ICT Resources and Use: Examining differences in pathways to improved small firm performance

Abstract

Purpose: The paper shows how small firms perceive the pathways through which access to and adoption of superfast broadband enabled resources strengthen business performance. Improvements to broadband infrastructure do not automatically lead to adoption of opportunities made available through the broadband resource. Then interventions can be used to alert small firms to new opportunities. However, the quality of interventions in terms of education and digital audits can be better targeted with information available on how small firms perceive the benefits from broadband access and whether these perceptions are reflected in business performance outcomes.

Methodology: Data is used from the Digital Maturity Survey from Wales. We use principal component analysis and a dual stage cluster approach to show how SMEs believe they are benefitting from broadband access. These belief-based perceptions of broadband inferred business benefits are tested against business performance variables.

Findings: The analysis shows variation in SME perceptions of the benefits of broadband enabled services. We reveal a cluster of firms which perceived routes to business value in terms of variables linked to security and risk management, and then more commonly held notions linked to communication, competition enhancement and productivity.

Originality: While the research literature points to ICT resources (ICT investment and skills) and use (digital applications), leading to new to business value improvements, we suggest less work has sought to identify the critical themes identified by business owners in explaining how ICT resources and use tie to observed business performance. We identify these critical themes. Our analysis suggests that these critical themes in terms of business value benefits as perceived by business owners can be summarised in terms of communication and competition benefits, and security and risk related benefits. The findings have a series of implications for interventions in the space.

Introduction

This study examines how SMEs assess the benefits that derive from broadband infrastructure. We develop a framework through which to understand the connection between improved broadband infrastructure and business performance. We show that while the research literature points to ICT resources (such as ICT investment and skills) and use (digital applications) leading to new to business value improvements, rather less work has sought to identify the critical themes identified by business owners in explaining how ICT resources and use tie to observed business performance. We seek here to identify these critical themes using case evidence from Wales. Our analysis suggests that these critical themes, in terms of business value benefits as perceived by business owners, can be summarised in terms of communication and competition benefits, and security and risk related benefits. We are then able to test whether these critical themes are supported in terms of observed business performance. It is important that these themes are better communicated into marketing messages for business intervention programmes in the context of observed poor adoption of ICT technologies by the smallest firms.

With regard to method, we employ a principal component analysis (see Hair et al., 2010) and a dual stage cluster approach (Bacher et al., 2004; Şchiopu, 2010) to elucidate how SMEs believe they are benefitting from access to broadband resources. We then test these belief-based perceptions of broadband inferred business benefits against business performance variables. Profiling of the established SME clusters offers an additional dimension through which to contextualise the perceived benefits of broadband. We investigate both the practical and policy implications of the findings.

We examine these issues through the lens of the Welsh economy which has devolved responsibilities for economic development, and has seen a considerable public investment in improving superfast broadband infrastructure. Indeed, between 2012-2017 the Welsh Government managed the Superfast Cymru programme, part-funded through the European Regional Development Fund (ERDF). For the Welsh Government, intervention in this space was associated with concerns over the persistent productivity weaknesses of the economy.

The remainder of the paper is structured as follows. The next section considers literature that examines how firms benefit from access to better quality broadband infrastructure. Here, we seek to make connections between new ICT infrastructure, ICT skills, investment and use, and then business performance. The third section describes the data used from the Welsh *Digital Maturity Survey*, and the specific context of the study. The fourth section outlines the principal component analysis and dual stage clustering approach employed and reveals the main findings from the study. The final section concludes with practical implications from the study.

ICT and SME performance

The connection between improvements to ICT infrastructure and ICT investments made by firms and business performance has been an important area of study (see for example, Berndt

and Morrison 1995; Brynjolfsson and Hitt, 1996; Cardona et al., 2013; Nath and Liu, 2017; Barba-Sanchez et al., 2018). A better understanding has developed of the process through which ICT investment yields performance changes (see Kohli and Devaraj, 2003; Sabherwal and Jeyaraj, 2015; Samoilenko and Osei-Bryson, 2018; Yunis et al., 2018). In an important early study, Melville et al. (2004) proposed a model where ICT resources embrace investment and use of ICT-related technological and human elements. They acknowledge that the effectiveness of ICT resources also depends on complementary firm resources, such as labour practices, industry partners and country infrastructure. Indeed, Sabherwal and Jeyaraj (2015) and Yunis et al. (2018) also reveal that an association between ICT investment and business value needs to include consideration of complementary firm assets and capabilities.

In consequence, ICT use in terms of factors, such as cloud and digital commerce applications, allows workers to gain access to new knowledge and with this complementing existing firm capital leading to improved firm performances (Steinfield et al., 2010). A question is how might different patterns of ICT use (in terms of variables such as use of cloud applications, website, social media, e-sales and e-purchases) connect through to improved business performance?

There are a series of ways in which ICT use, as described, might lead to improvements in business performance, and with some of the factors outlined likely interconnected. ICT use may mean that SMEs are better able to respond to customer or supplier requirements in a timely manner, improving service standards. For example, an early contribution from Daniel and Grimshaw (2002) pointed to evidence showing that small firms saw enhanced customer services, and the opportunity to have a better interaction with customers (via broadband enabled services), as a way of improving competitiveness. In an examination of cloud usage and adoption by SMEs, Gupta et al. (2013) revealed perceptions of significant cost savings, as well as greater collaboration between firms. Indeed, the value of ICT use in improving knowledge management, information sharing, and improving communications, was identified earlier by Drew (2003), who investigated the strategic use of e-business by SMEs. They found that knowledge intensive firms were more sophisticated in their use of internet technologies, attaching greater importance to it for recruitment, supply chain management, and internal communications. Knowledge intensive firms also experienced the greatest impacts across all areas of business, helping to increase sales, reduce costs and streamline operations.

However, while ICT use means the SME has stronger and more effective links to its value chain, there may also be a case that ICT use allows SMEs to better track the nature of competition, to price more effectively, and differentiate products and services from those of competitors to meet specific consumer demands (see Barba-Sanchez et al., 2018). Competitiveness improvements may result through access to new technologies, allowing SMEs to overcome scale disadvantages in some business areas. Clearly, ICT use may also allow SMEs to gain access to new geographical markets.

Many studies of the benefits of ICT use focus on productivity improvements (see for example, Tisdell, 2017; Bartelsman et al., 2019). With respect to small firms, Colombo et al. (2013) focused on the take-up of broadband technology and ICT services, and their impact on small firms' productivity gains, concluding that the adoption of broadband alone does not positively affect productivity. Substantial productivity gains only ensue when SMEs adopt broadband-enabled services that are relevant to their industry, and if this adoption is allied to wide-ranging strategic and organisational changes to the way business is done. Observed improvements to business efficiency and flexibility may arise from SMEs having remote access to digital resources, reducing the need to have physical infrastructure in the workplace and through employee flexibility to work from multiple locations, leading to changes in work patterns.

While elements of the literature around the benefits of ICT may be seen to link to competition and improved communication effects, ICT use might lead to these benefits through increased ICT security and data protection. Kurpjuhn (2015) notes that employees taking advantage of the consumer applications and devices they feel most comfortable and secure with, using cloud services on their own devices, to check e-mails and produce documents while travelling or working from remote locations, may increase their productivity and value to the business. Indeed, Gupta et al. (2013) also observed that after ease of use and convenience, the biggest factor influencing cloud usage by SMEs was security and privacy. Provision of security and software updates from remote sources reduce business risks, with SMEs typically not having the in-house expertise to treat with security and data issues. For selected SMEs, ICT use may also be connected to improvements in general risk management (for example, continuity planning).

Despite the innovation and productivity enabling potential of ICT, evidence shows that adoption and usage of ICT-related technologies and engagement in e-commerce are limited in smaller firms (Price et al., 2018; OECD, 2017). OECD (2017) reveals that many SMEs simply adopt basic digital technologies and that the development of innovative digital technologies in spaces, including AI, 3D printing and robotics, will place a strong challenge on smaller firms to develop their capabilities and gain productivity benefits. Limited engagement could be related to poor recognition of the longer term strategic potential of ICT, and a perception that the risks attached to adoption are greater than the benefits. Jones et al. (2014) who adopted a longitudinal case study approach to consider attitudes and strategic responses of micro-enterprise sole proprietors in adopting ICT, show that attitudes to ICT adoption were often set against a backdrop of business models focused on more "immediate and attainable outcomes" targeting business sustainability. The need then is to better understand how SMEs think they benefit and the issues that lead through to better business performance from ICT usage. Moreover, knowledge of how ICT use works to improve business value is important for policymakers designing and marketing business assistance interventions and business advice. In this respect Pickernell et al. (2013) distinguish within the SME environment a variety of contributory variables that have a bearing on E-commerce trading activity. Interestingly, and

relevant for the case explored in our paper the importance of good business advice was found in this study to enhance business capacity and to have a positive association with e-commerce trading activity.

Figure 1 about here

Figure 1 seeks to summarise the ways in which different patterns of ICT use may lead through to improvements in business performance. It is accepted that these factors might be inter-related. The review suggests that ICT resources and use (digital applications) are connected to business improvements. However, there has been a paucity of research seeking to identify the key themes identified by SMEs in explaining how ICT resources and use tie to business value. In what follows we identify these critical themes and test whether these same themes are supported in terms of observed business performance. Key context is observed poor adoption of ICT technologies by the smallest firms, and then how far key factors can be summarized into marketing messages for business interventions. We seek to answer these questions through an analysis of the findings from the *Digital Maturity Survey for Wales* 2018.

Data and case material

The Welsh economy has seen extensive public (through Welsh Government backed Superfast Cymru and successor programmes) and private sector investment in rolling out superfast broadband infrastructure. The Welsh Government ran the £425 million Superfast Cymru programme, part-funded through the European Regional Development Fund (ERDF). The need for the Superfast Cymru programme, and its successors, signalled that the free market provision of broadband infrastructure, mainly in urban areas, had come to an end, leaving some localities with slow, or non-existent, internet access. A main focus of investment was to connect premises that did not have access to "superfast broadband" - defined as being able to achieve download speeds of at least 30 megabits per second [Mbps] or more - at the start of the programme.

The Superfast Cymru programme linked to a number of Welsh Government strategies, such as *Taking Wales Forward* and the *Prosperity for All: Economic Action Plan.*[1] Policy context here was ensuring that businesses both had access to digital infrastructure, but also had the skills to use it. The policy challenge is reflected in the *Superfast Business Broadband Exploitation Programme*[2] with its provision of free workshops and one-to-one advice to SMEs across Wales. Context for intervention here is given in respect of Wales' relatively poor productivity performance (see Welsh Government, 2019). Indeed, without intervention there are concerns in Wales that uneven access to and use of broadband will reinforce economic disparities between rural and urban parts of the country. In this respect conclusions from the

[1] See *Taking Wales Forward* available at https://gov.wales/sites/default/files/publications/2017-08/taking-wales-forward.pdf See also: *Prosperity for All: the national strategy*, available at https://gov.wales/sites/default/files/publications/2017-10/prosperity-for-all-the-national-strategy.pdf

[2] See https://businesswales.gov.wales/superfastbusinesswales/about-us

Welsh lens of analysis are expected to be relevant to other regional cases. Wales typifies the case of many peripheral regions and nations of the UK where there has been a persistent problem of low productivity growth and where the roll out of superfast broadband to business has been aided by public resources, including European funds, with the hope that this will assist in a levelling up of economic prospects. In consequence, improving SME access to superfast broadband is a possible means of improving prospects for firms in more disadvantaged areas of Wales. For these reasons the results from the analysis might be generalized to other areas facing economic development challenges and with the developed practical implications also having a wider geographical relevance.

With the use of public funds to finance both the roll out of new infrastructure and to assist businesses to benefit from new digital opportunities, it is useful to track SME take-up and adoption of new technology, but also to develop metrics to explore the economic impact resulting from the adoption of faster broadband speed infrastructure by business. Similar themes have been investigated in other recent studies examining business adoption of digital technologies and related issues of the quality of connectivity. For example, the *State of Small Business Britain* report by the Enterprise Research Centre (2018) investigated the adoption of digital technology by micro-businesses in the UK, while Ofcom, the UK communications regulator, published a Connected Nations Wales report (Ofcom, 2018) which used operator data to inform estimates of digital connectivity. Moreover, the *Digital Economy and Society in the EU* report, from European Union (Eurostat, 2018), utilises data from the Community Survey on ICT usage and E-commerce in enterprises. Finally, a study commissioned by Amazon and undertaken by Rural England and Scotland's Rural College (2018) examined data on digital adoption outside of urban areas in the UK.

Our analysis is based on Welsh data collected as part of the *Digital Maturity Survey*[3] for Wales. The Survey is intended to understand the transition towards digitalisation of business processes and the benefits that are enabled by superfast broadband.

The 2018 *Digital Maturity Survey* collected a representative survey sample of SMEs in Wales (see Table 1). The survey sample was created with the aid of Bureau van Dijk's FAME database and was disseminated using an online questionnaire via the Qualtrics platform. The survey link went out by e-mail to 11,290 SMEs and achieved a response rate of 4.24% (479 responses). The support of research partners (Business Wales, Superfast Business Wales, the 22 Welsh local authorities, Federation of Small Businesses Wales and Institute of Directors Wales) was utilised to raise awareness and promote the survey. The key areas of survey questioning are summarized in Appendix A.

To ensure representativeness of the sample to the population of SMEs in Wales, data from the *Digital Maturity Survey* was compared with information from the ONS Inter-Departmental Business Register (IDBR) for 2017. This was the latest year of data available at the time of our analysis. Here, variables including size (number of employees) and business sector were examined. In terms of these variables, the enterprises in our sample were found

[3] See https://www.cardiff.ac.uk/__data/assets/pdf_file/0008/1483685/dms-report-2018-v1-5.pdf

to be broadly representative of SMEs as a whole in Wales. The largest deviation between the survey sample and the actual Welsh SME population was found in the construction sector (9.3% of the sample as compared to 18.1% of the actual population). To fine tune the sample and achieve representativeness of major industry sectors and different sizes of SMEs a stratification method was used. The post stratification weights were then applied to the responses to reflect the breakdown of firm size and industrial structure of the Welsh economy.

Table 1 and Figure 2 about here

Among the responding SMEs, over half (53%) reported using superfast broadband. Figure 2 shows that the adoption of superfast broadband by industrial sector was highest in Information and communication (65%), and Business and other services (56%) sectors. The Accommodation and food services sector had the lowest share of SMEs with superfast broadband in 2018 (31%).[4]

A key element of the Survey related to use of broadband-enabled services. The Survey asked SMEs whether they used basic, foundational cloud computing services (digital tools such as email, office software and file sharing/ storage), as well as more advanced cloud computing services (see Figure 3). The latter included: accounting and bookkeeping; data back-up; voice over internet protocol; electronic payment; video conferencing; customer relationship management; project management software; computing power to run business software; human resource management software; and enterprise resource planning. Analysis of the Survey findings with those of the previous (2017) year revealed that more SMEs were using a number of advanced cloud computing services in 2018 as compared to 2017.[5]

The 2018 Survey also revealed that some 88% of the businesses taking part reported having a website and with just over three-quarters of SMEs (76%) reported using social media for business. Finally, 80% of SMEs surveyed reported using social network platforms in 2018.[6]

Figures 3 and 4 about here

Part of the Survey, which is employed in subsequent analysis in this paper, examined the business perceptions of using broadband-enabled services. The benefits here are linked to expectations summarized in the earlier review of the research. For example, the Enterprise

[4] Ofcom (2018) reported that in analysis of operator data, 38% of superfast lines in Wales were delivering superfast speeds – this being seen as indicative of take-up of superfast broadband. However, this data includes all premises, considering residential as well as business sites.

[5] Comparing these results with data from other studies is problematic due to differences in make-up of components included. Related studies such as Enterprise Research Council (2018) found that 18% of micro-businesses in the UK had adopted customer relationship management cloud services, 42% web-based accounting software, and 30% e-commerce (electronic payment) in 2018.

[6] Eurostat (2018) noted that in the EU, 79% of businesses with internet access had their own website in 2017, compared with 71% in 2010. Eurostat data also indicates that just under a half (49%) of enterprises in the EU were using social media in 2017. Rural England CIC and Scotland's Rural College (2018) show that 81% of UK rural businesses had their own website, and around three-quarters of rural businesses used digital connectivity for social media.

Research Centre (2018) identified the advantages of using digital technology as cost savings, efficiency, flexibility, resilience, business model, and market access- with perceived disadvantages identified as security, cost, time-consuming, skills required, and stress. Rural England et al. (2018) noted that the most positive impacts of digital connectivity were found in business efficiency, access to customers and suppliers, remote working, and business flexibility. Pickernell et al. (2013) concluded that the use of e-commerce capability and capacity was positively linked in SMEs with growth goals and desire to innovate. Our analysis presented in Figure 4 requested firms responding to the *Digital Maturity Survey* to show how far they agreed or disagreed that "Access to broadband enabled services had enabled them to…":

i. Better respond to customer or supplier requirements
ii. Keep pace with competition
iii. Improve knowledge management/information sharing
iv. Enhance communication
v. Improve productivity/efficiency
vi. Gain access to new geographical markets
vii. Increase IT security and data protection
viii. Engage in better risk management
ix. Achieve overall firm strategic objectives

The unit of response here is a respondent SME, and each of these items' statements was measured over a 1 to 5 Likert scale (ranging from 1 – Strongly Agree to 5 – Strongly Disagree). In Figure 4, the percentage of SMEs agreeing with statements about the perceived benefits of broadband-enabled services are illustrated. Nine out of ten businesses (90%) indicated that adoption of broadband enabled services enhanced their communication. Four-fifths of SMEs (80%) noted improved knowledge management/information sharing as a benefit of broadband-enabled services, while a similar figure (77%) reported being better able to respond to customer or supplier requirements.

Our analysis uses the data underlying Figure 4 to explore whether a typology of responses can be developed, and, if this is the case, how such a typology relates to SME performance - with components of the Survey also picking up information in respect of the recent performance of SME respondents.

Methodology and analysis

In terms of methodological approach, we first employed Principal Component Analysis (PCA, see Pearson, 1901). We follow this with a clustering analysis to identify groups of SMEs connected with the identified components from the PCA.

Principal Component Analysis (PCA) aims to reduce a set of possibly related variables into a set of uncorrelated variables, termed components. A PCA based approach is useful when the objective is to summarize most of the original information (variance) in a minimum

number of principal components (see Hair *et al*., 2010). We undertook a PCA of the nine 'Advantages' to broadband enabling questions (see Figure 4). The initial PCA showed two items, "Achieve firms overall strategic objectives" and "Gain access to new geographical markets" to be heavily cross-loaded across the identified two potential principal components (based on associated eigenvalues greater than 1.00 – see Hair et al., 2010). These were subsequently removed from consideration (being removed iteratively one at a time). Tables 2 and 3 show the details of the PCA of the remaining seven SME 'advantages of access to broadband' items.

Tables 2 and 3 about here

Table 2 reveals a snapshot of the 'Total Variance Explained' by the PCA. The components are ordered based on latent root criterion, with eigenvalue-based elucidation of the potential principal components. We initially select the number of components based on eigenvalues above 1.00 (in this case a single component - and total variance explained -would be 60.5%). However, this is not the only consideration. Further inspection of Table 2 shows the next (second) largest eigvenvalue is around 0.97, close to the 1.00 threshold. If this is also representative of a component then the two components together appear to explain 74.3% of the total variance. Hair *et al*. (2010) show that within this method that this is a valid consideration where there is an understandable substantive position in component terms (see later).

Table 3 reveals that the seven items load cleanly onto the considered two component solution. The associated Cronbach alpha scores are 0.89 for component 1 and 0.76 for component 2, above normal thresholds of 0.70 (see for example, Hair *et al*., 2010). Further, for the second component the two items "Increase IT security and data protection" and "Better risk management (continuity planning)" load onto it. The preservation of a two-item solution is found in prior research (for a good example see Raubenheimer, 2004) and this component was retained (and acknowledging here from Table 2 the near 14% increase in total variance explained by the component).

Inspection of Component 1 shows it is associated with items such as broadband access allowed SMEs: better responses to customer or supplier requirements, better ability to keep pace with competition, improved knowledge management/information sharing, enhanced communication and improved production efficiency. We term this first component 'Communication and competition'. We note that this links to key aspects of the earlier review in terms of the business value attached to adoption of broadband resources (see for example, Tisdell, 2017; Bartelsman et al., 2019, and more recently, Pathak et al., 2020).

The second component speaks to items, better IT-security, and better risk-management. Indeed, the earlier review (see for example, Gupta et al., 2013) revealed that after ease of use, the most important factor influencing cloud usage by SMEs was linked to security and privacy. We term this second component 'Security and risk management'.

These two components 'Communication and competition' and 'Security and risk management', describing the 479 responding SMEs, are quantified based on the subsequent regression scores evaluated (see Hair et al., 2010). The standardised regression scores were then analysed using a cluster analysis (the standardisation of scores allowed both components to contribute equally to the definition of clusters). Cluster analysis groups individuals or objects into clusters, so that objects in the same cluster are more similar to one another than they are to objects in other clusters (see Hair *et al*., 2010, p.483). The clustering undertaken is through an inductive approach, with neither the number of and nature of the resulting clusters evidenced from associated deductive theory (see for example, Ketchen and Shook, 1996).

We employed a two-step clustering approach (see Bacher et al., 2004; Şchiopu, 2010). The two-step approach permits the analyst to retain full information and provides a richer explanation for managerial decision-making purposes (see Rundle-Thiele et al., 2015). The first step is an inspection on the 'pertinent' number of clusters to consider, followed by the actual clustering (step 2). In step 1 the number of clusters is automatically determined through the Bayesian Information Criterion, and then by examining the ratio change in distance between clusters (see for example, Beynon *et al*., 2019), which is then quantified in quality terms using a silhouette coefficient plot (see Zhou and Gao, 2014).

The analysis revealed that a four-cluster solution was most appropriate. Having identified four clusters, Ward's hierarchical clustering technique was used. Ward's method starts with *n* single object clusters combined to make a small set of cluster containing all objects where at each step a new cluster identified which minimizes associated variance). Ward's method was chosen here because it is considered to be a robust method (Janssens et al., 2003; Aldenderfer and Blashfield, 1984). We also note in Strauss and Maltitz (2017) that Ward's algorithm characteristic of minimising intra-cluster variation and maximising inter-cluster variation is not violated when using the Manhattan metric. Here then we have prioritised hierarchical clustering (with the traits inherent in Ward's method), over non-hierarchical clustering like, with k-means, which can suffer from, i) choice number of clusters (we have adopted a two-step approach where the number of clusters to work with is found in the analysis and not from an author-based choice), ii) initial choice of seeds to perform clustering and iii) impact of outliers.

The established clusters, termed initially, C1 to C4, have, 110, 130, 62 and 105, SME members respectively associated with them (and with 72 out of the 479 missing due to incomplete responses). This spread supports the robustness supposition discussed in Ketchen and Shook (1996), whereby Ward's method tends to produce clusters with roughly same number of observations.

Since the clustering is based on two components (Communication and competition, and Security and risk management), each SME respondent can be represented on a scatterplot, see Figure 5 (includes boxplots describing sets of component values across each cluster). The explicit visualisation in Figure 5a reveals the wide variations in combinations of

component values found for individual SMEs. ANOVA and post-hoc comparison results indicated that the clusters of SME respondents, through the spread of regression score values across the different clusters, are significantly different from each other, regarding each of the components, Communication and competition (x-axis) and Security and risk management (y-axis) (see also Appendix B).

Figure 5 about here

The four clusters were then interpreted, based on their domain positions in the scatterplot and boxplot based results (noting in Figure 5 the mean component points are also shown for each cluster), acknowledging that there are statistical differences between them in component terms (and with the direction of the domains the regression scores follow the original Likert scores inference - namely from agreement to disagreement i.e. in this case ranging from 1 – Strongly Agree to 5 – Strongly Disagree). These were interpreted as:

C1: **Communication and competition challenge (110 firms)**: interpreted as SME members disagreeing with variables relating to communication, efficiency and competitive effects, and with a varied view on security and risk management benefits of broadband resources.

C2: **Security and risk management challenge (130)**: interpreted as SME members being neutral on communication, efficiency and competitiveness effects of broadband access; but with SME members disagreeing on positive performance effects with respect to security and risk management.

C3: **Security and risk management aware (62)**: SME members of this cluster characterised by slight agreement on communication, efficiency and competitive effects, but with SMEs revealing strong agreement on benefits from broadband in respect of security and risk management.

C4: **Communication and competition aware (105)**: with SMEs in this cluster having agreement with the performance enhancing effects of broadband in variables relating to communication, efficiency and competitive effects; but with SME members of this cluster having a more neutral view on security and risk management benefits from broadband access.

The results of the clustering procedure reveal that the benefits to patterns of ICT use are quite different. Cluster C3 (Security and risk management aware) sees slight agreement on benefits related to communications, competition, and productivity effects, but strong agreement on risk and security benefits. In Cluster C4 (Communication and competition aware), there is stronger agreement of communications, competition, and productivity effects, but more neutral views on risk and security benefits.

There is a question of how far agreement or disagreement with the benefit derived from broadband actually relate to business performance. The *Digital Maturity Survey* sought respondent views on how far access to broadband services affects variables such as sales,

profit, employment and new product innovation (and with SME respondents asked these questions in terms of categories: increased; decreased; and no change in terms of effects of access to broadband services). These performance variables were not considered in the actual clustering process, but such an analysis represents an important form of validation on the SME achieved clustering (see Ketchen and Shook, 1996). Similarly, we identify a series of profiling variables from the *Digital Maturity Survey* in terms of SME industry, size, location (urban or rural), and importantly broadband type (i.e. standard or superfast broadband) and associated download speeds.

Starting with 'service-effects' variables related to how far SME respondents believed access to broadband services had impacted sales, profits, employment and new products introduction. Here, we examine these service-effects variables against the established four clusters, and with the process needing to consider three elements; i) If there is a statistical difference across the clusters (ANOVA based results); ii) What are the spread of values for a service-effect across the different clusters (boxplot based results - noting that not all SME responses in the *Digital Maturity Survey* included a response to each of the service effect variables); and iii) Is there statistical difference between specific clusters (post-hoc based results). In Table 4 and Figure 6 we summarise the findings.

Table 4 and Figure 6 about here

Table 4 shows that in terms of Turnover and Profit performance that Clusters C3 and C4 (Security and risk management aware, and Communication and competition aware) appear to be reporting relatively stronger associated performances than either Clusters C1 and C2. Indeed, Cluster C1 (Communication and competition challenge) seems to report significantly worse outcomes with respect to how far broadband services affected turnover and profits, than each of the other clusters. Recall that this cluster has SME members disagreeing with variables relating to communication, efficiency and competitive effects, and with a varied view on security and risk management benefits of broadband resources. This level of disagreement seems to be born out in perceptions of how broadband services have impacted business performance.

In terms of reported employment outcomes linked to broadband services, again, Clusters C3 and C4 report stronger outcomes (i.e. increased employment linked to broadband services) than both Clusters C1 and C2. However, on employability there are also significant differences between Clusters C3 and C4 (i.e. the Security and risk management aware, and Communication and competition aware), with SMEs in Cluster C3 reporting proportionately more favourable employment outcomes linked to broadband services. Once again, stronger employment outcomes from Clusters C3 and C4 are shown with respect to how far SMEs in these clusters reported how broadband services had influenced the introduction of new products and processes.

The next set of external variables considered are profiling variables (see Table 5), those which describe other characteristics of the SME respondents, which may or may not

have contributed/swayed their inclusion in the various clusters previously defined. There were significant differences between clusters here in terms of, industry sector, urban-rural location, broadband type and download speeds experienced.

In summary, the analysis of profiling variables, see Table 6, suggested that SMEs in Cluster C1 (Communication and competition challenge) were more strongly represented in businesses and other services compared to Clusters C2, C3 and C4, and less well represented in manufacturing and wholesale etc. SMEs in this cluster (C1) were more likely to be located in urban areas, but with around 47% of firms in the cluster having access to poor download speeds of less than 30Mbps.

SMEs in Cluster C2 (Security and rick management challenge), revealed in comparison to the other clusters, a weaker representation in business and other services, and ICT (i.e. high productivity sectors), but with relatively larger numbers of SMEs in this cluster in manufacturing and construction. Moreover, our analysis revealed that SMEs in this cluster were more likely to be located in a rural area, but with lower numbers of firms in this cluster (around 44%) having access to broadband speeds of less that 30Mbps, i.e. standard as opposed to superfast broadband. SMEs in Cluster C3 (Security and risk management aware) had a relatively weaker representation in construction, and in manufacturing, but stronger representation in ICT sectors, warehouse and retail. SMEs in Cluster C3 were more likely to be located in an urban area, and feature much higher use of superfast broadband (i.e. close to 70% of firms in the cluster having access to speeds of over 30Mbps). Finally, SMEs in Cluster 4 Communication and competition aware were more likely to be located in urban areas, and more likely to have superfast broadband access compared to SMEs in any other clusters. As part of the analysis around profiling variables we did examine the issue of firm size, differentiating micro, small and medium sized firms in each of the four identified clusters. However, we found no significant differences between the clusters in terms of the employment size of group members.

Conclusions

The paper reveals a paucity of work that seeks to examine the critical themes identified by business owners in explaining how ICT resources and use tie to observed business performance. The paper shows that these themes in terms of business value benefits can be usefully summarised in terms of communication and competition benefits, and security and risk related benefits. We believe there are a series of implications from the study in terms of the design of interventions to assist SMEs in adopting broadband services, but also in terms of future work.

First, our paper suggests a role for intervention to encourage adoption of digital resources, revealing groups that are challenged in terms of gaining the full benefits from digital adoption. Mere access to new broadband infrastructure does not guarantee access to new opportunities. Rather, the challenge is for SMEs to actively engage with the opportunities made available through the new resource. For example, we find in one of our identified

clusters SMEs having high quality broadband access in terms of download speeds, but poorer performance across a series of business metrics.

Second, interventions need to be developed in a context that business owners may perceive benefits in very different ways. One finding, for example, was a cluster of firms (C3 Security and risk management aware) that perceived routes to business value in terms of variables linked to security and risk management, rather than the more commonly held notions summarized in our review, that the advantages of broadband enabled services are largely understood in terms of factors linked to communication, competition enhancement and productivity. Messaging to SMEs to encourage digital adoption then may need to differentiate in terms of security and risk benefits, distinct from benefits arising from communication and competition effects. Much of the marketing encouragement for firms to engage with schemes in Wales has been understood in terms of successful adoption leading to falling costs, increased profits, savings in time, customer reach, trade and management structures. These in some measure link to competition and communication effects, but with our results revealing that for some SMEs that it might be security and risk management that leads to expected benefits. Typically in Wales, in encouraging SME engagement with policy, case studies of adopting firms are used. Such cases might need to better cover off instances where issues of IT security and data protection and better risk management lead to positive business returns.

Third, the research reveals that 'challenge' and 'aware' clusters were more strongly represented in some sectors. For example, construction and manufacturing firms were more strongly represented in the cluster Security and risk management challenge. An implication here is that policy resources, and marketing of those same resources, might need to be directed and refined to appeal to SMEs in different industry sectors.

Fourthly, more research is required in the space. While the paper signals linkages between ICT and business value, there is a challenge for more investigation into the types of new ICT investment, ICT skills and digital applications that lead to the greatest returns to SMEs. Moreover, there are a series of research questions unanswered around returns to early adopters as opposed to late adopters of new digital technology. More generally, a limitation in the work presented in this paper was that performance variables were presented in terms of sales, employment, profits and innovation, but with research needed to explore links between ICT investment, skills and use and then firm productivity. This latter is particularly important in terms of the challenges facing the contemporary Welsh economy.

Finally, in terms of methods we are conscious that a specific clustering approach has been employed in this paper, but with prior research often using a mix of hierarchical and non-hierarchical clustering. There could be value in exploring the sensitivity of different clustering approaches to the same problem.

References

Aldenderfer, M.S. and Blashfield, R.K. (1984), *Cluster analysis. Quantitative applications in the social sciences series, no. 44.* Sage, Newbury Park, CA.

Bacher, J., Wenzig, K. and Vogler, M. (2004), *SPSS TwoStep Cluster – A First Evaluation*, https://www.ssoar.info/ssoar/handle/document/32715 (last accessed 26 November 2020).

Barba-Sánchez, V., Calderón-Milán, M. J. and Atienza-Sahuquillo, C. (2018), "A study of the value of ICT in improving corporate performance: a corporate competitiveness view", *Technological and Economic Development of Economy*, Vol. 24 No. 4, pp.1388–1407. https://doi.org/10.3846/tede.2018.3114

Bartelsman, E.J., Falk, M., Hagsten, E. et al. (2019), "Productivity, technological innovations and broadband connectivity: firm-level evidence for ten European countries", *Eurasian Business Review*, Vol. 9, pp.25–48.

Berndt, E. and Morrison, C. (1995), "High-tech capital formation and economic performance in U.S. manufacturing industries An exploratory analysis", *Journal of Econometrics*, Vol. 65 No. 1, pp.9-43. https://doi.org/10.1016/0304-4076(94)01596-R

Beynon, M. J., Jones, P. and Pickernell, D. (2019), "The role of entrepreneurship, innovation, and urbanity-diversity on growth, unemployment, and income: US state-level evidence and an fsQCA elucidation", *Journal of Business Research*, Vol. 101, pp.675-687.

Brynjolfsson, E. and Hitt, L. M. (1996), "Paradox lost? Firm-level evidence on the returns to information systems spending", *Management Science*, Vol. 42 No. 4, pp.541–558. https://doi.org/10.1287/mnsc.42.4.541

Cardona, M., Kretschmer, T. and Strobel, T. (2013), "ICT and productivity: conclusions from the empirical literature", *Information Economics and Policy*, Vol. 25 No. 3, pp.109–125. https://doi.org/10.1016/j.infoecopol.2012.12.002

Colombo, M. G., Croce, A. and Grilli, L. (2013), "ICT services and small businesses' productivity gains: An analysis of the adoption of broadband Internet technology", *Information Economics and Policy*, Vol. 25 No. 3, pp.171–189.

Daniel, E. and Grimshaw, D. (2002), "An exploratory comparison of electronic commerce adoption in large and small enterprises", *Journal of Information Technology*, Vol. 17, pp.133-147.

Digital Maturity Survey for Wales (2018). Report from the Welsh Economy Research Unit, Cardiff Business School. Available at https://www.cardiff.ac.uk/__data/assets/pdf_file/0011/1483688/digital-maturity-survey-2018-summary-v3.pdf (last accessed 29/10/2020).

Drew, S. (2003), "Strategic uses of e-commerce by SMEs in the East of England", *European Management Journal*, Vol. 21 No. 1, pp.79-88. https://www.sciencedirect.com/science/article/pii/S0263237302001482 (last accessed 03/02/2020).

Enterprise Research Centre (2018), *State of Small Business Britain Report* (2018), Report by Enterprise Research Centre, Aston Business School, Birmingham, and Warwick Business

School, Coventry. Available at https://www.enterpriseresearch.ac.uk/wp-content/uploads/2018/06/SSBB-Report-2018-final.pdf (last accessed 17/03/2021)

Eurostat (2018), *The Digital economy and society in the EU*, Report from Eurostat, Luxembourg. Available at https://ec.europa.eu/eurostat/cache/infographs/ict/bloc-1b.html (last accessed 18/03/2021).

Gupta, P. Seetharaman, A. and Raj, J. R. (2013), "The Usage and adoption of cloud computing by small and medium businesses", *International Journal of Information Management*, Vol. 33, pp.861-874.

Hair, J. F., Black, W. C., Babin, B. J. and Anderson, R. E. (2010), *Multivariate data analysis*: Global edition.

Janssens, M., Sels, L. and Van den Brande, I. (2003), "Multiple types of psychological contracts: A six-cluster solution", *Human Relations*, Vol. 56 No. 11, pp.1349-1378.

Jones, P., Simmons, G., Packham, G., Beynon-Davies, P. and Pickernell, D. (2014), "An exploration of the attitudes and strategic responses of sole-proprietor micro-enterprises in adopting information and communication technology", *International Small Business Journal*, Vol. 32, No. 3, pp.285-306. https://doi.org/10.1177/0266242612461802

Ketchen, D. J. and Shook, C. L. (1996), "The application of cluster analysis in strategic management research: an analysis and critique", *Strategic Management Journal*, Vol. 17 No. 6, pp.441-458.

Kohli, R. and Devaraj, S. (2003), "Measuring information technology payoff: a meta-analysis of structural variables in firm-level empirical research", *Information Systems Research*, Vol. 14 No. 2, pp.127–145. https://doi.org/10.1287/isre.14.2.127.16019

Kurpjuhn, T. (2015), "The SME security challenge". Computer Fraud and Security, Vol. 2015(3), pp.5-7.

Melville, N., Kraemer, K. and Gurbaxani, V. (2004), "Review: information technology and organizational performance: an integrative model of IT business value", *MIS Quarterly*, Vol. 28 No. 2, pp. 283–322. https://doi.org/10.2307/25148636

Nath, H. and Liu, L. (2017), "Information and communications technology (ICT) and services trade", *Information Economics and Policy*, Vol. 41, pp.81-87.

OECD. (2017) *OECD digital economy outlook 2017.* OECD, Paris, http://dx.doi.org/10.1787/9789264276284-en.

Ofcom (2018), *Connected Nations Wales* (2018), Report from Ofcom, London. Available at https://www.ofcom.org.uk/__data/assets/pdf_file/0016/130822/Connected-Nations-2018-Wales.pdf (last accessed 17/03/2021).

Pathak, S., Krishnaswamy, V. and Mayank Sharma (2020), "Impact of IT practices and business value of IT measurement", *International Journal of Productivity and Performance Management,* Vol. 69 No. 4, pp.774-793.

Pearson, K. (1901), On Lines and Planes of Closest Fit to Systems of Points in Space. *Philosophical Magazine*, Vol. 2 No. 11, pp.559–572.

Pickernell, D., Jones, P., Packham, G., Thomas, B., White, G. and Willis, R. (2013), "E-commerce trading activity and the SME sector: an FSB perspective", *Journal of Small Business and Enterprise Development*, Vol. 20, No.4, pp.866-888. https://doi.org/10.1108/JSBED-06-2012-0074

Price, L., Shutt, J. and Sellick, J. (2018), "Supporting rural small and medium-sized enterprises to take up broadband-enabled technology: What works?" *Local Economy,* Vol. 33 No. 5, pp.515-536, https://doi.org/10.1177/0269094218791508.

Raubenheimer, J. (2004), "An item selection procedure to maximize scale reliability and validity", *SA Journal of Industrial Psychology*, Vol. 30 No. 4, pp.59-64.

Rundle-Thiele, S., Kubacki, K., Tkaczynski, A .and Parkinson, J. (2015), "Using two-step cluster analysis to identify homogeneous physical activity groups", *Marketing Intelligence & Planning*, Vol. 33 No. 4, pp.522-537.

Rural England CIC and Scotland's Rural College (2018), *Unlocking the digital potential of rural areas across the UK* (2018). Available at https://ruralengland.org/wp-content/uploads/2018/03/Unlocking-digital-potential-website-version-final.pdf (last accessed 17/03/2021)

Sabherwal, R. and Jeyaraj, A. (2015), "Information technology impacts on firm performance: an extension of Kohli and Devaraj (2003)", *MIS Quarterly*, Vol 39 No. 4, pp.809–836. https://doi.org/10.25300/misq/2015/39.4.4

Samoilenko, S. and Osei-Bryson, K-M. (2018), "An analytical framework for exploring context-specific micro economic impacts of ICT capabilities", *Information Technology for Development*, Vol 24 No. 4, pp.633-657.

Şchiopu, D. (2010), "Applying Two Step cluster analyses for identifying bank customers' profile", *Bulletin Petroleum-Gas University of Ploiesti*, Vol. 62 No. 3, pp.66-75.

Steinfield, C., Scupola, A. and López-Nicolás, C. (2010), "Social capital, ICT use and company performance: findings from the Medicon Valley biotech cluster", *Technological Forecasting and Social Change*, Vol. 77 No. 7, pp.1156–1166. https://doi.org/10.1016/j.techfore.2010.03.004

Strauss, T., von Maltitz, M. J. (2017), "Generalising Ward's Method for Use with Manhattan Distances". *PLoS*, Vol 12 No. 1, pp.1-21.

Tisdell, C. (2017), "Information technology's impacts on productivity and welfare: a review", *International Journal of Social Economics*, Vol. 44 No. 3, pp.400-413.

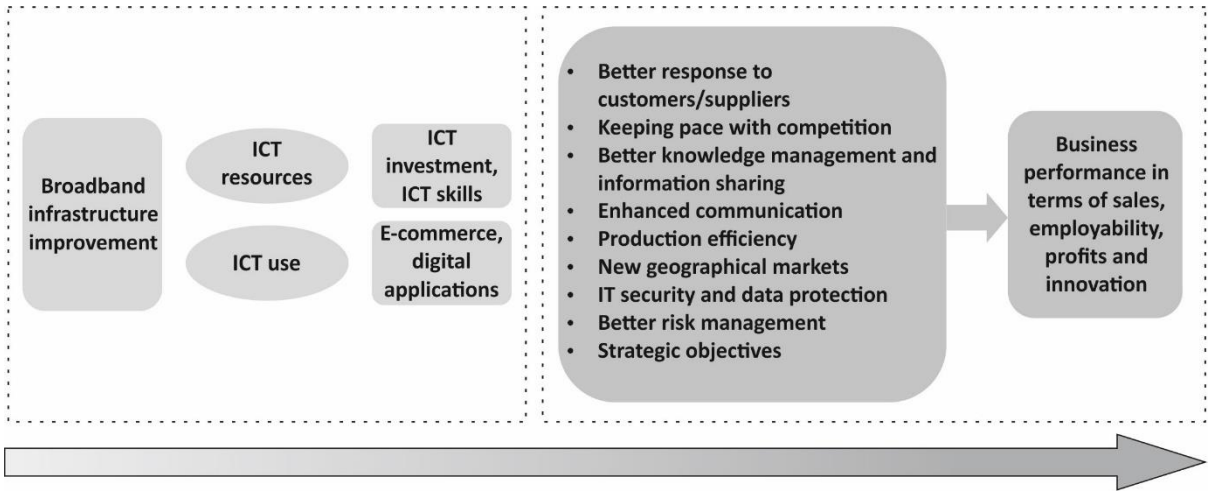
Welsh Economy Research Unit (2017), *Digital Maturity Economic Impact Report 2017*. Report for Welsh Government. Available at: https://www.cardiff.ac.uk/__data/assets/pdf_file/0009/1212201/SFBE-Economic-Impact-Report-1-0.pdf (last accessed 29/10/2020)

Welsh Government (2019). *Welsh Budget 2019: Chief economist's report,* Available https://gov.wales/welsh-budget-2019-chief-economists-report (last accessed 29/10/2020).

Yunis, M., Tarhini, A. and Kassar, A. (2018), “The role of ICT and innovation in enhancing organizational performance: The catalysing effect of corporate entrepreneurship”, *Journal of Business Research*, Vol. 88, pp.344-356.

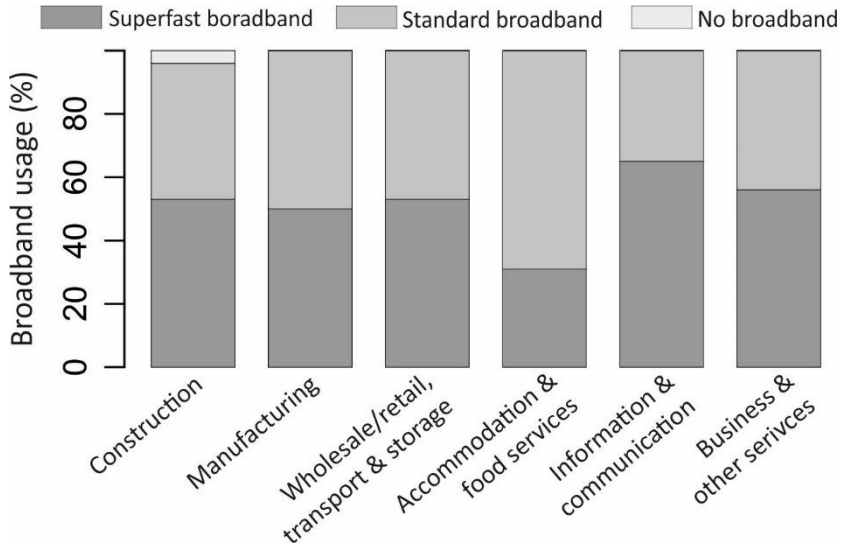
Zhou, H.B. and Gao, J.T. (2014), “Automatic method for determining cluster number based on silhouette coefficient”, *Advanced Materials Research,* Vol. 951, pp.227-230.

Figure 1: Business improvement and broadband infrastructure



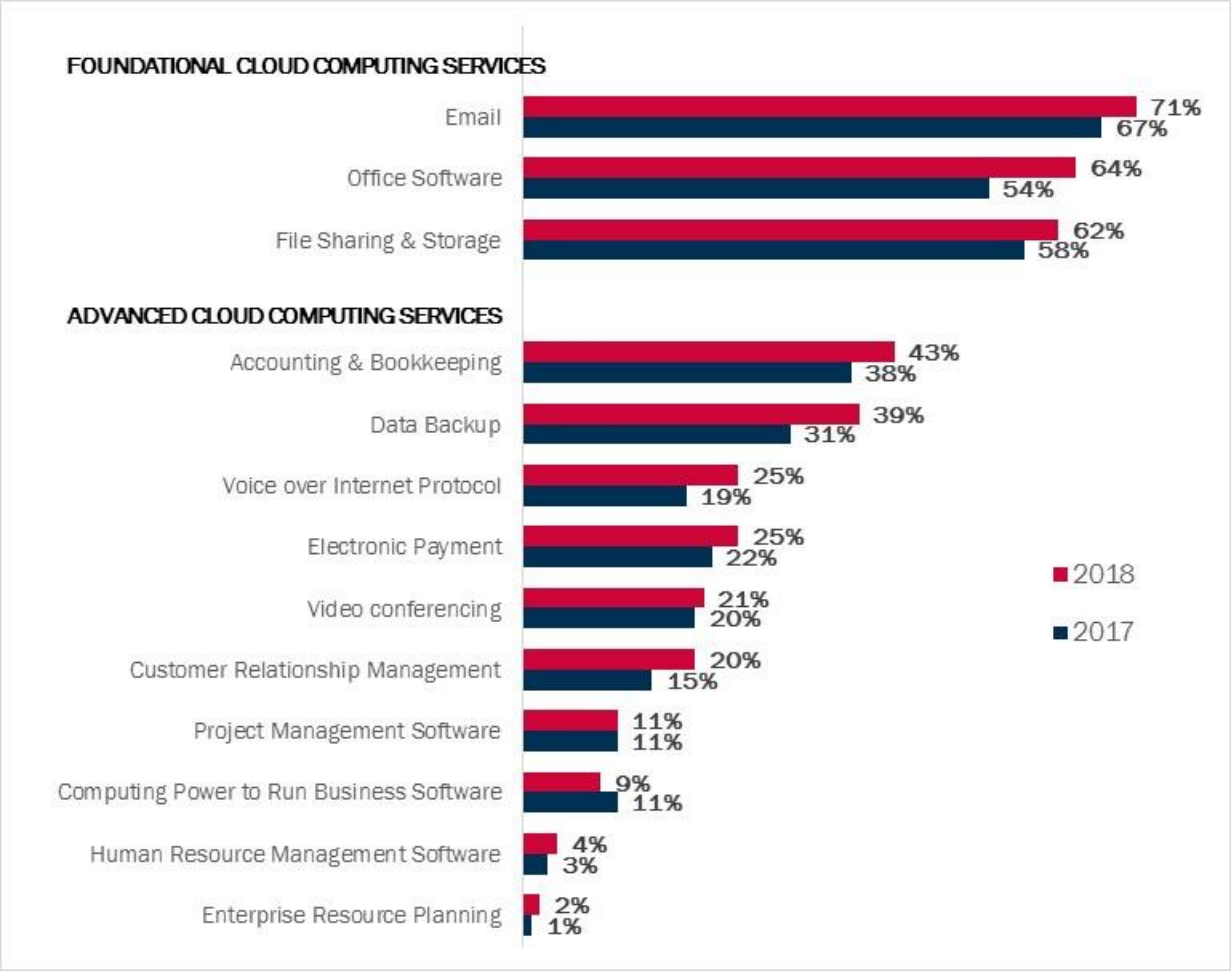
Source: Adapted from Digital Maturity Survey for Wales, 2018

Figure 2: Types of Broadband Usage of SMEs by Industry



Source: Digital Maturity Survey for Wales 2018

Figure 3: Percentage of Responding SMEs using Broadband Enabled Services



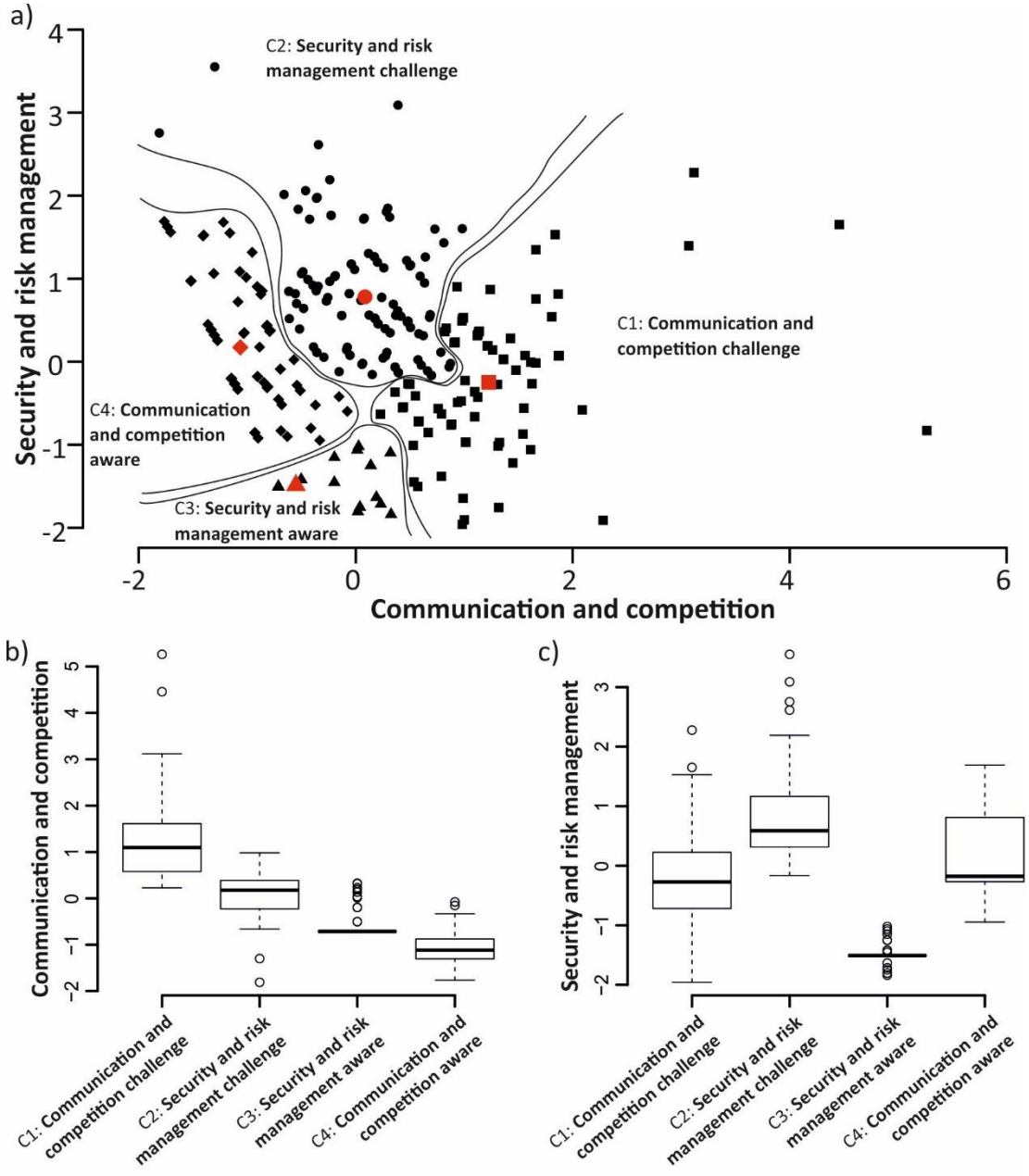
Source: Digital Maturity Survey for Wales 2018

Figure 4: Benefits of broadband-enabled services (% of SMEs)

N.B. The question on "Enhance communication" was not included in the 2017 Survey.

Source: Digital Maturity Survey for Wales 2018

Figure 5: Graphical scatterplot of the four clusters



N.B. Ward's hierarchical clustering technique was used

Figure 6: Graphical barplot of the four clusters and business effects of broadband access

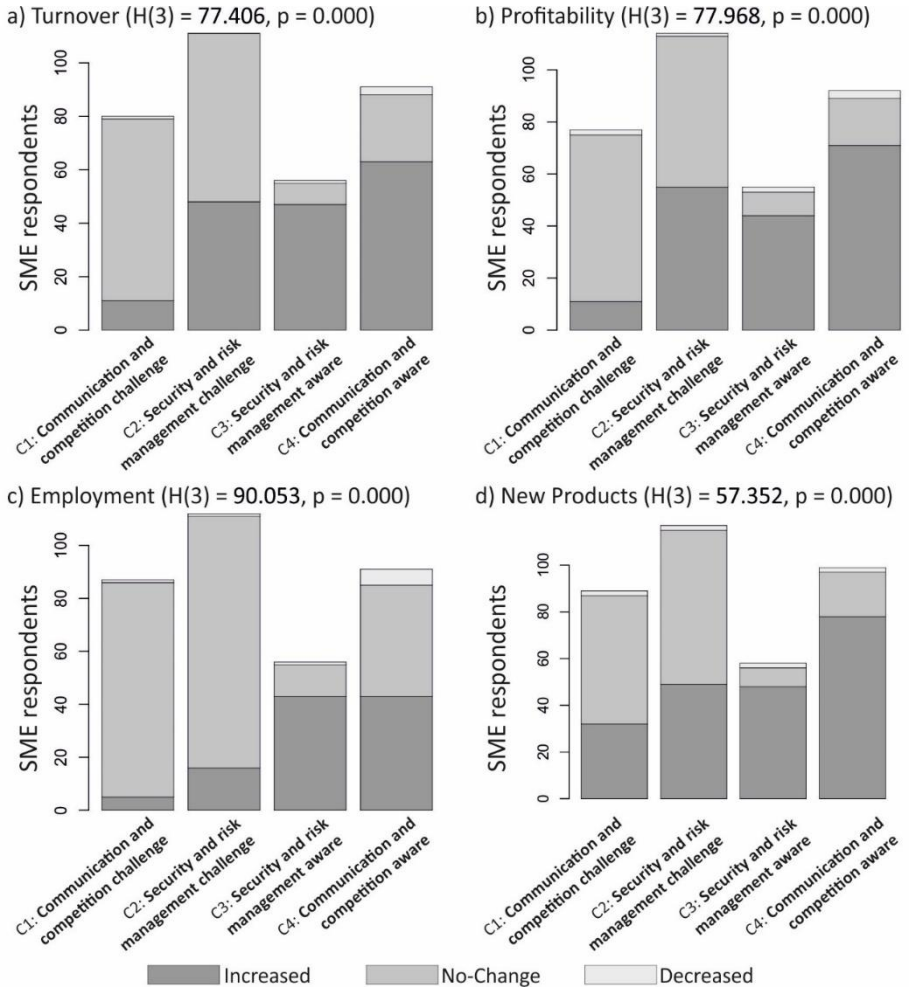


Table 1. Breakdown of Digital Maturity Survey 2018 Responses

Location: EU region	Number of responses	% of total responses
West Wales and the Valleys	286	*59.7*
East Wales	193	*40.3*
Location: Urban/Rural[2]		
Urban	265	*55.3*
Rural	214	*44.7*
Firm Size[3]		
Micro	318	*66.4*
Small	119	*24.8*
Medium	41	*8.6*
Unknown	1	*0.2*
Industry Sector[4]		
Construction	45	*9.4*
Manufacturing	76	*15.9*
Wholesale/retail, transport and storage	58	*12.1*
Accommodation and food services	31	*6.5*
Information and communication	53	*11.1*
Business and other services	214	*44.6*
Unknown	2	*0.4*

Notes:
1. Percentages may not sum due to rounding.
2. Postcodes were utilised to classify respondents by the 2011 Census rural-urban classification (A1-F2), available at https://onsdigital.github.io/postcode-lookup/ (last accessed 22/01/19).
3. Micro businesses have 0 to 9 employees, small - 10 to 49 employees, medium - 50 to 249 employees.
4. Industry sectors refer to SIC 2007 categories and are listed in the table as F, C, G-H, I, J, and K-S, respectively.

Table 2. Variance explained results from extraction of components

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.236	60.516	60.516	3.307	47.241	47.241
2	.965	13.792	74.308	1.895	27.068	**74.308**
3	.434	6.198	80.507			
4	.402	5.746	86.252			
5	.373	5.324	91.577			
6	.335	4.789	96.366			
7	.254	3.634	100.000			

Table 3. VARIMAX rotted component analysis factor matrices

Variable	Component	
	1	2
Access to broadband enabled services ...? - Better respond to customer or supplier requirements	**.868**	.135
allowed your business to...? - Keep pace with	**.805**	.310
allowed your business to...? - Improve knowledge management/information sharing	**.776**	.312
allowed your business to...? - Enhance communication	**.819**	.184
allowed your business to...? - Improve productivity/efficiency	**.717**	.415
allowed your business to...? - Increase IT security and data protection	.254	**.853**
allowed your business to...? - Better risk management (continuity planning)	.233	**.866**
Cronbach alpha	**0.894**	**0.761**

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 3 iterations.

Table 4. Identified Clusters and SME Performance

What effects has access to broadband services had on SALES (increased=1; No change=2, decreased=3)				
	n	mean	Standard error	Mean difference between clusters *-mean difference significant at 0.05 level
C1: Communication and competition challenge	80	1.88	0.041	C1-C2*; C1-C3*; C1-C4*
C2: Security and risk management challenge	111	1.57	0.047	C2-C1*; C2-C3*; C2-C4*
C3: Security and risk management aware	56	1.18	0.058	C3-C1*; C3-C2*; C3-C4
C4: Communication and competition aware	91	1.34	0.057	C4-C1*; C4-C2*; C4-C3
What effects has access to broadband services had on PROFITS (increased=1; No change=2, decreased=3)				
	n	mean	Standard error	Mean difference between clusters *-mean difference significant at 0.05 level
C1: Communication and competition challenge	77	1.88	0.045	C1-C2*; C1-C3*; C1-C4*
C2: Security and risk management challenge	114	1.53	0.049	C2-C1*; C2-C3*; C2-C4*
C3: Security and risk management aware	55	1.24	0.068	C3-C1*; C3-C2*; C3-C4
C4: Communication and competition aware	92	1.26	0.053	C4-C1*; C4-C2*; C4-C3
What effects has access to broadband services had on EMPLOYMENT (increased=1; No change=2, decreased=3)				
	n	mean	Standard error	Mean difference between clusters *-mean difference significant at 0.05 level
C1: Communication and competition challenge	87	1.95	0.028	C1-C2; C1-C3*; C1-C4*
C2: Security and risk management challenge	112	1.87	0.035	C2-C1; C2-C3*; C2-C4*
C3: Security and risk management aware	56	1.25	0.064	C3-C1*; C3-C2*; C3-C4*
C4: Communication and competition aware	91	1.59	0.064	C4-C1*; C4-C2*; C4-C3*
What effects has access to broadband services had on NEW PRODUCTS, PROCESSES OR SERVICES (increased=1; No change=2, decreased=3)				
	n	mean	Standard error	Mean difference between clusters *-mean difference significant at 0.05 level
C1: Communication and competition challenge	89	1.66	0.055	C1-C2; C1-C3*; C1-C4*
C2: Security and risk management challenge	117	1.60	0.049	C2-C1; C2-C3*; C2-C4*
C3: Security and risk management aware	58	1.21	0.064	C3-C1*; C3-C2*; C3-C4
C4: Communication and competition aware	99	1.23	0.047	C4-C1*; C4-C2*; C4-C3

Table 5. Profiling Variables from the Digital Maturity Survey

Variable	Measurement
Industry section	SIC Categories (2007): C. Manufacturing; F. Construction; G.H Wholesale and retail trade & transportation/storage; I. Accommodation and food service activities; J. Information and communication; K-S. Professional, scientific and technical activities; Financial and insurance activities; Real estate activities Administrative and support service activities: Public administration & Defense; Education; Human health and social work activities Other service activities; arts, entertainment and recreation
ICT (technological) infrastructure	An average of broadband download speed available to the firm. Based on the reported speed of connection: < 2 Mbps = 1; 2 Mbps - 10 Mbps = 2; 10 Mbps - 30 Mbps = 3; 30 Mbps - 100 Mbps = 4; > 100 Mbps= 5 – Speeds under 30Mbps = standard broadband. Speeds over 30Mbps = Superfast broadband.
Firm size	Dummies based on the number of employees: 0-1 = 1; 2-5 = 2; 6-9 = 3; 10-49 = 4; 50-249 = 5
Regional location	Dummies based on the location within Wales ONS Categories: Urban = 1; Rural = 0

Table 6. Profiles of the SME respondents in the four clusters

Characteristics	C1	C2	C3	C4	All SME respondents
Rural / Urban (percent) - X^2 (3, N = 407) = 10.933, p = .012					
Rural	34.5	53.8	35.5	41.9	42.8
Urban	65.5	46.2	64.5	58.1	57.2
Total	100.0	100.0	100.0	100.0	100.0
Industry sector (percent) - X^2 (15, N = 407) = 35.248, p = .002					
Accommodation and food services	4.5	7.7	8.0	4.8	6.1
Business and other services	57.3	37.7	40.3	46.7	45.8
Construction	9.1	15.4	1.6	5.7	9.1
Information and communication	10.9	6.9	19.4	12.4	11.3
Manufacturing	10.9	22.3	11.3	17.1	16.2
Wholesale & retail, etc	7.3	10.0	19.4	13.3	11.5
Total	100.0	100.0	100.0	100.0	100.0
Download speed (percent) - X^2 (12, N = 326) = 25.590, p = .012					
Less that 2 Mbps	5.6	5.2	8.8	2.4	5.2
2 Mbps or more and less than 10 Mbps	20.0	16.4	5.4	14.7	15.1
10 Mbps or more and less than 30 Mbps	21.1	22.5	14.3	18.3	19.6
30 Mbps or more and less than 100 Mbps	43.3	45.9	42.9	57.3	47.5
100 Mbps or more	10.0	10.0	28.6	7.3	12.6
Total	100.0	100.0	100.0	100.0	100.0