as nodes or as the Gioia model describes concepts, themes and dimensions presenting an overview of the findings aligned with the relevant research question.

This process created 277 nodes and from that 13 sub-themes or 2nd order themes and 9 aggregate dimensions or core themes which are mapped in relation to structural features, firm-level features and technological factors.

4. Results

This section of the paper presents a high level overview of the results presented within the Corley and Gioia (2004) template before discussing the findings in reference to the research questions and literature relevant to the data. The analysis of the data is presented first separately to reinforce methodological process before comparison and synthesis in the Discussion section of this paper.

Figure 2. Analysis of Qualitative Data based on Corley and Giola (2004)



5. Discussion

5.1 Structural Factors: Funding (RQ1)

The impact of government funding on innovation can also be hugely influential, as outlined in the literature review section of this paper (Rhisiart *et al.*, 2014; Prokop and Stejskal, 2019). The participants of this study highlighted, in general, government funding was important for undertaking collaborative open innovation work with other SMEs:

PT1M – *“If there’s any government funding going for particular areas of product development then we will be actively involved in that.*

PT1M0 – *“there is quite a bit of funding available...its the amount of work you’ve got to do to get that funding.*

PT1M3 – *“So if we get funding for improvement of production facilities in innovation and production, then if we can say that at the end of this we’ll be taking on ten extra people, even at the lower level jobs like packers and this sort of stuff”*

In general, participants across the interviews illustrate that innovation has both positive impacts in terms of product development and innovation activity summarised by PT1M and drawbacks summarised by PT1M0 and PT1M3. The comments of PT1M0 and PT1M3 illustrate the some of the potential hurdles are both at a structural level with the funding process, and at firm level with job

retention/protection for medium-sized enterprises. Firstly, is the “*work*” involved in getting that funding which alludes to the challenges that businesses face in bid development and securing funding through a competitive process. Wales has a historically poor record in gaining UK R&D funding, alongside investing in R&D, (Jones-Evans, 2021) and the participants here continue this narrative. This potentially illustrates that existing funding assessments and interventions from UK Government and Welsh Government need to be reviewed to ensure this historical trend of low funding levels for Welsh businesses is arrested and that the drive of UK Government to ‘level-up’ becomes a reality (Forth *et al.*, 2020). Although, a different perspective from an individual participant indicated that government funding would actually be a barrier to that company engaging with external open innovation partners:

Participant 12 (PT1M2) – “*I think that if you had the funding to progress a project then there would be less of a tendency to go outside because you would not be able to control all those monies being spent in the same way as you could control them if it was spent inside.*”

This participant’s reluctance to engage with other SMEs in open innovation is due to the risk of losing ‘*control*’ of the innovation process which is also echoed in relation to intellectual property in . Some studies reflect on the process of open innovation as actually outsourcing of this risk to third parties, who substitute in part the needs of the R&D department (Schroll and Mild, 2011a).

But open innovation also carries inherent risk as third-party organisations, collaborating SMEs in this case, can fail to understand the validity of disruptive technology and the needs of organisational fit. This can in turn lead to issues in terms of procuring the correct solutions to the innovation sought (Veugelers, Bury and Viaene, 2010). In order to manage the risk of initiating open innovation while providing valuable funding that PT1M, PT1M0, and PT1M3 require, Welsh Government provide the Open Innovation Feasibility Support (Business Wales, 2018) fund as part of the SmartCymru offer. This funding mechanism allows businesses to plan out an R&D roadmap and relevant partners using open innovation. This funding targets early stage feasibility into open innovation but is not aligned with participants' suggestions that funding be used for "*product development*", "*production facilities*" and "*new product lines*" which are typically post the feasibility stage of development. The suggestions from participants that funding is needed and used in the industrial research portion of the research and development process rather than the earlier development feasibility stage pose an important question to Welsh Government about the relevance and scope of existing funding (RQ1). The successes and failures of this particular Open Innovation Feasibility Support fund in generating open innovation activity with SMEs are currently unknown, but are a worthwhile avenue for future study to understand the impact of public funding on open innovation in Wales.

5.2 Structural Factors: Collaboration with Large Enterprises in Open Innovation (RQ2)

The role of collaboration in enabling open innovation was also important for Welsh medium-sized enterprises and the relationships prove equally complex (RQ2). Following on from the results of the questionnaire in 5.3.3.1 which illustrated the importance of working with large enterprises, it was important to understand why participants wanted to work with organisations of this size.

Participants illustrated the following benefits for the majority of respondents:

PT1M0 *“It’s to obviously have a better product because you’ve got lots more people with different values, different cultural diversity and expertise in different areas and of course, the resource.”*

PT1M – *“simply because they have connections that we would need to get the product into service.”*

PT8M - *“They key to that is a good relationship, and a low-cost service to them. But that works. If people have the time, it works.”*

PT2FS – *“think with them it worked because we did have those shared values and that kind of shared ethos.”*

PT1M2 – *“they potentially might be a front-runner and they might have a lot of talent, they might have a lot of expertise, a lot of value the other*

wouldn't have. So the resource would be there for the SMEs or medium-sized enterprises to exploit."

Several participants outline the power relationships within this partnership between medium and large enterprises as the larger organisations are described as being "*the biggest influencers*" and having "*resource*", "*connections*" and "*expertise*". This perspective on partnering with large enterprises is conceptualised by O'Mahony and Bechky (2008, p. 425) as being made of "*social behaviours*" and "*objects*" which both parties interact with. The objects for these respondents are "*resources*", "*systems*", "*infrastructure*". On the other side of this relationship are the social behaviours, which are described as "*influencers*", "*shared values*", "*good relationship[s]*", "*expertise*" and "*connections*". The importance of these social factors are also highlighted by de Paulo, De Oliveira and Porto (2017, p. 115) whose study suggested that alongside "*improving partnership relationships*" that understanding and insights of cultural fit, which is also suggested by PT2FS as "*shared values*", is vital for success in this kind of collaborative open innovation activity. These social behaviours are important to the process of collaboration for these medium-sized enterprises and support the answering of the central research question of this study (RQ2).

5.3 Structural Factors: Barriers to Collaborating with Large Enterprises in Open Innovation (RQ2)

Park's (2018) quantitative study finds that SME innovation activity actually decreases with collaboration as the costs of finding and resourcing innovation outweigh the benefits. Interestingly, the participants didn't highlight financial factors or return-on-investment as prohibitive factors for engaging with large enterprises but did outline these disbenefits of collaboration;

PT6M – *“Got to a point where, with previous launches, that they used to take these products and fast-track them. And then manufacture and release them as their own products.”*

PT2FS – *“very much feels like we are the small partner in it. That we have limited input. Limited control. And limited scope for innovation within that.”*

PT1M1 – *“Even though people come together, they are extremely competitive and not overly collaborative.”*

PT5C – *“So it's a lot more difficult working with large corporations, especially around the bureaucracy around it...in a large corporation you're probably going to be dealing with somebody completely different every single time.”*

PT3M – *“Especially communication channels. It’s especially difficult to work with a large company, where you have to go through various people to get an answer. They are far less dynamic than the smaller companies are.”*

The barriers for engagement in open innovation with large enterprises from these companies’ perspectives are the presence of competitive trust between partners and communication between the partners. The issue of trust between partners is present widely within the literature (Tödtling and Trippel, 2005; Lee *et al.*, 2010; Colombo, Dell’Era and Frattini, 2015; Johnston and Huggins, 2016). Colombo, Dell’Era and Frattini (2015) state that trust can be achieved by developing “*socialisation capabilities*”, similar to O’Mahony and Bechky’s (2008) construct, which they define as “*enhancing the capability to assess, without cognitive boundaries, the contributions of distant and heterogeneous potential partners*”. This approach to establishing trust is not suggested by the comments from the subjects of this study, as they see these larger enterprises as taking and competing with them. In fact, the effect of this mistrust can be quite detrimental leading to “*fatal to the successful operation of systemic interaction*”(Pinto, De Noronha and Faustino, 2015, p. 86). This need for further socialisation to enable interaction with larger enterprises is an important finding for the paper (RQ2) and indicates a potential pathway for awareness and public sector interventions in order to drive further open innovation between

these companies in the Welsh economy. Intriguingly, the commentary presented by medium-sized enterprises on working with other small and medium-sized businesses in the next section was markedly different focusing on financial considerations, rather than trust issues.

5.4 Structural Factors: Collaboration with SMEs in Open Innovation (RQ2)

To provide a balanced perspective on partnership and collaboration participants were also asked about their experience of working with other SMEs on open innovation activity. Respondents outlining the importance of accessing the knowledge and expertise from these partners;

PT1M0 - different companies have different expertise and you come out ending up with a better product really.

PT2FS - you can bring in expertise to fill the gaps where necessary.

PT1M2 - it comes around to expertise. Whether the SME has it or medium-sized company, certain expertise in a certain area which makes the difference to the product innovation

The importance of this expertise is directly related by several participants to product innovation and manufacturing, which may be due to the number of participants from that particular sector, but also illustrates the openness to

collaborate in an open innovation environment. This openness towards expertise and knowledge from SMEs is highlighted in the findings of Freel and Robson (2017) who also conclude that this openness is not present in relation to larger enterprises.

5.5 Structural Factors: Matching of Organisational Values (RQ2)

To enable the collaboration, a number participants in medium-sized enterprises also indicated that they collaborate with SMEs because of organisational values:

PT2FS – *“[SME collaboration] it worked because we did have those shared values and that kind of shared ethos.”*

PT8M – *“key to that is a good relationship, and a low-cost service to them. But that works. If people have the time, it works.”*

PT3M – *“it [SME collaboration] allowed us to have a bit more freedom”*

The need to construct and mirror organisational value is clearly illustrated in these contributions. A number of values statements are expressed which stress the importance of collaboration as part of the innovation process which is part of the oppositional binary that Felin, Lakhani and Tushman, (2017, p. 130,) state exists against *“competition”*. Brunswicker and Chesbrough (2018, p. 31) develop a further set of binaries to complement this existing theory in order to create an axis of value with collaborative versus transactional, and multi-actor

versus bilateral. In this case, we get a clear indication of both the transactional values, in this case profit/sales, and the multi-actor values which are “relationships” and “freedom”. This model is a useful tool for assessing the concept of “value” in its broadest sense created by open innovation and in this case highlights how Welsh medium-sized enterprise can target “both value creation and value appropriation” (Gambardella and Panico, 2014, p. 909) and leads us to consider that the reasons, benefits and outcomes for open innovation in Welsh medium-sized enterprises may be much broader than just economic growth (RQ2).

5.6 Structural Factors: Barriers to engagement with SMEs in Open Innovation (RQ2)

In order to provide balance, to the evidence presented in 5.4 and 5.5, and as a comparison to the barriers to engagement with large enterprises (5.3) participants also responded to the barriers to working with other SMEs. The comments are outlined below:

PT8M – “we outsourced all of our HR admin to an SME, and they changed all of our processes, and basically gave it back. And gave it back broken. So, once you start outsourcing or using other companies, you are then furthering your risk.”

PT4E – *“ideally, you would want to bring it inhouse, so you have control of the quality and the manufacturing of it.”*

PT1M3 – *“I think that one of the reasons you might not is because if you can’t find the right SME to work with, or the right company to support you”*

The quality of SMEs available for collaboration is the identified barrier to collaboration for these respondents. Participants cite the quality of issues around “process”, “manufacturing” and “the right SME” The barriers to collaboration between SMEs in open innovation gained less coverage in the interviews than the positive perspectives on SMEs (5.2) and the resulting criticism of large enterprises 5.3 from which we can infer that open innovation collaboration with SMEs is preferred by Welsh medium-sized enterprises. The importance of quality of collaboration is viewed, particularly through literature in the space, as focused on the outputs of innovation (Lee, Cho and Park, 2015) in particular patent data (Beaudry and Schiffauerova, 2011), international collaboration in research (Hsieh *et al.*, 2018), and university/industry collaboration (Kafouros *et al.*, 2015). These quantitative expressions around quality lack the direct relation to the social or humanist interactions that drive collaboration (RQ2) and is illustrated by the comments above. These human-centred enablers to open innovation and collaboration need to be studied further to understand how human-interactions are divorced from the simplified outcome metrics such as

patent and research partnership data of the studies highlighted above.

5.7 Structural Factors: Collaboration with Universities (RQ2)

The importance and positive aspects of university collaboration in both conceptual (Youtie and Shapira, 2008; Pugh, 2017) and quantitative studies (Johnston and Huggins, 2016; Hewitt-Dundas, Gkypali and Roper, 2019) is clearly outlined and supported practically by large amounts of government funding for collaborative R&D. In stark contrast to this hegemony, participants of this study highlight a different perspective. Welsh medium-sized enterprises interviewed as part of this process in the main demonstrated a negative view of collaborating with universities;

PT3M - the process the university is going through is different to the way that we innovate in manufacturing...traditional manufacturing companies, like ourselves, are becoming less compatible with educational facilities...we find that they work at a different pace to how we work.

PT5C – *“Our management team, in their words, they’ve had bad experiences with working with universities in terms of product*

development. They find it laborious, it takes too long, and it's too, in inverted commas, academic."

PT1M3 – *"You've got to get your money, you've got to keep the turnover going to continue in business, so anything that slows that up I would frown on. And working with academics can do that."*

The central theme to the responses to this issue relates to the speed in which medium-sized enterprises innovate compared with the “*slow*” and “*laborious*” academic institutions. Kessler and Bierly (2002) illustrate a positive relationship between the speed of innovation and quality of new products, and also that more productive innovation is linked with stability factors such as less radical innovation and externally sourcing the development through partners such as universities. Prior studies also highlight the importance of speed in the innovation process (Carbonell and Rodriguez, 2006; Afuah and Tucci, 2012) and competitive advantage (Luoma *et al.*, 2017; Dogan and Dogan, 2020) but do little to understand speed as a barrier to entry for innovation. The previous quantitative studies (Kessler and Bierly, 2002; Luoma *et al.*, 2017) use purposive sampling strategies of those involved in specific innovation activity, and do not consider the speed variable as a barrier to entry, instead focusing on speed as an antecedent of innovation activity. These findings add to this existing

body of knowledge by understanding from a qualitative perspective that the speed on innovation, specifically in relation to university-industry collaboration, is a barrier to engaging medium-sized enterprises in further innovation activity (RQ2). Further study should explore from a quantitative perspective not only the presence of this barrier within regional and national innovation systems, but how to overcome these barriers.

5.8 Structural Factors: Intellectual Property and cost considerations influence collaboration in open innovation (RQ2)

This section of the papers deals with questions relating to how the external environment influences medium-sized enterprise's approach to open innovation. Participants were asked about the barriers to using open innovation and the responses outlined that intellectual property was a key barrier:

PT1M – *“If we work with people outside we are usually funding it totally. We are usually doing that simply because of IP issues. The IP belongs to us from the word go.”*

PT2FS – *“I think the cost implications and the intellectual property risk, or the risk of losing control of something”*

PT3M – *“we don’t want to be sharing all the advantages and all of the secrets that we have.”*

These barriers to the engagement with open innovation (RQ2) are to some extent a reflection of the opportunities to capture valuable intellectual property provided by the process. For example, Worsnop, Miraglia and Davies (2016) highlight in their qualitative study of open and closed innovation in the CrossRail project that subcontractors involved in innovation across this “megaproject” were reluctant to unveil *“innovative solutions, especially in the area of construction methodologies, which were likely to give the firm a considerable advantage over competitors”* (Worsnop, Miraglia and Davies, 2016, p. 90). The openness of the innovation creates reluctance for some contributors to reveal their valuable intellectual property (Gambardella and Panico, 2014), and in-doing so restricts the benefits to the sector and the project in this case (Dahlander and Gann, 2010). Ettlinger (2017, p. 67) views the problem from a slightly different perspective seeing the openness as exploitive with *“firms that reap huge profits while workers often receive little to no remuneration”*. This rather proletarian view on the exploitation of the innovation provider is at odds with open innovation contests that feature both financial rewards (Jouret, 2009; Hofstetter, Zhang and Herrmann, 2018), and are open to organisations retaining intellectual property of their solutions. Still the evidence presented here clearly illustrates that the barriers for medium-sized

enterprises in open innovation activity are linked with the retention and exploitation of intellectual property supporting the answering of RQ2.

5.9 Firm Level: Collaboration cost as barrier to open innovation (RQ2)

Another consideration for collaboration with SMEs was the financial considerations of open innovation which participants tended to view as costly:

PT8M – *“Our financials are good. The moment we start utilising another company, it could put us at risk in that respect.”*

PT1M – *“If there was a big risk involved in financial terms, I don’t think we’d start it even.”*

PT1M0 – *“I think cost is one of the barriers I think in this industry to innovate...cost is definitely a massive barrier. It’s how much cost you should reallocate to that.”*

The barriers to engagement with SMEs are centred around cost and financial risk to the medium-sized enterprise. This link between risk of financial loss and innovation collaboration has been noted elsewhere (Casimir et al., 2012; Foss et al., 2010; Husted and Michailova, 2010) while the competitive risk outlined by

PT8M and PT4E is considered by Arias-Pérez, Lozada and Henao-García (2020, p. 1814) can lead to “*knowledge leakage*”. These knowledge leaks, or spillovers, are balanced with an appreciation that actually having an openness with knowledge can be beneficial to innovation (Inkpen, Minbaeva and Tsang, 2019; Arias-Pérez, Lozada and Henao-García, 2020). Further exploration with interviewees of the reasons for overcoming these financial and competitive barriers to collaboration outlined the importance of organisational values illustrated in 5.5. The findings here illustrate that cost of collaboration is important for enabling open innovation (RQ2) and adds to the dialogue about how policy and funding mechanisms, such as Welsh Government Open Innovation funding can potentially drive higher levels of innovation activity within Welsh medium-sized businesses.

5.10 Firm Level: Importance of New Product Development in Open Innovation (B2)

Several authors have looked at the importance of new product development (NPD) and open innovation (Lichtenthaler, 2008; Schroll and Mild, 2011b; Ahn *et al.*, 2016). But understanding what motivates medium-sized enterprises to use open innovation for new product development is crucial to understanding the enabling and disabling factors in the Welsh economy (RQ2). Interestingly, several participants identified that perceived “*control*” (PT1M) and “*financial cost*” (PT6M) prevent further uptake of open innovation to provide new

products:

PT4E – *“So, that is number one. That we have got control over the quality of our products”*

PT9IC – *“you’re paying external individuals for outsourcing service as well.”*

The perspective from these participants that OI is cost prohibitive is at odds with the *“cost reduction”* (Gassmann et al., 2010, p. 214) and *“cost advantage”* (Worsnop et al., 2016, p. 81) that is thought to drive this particular form of innovation. This view of open innovation as having a positive financial impact may be explained by studies such as Gassman et al. (2010) and Worsnop et al.’ (2016) specifically referencing large organisations such as Xerox, and the CrossRail project which capture greater cost savings and profits than a medium-sized company working on business as usual. This perspective would be enhanced with comparative surveying and analysis with start-up, micro, small and large enterprises, but provides useful insight aligned with this study’s research questions around how and why medium-sized firms use open innovation (RQ2).

5.11 Firm Level: Staff expertise influencing open innovation (RQ2)

In this section of the interview, participants were asked about the internal

organisational factors influencing open innovation. The key point made by several contributors was that the reason for engaging in open innovation was the need to access knowledge and expertise outside of their organisation:

PT7M – *“Knowledge. We’re very respectful of institutions who have far superior knowledge than us”*

PT1M – *“we haven’t got the expertise in-house and we need to bring in partners or friends to work with us on that”*

PT5C – *“you need resources that are outside of your comfortable expertise”*

Bringing these knowledge inflows into the process of innovation is crucial to successful open innovation(Hutter *et al.*, 2013; Radicic and Pugh, 2017), as these participants suggest. But the dispersion of knowledge or intellectual property also proved a barrier for some organisations to engage external partners in innovation:

PT1M – *“we like to keep things in-house simply because of the IP”*

PT4E – *“we don’t really have the full confidence that it’s not going to be knocked off by another company.”*

PT5C – *“it’s hugely important for a small company to retain IP, but then you can get into quite a minefield of who owns what part of IP, and how that works when you collaborate”*

This focus on both the access too and restriction of knowledge leads us to consider the concept of absorptive capacity (Cohen and Levinthal, 1990), which was developed to describe the ability of organisations to absorb external information and knowledge as part of a research and development process. This is crucially important as Ernst and Lichtenthaler (2006, p. 376) comment that; “*neglecting inventive activities may finally result in the failure to build up a strong intellectual property portfolio which will negatively affect the firm’s knowledge commercialisation potential*”. This process of knowledge assimilation is also reliant on the ability of individuals to intellectually repurpose and apply information (Robertson, Casali and Jacobson, 2012). Developing this absorptive capacity within Welsh medium-sized enterprises will support further growth of these MSEs and allow them to utilise open innovation (in reference to RQ2) further.

The focus of participants on issues of retaining intellectual property aligns with Felin and Zenger's (2014, p. 918) claim in their study of closed innovation that “*the assignment of intellectual property rights to firms avoids the rather arbitrary and costly task of trying to impute the specific contributions of disparate actors.*” This ability of a firm to own intellectual property (IP) relating to innovation reduces the “*very risky investment*” of trade and negotiation with external partners around new products and services (Prokop and Stejskal, 2019, p. 387). Conversely, several authors (such as Hossain (2013) and Rhisiart *et al.* (2014))

identify the sharing of risk through OI as a benefit of the approach, so given the diverse set of responses received in this study the findings are far from conclusive. The links between method of innovation and the risk relating IP will require exploration as part of future study, as the results of this study portray a different picture of open innovation and IP risk for medium-sized enterprises.

6. Conclusions

The follow passage will respond to the research questions individually, illustrating in summary the evidence and analysis presented that leads to new knowledge in the space:

6.1 RQ1: How does Welsh Government funding for open innovation incentivise Welsh medium-sized enterprises to innovate?

The findings of this paper illustrate that medium-sized enterprises use public funding for open innovation activity to support job creation and new product development (5.1). The underlying theme of access to innovation funding for these medium-sized enterprises centred around the management of risk in collaborating with other partners (Schroll and Mild, 2011a). This is an important finding for policy in Wales as specific funding for open innovation feasibility studies is available through Welsh Government (Business Wales, 2018), but given the responses of several representatives from medium-sized

enterprises in Wales, it seems that targeting this funding at the feasibility stage maybe unwise given the need to reduce costs in product development which usually occurs in the post-feasibility stage of the innovation process. This has implications for practice and policy makers around funding interventions and adds to the expanding dialogue about how best to support medium-sized enterprise growth in Wales(RQ1).

6.2 RQ2: What are the observed barriers and enablers to open innovation in Welsh medium-sized enterprises.

Participants of this study illustrated a direct bias towards collaborating with smaller companies (5.4) on the whole due to issues of trust and the need for further socialisation to enable interaction with larger enterprises (5.6). The experience of collaborating with SMEs tended to be predicated by the need to access particular expertise in line with the findings of Freel and Robson (2017) who also observed the negative side effects of collaboration with larger enterprises. The other theme to emerge from medium-sized enterprises in relation to their collaboration with other SMEs was the presence and alignment of organisational values, which when viewed with the issues around socialisation with large enterprises illuminate the importance of human-capital elements. The process of collaboration for medium-sized enterprises involves value alignment, acquisition, and creation (Gambardella and Panico, 2014) and leads us to consider that the financial benefits of innovation are not the

predominant motivating factor for collaboration building on the findings of previous studies which focus on these economic impacts (Chesbrough and Crowther, 2006; Ahn *et al.*, 2016; Park, 2018) to provide a more nuanced perspective helping us provide clarity on why Welsh medium-sized enterprises use open innovation (RQ2).

The other collaboration partner for innovation for these medium-sized enterprises are universities which participants view in less than favourable terms. The speed of innovation when working with Higher Education is viewed by participants as slow and while prior studies also illustrate this finding (Carbonell and Rodriguez, 2006; Afuah and Tucci, 2012) they do little to understand speed as a barrier to entry for open innovation. This finding adds to dialogue around open innovation effectiveness in Wales and is important for policy-makers and academic institutions to consider when designing both policy interventions and innovation programmes with medium-sized enterprises (RQ2).

The third facet of structural influence on the process of collaboration between medium-sized enterprises is intellectual property (IP). This study illustrates that in order to engage medium-sized enterprises in open innovation activity that clear guidance and support relating to the retention and exploitation of intellectual property is needed to ensure open and honest collaboration. These findings add nuance to the simply give/take relationships between large and

smaller organisations (Ettliger, 2017) again adding to our perspective on how and why Welsh medium-sized firms innovate.

The final influencing factors at a firm level are the cost of collaboration and sector specificity in innovation. Financial costs provide a barrier to external collaboration, while sector driven needs also provided structure and limitations to the innovation process as participants indicated the predominance of approach used by individual sectors. The final factor identified by participants as being crucial to the open innovation process is the presence and control of knowledge and expertise (5.11) at both an individual and organisational level leading to the development of absorptive capacity. The development of this absorptive capacity within Welsh medium-sized enterprises will support their growth and lead to further innovation activity. However, several participants highlighted the sharing of knowledge and expertise through intellectual property was a barrier to collaborative open innovation. This challenges the view of authors such as Hossain (2013) and Rhisiart *et al.* (2014) who identify the sharing of risk through open innovation as a benefit of the approach, whereas the participants of this study in practice contradict this perspective preferring to keep knowledge and expertise internally within these medium-sized enterprises. Supporting the sharing, protection, and development of expertise and knowledge in these businesses is important for innovation and growth across the

Welsh economy and links with the availability of skills highlighted in 5.11 in this paper.

7. Summary

In summary, this paper has used evidence captured through qualitative interviewing to reinforce the importance of funding and collaboration for medium-sized enterprises using open innovation. The evidence presented by interview participants has culminated in the following key findings and recommendations;

Structural Factors:

- 1) Increased funding is required for open innovation for Welsh medium-sized enterprises
- 2) Medium-sized enterprises express a preference for collaborating with SMEs in open innovation rather than large enterprises and universities.
- 3) Intellectual property is a barrier to open innovation uptake in medium-sized enterprises

Firm Level Factors:

- 1) Cost of collaboration is a barrier to open innovation

- 2) New product development through open innovation is difficult due to cost and control
- 3) Expertise both internally and externally within medium-sized enterprises provides a driver for open innovation

The findings of this study illustrate a broad range of recommendations for policy and practice in the Welsh economy, and while the small scale nature of the research limits the generalisability of the results, open innovation is clearly part of the solution to supporting the future growth aspirations of the so-called ‘missing middle’. Finally, the issues of risk and cost associated with open innovation, identified in this study, need to be considered by policy makers to shape the needs and the next phase of the SmartCymru OI Feasibility call. The current intervention is focused on feasibility which, while reducing upfront risk, does little to reduce the cost of engaging in OI in the longer term.

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