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ABSTRACT

Across all sectors, firms face pressure to serve their customers better by innovating in the delivery of goods and services. Undertaking innovation involves a range of different activities, however, from exploratory knowledge creation or acquisition to commercial exploitation. This may create tensions due to the very different resource and organisational requirements of effective exploration and exploitation. Here, we draw on new survey data for five UK service sectors which separately identifies firms' exploratory and exploitative activities, to identify those organisational practices which are associated with effective exploration and effective exploitation. Strong contrasts emerge, with more 'organic' practices associated with exploration and more 'mechanistic' practices better supporting exploration. We find no evidence, however, that those organisational practices associated with effective exploration have any detrimental effect on exploitation, and vice versa. Our results suggest very different organisational strategies for services firms adopting business models which emphasise exploration, exploitation or both.

Key words: Innovation; Organisational practices; Exploration; Exploitation.

JEL Codes: O31, O33, K40

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1. INTRODUCTION

Across all sectors, firms face escalating pressure to serve their customers better by innovating in the delivery of goods and services (Pekovic and Galia 2009; Turner, Swart, and Maylor 2013). The nature of innovation differs across sectors, however, with an increasing recognition that, particularly in services, 'technological innovation is by no means the only field in which firms innovate … over time there has been a shift from the focus on binary frameworks towards frameworks that recognise a wider range of different types of innovation' (Vergori 2014, p. 147). Studies also emphasise the complex nature of the process of innovating, and the need for firms to balance the requirements of exploration and exploitation (March 1991; Turner, Swart, and Maylor 2013). March (1991) explains: 'Exploration includes things captured by terms such as search, variation, risk taking, experimentation, play, flexibility, discovery, innovation. Exploitation includes such things as refinement, choice, production, efficiency, selection, implementation, execution' (March 1991, p.71). The strategic and managerial challenge for innovating organisations is then to balance the short-term benefits of exploitation with the longer-term gains from exploration (Levinthal and March 1993).

Tension arises here as exploration and exploitation each require different resources and capabilities, implying different patterns of investment and external relationships (Turner, Swart, and Maylor 2013). For example, technical or creative staff may play a key role in the exploratory stage of an innovation project, but marketing staff are likely to be more important in exploitation (Herrmann and Peine 2011). Organisational practices may also be specific to different innovation activities. Team-working and multi-functional working may be more important at earlier stages of an innovation process where a diversity of ideas and perspectives is more important (Love and Roper 2004). Leadership styles may also need to change, moving from transformational leadership in the ideation phase of an innovation project towards more focussed transactional leadership as innovation projects move closer to market (Rosing, Frese, and Bausch 2011). Patterns of engagement with external innovation partners such as suppliers or customers may also differ between exploratory and exploitative activities. Jespersen (2008), for example, identifies five different modes of customer engagement - first buyers, requesting, launching, pioneering and lead

users – each of which delivers different value and engages with different elements of an innovation process.

We can view the tension between exploration and exploitation in innovation as reflecting that between organic and mechanistic forms of organisational capital (Kang and Snell 2009). Mechanistic forms of organisational capital employ standardised practices and detailed routines to reinforce efficent coordination, and provide reliable and consistent exploitation outcomes (Katila and Ahuja 2002). On the other hand, more organic forms of organizational capital provide workers and teams with flexibility and autonomy for knowledge search and problem solving and may be more consistent with effective exploration. Here, based on a new survey covering five UK professional services sectors (Software & IT Services, Accountancy, Architectural Services, Consultancy and Specialist Design) we examine the impact of mechanistic and organic organisational practices on firms' exploration and exploitation activities. We make two main contributions. First, as our survey data is explicitly structured around firms' exploration and exploitation activities we are able to examine the impact of organic and mechanistic practices in the same corporate context. Second, our results clearly identify those organisational practices which best enable exploration and exploitation and provide lessons for firms seeking to maximise innovation success. In this sense, our analysis responds to the suggestion of O'Reilly and Tushman (2011, p. 8) that 'what is missing is a clear articulation of those specific managerial actions that facilitate the simultaneous pursuit of exploitation and exploration . . . what is needed is greater insight into the specific micro-mechanisms required for a manager to implement and operate an ambidextrous strategy'.

The argument proceeds as follows. In Section 2, we focus on the conceptual context and present our hypotheses. Section 3 describes our data and empirical approach and Section 4 outlines the key results, as well as robustness tests. A discussion of the main implications follows in Section 5.

2. CONCEPTUAL CONTEXT – ORGANISATIONAL CAPITAL AND INNOVATION

2.1 Organisational Capital: organic and mechanistic dimensions

Organisational capital describes the knowledge preserved within a firm over time by behaviours, mental maps, norms, customs and values (Subramaniam and Youndt 2005; Crossan, Lane, and White 1999).[1] Such structures not only establish patterns of behaviour and interpretation that guide knowledge acquisition and sharing (Crossan, Lane, and White 1999), but can also provide an essential mechanism for integrating and combining that knowledge into the knowledge base of the organisation (Grant 1996).

Organisational capital includes both institutionalized knowledge and codified experience; and in general, objectivist, scientific organisational practices are termed 'mechanistic' while subjectivist, social practices are considered to be more 'organic' in nature (Kang and Snell 2009). Over time a firm develops a specific organisational culture which has both 'rule following' and 'enactment' characteristics (Morgan 1986). The former emphasises the conformity of employees to established and standardized rules, procedures and structures; whereas the latter encourages employees to proactively consider alternative perspectives and interpretation systems, thereby shaping and responding to established cultural values and norms. Mechanistic organisational practices reinforce efficient coordination by establishing ingrained patterns of behaviour and interdependence (Kang and Snell 2009), ensuring that employees see things similarly, and reduce the need for discussion with respect to interpretation and understanding of issues as they arise (De Boer, Van Den Bosch, and Volberda 1999). Therefore, mechanistic organisational practices are often seen as reliable and robust with organisational learning proceeding within the confines of refining and improving existing knowledge (Kang and Snell 2009). However, mechanistic

[1] Organisational capital, together with human and social capital, are the key elements of a firm's intellectual capital, which represent its distinctive knowledge stocks, accumulated and distributed through individuals, relationships between individuals, and the structure of the organization itself (Subramaniam and Youndt 2005). While the focus of this paper is the organisational capital-innovation relationship, human and social capital variables are included in our analysis and discussed in Section 4.

practices may bias a firm's problem-solving activities towards incremental change and previously 'tried-and-tested' decision-making approaches (Subramaniam and Youndt 2005); and may limit opportunities for new ideas to surface. Organic organisational practices take a bottom-up approach and may be characterised as dynamic and fragmented, albeit interconnected, composed of competing perspectives and interested and supported by informal systems, allowing the firm to adapt to its changing environment and promoting continuous improvement (Crawford et al. 2003).

Parallels exist in the demarcation of organic and mechanistic practices across the spectrum of organisational activities and literatures (Bourke and Roper 2017). For instance, for project management activities, the mechanistic paradigm assumes that goals and methods are already well defined, and the objective is to find the best solution to a particular problem, however 'best' is defined and measured. Contrastingly, an organic perspective would suggest that the aspects of a situation that cause it to be problematic are not easily defined or isolated, and therefore an understanding that it is unlikely that there will be a unique 'best' solution and an informal, less rigid approach is likely required (Midgley 2000). Human resource scholars typically categorise organic practices as those which encourage and support knowledge sharing, engagement, empowerment, intelligence gathering and reflection whereas mechanistic practices often are rule-based and require conformity, standardisation, discipline and stability (Jenkins and Delbridge 2013). Quality management (QM) also differentiates between mechanistic and organic practices: mechanistic QM emphasises conformity with quality standards and manufacturing specifications, and comprises processes such as work design and statistical process control. Organic QM focuses on leadership, empowerment and training, and encourage employees to scan the environment for new trends, approaches and technologies allowing the firm to adapt to its changing environment and promoting continuous improvement (Bourke and Roper 2017).

Similarly, the organic vs. mechanistic nature of organisational capital paradigms dictates contrasting organisational practices. Given the hierarchical, top-down nature of mechanistic organisational capital models (Crawford et al. 2003), these organisational practices may be expressed by means of formal structures for

sharing information at scheduled team meetings or via regular newsletters, or may include formal management practices for improving quality standards, such as ISO9000 (Bourke and Roper 2017). These standardised processes capture and institutionalise existing knowledge within organisational practices establishing a common frame of reference for employees (Crossan, Lane, and White 1999). By contrast, organic organizational capital is characterised by simple and enacted routines, structures, and cultures which are more loosely connected to precedent, rules, and traditional expectations about work (Eisenhardt and Sull 2001). Organisational cultures with organic characteristics feature practices which provide opportunities and autonomy for individuals, allowing them to establish flexible behavioural practices and consider alternative perspectives (Kang and Snell 2009). Such organisational practices can include those which provide employees with access to flexible working and with discretion over how they perform work tasks, enabling faster and more effective decision-making as the most technological knowledge generally resides in the lower levels of an organised hierarchy (Hayton 2005; Mendelson and Pillai 1999). Clearly, organisational practices, whether organic or mechanistic in nature, play an important role in the process of acquiring, sharing and integrating the new knowledge which leads to innovation (Crossan, Lane, and White 1999)

2.2 Innovation: exploration and exploitation

Innovation scholars have long recognised the different activities implicit in the innovation process (Harmancioglu et al. 2007; Gronlund, Sjodin, and Frishammar 2010), ranging from opportunity recognition and ideation to commercialisation (Carlborg, Kindstrom, and Kowalkowski 2014). Within the innovation literature, a number of different approaches to categorising and differentiating innovation activities have emerged. For instance, Hidalgo and D'Alvano (2014) identify five separate innovation activities – scan, focus, resource, implement and learn – in their examination of the organisation of service innovation activity in Venezuela. Love et al. (2011) suggest a less specific breakdown - the innovation value chain or IVC - comprising three different activities: knowledge acquisition, knowledge transformation and knowledge commercialisation (Hansen and Birkinshaw 2007).

However, common to these approaches is the differentiation between exploration and exploitation activities within the innovation process, a distinction which is also emphasised in the management literature (March 1991).

Maintaining an appropriate balance between exploration and exploitation activities has been shown to be important for product innovation, firm survival and prosperity (March 1991; Kollmann and Stoeckmann 2010; Chang and Hughes 2012). Firms that successfully balance exploration and exploitation activities tend to be in a better position to consistently search and absorb novel information as well as integrate new knowledge associated with exploratory learning (Kollmann and Stoeckmann 2010; Chang and Hughes 2012; Kang and Snell 2009). However, it is not easy to excel at exploration and exploitation simultaneously, as both activities require different resources and capabilities, implying different patterns of investment and external relationships. Some authors argue that exploration and exploitation activities tend to drive out the other, making it difficult for firms to achieve both, and perhaps encouraging specialisation in specific elements of the innovation process (Benner and Tushman 2003).

Despite the managerial challenges it poses there is a large body of work which highlights how firms can benefit from successfully balancing the requirements of exploitation and exploration effectively (Turner, Swart, and Maylor 2013). For instance, previous studies have shown that successfully balancing both requirements to be beneficial in terms of new products, financial performance, and increased organizational durability (Kristal, Huang, and Roth 2010; Lubatkin et al. 2006; Morgan and Berthon 2008; O'Reilly and Tushman 2011; Sarkees and Hulland 2009; He and Wong 2012). However, Ebben and Johnson (2005) found that small firms which followed efficiency or flexibility strategies outperformed those attempting both. Turner, Swart, and Maylor (2013) also caution that that success in balancing exploration and exploitation activities should not be seen as a foregone conclusion, advising that consideration should be given to the tensions that exist in pursuing both activities if such a strategy is to be attempted.. On balance, however, theoretical and empirical studies support the benefits of balancing an exploration and exploitation approach to innovation (Turner, Swart, and Maylor 2013).

2.3 Organisational capital and exploration and exploitation

He and Wong (2012, p.481) advise: “exploration and exploitation require substantially different structures, processes, strategies, capabilities, and cultures to pursue and may have different impacts on firm adaptation and performance. In general, exploration is associated with organic structures, loosely coupled systems, path breaking, improvisation, autonomy and chaos, and emerging markets and technologies. Exploitation is associated with mechanistic structures, tightly coupled systems, path dependence, routinization, control and bureaucracy, and stable markets and technologies”.

Innovation is a collective process of idea generation and implementation that builds upon resources, skills, and personnel from across firms (Gibson and Gibbs 2006), and these two types of learning typically involve different processes, structures, affiliations, and cognitive orientations (Ahuja and Morris Lampert 2001). Therefore, it follows that the practices, processes, systems, and structures implemented by firms to guide knowledge acquisition and sharing – their organisational capital – has a significant part to play in the innovation process. In addition, exploration and exploitation require distinct configurations of absorptive capacity at the individual level - creativity and enhancing competencies for exploration and routinized competencies for exploitation (Enkel et al., 2017, Hafkesbrink and Schroll, 2014). There is also value in considering tangible as well as intangible investments as part of any explanation of firms’ innovation (Bourke and Roper 2016). Previous studies report the positive influence of innovation strategies and information-sharing on innovation performance (Cuijpers, Guenter, and Hussinger 2011; Peeters and Van Pottelsberghe 2006), as well as the importance of culture (Hogan and Coote 2014) and leadership in shaping firms’ innovation outcomes (Love and Roper 2015; Garcia-Morales, Jimenez-Barrionuevo, and Gutierrez-Gutierrez 2012). Many studies exploring the relationship of Human Resource Management (HRM) practices and innovation focus on the role of high performance work systems or a system of work practices designed to enhance employees’ skills, commitment and productivity in such a way that employees become a source of sustainable competitive

advantage' (Fu et al. 2015).

While previous studies typically report a positive relationship between organisational practices and innovation (Tether et al. 2005; Toner 2011; Combs et al. 2006; Guest 2011), they generally focus on one activity within the innovation process or treat the innovation process itself as a single activity. With respect to explorative innovation activities, multi-functional working and team-working have been shown to have a positive role (Love, Roper, and Bryson 2011; Love and Roper 2004). Furthermore, team and workforce diversity have also been linked to enhanced creativity as engaging with a broader range of perspectives, less likely to resist change and new ideas and develop more novel solutions (Shipton et al. 2006). In relation to exploitation, positive relationships between formal work practices (generally implemented as a count variable of the adoption of different bundles of HR practices) - and innovation output measures are reported: in the UK, Michie and Sheehan (2003) and Shipton (2005); in Denmark, Laursen and Foss (2003); in Switzerland Arvanitis (2005); in the Netherlands Beugelsdijk (2008) and Zhou et al (2011); in Spain Jimenez-Jimenez and Sanz-Valle (2008); in Canada Zoghi et al. (2010); in Italy Giannetti and Madia (2013); in China Eriksson et al. (2014); in the US Stock et al. (2014); and in Ireland Fu (2015). There is also some evidence that different types of HR practices, such as performance related pay are associated with incremental innovation, while job autonomy and flexibility are more strongly linked to radical innovation (Beugelsdijk 2008). In addition, the organic versus mechanistic distinction within management systems has previously been shown to be important in understanding the impact of organisation capital on innovation outcomes (i.e. exploitative activity) (Bourke and Roper 2017; McGrath 2001). For instance, Bourke and Roper (2017) suggest that maximising the returns to innovation and quality improvement requires consideration of the organic and/or mechanistic nature of individual quality improvement methods (e.g. quality circles vs. ISO 9000).

2.4 Hypothesis Development

Kang and Snell (2009) propose that the trade-off between exploration and exploitation activities may hinge on the nature of firms' organisational capital. The tension between exploration and exploitation is often rooted in the trade-offs between the efficiency of specialized knowledge resources versus the flexibility and robustness of knowledge resources which are relevant to a range of future development pathways (Ghemawat and Ricart Costa 1993; Sanchez 1995). At the same time, the success of firms' exploration and exploitation activities are intimately linked: successful exploration is a necessary although not sufficient condition for successful exploitation (Figure 1).

With respect to organisational capital, Kang and Snell (2009) differentiate between its organic and mechanistic characteristics, and suggest rather different impacts on exploration and exploitation activities within the innovation process. Organic organisation capital is loosely connected to precedent, and rules and can empower workers to integrate new knowledge associated with exploratory learning into the innovation process. This suggests that organic organisational practices which cultivate, support and incentivise the introduction of new ideas and knowledge to the firm will benefit the exploration stage of the innovation process. The dynamic, fragmented and informal nature of organic organisational practices allows the firm to adapt to changing conditions by exploring new ways of doings things. On the other hand, mechanistic organisational practices which ensure that organisational learning proceeds within the confines of refining and improving existing knowledge may limit prospective exploration activity. Mechanistic practices may superimpose a logic, order, and structure on an otherwise irrational social process (Crawford et al. 2003). Hence, we hypothesise that organic and mechanistic organisation practices contrast in their impact on exploration:

H1a: Organic organisational practices positively benefit explorative innovation activities

H1b: Mechanistic organisational practices negatively impact explorative innovation activities

In addition, firms with diversity in the skills, knowledge and experiences among their employees increase the possibilities for new combinations of internal knowledge through interaction and learning (Østergaard, Timmermans, and Kristinsson 2011; Cohen and Levinthal 1990). Firms typically use organisational practices or the HR function to develop mechanistic systems and processes to exploit internal knowledge and organisational learning. This suggests that routinized, standardised work practices may positively influence firms' exploitative activities (He and Wong 2012). However, the dynamic, fragmented and informal nature of organic organisational practices are unlikely to advance the path-dependent, tightly-coupled systems of exploitation. Our second set of hypotheses in relation to exploitation state:

H2a: Mechanistic organisational practices positively benefit exploitative innovation activities
H2b: Organic organisational practices may negatively impact exploitative innovation activities

3. DATA AND METHODS

3.1 Empirical context

Our analysis covers five professional services sectors: Software & IT Services, Accountancy, Architectural Services, Consultancy and Specialist Design[2]. These sectors differ markedly in their level of regulation, competition and professionalization. Some common trends are also evident across the sectors,

[2] Software & IT included: 58.21, Publishing of computer games; 58.29, Other software publishing; 62.01/1, Ready-made interactive leisure and entertainment software development; 62.01/2, Business and domestic software development; 62.02, Computer consultancy activities; 62.03, Computer facilities management activities; 62.09, Other information technology and computer service activities; 63.11, Data processing, hosting and related activities; 63.12, Web portals. Accountancy included: 69.20/1, Accounting, and auditing activities; 69.20/2, Bookkeeping activities; 69.20/3, Tax consultancy. Consultancy included: 70.22/1, Financial management; 70.22/9 Management consultancy activities. Architectural Services included: 71.11/1, Architectural activities; 71.11/2, Urban planning and landscape architectural activities;71.12/1, Engineering design activities for industrial process and production;71.12/2, Engineering related scientific and technical consulting activities;74.90/2, Quantity surveying activities. Specialist Design included 74.1.

however, most notably perhaps the breakdown of traditional functional divisions between firms.

Studies of innovation in the Software & IT Services sector have tended to emphasise the importance of human capital (i.e. levels of education, prior experience), R&D expenditure per employee, external collaborations and innovation networks (West and Gallagher 2006). Interactions with suppliers, customers and external bodies such as public organisation and trade associations have also been highlighted as providing critical inputs which the firm itself would be unable to provide (Bygstad and Lanestedt 2009). In accountancy, firms have experienced a move from professionalism to commercialism as the profession has moved from the traditional domains of reviewing and auditing company accounts into environmental auditing, forensic accounting and consulting services. (Picard, Durocher, and Gendron 2014; Khalifa 2013). Increasing commercial pressures have been accompanied by an increasing emphasis on international or supra-national regulation, challenging the role of national regulatory bodies particularly where firms are global in nature (Gillis, Petty, and Suddaby 2014).

Architectural Services includes a range of activities related to architecture and the built environment. Innovations in architecture tend to be produced from team work within the firm and collaborative arrangements between experts with different skill sets (Falconbridge 2006). It has been suggested, however, that one of the key difficulties in architectural practices is the management of architects who tend to be “culturally resistant” to being managed (Winch and Schneider 1993). In their study of architecture, engineering and construction firms Kamara *et al*.(2002) stressed the importance of a number of factors in knowledge management in these firms. These factors include the accumulation of knowledge from individuals, long standing relationships with suppliers, lessons learnt from completed projects, formal and informal feedback, transfer of people in different activities, informal networks and collaborations, the reliance on the departments to disseminate the knowledge gathered and the use of IT tools to support information sharing and communication.

It has been suggested that the consultancy sector – in contrast to professions such as accountancy or architecture – is characterised by 'weak professionalism' with limited regulation and professional organisations which have only limited control over entry and/or the supply of qualified labour (Fincham 2006, p. 20). Kipping and Kirkpatrick (2013, p. 782) suggest that this weak professionalism may …' a greater freedom to establish new firms and, for organisations from other sectors to enter the market… changes in population will be associated with a greater diversity in organisational forms. This has resulted – at least in the UK – in a dynamic sector characterised by the entry of new firms providing different kinds of services and entering the industry often from other related sectors (Kipping and Kirkpatrick 2013). Specialist Design is also characterised by 'weak professionalism', with limited regulation, and attention increasingly focussed on designers as strategic consultants rather than simply product aesthetics (Roper et al. 2016; Valencia, Person, and Snelders 2013). Innovation in the design sector is seen as highly dependent on human capital both in-house and external and on networks with customers, colleagues, friends, suppliers, and design authorities and associations (Rusten and Bryson 2007). Environmental factors are also seen as important, however, with government playing a role in facilitating the creation of networks, encouraging enterprise and finance and academia providing suitably skilled and design educated graduates (Rusten and Bryson 2007).

3.2 Data and measurement

Our analysis is based on new survey data (OPIPS) intended to provide a representative view of organisational practices and innovation activity across the five UK professional services sectors described earlier. The survey sample was purchased from a commercial provider (Experian) and was structured by sizeband (5-19 employees; 20-49 employees and 50 plus employees). Over-sampling in the 20-49 employee and 50 plus employee size groups was intended to ensure reasonable cell sizes in these groups. Following a series of pilot interviews, the main survey was conducted by telephone between January and March 2016 and the achieved response included 900 firms across the five

sectors. Coverage ranged from 1.4 per cent of UK Software & IT Services firms to 2.9 per cent of Specialist Design firms[3].

Dependent variables

The OPIPS survey provides detailed information on the background to each business, firms' exploration and exploitation activities and organisational practices.[4] Separate sections of the questionnaire were devoted to exploration and exploitation, collecting both outcome metrics and related organisational practices. To reflect the outcomes of firms' exploration activity, the survey includes a measure of the proportion of new service ideas originating outside the firm. This measure provides an indication of the openness of firms to external knowledge and their ability to incorporate external ideas into new service offerings. Previous studies of service sector businesses have suggested this measure provides a strong link between firms' exploration and exploitation activities (Love, Roper, and Bryson 2011). Here, we reflect this link by including the proportion of new service ideas originating outside the firm as the dependent variable in the analysis of firms' exploration activities and as an independent variable in our analysis of firms' exploitation activities (Figure 1).

Outcomes from firms' exploitation activities are reflected in two innovation output measures. First, we reflect the diversity of firms' innovation activity by deriving a count variable indicating the number of types of innovation a firm undertakes[5]. Previous studies have suggested a positive association between this innovation measure and sales and employment growth (Love, Roper, and Bryson 2011). Second, the success of firms' innovation activity is reflected by the share of sales derived from innovative products. This is a standard innovation output indicator and has been widely used in previous studies (Brady and Doran 2012; Doran and Ryan 2014; Hewitt-Dundas and Roper 2008; Leiponen and Byma 2009; Leiponen 2012).

[3] Sectoral coverage in each sector was: Software & IT Services, 1.4 per cent; Accountancy, 2.3 per cent; Consultancy, 2.3 per cent; Architectural Services, 2.1 per cent; and, Specialist Design, 2.9 per cent.
[4] Tables 1 and 2 provide descriptive statistics and correlations for all dependent and independent variables for this data set.
[5] Following standard practice in the EU Innovation Survey we identify six types of innovation in the survey – service, process, managerial, organisational, strategic and marketing

Independent variables

The OPIPS survey also asked a series of questions concerning firms' adoption of twenty-one organisational practices using a series of binary measures. Descriptive statistics for each practice by sector are available in the Annex. Strategically, firms do not always adopt an individual organisational practice in isolation; and there is growing evidence of complementarities between different practices. To reflect potential complementarities, and the way firms combine different groups of organisational practices, we undertake principal component analysis (PCA), a form of factor analysis, to reduce the broad set of 21 practices to 'bundles' which then form our key indicators of firms' adoption of 'mechanistic' and 'organic' practices.

The PCA method estimates linear combinations of the underlying variables, which in this case are the organisational practice variables, that explain the highest possible fraction of the remaining variance in the dataset (Laursen and Foss, 2003). The first principal component is estimated to explain the highest possible fraction of the total variance. The second principal component is estimated to explain the highest possible fraction of the total variance that is not explained by the first, and so forth, until the explained residual variance in each round is maximised. The organisational practice indicators are discrete in this study. There is no consensus on using PCA on binary data, specifically because standard methods of performing factor analysis (i.e. those based on a matrix of Pearson's correlations) assume that the variables are continuous and follow a multivariate normal distribution. To overcome this issue, we do not use the 'raw' binary data for the PCA analysis, but transform the variables and make them smooth (see Laursen and Foss, 2003). To do this, we employ a polychoric correlation matrix on the underlying data for the discrete management practices making the variables suitable for PCA analysis (UCLA, 2015). Following Laursen and Foss (2003), an economic interpretation of the sets of factor loadings from the PCA analysis is that the typical pattern is one in which some of the organisational practices play a major role in the configuration of the factor.

The sets of factor loadings for each factor are presented in Table 3. Following consideration of eigenvalues and visually inspecting the scree plot, four factors are identified which explain most of the variability in the data. We consider the first two factors as 'mechanistic', relating to Strategy and Information Sharing and Recruitment and Training. The Strategy and Information Sharing factor is dominated by variables capturing the communication and sharing of information via annual staff surveys, suggestion schemes, newsletters and team meetings as well as written strategies to support the introduction of new ideas. The second mechanistic factor - Recruitment and Training - includes variables relating to recruitment and training and formal equal opportunities policy. The other two factors reflect more organic organisational practices, with Work Flexibility and Discretion capturing the extent to which employees have access to flexible working, discretion over how they do their work, and variety in their work. The final organic factor, Culture and Leadership, includes indicators of leadership, culture and structured processes that supports the introduction of new ideas. Based on the PCA, we create four variables to represent firms' adoption of organic and mechanistic organisational practices and these are included as independent variables in our exploration and exploitation models..

We also include in the estimated models a number of firm-level controls which have proved important in previous studies of innovation. First, and reflecting the human aspect of firms' intellectual capital, we include variables related to the scale and quality of firms' internal resource base. Firm size is generally positively associated with innovation indicators as is the proportion of firms' workforce with a degree – an indicator of labour quality (Toner 2011). Team-working has also been linked positively to innovation outputs and we include in the models a measure of firms' commitment to team-working[6]. Previous studies have also suggested a positive association between exporting and innovation (Love and

[6] In the survey firms were asked whether they agreed with five statements relating to team-working in their firm: Team-working plays a major role in the development of new products/services; Development teams are cross-functional and involve people from different parts of the organisation; Teams operate very independently and are left to get on with solving the problem; Our organisation invests in training in team working; Teams often involve customers or suppliers. Our team-working measure is a count variable relating to the number of these statements firms agreed with.

Roper 2015). Here, we include an indicator variable which takes value one where a firm exports more than five per cent of its services. Second, we include a series of binary variables reflecting firms' current investments which might support innovation. Investments in research, for example, may both generate new knowledge which may drive innovation but also increase firms' ability to absorb external knowledge (Cohen and Levinthal 1989). Investments in design and branding have also been linked positively to innovation outputs and value generation in previous studies (Hertenstein et al., 2005; Utterback et al., 2006; Verganti, 2006; Ravasi and Stigliani, 2012). For example, Hertenstein et al. (2005) find that investments in design are capable of generating financial returns in the form of more profitable sales, higher returns on sales, and higher returns on assets.

Other control variables are included only in the specific innovation activities to which they relate. For example, to capture the relational element of intellectual capital, we include variables relating to the breadth of firms' external partnering. In each case we identify eight partner types and construct a count variable depending on the number of partner types with which firms are working (Laursen and Salter 2006)[7]. Multi-functional working has also been linked to innovation success in previous studies and we capture this here using a count measure of the number of occupational groups involved in ideation and innovation[8].

3.3 Empirical approach

We first model the impact of organisational practices on firms' openness to new innovation ideas XI_i as follows:

$$XI_i = \beta_0 + \beta_1 FC_i + \beta_2 KAA_i + \beta_3 DES_i + \beta_4 RES_i + \beta_5 OP_i + \varepsilon_1$$

[7] These were: suppliers, clients, competitors, business or management consultants, universities, professional and trade associations, regulatory bodies and technology providers.

[8] We identify six occupational groups: directors, partners or senior managers, function managers (e.g. HR, marketing), client facing staff involved in service delivery, administrative support staff, technical or IT support staff, marketing staff / bid managers.

Where (for firm i): FC_i is a vector of firm characteristics, KAA_i is a vector summarising firms' exploratory relationships with external partners, DES_i is internal spending on design, RES_i is spending on research, and OP_i are our four organisational practice indicators. As the dependent variable is a percentage we adopt a Tobit estimator. Hypothesis 1a suggests positive and significant values of β_5 for the organic organisational practices. Hypothesis 1b suggests negative and significant values of β_5 for the mechanistic organisational practices.

The second element of our analysis relates to firms' ability to generate marketable new services. Here, we estimate the innovation production function for innovative outputs IO_i as follows:

$$IO_i = \delta_0 + \delta_1 FC_i + \delta_2 DES_i + \beta_3 RES_i + \beta_4 XI_i + \beta_5 KAB_i + \beta_6 OP_i + \varepsilon_2$$

Where: FC_i is a vector of firm characteristics, DES_i is internal spending on design, RES_i is internal spending on research, XI_i is the proportion of externally sourced ideas, KAB_i is a vector summarising firms' external relationships and OP_i are our organisational practice indicators. Hypothesis 2a suggests we would expect positive and significant values for β_6 on the mechanistic organisational practice indicators. Hypothesis 2b suggests negative and significant values of β_6 for the organic organisational practices. Coefficient β_4 represents the link between firms' exploration and exploitation activities as suggested in Figure 1. As both dependent variables – innovative sales and the diversity of innovation – are expressed as percentages we use a tobit estimator. We include sectoral dummies in all estimated models.

Our analysis is based on information provided by a single rater in each organisation with the dependent and explanatory variables derived from the same survey. Common methods variance is therefore a concern (Podsakoff et al. 2003). In the questionnaire design we use different scale types to reduce potential concerns and, wherever possible, randomise item lists to offset any cognitive biases. We also use multivariate statistical analysis and alternative dependent variables which use different scale types to reduce any related biases (Chang, van Witteloostuijn, and Eden 2010). Among those variables used in our analysis of exploration principal components factor analysis identified five factors with eigenvalues greater than one which, in combination, accounted for 56.4 per

cent of the sample variance. The single most powerful factor accounted for 21.3 per cent of the sample variance. A single factor model also fits the data poorly with SRMR of 0.132. In our analysis of exploitation, principal component factor analysis identified seven factors with eigenvalues greater than one which accounted for 64.6 per cent of the sample variance. The single most powerful factor accounted for 34.0 per cent of the sample variance. A single factor model is again a poor fit to the data with SRMR of 0.117-0.153 (depending on the dependent variable). Both tests suggest that common method variance is unlikely to compromise our analysis.

4. RESULTS

4.1 Econometric Results

We examine the relationship between organisation capital and firms' exploratory and exploitative innovation activities. The success of firms' exploration activities is reflected in the share of new service ideas coming from outside the firm (Table 3). Exploitative activities are represented by the diversity of innovation and innovation success (Table 4). Perhaps the most notable feature of these models is the variability in the importance of the organisational practices across exploration and exploitation activities (See Table 5 for a symbolic summary). Organic practices prove important in terms of sourcing new ideas from outside the firm, i.e. exploration; and mechanistic practises are positively associated with firms' exploitation activities.

Organic Culture & Leadership practices are important for firms' exploration activities (Table 3). Firms which implement leadership and culture work practices which support new ideas source a higher proportion of new ideas from outside the firm than those which do not use such practices[9]. This Culture & Leadership factor is statistically significant at the 1 per cent level in relation to exploration (Table 3) but has no significant link to firms' exploitative innovation activities

[9] Previous studies have reported the importance of culture (Hogan and Coote 2014) and leadership in shaping firms' innovation outcomes (Love and Roper 2015; Garcia-Morales, Jimenez-Barrionuevo, and Gutierrez-Gutierrez 2012), although we are not aware of other studies examining the influence of culture and leadership on idea generation sourced from outside the firm.

(Table 4). None of the other three organisational practice factors have a statistically significant link to exploration activities. The Culture & Leadership factor comprises organic organisational practices related to culture, team leadership and incentive structures for staff for valuable new ideas. These organic practices (Kang and Snell 2009) match our *a priori* expectation that organic organisation capital can empower workers to integrate new knowledge associated with exploratory learning into the innovation process (Hypothesis 1a). However, we find no support for Hypothesis 1b that mechanistic organisational capital practices adversely impact firms' exploration activities. Both mechanistic factors prove insignificant with respect to exploration (Table 3).

Strategy & Information Sharing proves strongly associated with firms' exploitative innovation activities, in relation to the diversity of innovation and innovation success (Table 4). The Strategy & Information factor comprises mechanistic work practices for communicating strategy and sharing information with a firms' workforce. Innovation is a collective process of idea generation and implementation that builds upon resources, skills, and personnel across firms (Gibson and Gibbs 2006), and previous studies report the positive influence of innovation strategies and information-sharing on innovation performance (Cuijpers, Guenter, and Hussinger 2011; Peeters and Van Pottelsberghe 2006). Our results support Hypothesis 2a that routinized, standardised work practices can be beneficial for exploiting internal knowledge and organisational learning and so positively influence firms' exploitative activities.

In addition, the Recruitment & Training factor is statistically significant at the 10 per cent level in relation to innovation success. Therefore, recruitment, training and equal opportunities practices are positively associated with sales from new and/ or improved services. The Recruitment & Training factor comprises mechanistic work practices which enable firms to hire and develop employees. While our results in relation to recruiting staff with varying skill sets and developing their skills are not particularly strong, we must acknowledge prior studies which have found that employee diversity - combining fundamentally different skills - leads to a competitive advantage (Laursen, Mahnke, and Vejrup-Hansen 2005; Østergaard, Timmermans, and Kristinsson 2011). This finding again provides some (weak) evidence that mechanistic organisational practices

are positively related to firms' exploitative activities (Hypothesis 2a). However, we find no evidence that organic practices negatively influence exploitation activities, i.e. we find no statistically significant relationship between the organic practices - Work Flexibility & Discretion and Culture & Leadership – and exploitative innovation activities (Table 4)[10].

Our results demonstrate the importance of organisational capital to firms' innovation activities, with organic practices linked to exploration and mechanistic practices linked to exploitation. We control for the human and social elements of intellectual capital in our estimation. Human capital - essentially the knowledge, skills, and abilities of individuals – is captured by work-force education. Social capital, the knowledge embedded in and available through relational networks, is reflected in variables measuring team-work, multi-functionality knowledge-seeking and knowledge transforming activities, as well as investments in IT and design.

Surprisingly, we find no relationship between workforce education and firms' exploration or exploitation activities. However, in general, our results in general illustrate the importance of social capital for innovation. Team-work and multi-functionality have strong and significant links to exploitative innovation activities. Multi-functional teams combining different skill sets are also positively related to the diversity of innovation and innovation success, although there are diminishing returns from such teams (Table 4). The team-work index also has a positive and significant coefficient in the diversity of innovation model, indicating that developing and supporting teams is positively related to a more diverse range of innovations (Table 4).

Surprisingly, IT investment is negatively related to new service ideas from outside the firm (Table 3). However, in line with Love, Roper, and Bryson (2011), design investment is positively related to external service ideas, albeit only at a 10 per cent level of significance. Design investment also has a strong and significant link to firms' exploitative activities (Table 4). The importance of design investments here emphasises the argument made by Canid and Saemundsson (2008) that

[10] Previous studies, such as Crowley and Bourke (2016), have demonstrated that firms which allow their employees flexibility and discretion in their work are more likely to introduce new product and service innovations than firms which do not.

design plays a consistently important part in services innovation across a range of different contexts. Indeed, our results suggest that for services firms design makes a more important contribution to innovation than in-house research (see also Love, Roper, and Bryson 2011). A possible explanation for the insignificance of research across exploration and exploitative activities, is that it may be the case that services innovation is less technologically based than manufacturing innovation (Vergori, 2014).

Our results in relation to knowledge sourcing activities are also interesting. External knowledge sourcing is important for exploration, although the relationship is inverted-U shaped with the strength of the link to external connectivity diminishing after a certain point (Table 3). In exploitation, external connectivity is not related to innovation success, although it is linked to innovation diversity (Table 4). We also control for exporting, as many previous studies report a positive exporting-innovation relationship (Gourlay, Seaton, and Suppakitjarak 2005; Wakelin 1998; Roper and Love 2002). We find that exporting has little relationship to service firms' innovation activities (Table 4), although it is negatively related to the diversity of innovation (Love, Roper, and Bryson 2011). This may indicate that firms who export face less pressure to increase the range of innovations they introduce relative to their counterparts focused on the domestic-market.

4.2 Robustness Tests

We conduct two robustness tests to confirm our results. Essentially we determine if our results in relation to organisational capital and innovation are moderated by firm size and/or sector. These robustness tests are motivated by earlier studies which have established that organisational practices, and innovation outcomes vary with firm size (Laursen and Foss 2014; Wu et al. 2015). Other recent studies have suggested the potential non-linearity of the practices-innovation relationship, particularly for smaller firms and the potential for what White and Bryson (2016) call 'thresholds' of effectiveness'. In addition, variations in the nature of innovation across different sectors, and the associated skill needs, are increasingly being reported (Leiponen 2005; Toner 2011; Doran and Ryan 2014; Verma 2012).

To determine if the organisation capital - innovation results vary by firm size we partition the four organisational practices factors using three employment size bands (<19, 19-49, >49) and re-run our estimation. We then test the equality of the key coefficients between size bands (Table 6). The F-tests are broadly insignificant, indicating that organisational capital links to innovation are generalizable across firms of different sizes. In a second robustness test, we partition the four organisational practice factors using the five sectors covered by our survey (i.e. software and IT, accountancy, architectural services, consultancy, specialist design) to examine if the organisation capital-innovation results are conditional on sector. The largely insignificant F-tests imply again that there is no systematic difference between the size of the effects reported across sectors (Table 6).

5. DISCUSSION

Previous studies have suggested a potential trade-off between organisational practices which favour exploitation and exploration (Rosing et al. 2011). Here, as in previous studies, we find clear evidence that different types of organisational practices are more strongly associated with exploration (organic) and exploitation (mechanistic) innovation activities. We find no evidence, however, of any significant trade-off between those practices which favour exploitation and exploration. More specifically, the adoption of organic Culture & Leadership practices which are associated with successful exploration are associated with no detrimental effect on firms' exploitation activities. And, conversely, mechanistic Strategy & Information practices which are strongly associated with exploitation success, are associated with no detrimental effect on firms' exploration activities. As we also find a strong association between exploration outcomes and exploitation success (Table 4), this implies a complementarity (rather than contradictory) relationship between those organisational practices which favour exploration and exploitation. In an investigation on enterprise performance across 15 countries, Derbyshire (2014) also reported a mutually enhancing relationship between exploration and exploitation in the Professional, Scientific and Technical Activities (NACE Rev. 2 section M) sector. Our finding that different types of organisational capital practices matter for exploration and exploitation activities

refines our understanding of the context-specific nuances associated with the different type and nature of practices adopted within professional services (Derbyshire, 2014).

The lack of any trade-off between the organisational practices enabling exploration and exploitation may be linked to the focus of our analysis on services firms. In manufacturing – the focus of the majority of studies of exploration and exploitation in innovation – exploration and exploitation may be more distinct activities involving very different investment priorities, external relationships and occupational groups within the firm. In services, where innovation may be less capital intensive, less technologically oriented (West and Gallagher 2006), and more strongly linked to human interaction and creativity, the functional distinction between exploration and exploitation activities may be less marked. Nonetheless, our analysis does suggest a clear distinction between the organisational practices which favour each activity.

Our analysis has clear managerial implications for services firms seeking to innovate effectively. At the broadest level we show that organisational practices do have a significant impact on the effectiveness of both exploration and exploitation activities. And, that rather different bundles of practices help optimise exploration and exploitation activities (Parkhe 1991). Where firms' business model dictates a focus on a single innovation activity, e.g. ideation, commercialisation, our analysis suggests the adoption of *either* an organic set of organisational practices associated with Culture & Leadership or a broader mechanistic set of organisational practices reflecting information sharing. Where firms seek to optimise across both exploration and exploitation activities, the adoption of the broader set of mechanistic practices included in our Strategy & Information Sharing factor seems most appropriate as this embodies elements of organic practices related to culture and leadership as well as a range of more mechanistic organisational practices related to information sharing. Currently, among our survey respondents, while around nine-tenths reported having a culture and leadership team which supports the introduction of new ideas, only around half have implemented structured processes or incentives to support the development of new ideas and information (Roper et al., 2016). The scope for more widespread adoption of such practices is clear.

6. CONCLUSIONS

Our analysis confirms the existence of a strong positive link between organisational practices and innovation outcomes in professional services firms. By adopting an activity-based approach to firm-level innovation we are able to examine the role of different bundles of organisational practices on different innovation activities. Organic organisational practices linked to culture and leadership prove important in exploratory innovation activities; more mechanistic organisational practices linked to information sharing and work organisation prove important in firms' ability to develop marketable innovations. For our sample of services firms, we find no evidence of a trade-off, however, between those organisational practices associated with exploration and exploitation.

A key limitation of our study is its cross-sectional nature limiting inference to correlation rather than causality. Our current study also focuses on five professional services sectors and omits other potentially important sectors such as financial services and legal services. Essentially similar results emerge when we consider these other sectors, however (Roper et al. 2015). Our results are also limited in that they only consider firms operating in the same UK labour market. Issues around leadership, hierarchy and job flexibility undoubtedly have a cultural dimension and this limits the generalisability of our results. Replication in different sectors and national contexts would therefore be a useful robustness check.

Figure 1: From organisational practices to innovation

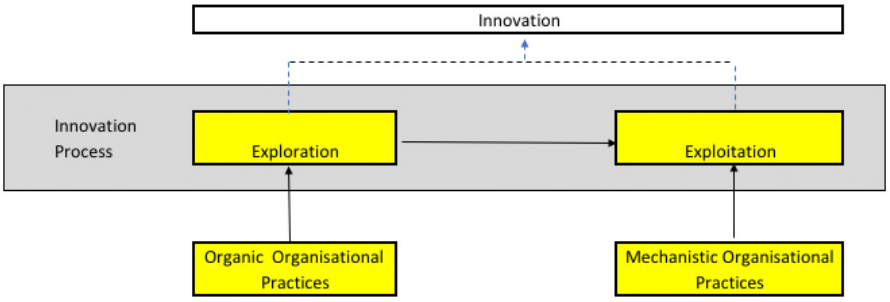

Table 1: Sample Descriptives

	Mean	Std. Dev.
Performance Indicators		
New Service Ideas from outside the firm	11.601	20.920
Diversity of Innovation Activity	46.325	29.347
Innovative Sales (%)	16.658	24.247
Firm Size (employment)	87.427	393.333
Firm age	20.174	9.666
Workforce with degree (%)	54.704	27.151
Exporting Firm (> 5% of sales)	0.355	0.479
IT investment (0/1)	0.655	0.476
Research investment (0/1)	0.674	0.469
Design investment (0/1)	0.480	0.500
Multi-functionality: Exploration	39.874	35.954
Multi-functionality: Exploitation	37.140	34.839
External Knowledge Seeking: Exploration	23.947	27.866
External Connectivity: Exploitation	12.043	21.893
Teamwork Index	31.379	39.777

Source: OPIPS Survey. Observations are weighted to give representative results.
Notes: Descriptive statistics for the Organisational Practices (factor) variables are presented and explained in Table 2.

Table 2: Factor Loadings for Organisational Practices

	Factor 1	Factor 2	Factor 3	Factor 4
	Mechanistic: Strategy & Information Sharing	*Mechanistic: Recruitment & Training*	*Organic: Work Flexibility & Discretion*	*Organic: Culture & Leadership*
Written strategies or policies to support the introduction of new ideas	0.669			
A culture that supports the introduction of new ideas	0.443			0.774
Structured processes to support the introduction of new ideas	0.585			0.307
Offer staff rewards or incentives for valuable new ideas	0.482			
A leadership team that supports new ideas	0.464			0.728
Communicate or share information via annual staff surveys	0.562			
Communicate or share information via formal staff suggestion schemes	0.629			
Communicate or share information via scheduled team meetings	0.636			
Communicate or share information via intranet	0.458			
Communicate or share information via newsletters	0.568			
Communicate or share information via employee forums or work councils	0.547			
Work variety			0.574	0.303
Access to flexible working			0.791	
Discretion over how to do work			0.780	
Give employees about financial position	0.444			
Project –specific teams (of people who don't usually work together)	0.479			
Problem-solving or continuous improvement groups	0.539			
Equal opportunities policy	0.457	0.408		
Formal procedures for employee consultation	0.587			
Hold ISO9000 Standards	0.536			
Disciplinary and dismissals formal procedures	0.508	-0.412		
Recruit people with experience from outside sector				
Recruit people with experience working in other firms in your sector		0.495		
Develop staffs' professional skills		0.422		
Train staff on how to develop ideas for new services		0.500	0.315	
Variation explained	0.368	0.063	0.152	0.085
Coefficient Score (means)	0.991	0.314	0.546	0.682
Standard Deviation	0.354	0.342	0.463	0.561
Min	-0.142	-1.207	-0.617	-1.079
Max	1.784	1.451	1.709	2.242

Source: OPIPS Survey. Observations are weighted to give representative results.
Notes: 1. After running the PCA, the factors were rotated to get a clearer pattern of the underlying variables in each factor. The rotation method chosen is oblimin given the relationship between the factors. Loadings of less than 0.3 are excluded for presentation purposes. Next, new variables were created that produce the regression coefficients to estimate the individual scores. **2.** A high coefficient score within the min and max represents a high level of bundling. The coefficients do not produce any real meaningful interpretation. However, their sign is important in identifying if combining practices has a positive or negative effect on the dependent variable in question. **3.** These four factors explain 67% of the total variance observed.

Table 3: Exploring Innovation: Tobit model of the share of new ideas from outside the firm

	External Ideas	External Ideas
	Initial Estimates	Final Estimates
Organisational Practices		
Mechanistic: Strategy & Information Sharing	7.624	8.440
	(6.986)	(6.701)
Mechanistic: Recruitment & Training	4.012	4.479
	(5.516)	(5.516)
Organic: Work Flexibility & Discretion	-4.407	-4.684
	(4.194)	(4.050)
Organic: Culture & Leadership	11.542***	11.499***
	(3.810)	(3.799)
Firm size (employment)	-3.108*	-2.846
	(1.853)	(1.738)
Firm age (years)	-0.027	
	(0.189)	
Workforce with degree (%)	-0.094	-0.092
	(0.065)	(0.065)
Exporting firm	-0.729	
	(4.046)	
Multi-functionality: exploration	0.080	
	(0.067)	
IT investment(0/1)	-12.092***	-12.206***
	(3.971)	(4.009)
Research investment(0/1)	-0.038	
	(4.082)	
Design investment (0/1)	5.757	6.095*
	(3.619)	(3.664)
External Knowledge Seeking	2.537***	2.613***
	(0.229)	(0.218)
External Knowledge Seeking squared	-0.021***	-0.021***
	(0.003)	(0.003)
Number of observations	716	717
P	0.000	0.000
Pseudo-R^2	0.418	0.417

Notes and source: OPIPS Survey. Observations are weighted to give representative results. Models contain sector dummy variables and constant term. Reference category for competition: local. Marginal effects are reported. *denotes significance at the 10% level; **at the 5% level and *** at the 1% level.

Table 4: Exploiting Innovation: Tobit models of innovation diversity and innovation success

	Diversity of Innovation	Diversity of Innovation	Innovation Success	Innovation Success
	Initial Estimates	Final Estimates	Initial Estimates	Final Estimates
Organisational Practices				
Mechanistic: Strategy & Information Sharing	13.589***	14.032***	20.405***	19.773***
	(3.674)	(3.517)	(6.980)	(6.862)
Mechanistic: Recruitment & Training	1.788	1.554	10.079*	10.051*
	(2.469)	(2.485)	(5.376)	(5.219)
Organic: Work Flexibility & Discretion	2.118	1.855	5.593	5.208
	(2.073)	(2.058)	(3.572)	(3.597)
Organic: Culture & Leadership	-1.730	-1.644	2.688	2.844
	(1.865)	(1.847)	(3.830)	(3.783)
Firm size (employment)	0.810		-5.308***	-5.189***
	(0.923)		(1.888)	(1.860)
Firm age (years)	-0.342***	-0.348***	-0.753***	-0.758***
	(0.104)	(0.102)	(0.213)	(0.204)
Workforce with degree (%)	-0.024		-0.009	
	(0.037)		(0.078)	
Exporting firm	-4.064*	-3.982*	6.631	6.355
	(2.124)	(2.122)	(4.284)	(4.151)
Multi-functionality: Exploitation	0.948***	0.968***	1.932***	1.931***
	(0.100)	(0.099)	(0.197)	(0.187)
Multi-functionality (squared)	-0.008***	-0.008***	-0.016***	-0.016***
	(0.001)	(0.001)	(0.002)	(0.002)
Team-working index	0.069**	0.069**	-0.031	
	(0.030)	(0.031)	(0.052)	
IT investment(0/1)	3.017	2.896	4.075	
	(2.077)	(2.074)	(4.098)	
Research investment(0/1)	2.946	2.807	-2.138	
	(2.235)	(2.236)	(4.207)	
Design investment (0/1)	10.190***	10.330***	17.488***	16.928***
	(2.088)	(2.072)	(4.385)	(3.996)
Externally sourced ideas	0.088**	0.084**	0.114	0.097
	(0.041)	(0.041)	(0.081)	(0.082)
External connectivity: exploitation	0.211*	0.101**	0.055	
	(0.125)	(0.050)	(0.267)	
External connectivity: exploitation (squared)	-0.002		-0.001	
	(0.002)		(0.004)	
Observations	691	698	666	680
P	0.000	0.000	0.000	0.000
Pseudo-R^2	0.133	0.132	0.103	0.102

Source: OPIPS Survey. Observations are weighted to give representative results. Models contain sector dummy variables and constant term. Reference category for competition: local. Marginal effects are reported. *denotes significance at the 10% level; **at the 5% level and *** at the 1% level.

Table 5: Symbolic Summary of influence of Organisation Practices on Innovation

	Exploration	**Exploitation**	
	External Ideas	Diversity of Innovation	Innovation Success
Mechanistic: Strategy and Information Sharing	(+)	**+**	**+**
Mechanistic: Recruitment and training	(+)	(+)	+
Organic: Work variety, flexibility and discretion	(-)	(+)	(+)
Organic: Culture and leadership	**+**	(-)	(+)

Notes: + a significant and positive effect; - a significant and negative effect; (+) an insignificant positive effect; (-) an insignificant negative effect

Table 6: Equality of coefficients tests with size and sectoral splits

	External Ideas	Innovation Diversity	Innovation Success
Size Splits			
Mechanistic: Strategy and Information Sharing	F(2,695) = 1.49 Prob >F = 0.2271	F(2,652) = 1.35 Prob >F = 0.2593	F(2,637) = 0.98 Prob >F = 0.3769
Mechanistic: Recruitment and training	F(2,695) = 0.47 Prob >F = 0.6226	F(2,652) = 1.69 Prob >F = 0.1854	F(2,637) = 0.08 Prob >F = 0.9215
Organic: Work variety, flexibility and discretion	F(2,695) = 0.71 Prob >F = 0.4938	F(2,652) = 0.85 Prob >F = 0.4273	F(2,637) = 1.21 Prob >F = 0.2997
Organic: Culture and leadership	F(2,695) = 0.83 Prob >F = 0.4376	F(2,652) = 1.98 Prob >F = 0.1383	F(2,637) 0.23 Prob >F = 0.7909
Sectoral Splits			
Mechanistic: Strategy and Information Sharing	F(4,687) = 1.56 Prob >F = 0.1836	F(4,664) = 1.46 Prob >F = 0.2130	F(4,629) = 1.08 Prob >F = 0.3650
Mechanistic: Recruitment and training	F(4,687) = 1.66 Prob >F = 0.1585	F(4,664) = 0.44 Prob >F = 0.7764	F(4,629) = 1.28 Prob >F = 0.2760
Organic: Work variety, flexibility and discretion	F(4,687) = 0.63 Prob >F = 0.6417	F(4,664) = 1.66 Prob >F = 0.1584	F(4,629) = 0.48 Prob >F = 0.7481
Organic: Culture and leadership	F(4,687) = 2.41 Prob >F = 0.0480	F(4,664) = 1.52 Prob >F = 0.1943	F(4,629) = 0.30 Prob >F = 0.8751

Annex 1: Correlation Matrix

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	External ideas	1																		
2	Diversity innov	0.3	1																	
3	Innov Success	0.28	0.42	1																
4	Firm size (employ)	0.08	0.07	-0.08	1															
5	Firm age	-0.08	-0.12	-0.24	0.07	1														
6	Workforce with degree	0.01	0	0.02	-0.01	0.01	1													
7	Exporting firm	0.03	0.1	0.12	0.1	-0.01	0.1	1												
8	IT investment	0.03	0.18	0.08	-0.05	0.02	0.08	-0.03	1											
9	Research Investment	0.16	0.38	0.19	0.08	-0.07	0.09	0.12	0.14	1										
10	Design Investment	0.17	0.47	0.35	0	-0.06	0.05	0.14	0.11	0.3	1									
11	Multif. exploration	0.27	0.52	0.33	0.07	-0.05	-0.01	0.15	0.15	0.31	0.29	1								
12	Multif. exploitation	0.29	0.5	0.34	0.09	-0.08	0	0.17	0.12	0.33	0.32	0.82	1							
13	Ext_Knowledge: exploration	0.49	0.47	0.21	0.07	-0.06	0.01	0.06	0.14	0.32	0.29	0.54	0.5	1						
14	Ext_Knowledge: exploitation	0.2	0.35	0.15	0.04	-0.01	-0.02	0.01	0.12	0.24	0.26	0.37	0.37	0.44	1					
15	Teamwork	0.16	0.5	0.28	0.1	-0.07	0.02	0.13	0.12	0.3	0.33	0.48	0.45	0.42	0.39	1				
16	Mechanistic: Strategy & Info Sharing	0.08	0.38	0.13	0.17	0.04	0.06	0.06	0.13	0.33	0.24	0.28	0.29	0.26	0.24	0.37	1			
17	Organic: Work Flexibility & Discretion	0.01	-0.01	0.06	0.01	0.03	0.11	0.09	0.03	0.01	-0.01	-0.04	-0.03	-0.01	-0.04	0.02	-0.07	1		
18	Organic: Culture & Leadership	0.06	-0.09	-0.02	-0.04	0.1	-0.02	0.01	0.03	-0.06	-0.1	-0.05	-0.08	-0.03	-0.01	-0.06	-0.38	-0.23	1	
19	Mechanistic: Recruitment & Training	0.02	0.04	0.11	-0.05	-0.1	0.07	0.03	0	-0.04	0.03	0	-0.01	0.01	0.01	0.08	-0.15	-0.12	-0.17	1

Source: OPIPS Survey. Observations are weighted to give representative results.

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