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Interactive adaption in 'mid-chain' firms: How are supply chains enabling digital and net zero transitions?

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Interactive adaption in 'mid-chain' firms: How are supply chains enabling digital and net zero transitions?

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ABSTRACT

The business landscape is changing as manufacturing processes undergo the digital transition and the shift towards net zero practices. Conceptual perspectives suggest that supply chains might play an important role in these transitions where they are characterised by: (a) firms which are aware of the advantages of new technologies and able to evaluate their benefits; (b) goodwill trust which facilitates open and intensive knowledge sharing; and, (c) power imbalances which might facilitate knowledge flows where innovative firms hold more power. Our empirical evidence suggests that for mid-chain companies their lived experience of the supply chains in which they operate is rather different. While goodwill trust with suppliers is not uncommon, trust-based relationships with customers are less evident, often complicated by commercial pressures, short-term or intermittent contracts and power imbalances. Often, too, mid-chain firms' supply chain partners seem unable or unwilling to appreciate the potential value of new technologies. Each factor limits knowledge sharing between supply chain partners, reducing the potential for collaborative innovation. Indeed, our empirical analysis suggests relatively limited collaboration for product innovation and little or no significant collaboration on digital diffusion or the dissemination of net zero practices. This suggests a significant gap exists between levels of knowledge sharing and technology diffusion in an idealised supply chain and the current reality. This is not to suggest that mid-chain firms are themselves not innovative. Indeed, almost all were engaged in product or service innovation, digital innovation and the implementation of net zero practices. However, mid-chain firms' innovations owed little to their supply chains. Instead, a lack of collaboration means that mid-chain firms' innovation tended to be initiated, resourced and delivered from within the mid-chain business. Current policy supports for supporting digital supply chains and adoption are positive but may require reinforcement and scaling.

Keywords: Supply chain; Digital adoption; Net zero; Mid-chain SMEs.

CONTENTS

1. INTRODUCTION

The business landscape is changing as manufacturing processes undergo the digital transition and the shift towards net zero practices. Both will be critical to achieving national net-zero targets and sustaining competitiveness in increasingly digitised markets[1]. Supply chains play a potentially important role in enabling such transitions operating as sets of integrated business units acting together to create common value. Interactions between supply chain partners can lead to knowledge sharing, with positive implications for the diffusion of innovation, digital technologies and green practices (Patterson et al, 2004, Power and Simon's, 2004, Cai et al, 2013, Hoejmose et al, 2012). As early adopters (Rogers, 1995) of digital technologies and green practices share knowledge with their supply chain partners, there is the potential to create and strengthen supply chains that can adapt to the demands of an environmentally friendly, digitised business landscape.

The digital and net zero transitions require significant innovation in products, services and business models by firms of all sizes. For larger firms this innovation may be internally resourced and driven; for smaller firms external financial and knowledge resources will be more critical in driving effective innovation (Vahter, Love, and Roper 2014). Addressing environmental concerns that have implications beyond the firm boundaries will also necessitate collaborative innovation and knowledge sharing with customers and suppliers (Dahlmann and Roehrich 2019; Choudhary et al. 2020). Despite its potential benefits, such knowledge sharing between firms is not easily achieved; it is a risky endeavour that raises the chances of opportunistic behaviour (Eisenhardt, 1989, Cai et al, 2013). Success in knowledge sharing will therefore depend not only on the characteristics of the innovation and firms involved (Rogers, 1995, Zhu et al, 2012) but also on relational elements such as the degree to which firms trust each other (Gulati, 2017, Cai et al 2013, Fawcett et al 2012) and have the power to influence one another (Hart and Saunders, 1997, Hall, 2006, Cai et al, 2013).

In this paper, we examine the enablers and inhibitors of the diffusion of product innovation, digital technologies and net zero practices in 'mid-chain' firms, i.e. small firms operating business-to-business models in manufacturing supply chains. We consider organisational

[1] See https://www.gov.uk/government/news/uk-becomes-first-major-economy-to-pass-net-zero-emissions-law. Accessed 30th August 2020.

enablers and inhibitors but also examine the role of trust and power relations in facilitating diffusion between these businesses and their suppliers or customers. We ask the overarching research question: what are the enablers and inhibitors of the diffusion of product innovation, digital technologies, and net zero practices in supply chains? Within this, we ask two specific questions: what role does inter-firm trust play in facilitating diffusion in supply chains? And, what role do power relationships play in facilitating diffusion in supply chains?

We draw on the theoretical literatures that examine the diffusion of innovation (Rogers 1995), new technologies (Davis, 1989, Venkatesh et al., 2003) and green practices (Hall, 2006), as well as literatures on the role of trust and power dynamics for knowledge sharing and successful supply chain management (Hall, 2006, Ireland and Webb 2007, Millington, 2008). Although various studies have investigated the processes of knowledge sharing and adoption of technologies in supply chains (Biotto et al, 2012, Patterson et al, 2004, Power and Simon, 2004), fewer studies have examined the role of trust or power relations in facilitating diffusion (Cai, et al, 2013, Hart and Saunders, 1997). Similarly, while numerous studies have examined the factors that drive the diffusion of green practices, or Green Supply Chain Management (GSCM) (Sarkis et al, 2011, Zhu et al , 2012, Liu et al, 2012, Seles et al, 2016), the role of trust or power has again received less attention (Hall, 2006, Hoejmose et al, 2012). Within the GSCM literature, most studies also focus on firms in consumer facing sectors since these are under greater institutional pressures to be environmentally friendly; less is known about adoption and diffusion in business-to-business activities which are our focus here (Hoejmose et al, 2012).

We make theoretical and empirical contributions to the literature on the knowledge sharing and diffusion in supply chains. First, we contribute to theory by integrating organisational models of the diffusion of innovation with inter-firm theories of trust and power relations. This facilitates a better understanding of the ways in which relationship dynamics influence the diffusion of innovations in supply chains. Empirically, through in-depth interviews with business leaders in twenty mid-chain small businesses, we highlight the importance of deep, interpersonal trust and long-term relationships in facilitating innovation diffusion to smaller firms. Our results suggest the limited extent to which digital technologies diffuse along supply chains. Instead, digital adoption is more often driven by third party suppliers outside the supply chain, and the use of these technologies is rarely passed on to suppliers or customers. We also find limited evidence for the interactive adoption of net zero

practices within supply chains. Instead, we find widespread adoption of net zero practices more commonly driven by regulatory requirements or top management support. Our results suggest that, while small firms are innovative, their relative lack of power in supply chains limits the extent to which they can lead collaborative diffusion. The general lack of innovativeness of other supply chain partners is also seen by mid-chain firms as a barrier to the diffusion of innovation. Our results have policy implications in terms of understanding the factors that underlie successful diffusion in supply chains. Our specific focus on digital technologies and green practices has implications for the UK government's focus on increasing business competiveness and productivity in the face of Industry 4.0 and transitions towards net-zero.

The remainder of the paper is organised as follows. Section 2 presents our theoretical framework, Section 3 introduces our methodology and describes the mid-chain firms we interviewed in late 2020 and their supply chain relationships. The interviews took place in the middle of the Covid-19 regional lockdowns and the effects of the pandemic were obvious in many of the companies to which we spoke. Many had lost considerable parts of their business, particularly if they relied in some way on the hospitality sector. Other mid-chain businesses had to stop sending out salespeople or had reduced the numbers of sales staff. Our focus in the interviews was on the nature of the relationships in the supply chain. Most reported these had been unaffected. Regular customers remained regular customers and communications had adapted to virtual means. However, a few respondents bemoaned that this form of communication was not as conducive to innovation as face-to-face meetings.

> *'We've done the usual, I've spoken to all my suppliers by phone, FaceTime, erm, Zoom, while… During the, during the lockdowns. But it's just not the same. We get stuff done…, it's not the requests, it's all the… chat that goes around it…when you're just sat talking nonsense for an hour .. You'll just talk nonsense, and it's just that snippet, that, that last… You know, that one minute out of the 60 minutes of me talking rubbish…I'll suddenly go, "Oh, hang on, that's really interesting, let's explore that. "And you don't get that from Zoom or from phone calls'.*
>
> **Small, niche, mid-chain business**

Therefore whilst Covid had impacted on business, it had not impacted on the relationships underpinning the supply chains, nor, largely, on business operations or procedures. Section 4 presents our results focusing on the impact of knowledge sharing along the supply chain on product innovation, digital and net zero adoption. Section 5 discusses our findings and offers some conclusions and policy recommendations.

2.THEORETICAL BACKGROUND

In this section we first present organisational models of the diffusion of product innovation, digital technologies and green practices. We then integrate these models with relational models relating to inter-firm trust, power relations and knowledge sharing in supply chains. This enables us to draw out a set of theoretical propositions relating to the role of trust and power relations as enablers or inhibitors of innovation diffusion, digital technologies and net zero practices in supply chains.

2.1. The diffusion of product innovation, digital technologies and net zero practices in supply chains

The most widely used theoretical framework for examining innovation diffusion is the Diffusion of Innovation (DOI) model developed by Rogers (1995). Here, innovation diffusion is defined as 'the process by which an innovation is communicated through certain channels over time among the members of a social system' (Rogers, 1995, p. 6). Within the DOI framework, successful diffusion requires that the potential adopters of the innovation go through five distinct stages: the knowledge stage in which they are made aware of the innovation, the persuasion stage in which they are convinced to adopt the innovation, the decision stage in which they decide to adopt it, the implementation stage in which they put the innovation to use, and the confirmation stage in which they evaluate its value. The rate at which a given innovation diffuses then depends on the innovations' perceived relative advantage of over previous practices, its perceived compatibility to existing values and experiences, its perceived complexity of comprehension and use, its trialability, i.e. the degree to which it can be tried or tested before adoption, and its observability, i.e., the degree to which its benefits are observable. The DOI model also posits that the attitudes of potential adopters, such as their innovativeness and degree of risk aversion, determines their willingness to adopt an innovation. 'Innovators' and 'early adopters' are among the most innovative and willing to embrace change, while 'late

majority' and 'laggards' are the most resistant to change. The DOI model is a useful framework for understanding the process of adoption of new innovations by individual firms and the influence of the characteristics of innovations and innovators in determining the rate of adoption.

Diffusion within the DOI model is driven by interpersonal communications; close strong ties are instrumental for the interpersonal influence necessary to persuade potential adopters to engage with the innovation. However, social learning theory suggests that adoption of new ideas does not necessarily require close relationships (Bandura and McClelland, 1977). Here, individuals or firms can adopt new behaviours simply by observing the behaviours of others and adapting it to their own situation with the aim of achieving a benefit similar to that derived by the original enactors of the behaviour (Bandura and McClelland, 1977). Indeed, this type of less risky imitation or second mover strategy may be optimal where markets are uncertain and information asymmetries between innovators are more intense (Rasmusen and Yoon 2012).

Two other theoretical models, closely linked to DOI, are particularly suited to understanding the diffusion of digital technologies. These are the Technology Acceptance Model (TAM) (Davis, 1989) and the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003). TAM is the most influential model of technology acceptance (Charness and Boot, 2016), and relies on two main tenets that determine an individual's intention to adopt a given technology: its perceived *ease of use* and its perceived *usefulness*. Here, firms will be more likely to accept a technology if they feel it is easy to use and it is beneficial in achieving their firm's objectives. The UTAUT model also relies on similar foundations; here, the effort required to use the technology *(effort expectancy*) and the performance benefits it will bring (*performance expectancy*) shape the intention to use a technology. In addition, the UTAUT model incorporates contextual factors, such as the perception of the availability of technical support and societal or peer pressure. In line with this model, therefore, a firm may be more willing to adopt a given technology if, in addition to requiring low effort and boosting performance, the technology is already widely used (or intended to be so used) and has the potential for accessible technical support should this be required. Both the TAM and UTAUT models have considerable overlap with the DOI theory (Carter and Bélanger, 2004); their basic principles regarding ease of use and usefulness of technologies are similar to the constructs of 'complexity' and 'relative advantage' of innovations within the DOI model.

Conceptual models of the diffusion of net zero practices are less developed, although the general DOI model has been adopted by some studies (Zhu et al, 2012). Hall (2006) introduces the 'Sphere of Influence' model in which the adoption of environmental innovation by smaller supply chain members is driven by a large customer organisation that themselves face environmental pressures. Such pressures come from regulators, organisational stakeholders, consumers, community groups and the media. These forces seek to leverage the power of the large organisation to influence the actions of its various smaller suppliers. Without this pressure from a large customer, Hall (2006) argue that small suppliers have little incentive to adopt environmental innovations beyond those prescribed by regulatory requirements. Here, therefore, the diffusion of environmental practices requires a powerful focal firm seeking to recover or maintain a good environmental reputation and reduce risks from external agents or market conditions (Hall, 2006). Small supplier firms will agree to adopt these innovations in order to be retained as suppliers, and to be viewed as reliable, flexible and credible partners. These types of buyer-supplier relations should result in collaborative environmental innovations which are distinct from passive requirements by customer firms that suppliers comply with regulatory obligations; the latter represents a form of regulatory function performed by the customer firm rather than an inter-firm innovation (Hall, 2006). Lin and Darnall (2010) also propose a framework where institutional pressures motivate firms to form strategic alliances for environmental protection, where such alliances increase the partnering firms' social legitimacy, improve their image, their resources and their market access.

Empirically, numerous studies have shown that the adoption of green practices across the supply chain, or Green Supply Chain Management practices (GSCM), is influenced by both external and internal factors (Zhu et al, 2005). External factors include regulatory, institutional and customer pressures (Zhu et al, 2012). Institutional pressures encourage firms to adopt GSCM practices mainly for reputational benefits, regulatory pressures motivate firms through the desire to avoid punitive measures associated with non-compliance, and customer pressures motivate firms through the desire to seek customer satisfaction or market penetration (Testa et al, 2009). Internal drivers of GSCM adoption include support from top management, the firm's absorptive capacity, as well as the linkages or synergy between external and internal factors (Liu et al, 2010, Testa et al, 2009). Internal adoption is mainly driven by strategic motivations in pursuit of cost effectiveness and efficiency (Testa et al, 2009). Strong strategic capabilities and a high level of internal commitment to environmental issues is necessary if a firm is to lead

members of its supply chain in the adoption of green practices. Zhu et al. (2012) examine the diffusion of green supply chain management practices among Chinese enterprises and find that diffusion occurs mainly through imitation or as second-movers; without regulatory pressures, few enterprises independently pursue these innovations as tactical or strategic decisions. Instead, they wait and see the value of these practices as demonstrated by the original innovators or early adopters, before themselves adopting these practices. This is consistent with social learning theory (Bandura and McClelland, 1977). The empirical literature has also identified several internal and external factors that affect technology diffusion along and within supply chains. Supplier interdependence and IT activity intensity have been found to be important for the diffusion of web technologies along the supply chain, while an individual firm's managerial IT knowledge and the presence of a centralised IT structure are likely to encourage adoption of these technologies in individual firms (Ranganathan et al, 2004).

Overall, the theoretical literature suggests a range of internal and external factors that might influence the diffusion of innovations within supply chains. The DOI model is a useful framework that summarises the basic processes of innovation diffusion. For digital technologies, TAM and UTAUT models suggest that the perceived complexity and relative advantage of the technologies are important in determining their speed of adoption. For green practices, the Sphere of Influence model suggests that diffusion can stem from stakeholder pressures that trigger influential members of the supply chain to instigate change, while empirical evidence suggests that most small enterprises are reactive in the adoption of green practices.

While the theoretical literature is useful in understanding why and how innovation diffusion occurs, few studies consider the particular nature of supply chain relationships that foster diffusion. In this paper, we integrate diffusion theories with theories of trust and power relationships among supply chain members. Trust and power are both means through which organisations can influence one another's actions and behaviour to achieve desired outcomes (Ireland and Webb, 2007). They can coexist in a relationship in different forms, and it has been argued that a supply chain becomes strategically and culturally competitive when there are moderate levels of trust and power: trust increases attachment, commitment and effort while (non- coercive) power enables the adoption of entrepreneurial orientation and risk taking behaviours in firms that are otherwise resource constrained or risk averse (Ireland and Webb, 2007). Integrating organisational theories of diffusion with

more relational theories of trust and power can, therefore, enhance our understanding of the role of supply chain relationships in innovation diffusion.

2.2. Trust and diffusion in supply chains

Diffusion of innovation within supply chains necessarily requires inter-firm knowledge sharing which is inherently risky. There are risks of unintended knowledge leakages that can erode competitive advantage for the firms which are knowledge sharing. Within supply chains, downstream firms may share the same suppliers, so that collaborations with a supplier may lead to knowledge spill-overs to competitors (Cai et al, 2013). In addition, if suppliers have full information about their customer's innovations, they have the opportunity to bring similar innovations directly to market. Trust is therefore important for the type of knowledge sharing and collaborations that foster innovation diffusion within supply chains (He et al, 2011).

Currall and Inkepen (2002) regard trust as being reflected in the decision to rely on a partner under conditions of risk, based upon positive expectations and confidence in the partner's actions. A useful framework for understanding the role of trust in supply chains is social capital theory (Adler and Kwon, 2002). It views trust as a factor which eases inter-organisational relationships, thereby increasing the benefits from knowledge transfer and joint learning, and facilitating the sharing of risks and costs associated with explorative and exploitative activities (Adler and Kwon, 2002, Ireland and Webb, 2007). Sako (1992) considers three levels of trust: contractual trust, competence trust and goodwill trust. Contractual trust is the belief that partners will adhere to a common agreement, and competence trust is the belief that a partner has the capabilities to successfully perform a given task; contractual and competence trust are usually required to enter into relationships.

As envisaged by Sako (1992), goodwill trust is a deeper level of trust, developed only with long-term relationships and repeated exchanges; it enables partners to go beyond contractual agreements, and it implies the absence of opportunistic behaviour (Sako, 1992). Under contractual trust, for example, a partner may act opportunistically by withholding a vital piece of information about a risky technology as long as this does not break contractual agreements, but this behaviour will be below the standards of goodwill trust (Sako, 1992). Goodwill trust is also governed by norms of reciprocity, i.e., the belief

that a firm acting in the benefit of another will eventually be rewarded with reciprocated behaviour in the future (Sako, 1992, Adler and Kwon, 2002, Ireland and Webb, 2007). It is the presence of goodwill trust that increases the willingness of firms to take on the risks of exchanging knowledge and resources, and when norms of reciprocity are established, there is an expectation that a favour will be returned (Ireland and Webb, 2007). The long-standing relationships that characterise goodwill trust lead to the alignment of firms' expectations, with strong social and cognitive embeddedness, which in turn creates greater incentives for firms to cooperate in bringing about change (Ireland and Webb, 2007).

Business-to-business supply chain trust relationships have been shown to encompass credibility and benevolence (Ganesan 1994) which are conceptually similar to the notions of competence trust and goodwill trust. Credibility is more important at the firm level since it instils confidence in the firm's ability to be relied upon. On the other hand, benevolence is important at a personal level as it requires trust in the individual suppliers' representatives rather than on the supplier firm (Hoejmose et al, 2012). This implies that the role of trust is likely to be stronger among small or micro businesses that are also business-to-business firms. Here, the representatives, usually the owner managers, will develop trust at a personal level while also being the face of the firm as a whole, increasing the strength of the interplay between the credibility and benevolence aspects of trust. Empirically, studies have found that trust is beneficial for collaboration and knowledge sharing between organisations. Trust increases operational effectiveness (Shin et al 2000), reduces the potential for conflict and the costs of negotiations and monitoring (Zaheer et al 1998). Various other studies have found that trust is essential for collaborative innovations within supply chains (Gulati, 2017, Cai et al 2013, Fawcett et al 2012).

Goodwill trust is closely related to the first two stages of the DOI, i.e. the stages of knowledge awareness and persuasion (Rogers, 1995). If firms have trusting, long-term relationships with the source of a new idea, they will be more likely to accept it and to be persuaded to adopt it. The source of the innovation serves the 'opinion leader' role, whose legitimacy relies on trust, credibility and respect from other members of the chain (Rogers, 1995). Such goodwill trust can also potentially smooth *communication channels* and reduce the *time* needed to adopt, thus facilitating two core elements of the DOI model and making for smoother and faster diffusion. This leads to us to predict that goodwill trust will be positively associated with diffusion in supply chains.

In terms of digital technologies, trust has implications for the predictions of the TAM and UTAUT diffusion models regarding the perceived complexity and befits of the technology. In particular, a trusted source can better convince a partner of the *usefulness* (Davis, 1989) or *performance expectancy* (Venkatesh et al., 2003) of a technology and, through demonstrating familiarity with the technology, can also increase the perceived *ease of use* (Davis, 1989) or, equivalently, reduce the perceived *effort expectancy* (Venkatesh et al., 2003) of the technology. Goodwill trust in the source can also enhance the role of contextual factors such as the perception of the availability of technical support (Venkatesh et al., 2003) since the trusted partner can be relied upon to assist with finding solutions to technical difficulties arising from adoption. Moreover, since goodwill trust is characterised by repeated exchanges over time, it can enhance the *trialability* and *observability* of innovations already adopted by the trusted source, hence facilitating faster diffusion as advanced in Rogers (1995). Empirically, Carter and Bélanger, (2005) examine citizen's adoption of digital technologies in the form of e-governance. They find that the intention to use the digital technology is influenced not only by factors suggested in DOI and TAM diffusion models, but also by citizens' perceptions of the trustworthiness of the technology and the government. This implies that successful diffusion of digital technologies requires trust in the technology and trust in the source of the technology, i.e. the partner. Cai et al (2013) find that trust has a positive influence on technical exchange and technology transfer within supply chains, and that trust has a stronger impact than power. This is in line with McKnight et al. (2002) who theorise that trust is central in the adoption and widespread diffusion of e-commerce technology.

Of course, too much trust can lead to an 'over-embeddedness' which may have detrimental impacts on innovation by limiting the ability or willingness of partners to seek new and additional partners, with negative implications for the diversity of ideas (Ireland and Webb, 2007). This is particularly relevant for digital technologies whose adoption can depend on the 'digital readiness' of firms, such that core suppliers may be unable to adapt their processes or components in a way that allows for the diffusion of such technologies. Indeed, Todo et al. (2017) find that, in the Japanese context, geographical proximity of suppliers and dense supply networks reduce the benefits of knowledge transfers through the supply chain; they argue that diversity in supply chains will encourage the diffusion of a broader and more diverse range of ideas. By contrast, Skold et al. (2018) contend that the intervention of external consultants in innovative activities in the utilities sector interferes with inter-organisational communications and learning processes, and eventually

reduces absorptive capacity of the sector. This resonates with the work of Wood et al. (2016), who argue that increasing reliance on remote suppliers leads to more distant relationships that inevitably impact negatively on knowledge transfer through supply chains. Overall, it is unclear whether over-reliance on particular supply chain members, which can result from excessive trust, is detrimental to diffusion. Based on previous arguments on the positive role of trust in enhancing diffusion mechanisms for digital technologies, therefore, we expect that goodwill trust will be positively associated with the diffusion of digital technologies in supply chains.

While it is widely accepted that the diffusion of green practices depends on power dynamics in supply chain relationships (Hall, 2006, Millington, 2008), inter-firm trust also plays a role. Millington (2008) notes that successful implementation of ethical supply chain management, which encompasses GCSM, depends on relational and obligational contracting systems that are 'characterized by long-term cooperative relationships between buyers and suppliers, which are based on trust and the relatively free exchange of information' (p. 371). When buyer firms request the adoption of green practices by small suppliers, as in the Sphere of Influence model (Hall, 2006), it is necessary that buyer firms have credibility trust in the suppliers; these suppliers need to signal their competence and commitment to the buyer in order to secure future orders (Nyaga, Whipple and Lynch, 2010; Hoejmose et al, 2012). This trust can facilitate collaboration by reducing relationship tensions (Hoejmose et al, 2012). In addition, trust at the inter-personal level between firm leaders, i.e., benevolence trust, can facilitate diffusion of green practices since it instils a culture of corporate responsibility in supply chains (Boyd et al 2007). Such inter-personal trust has been found to improve knowledge sharing in the context of green supply chain management (Cheng et al. 2008). Hoejmose et al. (2012) find that, while top management support is important for the adoption of GSCM, trust is crucial for facilitating the cooperation that leads to GSCM, and this effect is stronger in business-to-business sectors than in sectors that are consumer facing. Overall, the literature suggests that the diffusion of green practices can be enhanced when supply chain members have trust in their ability and commitment to adopt green practices, and when they trust in each other at a relational level. Here, although goodwill trust can be expected to exert a positive influence, such a deep level of trust does not appear necessary for green practices diffusion; credibility and benevolence trust appear sufficient (Hoejmose et al, 2012). We may therefore expect that general inter-firm trust is positively associated with the diffusion of green practices in supply chains.

2.3 Power and diffusion in supply chains

Ireland and Webb (2007) regard power as 'a multi-dimensional construct … encompassing an influence that can be used to evoke desired actions from partners' (pp.485). A useful theoretical framework for understating the role of power in inter-organisational relationships is the resource dependency theory (Eiesenhardt and Schoonhoven 1996). Resource dependency theory posits that, to the extent that firms do not entirely control the conditions necessary to achieve their desired outcomes, they become dependent on external partners with implications for the power dynamics between organizations (Pfeffer and Salancik 1978). This interdependence creates *power imbalance*, a relationship pattern in which one partner, the one holding scarce valuable resources, holds power over the other partner, the one that seeks to acquire these resources (Millington, 2008). In the supply chain context, the relative power of participants is likely to depend on the number of suppliers and buyers for the product, the importance of the supplier to the buyer, and the ability of supplier and buyers to switch to alternative buyers and suppliers (Millington, 2008). Therefore, customers can wield power over suppliers when they are one of a few major customers, when they are the source of a significant proportion of the supplier's revenue, or when they have several other potential suppliers for a given component.

In terms of the DOI model, it is logical that power can intensify a firm's ability to persuade, convince or coerce its partners to be receptive to new ideas. Both coercive power and non-coercive forms of power can achieve this; coercive power through the threat of punishment, and non-coercive power through the withholding of rewards (Molm, 1997).

Power dynamics also have important implications for knowledge transfer involving small firms. Because small firms are resource constrained, they usually have less power in supply chain relations (Cai et al, 2013). Hong et al. (2018) note that leading a collaborative approach to knowledge transfer in supply chains is perhaps more feasible for a large-scale firm which occupies a relatively dominant position within a supply chain; such collaborative approaches can be beyond the capabilities or resources of smaller organisations, which may need to find other ways to encourage knowledge transfer. While coercive power may be effective in extracting knowledge from less powerful partners, it can result in negative sentiments with undesirable long-term impacts (Cai et al 2013, Ireland and Webb, 2007). Non-coercive power is argued to be beneficial in collaborative knowledge sharing since it has the potential to facilitate faster consensus and decision making, and to promote

innovation (Ireland and Webb, 2007). Of course, too much power has disadvantages in terms of breeding exploitative and opportunistic behaviour; for small firms, larger corporations have the ability to gain substantial benefits from small firms and then terminate the relationship before the small firm has the opportunity to reap benefits through reciprocity (Ireland and Webb, 2007). However, for knowledge sharing, power imbalance does have the potential to elicit compliance from less powerful members of the chain (Cai et al, 2013). The existence of trust alongside power can help facilitating willing collaborative knowledge sharing (Ireland and Webb, 2007). We thus expect that the existence of power imbalance within a supply chain will facilitate innovation diffusion where the more powerful member wishes to lead a collaborative innovation approach.

For digital technologies, power imbalances within supply chains can be linked to the predictions of the TAM and UTAUT models. Specifically, a powerful buyer can elicit compliance from its suppliers irrespective of the perceived *ease of use* or *effort expectancy* of the technology, and even if the suppliers have a low perceived *usefulness* or *performance expectancy* of the technology for their own firms. This is because such a power imbalance creates a different set of incentives, where less powerful firms want to maintain their ties with the buyer and signal their commitment (Hoejmose et al, 2012), since the buyer may be able to make adoption a condition for recognition (Millington, 2008).

Other studies have linked power dynamics to the adoption of advanced information technologies (Hart and Saunders, 1997). Hart and Saunders, (1997) argue that coercive power has a limited impact on the adoption of technologies that facilitate information exchange. Since these technologies make firm boundaries more permeable, less powerful firms that are forced to adopt them will eventually develop a greater perceived vulnerability and this limits expansions and improvements to the adopted technologies. Non-coercive power, however, can be beneficial: despite a power imbalance, if the adoption of such technologies is viewed as an opportunity to reinforce trust between organizations, there are improved opportunities for continued exchange and improvements of the adopted technologies and for greater inter-organisational coordination (Hart and Saunders, 1997). Empirically, Cai et al. (2013) find that power positively influences technical exchange and technology transfer within supply chains. Again, smaller firms tend to be at a disadvantage in initiating such processes because transferring a new technology requires large scale commitment of resources and extensive coordination (Cai et al, 2013), and small organisations often lack the resources to influence their supply chain partners to adopt.

Thus, we argue that power imbalance has the potential to facilitate the diffusion of digital technologies.

Power dynamics in supply chain relationships are central to the Sphere of Influence diffusion model for green practices (Hall 2006). Here, buyer power over the suppliers is argued to be a precondition to successful GSCM (Hall, 2000). Since external stakeholder pressures are mainly directed towards lead buyer firms, smaller firms within the chain have little incentives to adopt green practices beyond regulatory requirements and cost and efficiency motivations. The influence of a powerful firm that is under stakeholder pressure is therefore essential for successful diffusion. Millington (2008) also regards power dependency as indispensable to the implementation of ethical supply chain management (ESCM), which encompasses GSCM. According to Millington (2008), 'both power imbalance and interdependence may be expected to contribute to the willingness of the supplier to adapt to buyer requirements.' (p.374) and '…it is clear that ESCM may only be possible within a subset of relationships. While lead firms may wish to implement ESCM, their ability to do so is restricted by the relative power of buyers and sellers' (p.375). Empirically, Hoejmose et al, (2012) find that power imbalances in the form of relative supplier dependence are strongly associated with GSCM practices in business-to-business sectors. We therefore propose that power imbalance is positively associated with the diffusion of green practices in supply chains.

2.3 Conceptual summary

Integrating organisation theories of adoption behaviour (e.g. DOI, TAM, UTAUT) with relational frameworks related to trust and power suggests a range of factors which may either enable or hinder the diffusion of innovations within supply chains. First, deeply rooted, goodwill trust will be positively associated with diffusion in supply chains due to improved and trusted knowledge sharing between partners. Second, inter-firm trust will be positively associated with the diffusion of net zero practices from influential supply chain partners. Third, diffusion may also be greater where influential and powerful supply chain partners are predisposed towards collaborative innovation. Finally, this effect may be stronger where the power imbalance is greater, i.e. diffusion may be strongest where a supply chain is dominated by a lead partner with a strong orientation towards collaborative innovation.

3. EMPIRICAL APPROACH

3.1 Sample selection

The aim of our analysis was to address three main research questions. These were:

- What are the enablers and inhibitors of the diffusion of product innovation, digital technologies, and net zero practices in supply chains?
- What role does inter-firm trust play in facilitating the diffusion of product innovation, digital technologies and net zero practices in supply chains?
- What role do power relationships play in facilitating the diffusion of product innovation, digital technologies and net zero practices in supply chains?

We identified a sample of small '*mid-chain'* firms – firms which had suppliers and customers which were other businesses, rather than end-consumers – from respondents to the ERC Business Futures survey. This survey was conducted during 2020q4 and focused on the adoption of net zero practices and digital innovation in UK SMEs. As part of the survey firms were asked whether they were willing to take part in further research. The survey also included a question relating to the nature of firms' suppliers and customers. Firms agreeing to further research and having suppliers and customers which were other businesses were included in the target sample for our qualitative follow-up. A total of ***** firms were approached of which 20 agreed to participate in follow-up research and interviews with senior managers in each firm took place in November and December 2020[2]. Interviews covered:

- Position in supply chain and nature of relationships
- Innovation diffusion in the supply chain
- Influence of the supply chain on adoption and diffusion of digital technologies
- Influence of supply chain on adoption and diffusion of net zero practices

Interviews were recorded with the permission of the respondent and subsequently transcribed for analysis.

[2] Of the businesses interviewed: 12 had 7-19 employees, 6 firms had 20-49 employees, one firm had 50-99 employees and one larger firm had around 150 employees.

3.2 Sample profile

The majority of firms we interviewed manufactured products, including chemicals, equipment used in neuroscience research, credit cards and fish products. Some acted as distributors for manufacturers, but added value to the product in some way (e.g., precision cutting product to size). One firm treated metal components to enhance their durability. One was a mail despatch company, having suppliers of materials that went into the printing and packaging of mail and customers who bought their packaging products and mailing services. Another supplied and fitted fire safety systems for businesses. The mid-chain businesses we interviewed split roughly 50-50 in terms of whether they operated in a wide, competitive market or whether they offered a niche product or service. In the latter case they were often the only supplier, or one of a few suppliers, to deliver a service or produce a product in the UK.

> *'We will build a machine to process a particular metal for a particular application…the joke… is we have 300 'standard' machines'.*
>
> **Micro, niche, mid-chain business**

We observed a wide variation in the nature of firms' supply-chain relationships with different types of relationships co-existing for individual mid-chain businesses. Some supply chain relationships are regular and contractual, e.g., Kanban arrangements with a customer, rights of distribution for a supplier while others are regular and long-standing but non-contractual. Typically these regular (contractual or otherwise) relationships are based on longstanding and personal relationships. Other supply chain relationships were short-term or occasional as the shelf-life of a product is long, a raw material is used infrequently so the customer is occasional, or the mid-chain business has a number of alternative suppliers and buys on an irregular basis from different people. None of the firms interviewed had formal 'supply chain manager' posts.

3.2.1 Relationships with suppliers

For most mid-chain businesses interviewed, it was quite typical to have a small number of regular suppliers, and others used more infrequently, as illustrated in this quote:

> *'Off the top of my head, I'd say probably 70 percent of our stuff probably comes from let's say between 15 and 20 suppliers, but we've probably got at*

least 100 suppliers…that we, that we'd use within a twelve month period, probably'.

Micro, niche, mid-chain business

One of the mid-chain businesses interviewed was the sole distributor in Europe for a product manufactured in Asia, and another for their German parent company, but both added value to the import (and also drew on other suppliers). A few businesses reported that they had relatively little choice in supplier due to the nature of their product or for regulatory reasons. For example, one mid-chain business was restricted as they needed all suppliers to have the same quality approvals as they had to have for the customer. In this case, customer requirements meant the whole supply chain had to have these approvals. Another mid-chain business experienced changes in the ownership of its suppliers, but supply the same raw materials.

Where there was choice of supplier, many mid-chain businesses remained loyal to their regular suppliers, but would go elsewhere if needed:

'Where suppliers react quickly to when we need stuff, we remain very, very loyal to them. Where they're not quick to react, then we'll use somebody else'.

Micro, niche mid-chain business

On the whole, the vast majority had long-term, loyal relationships with their suppliers. This might be because there were few suppliers, but mostly because there was longevity, personal relationships and a high degree of trust, as illustrated in these quotes:

'I'm very loyal to my suppliers…. I'm still buying from companies I was doing business with in 1978, 1979'.

Small, niche, mid-chain business

'Most of these guys that I, I deal with, we were kids in the market'.

Micro, competitive, mid-chain business

'I don't ever really drop suppliers unless they really, really have messed me over'.

Small, niche, mid-chain business

Many of the relationships with suppliers were described as being relationships with friends. Even in the case of one firm which was a sole distributor, a contractual relationship subject to regular review, they had worked together for a long-time and were like 'family'. But there is an awareness of that contractual relationship:

> *'It's a personal, sort of, business relationship that's, that's been quite successful over the years. But… ..There is a pressure there, I mean if… we weren't performing or weren't, you know, selling as much as they wanted us to then they'd, obviously… There's, there's an option there after the five years, er, to cancel it all, the whole thing'.*

Micro, niche, mid-chain business

Sometimes the relationships were held by one person in the mid-chain business, but even in one micro mid-chain business with their main supplier in Italy, there were contacts between counterparts in each company (e.g. finance officers working together).

None of the businesses said their choice of supplier was based on price, though price was a factor in discussions. The mid-chain businesses were aware of prices in the market and price was negotiated upon. The symbiotic relationship between the firms seemed to be a factor for both parties – if the business interviewed could not afford the price the supplier was offering, they would not be a longer term customer as they would go out of business. Overall, therefore, relationships with suppliers are characterised by *goodwill trust*, based on long-term, personal relationships, repeated exchanges, and loyalty. We anticipate that this type of longstanding and personally based relationship should provide a good basis for knowledge transfer to and from suppliers and the diffusion of innovation, digital technologies and net zero practices.

3.2.2 Relationships with customers

The mid-chain businesses varied widely in terms of their number of customers. One mid-chain business supplied 95% of their product to one major customer. Many had a small number of customers for their niche product, as illustrated in the quote below:

'Again, we're very niche in what we make and our customer base is actually quite small. We probably only have seven or eight major customers we deal with on a week in, week out basis throughout the year. And then probably around that ….we maybe have another eight who we do business with two or three times a year'.

Small, niche, mid-chain business

Some of these were contractual relationships. One firm described how the Kanban system meant they had to stock raw materials and finished products on behalf of the customer and be able to meet any order within 48 hours, acting as the storage for the customer. The nature of the Kanban arrangement for the mid-chain business…

'….is a two year guaranteed order where they commit to take at least 80 percent of those parts and so this is where our security comes into it…….it's difficult to get in [the door] but once you're in you're probably in for life'.

Small, niche, mid-chain business

This same mid-chain businesses described how he dealt with that same customer:

'I cultivate great relationships with people, …., I don't hold back, I don't pull my punches, if I think they're doing something completely stupid I tell them "You're doing this completely stupid. But, nevertheless, you're the customer, so if that's how you want us to do it that's how we'll do it".

Small, niche, mid-chain business

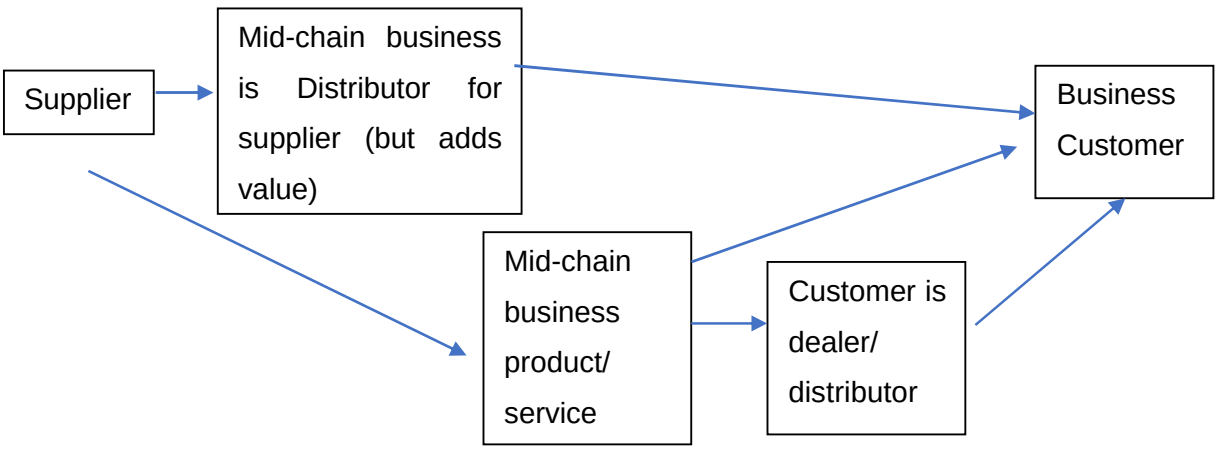
For a small minority of interviewees, their product was long-lasting and there was not an expectation of regular custom but they did provide an on-going service, which maintains relationships. This also meant they needed to identify and generate new leads and custom. For three of the mid-chain businesses interviewed, they did not work directly with the business consumers of their product but via another tier – through distributors or dealerships. This was on a contractual basis. Two of these were operating in a competitive market. The one operating in a niche market used distributors to market their product abroad. Their distributors acted as a mediator between the mid-chain business and their business customer. Those operating in a niche market tended to have fewer customers than those in competitive markets. Those in competitive markets were more likely to have

a large number of customers, account managers to maintain relationships and more sales staff than those in niche markets. But in all cases, there was again loyalty from business customers to the mid-chain businesses. Again, many of the mid-chain businesses characterised their relationships with customers as long-standing, as they focussed on providing a quality product or service. These relationships suggest also that, in many cases, there is goodwill trust between the mid-chain business and their customers. While mid-chain businesses operating in niche markets had some influence due to their unique products, there was also a high degree of buyer dependence since there were often few customers in these niche markets. Some of these relationships were thus governed by mutual dependence. Mid-chain businesses operating in competitive markets appeared to have lower buyer dependence.

3.2.3 Summarising supplier and customer relationships

Figure 1 summarises the range of supply-chain relationships amongst the mid-chain businesses interviewed. Relationships with suppliers were based on long-term relationships, friendships, loyalty and negotiations. Relationships with customers were based on long-term relationships, quality (including long lasting equipment) servicing equipment, and in competitive markets, account managers responsible for maintaining relationships.

Figure 1: Supply chain relationships of mid-chain businesses



4. FINDINGS

4.1 Diffusion of product innovations

Our theoretical framework identified that both trust and power within supply chain relationships influence knowledge sharing. Trust promotes willing co-operation whereas power is more likely to foster coercive knowledge sharing. Knowledge sharing is more likely to result from a partnership than a transactional relationship. There was a high degree of loyalty and friendship in the supply chain relationships held by the mid-chain businesses we interviewed, even those where there was a contractual underpinning. Does this help foster collaboration on innovation or innovation diffusion? We first consider examples of product innovation which occurred with little or no supply chain influence before focusing more specifically on customer-stimulated and supplier stimulated innovation.

4.1.1 Independent product innovation

Most frequently, mid-chain businesses undertook their own product innovation independent of their supply chain. They were the experts. They knew where and how the product could improve and they knew how to innovate themselves or how to adopt innovation from elsewhere to *anticipate* customer demand.

> *I'm a bit of a control freak … I want to know everything about everything in the market and if I do I know then when I make these decisions most of the time we'll get it right.*
>
> **Small, niche, mid-chain business**

However, most innovations led by the mid-chain business involved adoption of innovation from outside the supply chain, demonstrating little evidence of diffusion to the mid-chain business to its suppliers or customers. For example, one business had invested £200,000 in a plant to make more modern devices. They had seen what was happening elsewhere and held exploratory but non-committal discussions with their customers and had been willing to risk the investment:

> *'It's something I saw, having spoken to a few of the customers there aren't any [manufacturing] sources for that product in the UK….. they're all*

manufactured offshore. And so, they were all quite interested, erm, and hopefully they'll replicate that by putting some orders in'.

Micro, niche mid-chain business

The mid-chain business above was operating in a niche market, so might be more confident of a return on its investment. However, in another example of speculative investment in anticipation of customer demand, a micro mid-chain business operating in a competitive market invested £86,000 in digital machines to enable them to print on recyclable materials. Another firm operating in a competitive market invested a smaller sum, £20,000 in plant which could cut materials to minimise waste. Both of these examples draw on the adoption of digital technology for environmental purposes, but are discussed here to demonstrate innovations entirely at the initiative of the mid-chain business with no clear links to either customer or supplier collaboration. In each case there was little evidence that product innovation diffused through the supply chain. Rather, these examples demonstrate the adoption of innovation from outside the supply chain. In part this reflects the role of mid-chain businesses in offering a distinct product or service within the supply chain.

4.1.2 Customer-stimulated product innovation

Circumstances in which customers might demand or stimulate an innovation include:

- a need for product improvement to address operational inefficiencies
- when the customer's product range changes
- when the customer wants to commission an innovation in the field. For example, one company was producing an electric version of its vehicle on commission. Though unlikely to be marketable in the short-term, it was an opportunity to develop the product.

For one mid-chain firm, innovation responded to customer need, but was also necessary because raw materials were no longer available:

'There're two sorts of need for development. One is that the, the, 'It would be nice if your, your equipment would also do…' sort of, development….. and then, unfortunately, much more common is that we can't build this equipment anymore because some of the components we use have gone obsolete. So, we've got to redesign it, and in redesigning it we, we build in some new

features and, and use the latest components, and it usually runs faster, or has more memory, and things like that'.

Micro, niche, mid-chain business

Here, there was a transfer of ideas from the customer to the mid-chain business, and the innovation was facilitated by newer and more efficient components from the supplier. The mid-chain business therefore has benefitted from the innovativeness of its suppliers and customers. Although this diffusion required interactions with the customer, it did not require collaboration.

Some of the businesses interviewed responded to requests for developing new products without a specific order. These mid-chain businesses did this at their own risk, suggesting a positive attitude towards innovation and risk taking. One of the mid-chain businesses would respond and develop products on a trust basis and, even if the customer did not end up purchasing the product, they would have proven their ability, flexibility and hope, or expect to get new orders in the future. For example, if a large, regular, trusted customer asked:

"Er, would you mind making a weird shade of metallic pink?" And I'll go, "Yeah. Not, not a problem." And we go off and do it, erm…Now, they may… Might never use that weird shade of metallic pink, but then, then they'll phone me up in six months' time and say, "Can you make me a blue?" or, "Can you do this," and, and we'll, we'll eventually get one. Whereas our competitors tend to… say … "Yes. Of course, I can make that weird shade, but you need to give me an order now for £100,000."

Small, niche, mid-chain business

In the example above, the customer-initiated innovation is based on both trust and power imbalance: trust that the customer would purchase the product and hope that demonstrating ability and flexibility will lead to continued recognition and business with large powerful customers.

In the mid-chain business which had a Kanban arrangement, they identified the practice of undertaking customer-initiated R&D as beneficial to the customer because the customer

got free R&D. But the nature of the relationship meant the order was most likely to come to the mid-chain business if they did the R&D:

> *' ... they get our expertise for free cos, obviously, you're wanting that to ensure a, a new part going forward….they're gonna keep buying them from us. ..... We are at risk of them taking those drawings elsewhere now and, and I'd be extremely annoyed if, having done all of that development work with them for free…if they then run away and give that business to somebody else for the sake of 10 pence a part'.*
>
> **Small, niche, mid-chain business**

The above example illustrates a collaborative innovation process characterised by trust, as the mid-chain business accepts the risks of knowledge leakages but expects goodwill reciprocity from their customers in the hope of achieving collective competitive advantage.

4.1.3 Supplier-led and collaborative product innovation

We did not identify any example of supplier-led product innovation, where the supplier stimulated innovation activities undertaken in the mid-chain business. Instead, suppliers were typically involved in collaborative innovation with mid-chain companies. Collaboration with suppliers was only one fom of collaborative activity among other examples: collaboration between the supplier and the businesses; collaboration between the mid-chain business and the customer; and, situations where mid-chain business mediate between the customer and the supplier adding innovative value en route.

In one example, innovation was developmental and based on discussions between the customer and mid-chain business:

> *'Customers would….ask [for].. a solution for a problem and, and we'd come up with a couple of alternatives. And… they'd either adopt them, reject them, or discuss further. So, it, it was just, again, responding to market needs and market requirements'.*
>
> **Micro, competitive, mid-chain business**

Mid-chain businesses involved in distribution described how they mediated between suppliers and customers, sometimes contributing their own specialist expertise. Another

firm provided an example of how they facilitated collaboration up and down the supply chain:

> *'[the customer] come[s] to you with a core product and you maybe take various ideas that you've been exposed to, and then try and take their product the next step forward compared to where, maybe, their competitor is at the moment. Erm, and that would often involve working with the supplier as well as the customer, cos were usually taking a product and then bolting lots of bits to it, or modifying it, so we'd need ..suppliers to issue us something that was maybe different from what they'd done in the past'*
>
> **Micro, niche, mid-chain business**

They went on to describe how of their five regular suppliers, three might be willing to engage on this basis – the others would not because the mid-chain business could not guarantee the orders to warrant R&D investment.

For one company, innovation collaboration with a supplier was on the basis of trust and strong relationships and was also mutually beneficial – both would test developments for each other, and both had something to offer the other. The supplier has more reliable testing equipment, the mid-chain businesses can test the supplier's innovation in a customer setting. This is illustrated in the following quote:

> *'they're doing all the reliability testing for us over in Taiwan, cos it's cheaper than having it done in the UK….. We've worked with, erm, this particular company for about 25, 26 years. So, I've, kind of, grown up with them, erm, and they've grown up alongside us. But … quite often they'll phone us and say, "Hey, we've developed this, what do you think?" And then we'll have a play with it and say, "Erm, yeah, you need to look at this part of the circuit, I'm not sure about that, we're not happy with this output'.*

The supplier does this because:

> *'Because we, we do put quite a lot of business through them. And erm, it's a family owned company…. it's really a family to family thing…'*
>
> **Micro, niche, mid-chain business**

Overall, goodwill trust and long-term relationships with suppliers along with resource complementarity and a culture of reciprocity facilitated collaborative innovation diffusion in these businesses. These factors worked alongside a positive attitude towards innovation and change.

4.1.4 Product innovation barriers

We have seen above how one of the micro mid-chain businesses reported difficulty in getting some suppliers to collaborate on innovation because they could not guarantee sufficient volumes:

> *'We're probably just not big enough to have the large enough numbers for them to consider it…'*
>
> **Micro, niche, mid-chain business**

Here, it appears that the size of the mid-chain business, and hence its relative lack of power and resources, limited its ability to persuade suppliers to engage in collaborative innovation, preventing the diffusion of the innovation. In particular, if the mid-chain business had been a large organisation with greater influence within the supply chains, and with sufficient resources to guarantee a large order, the innovation would have been successfully diffused to their suppliers.

A number of the mid-chain businesses stated that while they could offer the customer innovative products, the customers themselves were not interested in innovating. When asked why they felt this might be a couple responded that the customer was sometimes 'lazy'. For example:

> *'I think a lot of people are quite lazy. I think that, erm, a lot of people just think, "As soon as I change anything or I do anything different it's gonna create a lot of work."*
>
> **Micro, niche, mid-chain business**

This respondent also noted that some people felt 'empowered' in their organisation to change things, whilst others did not, and noted differences in terms of entrepreneurial businesses and those which do not foster innovation:

'You might go and have a meeting with different sorts of people, one would… be saying, "Oh, we probably won't be allowed to do that, … Oh, we probably couldn't get that through, or it'd take too long to get that through, or quality would…" Whereas you'd go and see somebody else and they say, "Oh, that's brilliant, we could take that to our ideas meeting next Friday, or we could take that…" So, you'd see some real difference in how open a business is to actually wanting to make change, or whether there's a lot of barriers to that change. I think that's definitely the case. Whether everybody, erm, whether everybody starts as the young, enthusiastic one and has it driven out of them I don't know. That could well be the case in certain places… you're, you're either gonna be encouraged to be really… Almost entrepreneurial, within a big business, or you're gonna be… Or you're just gonna be encouraged to toe a line'.

Micro, niche, mid-chain business

The examples above point to negative attitudes towards innovation by supply chain partners as a barrier to diffusion. There is also the suggestion that even small, less powerful supply chain partners can influence innovation in large partners if the employees in the large organisations are encouraged to have positive attitudes towards new ideas.

Another barrier to innovation was the need for 'secrecy' and protecting the business:

'… they [the customer] don't want us to know too much, erm, because we could cut them out, in a way, couldn't we? If we're making all of the parts to build their valve then, then why don't, er, why don't I go to… [the end consumers] …and cut them out?

Small, niche, mid-chain business

Another firm suggested:

'… no one wants to expose too much.'

Small, niche, mid-chain business

These examples demonstrate that a lack of goodwill trust limits diffusion; although contractual and competence trust may exist, the goodwill trust that allows partners to

accept the risks of opportunistic behaviour in order to gain the benefits of collaborative innovation appears to be lacking.

4.2 Diffusion of digital technology

In this section we consider the diffusion of digital technologies. In the interviews we did not adopt a specific definition of digital technologies but rather invited respondents to define how they used digital technology within their business and supply chain and how the technology had been introduced. A wide range of digital technologies were being used from use of social media, to ordering and stock control systems, to the use of robots. There was an equally wide range of confidence in digital technology, from one firm which had pioneered the use of computers in their field in the 1970's to others who were aware that they perhaps could do more and were not as advanced as others in their market (see the barriers identified below). As with product innovation discussed earlier, the majority of mid-chain firms who had introduced some form of digital technology had done this independently. Adoption had, however, often been initiated in response to customer or supplier expectation or suggestion.

4.2.1 Independent digital technology adoption

In most cases, the adoption of digital technologies by mid-chain businesses was on the initiative of the business itself rather than its suppliers or customers. In one business, investment in digital technology had been essential as local workers lacked the skills to operate existing machinery and therefore there was a need for higher levels of automation. Other examples of independent digital adoption (rather than collaborative activity) were undertaken in anticipation of customer need. Examples of this include:

- A textile manufacturer upgraded their machinery with electronic controls to make dryers more efficient, but the machines themselves have not changed for 70 years;
- One firm, which needed to attract new custom as their main customer was moving off-shore, was investing in robots to cut costs of production and make their product more attractive. They already have robots and were working with their existing robot supplier to develop the new equipment.

As in this latter example, and similar to the situation with product innovation, most mid-chain businesses looked to businesses outside their usual supply chain to support the design, development or supply of the technology and for the skills or equipment needed.

Thus, new, short-term relationships are forged. None of the respondents had purchased a digital technology 'off-the-shelf' and all had had some form of engagement with the supplier to ensure the product would meet their needs. For example, a couple of businesses which purchased new IT systems to support business process management took 70-80% of the off-the-shelf product, augmented with bespoke modifications for their business. It took time and discussions to ensure those modifications were fit for purpose. Another business had long been frustrated by an inability to properly present the visuals of their product on websites. They met a web consultant at a trade fair who had an innovation which could be used to present their product and have been working for 2 years to implement it for their purposes. They are due to launch shortly:

> *'…two years ago, we spoke to somebody at an event we were doing. He actually came along to listen to us and some designers that we'd …. brought along to an event, and, he went, "You know, it'd be great if I could work with you guys cos I'd like to actually show you my new software that I developed which means you can actually put all your [product] visually on, on a computer screen. And just those chance, chance things that happen, …if you make them ..'*
>
> **Small, niche, mid-chain business**

Where companies had implemented digital technologies, we asked if they had influenced any other part of the supply chain to adopt such technologies and found no example of our smaller mid-chain businesses having this influence.

> *'No. I don't think so. When it comes to suppliers we, er, we can't influence them, they, they choose their methods and we've got to adopt them. … Apart from feeding back problems we don't have any say in, in what they do'.*
>
> **Small, niche, mid-chain business**

Consistent with previous findings, this again demonstrates that mid-chain businesses, although innovative, are unable to lead diffusion of digital technologies in their supply chains due to their relative lack of power and influence within the chain. Digital technology adoption in mid-chain firms may therefore by important in driving increased efficiencies and reduced costs for supply chain members, but don't promote broader supply chain integrations which could drive improved performance throughout the supply chain

(Patterson et al, 2004). Collaborative innovation for digital technology within the supply chain was not in evidence as for product innovation, and only one example of supplier stimulated technology innovation adoption was identified, as described in the next section.

4.2.2 Customer-stimulated digital technology adoption

Where customers expected the mid-chain businesses to use digital technologies, no examples were found where there was support or collaboration for business to implement this. The mid-chain business was required to do this independently in order to keep/attract custom:

> *Because the customer would never be prepared to pay that up-front cost for you*
>
> **Micro, niche, mid-chain business**

> *But the other [potential customers] wouldn't even look at us because we just couldn't, er, we couldn't pack the stuff for them, it was as simple as that.*
>
> **Micro, competitive, mid-chain**

Other customers were unconcerned with the process unless there was a problem with quality or price:

> *How we go about that is our business. If it's right they're fine with it, if it's wrong it's wrong*
>
> **Small, niche, mid-chain business**

It was often difficult for mid-chain businesses to transfer technologies to other customers. One mid-chain firm deploying a mail despatch technologies (e.g. personalising mail and offers according to the end-consumers spending behaviour) tried to make available to other customers to enhance their product offer, but many customers did not have the data or desire. This variation in customer demand was common. For one mid-chain company, it meant having to operate multiple processes. This is inefficient for the business itself:

> *'… all of our business is run … electronically.. with our drawings, and everything being… scanned, everything's, like, copied and traceable. All the medical stuff has to be traceable, from when it comes in the door to when it*

> *goes out the door. .. [But] some of our bigger customers would still send us a spreadsheet of bar codes, or a set of serial numbers that we then need to copy rather than just being able to scan a barcode, or something like that. Erm, so I think there's still definitely areas that we could be a lot more efficient if both [sets of customers] were embracing that sort of technology. Erm, so a lot of the medical companies will…because they have to … but then some of the other companies, like oil and gas, are a bit more traditional in doing things, they're maybe a bit slower to adopt some of those technologies'.*
>
> **Micro, niche, mid-chain business**

These examples demonstrate that unfavourable attitudes of customers towards digital adoption, as well as low digital 'readiness' of firms in certain sectors, limits the extent to which the mid-chain business could transfer knowledge relating to digital technologies and hence restricts diffusion. This also illustrates the *drivers* behind customer expectation and the adoption of digital technologies. As such, this inefficiency was likely to continue as the firm did not have sufficient control over its customers and would not change unless customers wanted to:

> *We're only a relatively small business, we turn over, like, between 3 and 4 million, so we're not a big company, but we get led, I guess…by our customers*
>
> **Micro, niche, mid-chain business**

Again, this clearly demonstrates the role (lack) of power within the supply-chain as a barrier to diffusion; the dependence of mid-chain business on the customer means they cannot effectively persuade them to adopt their own digital technologies.

4.2.3 Supplier-stimulated digital technology adoption

In the mail despatch mid-chain business, their printer supplier wanted to test new printers which would not require heat or solvent to print. The suppliers needed it tested and so worked with the mail despatch firm to ensure the product was reliable and robust. The mid-chain business was motivated to see if the new printer would work and if they would want to use it. This both illustrates digital technology adoption and net zero practices and was the only example of supplier-led diffusion we identified.

4.2.4 Barriers to digital technology adoption

Some businesses recognised they could do considerably more in the use of digital technology, e.g. adoption of CAD in a design and production business or more automated ordering systems. The reasons why they did not adopt these technologies might be because of cost or because their workforce lacked the skills to operate digital technologies. For example, in the case of the business which did not have CAD:

> *'A lot of knowledge is, in peoples' head, were all them naturally putting graphics together where you can design something and then check wind-flow and aerodynamics and stuff like that. We've never had the ability to do that, using technology. Erm, it's a step a little bit too far in terms of investment, for us'.*

Micro, niche, mid-chain business

One mid-chain business commented that they might have more digital marketing methods if they employed younger people who were more in tune with these developments.

> *'My, my daughter's 20, you know, and she'll look at me with disbelief when I explain …how we market the business… Because, obviously, we don't do things as quickly as she would, or the way that she'd expect it to be done… And I'm sure if we had a couple of people that were……more, maybe, enthusiastic about certain technologies they……probably would've just helped drag us along that way a little bit more, I guess'.*

Micro, niche, mid-chain business

On the whole it appears that if the mid-chain businesses need to adopt a digital technology to retain or attract customers cost barriers seem to be less of an issue than skills barriers. If it was needed, on the whole, they would invest (though some would appreciate more support for these risky investments, which would enable them to expand their market). Skills barriers could be overcome by working with third-party suppliers of specialist equipment, or, in one case, with other businesses in the same field sharing knowledge. Again, these arrangements were built on longevity of relationships and trust.

4.3 Diffusion of net zero practices in the supply chain

All of the firms interviewed were taking some measures to introduce net zero practices to their workplace. As with digital technologies, however, the adoption of net zero practices in our mid-chain businesses was largely the result of the initiative of the business itself rather than being driven, or passed on to, other parts of the supply chain. Though there are exceptions, referenced below.

4.3.1 Mid-chain business adoption of net zero practices

Most of the adoption of net zero practices within the mid-chain businesses was associated with a need for cost reduction and efficiency, particularly for energy costs. Energy costs were a significant factor in all of the business operations and many measures were being taken. These included: re-negotiating energy supply contracts, use of green vehicles, planning work scheduling to reduce mileage, use of alternative energy supplies such as solar, gas and heat recovery, new lighting systems or switching off lights, and recycling waste. Mid-chain businesses were also exploring reductions in water usage and recycling water through rainwater collection and investment in new or modifications to plant (as seen in the textiles example above).

While costs and legislation are drivers, environmental concerns of the business leaders also played a role; some reported that improving environmental practices was the right thing to do:

> *'.. the practice here was we had all these chemicals and a lot of them weren't used very much in the processes. I just went through all the processes and said, "Well, we actually don't need to do that, so that can come out," and in terms of the cyanide, that was a particular part of the process, and I said, "That has to go, we, we're not gonna do that anymore, we'll do it a different way." And so, we developed a different way of doing it, so that's how we got rid of it all. But it was a, a drive, really, cos I wanted to reduce all the, the chemicals on site because some of them were… Er, well, like cyanide, it's pretty noxious stuff'.*
>
> **Micro, niche mid-chain business**

This mid-chain business was innovating to reduce its use of noxious chemicals, another firm was innovating in response to changing legislation which bans use of Cadmium, essential in their equipment:

> *'I'm designing a way round not having to use that component. So, it's not the only thing in that particular kit, because it's a 30 year old design …., there are some other parts in there which are getting difficult to source, and a complete redesign would enable us to produce a more up to date design. Probably not, better performance, very similar performance, but something that met all the new regulations'.*

Small, niche, mid-chain business

This innovation will enable their customers to keep doing the research they do, in an indirect way, influencing the supply chain.

We find one example of where a mid-chain business more explicitly tried to influence the supply chain on environmental matters and diffuse net zero practices. The owner was passionate to lead both customer and suppliers and could be seen as a 'focal firm', influencing customers…

> *I know how to make our business and my customers' business as net zero as possible with my product;*

suppliers,

> *I've .. got one [supplier] in the far east, and they are building a brand new factory. And when they build that factory I've already told them that I want them to factor in, erm, the efficiency… The energy efficiency of the factory, and to put solar panels on the roof;*

and the supply chain as a whole,

> *when we cut the material we basically have to cut the material to different sizes to then send it to our customer. So, we always end up with a small amount of waste in the factory.. and that, that then gets converted ….into fuel as well. So, I've told all my, I've told all my supply chain what I'm doing.. tell them to look at doing the same.*

It appears that this mid-chain business has some influence or power over their suppliers that enables them to demand that environmental factors be considered in the development of their supplier's plant.

4.3.2 Customer-stimulated adoption of net zero practices

As suggested in the wider literature, regulation was a key driver for adoption of net zero practices in mid-chain firms. For some firms, customers expected the business to hold ISO 14000 standards[3]. Whilst this might be expected by the customer, the mid-chain business did not see this as an imposition. A couple of respondents referred to needing to complete environmental questionnaires for US customers, but that all issues were covered anyway by holding ISO 14000. Mid-chain businesses also held ISO 14000 to improve opportunities for business, even if not directly expected by the customer.

Other mid-chain firms were responding to direct or anticipated demand for more environmentally-friendly products. We have seen how one firm invested in new plant to be able to print on recyclable materials. In another example, the mail despatch firm introduced potato starch wrappings for magazines to replace polythene on the request of a client. They worked with one of their existing suppliers in Austria who already produced the materials. It did not require new plant, but some adjustments to the operation of existing plant.

There is some evidence of diffusion as some businesses were directly involved in the production of equipment used in net zero technologies, such as providing customers with refillable adhesive cartridges, contributing parts or processes to electric car batteries and wind turbines, for example.

4.3.3 Supplier and collaborative adoption of net zero practices

We observed no examples of supplier stimulated adoption of net zero practices aside from the one example cited earlier in relation to digital technology innovation enabling greener

[3] This is a family of standards related to environmental management that exists to help organizations (a) minimize how their operations (processes, etc.) negatively affect the environment (i.e. cause adverse changes to air, water, or land); (b) comply with applicable laws, regulations, and other environmentally oriented requirements; and (c) continually improve in the above

production. There also little evidence of collaborative adoption of net zero practices. Much of the adoption of net zero practices might have been initiated to some extent by the supply chain or by drivers of regulation and cost, but most of the activity was carried out by the mid-chain businesses themselves or with third-party suppliers. There was little collaboration involved.

5. DISCUSSION AND CONCLUSIONS

In this section, we summarise the research and consider the three core questions this research sought to address:

- What are the enablers and barriers of the diffusion of innovation, digital technologies, and net zero practices in supply chains?
- What role does inter-firm trust play in facilitating the diffusion of innovation, digital technologies and net zero practices in supply chains?
- What role do power relationships play in facilitating the diffusion of innovation, digital technologies and net zero practices in supply chains?

5.1 Enablers and barriers of the diffusion in supply chains

Overall, diffusion across the supply chain is most likely to occur in product innovation, where there is co-dependency and a need to work together to get the desired outcome. In these cases, collaboration in innovation, sharing knowledge and diffusion are more likely. Collaboration is less evident in digital technologies and still less in net zero practices (except where these overlap with product innovation). Firms were instead more likely to get new ideas through observations and horizon/market scanning, in line with non-interactive diffusions consistent with social learning theory (Bandura and McClelland, 1977) or peer pressure from adoption elsewhere, consistent with UTAUT (Venkatesh et al., 2003).

The drivers of product innovation, digital technologies and environmental practices are the same across the supply chain – mainly regulation and cost/efficiency. For the mid-chain businesses, these drivers combine with their own market scanning of trends, knowledge of their product or simply responding to their own set of circumstances (e.g. the availability or otherwise of appropriately skilled workers). The mid-chain business were most likely to be influenced by actual or anticipated demand from customers.

Specifically, for product innovation, the drivers of collaborative innovation and diffusion were: contractual relationships, personal relationships and trust, and longevity of working together. The barriers to collaborative innovation included lack of power, lack of customer demand, lack of trust in supply chains, unfavourable attitudes towards innovation by supply chain partners, existing high quality of product, and requirements to work to regulations and standards. On the other hand, drivers of independent adoption of product innovation within our mid-chain business were: customer requirements for improvements in product, expectation of future orders from customers, horizon scanning the market and being aware of developments, and firms' expertise in the product.

Digital technology innovation or adoption was mainly conducted with third party suppliers of the technological hardware or software, and there is limited evidence of diffusion of technology through the supply chains. Where this occurred, it was driven by goodwill trust characterised by long term relationships, as well as resource complementarity and the desire to achieve a common economy goal. Main barriers to the diffusion of digital technologies included partners' unfavourable attitude towards such technologies, or a general lack of innovativeness, as well as the lack of power and influence of small mid-chain business to lead collaborations. In some cases, there was no apparent need for knowledge transfer within the supply chain. The mid-chain businesses would respond to the product or process innovation internally or would draw on third party suppliers, outside the supply chain, who had the required expertise. Knowledge sharing did occur with these third-party partners as firms worked with them to customise technologies. The drivers for independent digital technology adoption included: customer demand, anticipated customer demand, the expertise and vision of the mid-chain business, need to improve efficiencies, and the need to alleviate the lack of skills/capabilities in available workforce. Barriers to adoption included the capability of the business to use the digital technology (skills) and costs, although the latter was less of a concern where adoption was considered a business imperative.

While environmental practices were common, there is little evidence of collaborative adoption of net zero practices. The one case of collaboration, which coincided with digital adoption, was based on trust, long lasting relationships and resource complementarity. Much of the adoption of net zero practices might have been influenced to some extent by activities in the supply chain, but without explicit collaboration. Non- collaborative diffusion also took place where the mid-chain business had influence on its suppliers. Independent

adoption of green practices was driven by legislation, customer demand, efficiency and the personal values of the mid-chain business owner.

It is striking that for both product innovation and digital technologies, firms emphasised the lack of innovativeness on the part of some supply chain partners as limiting diffusion. A willingness to change and an openness to new ideas, on both sides, was always essential to enable knowledge transfer. This is in line with Rogers (1995) DOI model in which some individuals, late majority or laggards, have negative attitudes towards new ideas and are the last to adopt, only doing so when the benefits are clearly demonstrated by a high number of early adopters and early majority. For digital technologies, this finding also demonstrates that individuals with negative attitudes towards change perhaps also have a lower perception of the usefulness (Davis, 1989) or performance expectancy (Venkatesh et al., 2003) of the technology; here not even long lasting and trusting relationships (Adler and Kwon, 2002) helped overcome their unfavourable attitudes.

6.2 Trust and diffusion in supply chains

Trusted relationships between the supply chain companies were a key facilitator for any collaborative diffusion of product innovation, digital technologies and environmental practices. This trust was often goodwill trust, as relationships are built on longevity and repeated personal exchanges. All collaboration, whether based on contractual or non-contractual relationships, was driven by trust. Trust also enabled innovation where mid-chain businesses did not stand to gain an immediate advantage from their innovation. Goodwill trust and long-term relationships with suppliers often worked alongside resource complementarity and a culture of reciprocity as well as a positive attitude towards innovation and change.

We have seen some examples of businesses collaborating within the supply chain, exposing themselves to risks of knowledge leakages but relying on goodwill trust and reciprocity (Adler and Kwon, 2002, Ireland and Webb, 2007), to develop new products or processes through:

- testing equipment for suppliers or
- developing new products in iterative stages in discussion with customers.

The influence of trust in facilitating diffusion is in line with our theoretical arguments, and with findings in Cai et al (2013) and Hoejmose et al, (2012), among others. In addition, we find complementary evidence that a lack of goodwill trust limits diffusion. Even when contractual and competence trust may exist, the absence of goodwill trust that allows partners to accept risks of knowledge leakages in order to gain the benefits of collaborative innovation prevents collaborative knowledge transfer.

6.3 Power relationships and diffusion in supply chains

We did not identify any cases where power facilitated collaborative knowledge transfer, but we identified many cases where the *lack of power* inhibited knowledge transfer. In the small number of cases where power was being exercised to trigger innovations in the supply chain, there was no evidence of corresponding knowledge transfer – mid chain businesses were expected to implement and resource changes themselves.

The mid-chain businesses we interviewed were all absolutely or relatively small and even those in niche markets had little influence on the behaviours and practices of suppliers or customers; in line with our theoretical arguments, these businesses were unable to persuade suppliers or customers to engage in collaborative knowledge transfer. In some cases, this was a source of inefficiency for the mid-chain business or frustration as some customers were less open to innovation than others. These results are in line with Cai et, al (2013) and Hall, (2006) who find power to be essential for knowledge transfer in the contexts of technologies and green practices respectively.

We also identified an example how the interaction of trust and power (Ireland and Webb, 2007) led to knowledge transfer in terms of product innovation. Mid-chain businesses sometimes implemented an innovation requested by a customer based on trust that the customer would purchase the product, but also based the hope that demonstrating their ability and flexibility will lead to continued recognition and business with the larger, more powerful customer.

6. THEORY, EVIDENCE AND THE IMPLICATIONS FOR POLICY AND PRACTICE

Organisational perspectives on new technology adoption suggest the importance of firms' awareness and positive evaluation of the benefits of new technologies and management

practices. Relational perspectives on supply chains also emphasise the importance of trust between firms – often the result of longstanding and personal relationships – as well as power relationships within the supply chain. Taken together these conceptual perspectives suggest an idealised view of a supply chain in which technology diffusion might flourish. This would be characterised by: (a) firms which are aware of the advantages of new technologies and able to evaluate their benefits; (b) goodwill trust which facilitates open and intensive knowledge sharing; and, (c) power imbalances which might facilitate knowledge flows where innovative firms hold more power.

Our empirical evidence suggests that for mid-chain companies at least their lived experience of the supply chains in which they operate is rather different. On the positive side, goodwill trust is not uncommon, most typically with suppliers, and often based on long-term and interpersonal relationships. Similar trust-based relationships with customers are less evident, often complicated by commercial pressures, short-term or intermittent contracts and power imbalances. Often too mid-chain firms' supply chain partners seem unable or unwilling to appreciate the potential value of new technologies, perhaps reflecting a version of the not-invented-here syndrome. Each factor limits knowledge sharing between supply chain partners, reducing the potential for collaborative innovation. Indeed, our empirical analysis suggests relatively limited collaboration for product innovation and little or no significant collaboration on digital diffusion or the dissemination of net zero practices. This suggests a significant gap exists between levels of knowledge sharing and technology diffusion in an idealised supply chain setting and the reality.

This is not to suggest that our mid-chain firms are themselves not innovative. Indeed, almost all were engaged in product or service innovation, digital innovation and the implementation of net zero practices. Aside from occasional instances where innovative ideas emerged from supply chain partners, however, mid-chain firms' innovations owed little to their supply chains. Instead, a lack of collaboration means that mid-chain firms' innovation tended to be initiated, resourced and delivered from within the mid-chain business. This reflects some wider evidence with only around a third of innovative firms in the UK regarding customers and/or suppliers as 'highly important' sources of information

for their innovative activity although no specific information is available for mid-chain companies[4].

Broader evidence also suggests that collaborative innovation can yield better outcomes than solo innovation with the potential to positively influence firm performance. Turner and Roper (2020), for example, illustrate the role of collaboration as a positive driver of product, process and organisational innovation in UK firms alongside other innovation investments. This suggests the potential value of policy intervention to overcome the informational and trust failures which limit knowledge sharing and innovation collaboration within supply-chains, while recognising that relatively little can be done in policy terms to overcome any power asymmetries. Policy intervention in supply chains may also enable greater information sharing and adoption of critical digital and net zero practices.

With regard to digital technology diffusion, the 2017 Made Smarter Review put forward recommendations from industry to enable the UK manufacturing sector to utilise the potential of Industrial Digital Technologies (IDTs). In response to a lack of leadership at the cross-sectoral, national level, and lower levels of adoption of digital and automation technology among SMEs, the review recommended measures to deliver stronger leadership at UK-level, providing a clear vision, strategy, marketing, and messaging of the UK's ambition. The review also recommended more widespread and rapid adoption of IDTs by manufacturers (especially SMEs), and across their supply chains, through the creation of a more visible and effective ecosystem that can accelerate the innovation and diffusion of the technologies. Training and education was also recommended to upskill industrial workers in the use of IDTs and incentivising take-up through targeted fiscal incentives.

The 'Manufacturing Made Smarter: Digital Supply Chain' competition, launched in July 2020 by UKRI as part of the Manufacturing Made Smarter ISCF may help achieve these objectives[5]. The purpose was to help UK manufacturing supply chains to develop digital technologies to become more efficient, productive, flexible, resilient and encourage the use of digital approaches to better integrate and optimise the performance of supply chains. However, this measure on its own is likely to be too small to achieve the scale of difference

[4] Source: UK innovation survey 2019, Statistical Annex, Table 9. Available at: https://www.gov.uk/government/statistics/uk-innovation-survey-2019-main-report.
[5] https://apply-for-innovation-funding.service.gov.uk/competition/658/overview#summary

required to influence digital adoption across the wide range of supply chains. The funded projects may, however, as they develop provide some useful insights which can support the development of a broader vision and strategy. The pandemic has forced many mid-chain and other businesses to accelerate the adoption of digital technologies, and the recently announced Help-to-Grow Digital funding should help smaller firms to continue to develop their digital adoption. For companies in the North West, Made Smarter also provides help and support for implementation of digital technologies although again issues of scale remain important[6].

While the pandemic has raised the priority of digital adoption for many firms it may have detracted attention from goals related to net zero. From a motivational standpoint, the Net Zero 2050 goal does send a strong message to business about government ambition on the environment, an ambition strongly supported by the businesses we interviewed. However, we found little evidence that currently there is very significant supply chain collaboration to progress towards net zero. Also, we found no evidence that supplier requirements promoted collaboration in adopting net zero practices. There is perhaps the opportunity to consider how procurement standards required by Government might foster the adoption of net zero practices. Again, this could be supported by the better sharing of best practice across firms and supply chains to help firms translate their ambition to move towards net zero into practical actions.

[6] https://www.madesmarter.uk/

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