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The formation of a firm's core competence and its development: an analysis with a special reference to North East England firms

A firm's core
competence
and its
development

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Abstract

Purpose – This paper provides remarkable insight into the structural components of a firm's core competence and its development via research and development (R&D) activities for innovation and exporting activities.

Design/methodology/approach – The authors have used a positivist design and a deductive methodology. The authors have examined the extant literature developing a theoretical framework to empirically investigate the relationships between a firm's core competence, organisational learning (OL), tacitness, dynamic capability and R&D activities. To carry out this investigation, the authors have collected stratified sample data from 330 firms operating in North East England, a peripheral region of England.

Findings – The authors have found that there are indeed significant statistical relationships between these structural components, R&D activities and a firm's core competence, and this nexus is pertinent to innovation and exporting. Furthermore, it is found that North East England is significantly constrained by the lack of finance, technological capability, experts and brain drain. Based on these findings, the authors propose a cooperative R&D framework to narrow down these constraints to assist firms in developing core competencies for innovation and exporting in peripheral regions.

Social implications – There is an urgent need to investigate the incidence of knowledge-driven activities, R&D, the extent of innovation and exporting activities of firms operating in North East England, a peripheral region of the United Kingdom (UK).

Originality/value – This study provides an original and systematic investigation of the firm's core competence and its formation via key structural components for innovation and exporting within an empirical framework.

Keywords Innovation, Firm's core competence, R&D, North East England

Paper type Research paper

1. Introduction

Against the backdrop of Brexit, examining the innovation and exporting activities of firms operating in the peripheral regions is pivotal to ensuring their competitive advantage and long-term growth (Duke *et al.*, 2006; Seddighi, 2015). Mirroring Romer (1990), much of the literature now asserts that innovation via knowledge-driven activities is the key source of exports and growth both at a regional and firm-level level (Seddighi, 2015; Walker, 2016). In a similar vein, building on Penrose (1959), it is generally now agreed that knowledge is the most valuable resource of a firm (Grant, 1996; Breznik and Hisrich, 2014). Specifically, literature on



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innovation asserts that a firm's innovation results from how it develops, integrate, applies, refines and reuses its knowledge (Bonjour and Micaelli, 2010; Bessant and Tidd, 2017).

Many scholars have expressed nuanced views by examining what knowledge means at the firm level. Having said that, synthesising the literature, one can identify that it is not a large bundle of the intellectual capital that generates a competitive advantage for a firm but the practical application of this knowledge and its dynamic capability (Teece *et al.*, 1997; Teece, 1998; Eisenhardt and Martin, 2000). Therefore, it is essential to investigate how the knowledge is put into practice by a firm in a specified context to earn a competitive advantage, also known as the core competence of the firm (Haarhaus and Liening, 2020; Ali *et al.*, 2021; Ceglinski, 2020; Chen and Liu, 2019).

In many views, a firm's core competence is "specialised expertise" (Gallon and Stillman, 1995, p. 20) or "knowledge of the firm" (Grant, 1996; Bonjour and Micaelli, 2010; Hafeez *et al.*, 2002; Chen and Liu, 2019) and the firm's "know-how to perform uniquely well" (Jabbouri and Zahari, 2014) to yield competitive advantage (Godbout, 2000; Torkkeli and Tuominen, 2002). However, core competence is an intangible concept and ill-defined in the literature (Schreyogg and Geiger, 2007; Ljungquist, 2008, 2010); therefore, the only way to identify a firm's core competence is via its output characteristics, such as unique value, inimitability and potential to enter new markets (Prahalad and Hamel, 1990, 1996; Ljungquist, 2008; Seddighi and Mathew, 2020). Although core competence has become a prominent concept in the strategic research domain, one of the criticisms faced by Prahalad and Hamel (1990a, b) was that they failed to delineate the organisational factors contributing to the formation of a firm's core competence (Ljungquist, 2008; Hafeez *et al.*, 2002), and the field of research is still less attuned to input factors of a firm's core competence. Therefore, this paper primarily aims to examine the organisational factors contributing to forming a firm's core competence.

The second objective of the paper is to examine the role of R&D activities in developing such organisational attributes that lead to the formation of a firm's core competence. Prahalad and Hamel (1990a, b) emphasise the requirement of nourishing a firm's core competence as it can become obsolete over time or core rigidities (Leonard, 1992; Bessant and Tidd, 2017). In this respect, mirroring the pioneering works of Romer (1990) and Grossman and Helpman (1991), Quelin (2000), Coombs (1996) and Seddighi (2015) posit that R&D activities are a major driving force for the refinement and development of the firm's core competence by reconfiguring existing knowledge and developing new competencies.

Our third objective in this paper is to provide new information on innovation and exporting concerning the firms located in North East England and to help formulate policies for the growth of this peripheral region. Available evidence (ONS, 2020) suggests that knowledge-driven innovation and R&D activities are predominately performed in key leading growth regions, with peripheral regions such as North East England contributing relatively little to these activities (Duke *et al.*, 2006). This view on the North East region is echoed in recent reports of NELEP (2016a, b), ONS (2019) and Round (2016). For example, North East England had the lowest research and development (R&D) expenditure (£443 m) among all the United Kingdom (UK) regions, and it contributed only 0.7% of the total R&D expenditure of the country. The picture is no different when we zoom into the R&D expenditure made explicitly by businesses in the UK by region (The Royal Society, 2019). R&D expenditure of firms located in North East England was the lowest among the regions in the UK (UKRI, 2017; R&D Spending, House of Commons Briefing Paper, 2020); also, it contributed only 1.7% of the total business R&D expenditure in the country, while a similar figure for the southern high-growth regions of the UK was 52% in comparison (ONS, 2019). Furthermore, NELEP (2016a, b) reported that businesses in the North East region spent only 1.4 m on R&D per 10,000 adult population compared to the national average of 4.8 million. In a similar vein, one can find that North East England had the lowest number of FDI projects in England over the period, which accounts for 3.06% of the total FDI projects in the country.

This region's impoverished R&D and knowledge-driven activities are reflected in its potential to enter new markets. In terms of exports, a key indicator of innovation via knowledge-driven activities (Love and Mansury, 2009; Ganotakis and Love, 2011; Siba and Gebreeyesus, 2017) seems to be relatively low in this region (ONS, 2020). For example, the value of exports of all the regions increased from 2016 to 2017, except in the North East and West regions (HMRC, 2018). Specifically, the value of exports to the European Union (EU) of the North East region in 2017 accounted for 7,613 million compared to 22,400 million in the South East region. Similarly, the value of exports to non-EU countries of the North East region in 2017 was reported as 3.9%, the lowest among the nine regions of England (HMRC, 2018).

Interestingly, the exports of the North East region appear to be reliant mainly on EU countries; for instance, of the total exports of the area, 59% were made to EU countries suggesting that Brexit would further derail the economy and there could be dire consequences. Finally, patents, considered direct indicators of knowledge-driven innovation activities, were relatively low in the region (23.1 patents/million adult population) compared to 55.7 patents granted across England (NELP, 2016a). Given this evidence, there is an urgent need to investigate the incidence of knowledge-driven activities, R&D, the extent of innovation and exporting activities of firms operating in North East England, a peripheral region of the UK. This study further complements earlier work in this area (Dixon and Seddighi, 1996; Seddighi and Mathew, 2020), and it reports on the results of a comprehensive survey undertaken on innovation, R&D and exporting activities of firms operating in North East England to assist policymakers in monitoring and framing innovation in this region.

The structure of the paper is as follows. Section 2 provides a theoretical framework for the long growth of firms via knowledge-driven activities. Section 3 explains the methodology of the investigation. Section 4 provides an analysis of data and a discussion of the implications. Subsequently, Section 5 provides a framework and a conclusion.

2. A theoretical framework for the long-term growth of a firm via innovation and exporting activities

Much of the extant literature argues that a firm's distinctive knowledge stack or the core competence is the pertinent source of innovation and competitive advantage (Prahalad and Hamel, 1990a, b, 1996; Bonjour and Micaelli, 2010; Seddighi, 2015; Srivastava, 2005; Hafeez and Essmail, 2007; Seddighi and Mathew, 2020). Nonetheless, a firm's core competence can be antiquated (Teece, 1998, 2007; Bessant and Tidd, 2017). Also, the literature provides anecdotal evidence on how a firm's core competence is formed, developed, integrated, managed and redeployed (Hafeez *et al.*, 2002; Bonjour and Micaelli, 2010; Shang *et al.*, 2009). In this respect, it is essential to heed the critical organisational attributes contributing to developing and refining a firm's core competence.

2.1 Organisational attributes contributing to the formation and development of a firm's core competence

Arguably, possessing knowledge or attaining core competence does not ensure long-term competitive advantage (Teece, 2017; Birchall and Tovistga, 2005; Walker, 2016). In fact, the current literature sees innovation as a process that requires continuous refinement of a firm's core competence (Mintzberg *et al.*, 2003; Pedler and Burgoyne, 2017; Teece, 2007, 2017; Haarhaus and Liening, 2020; Ali *et al.*, 2021; Ceglinski, 2020; Tseng and Lee, 2014).

2.1.1 Dynamic capability. Many scholars believe the concept of a firm's core competence evolved from the resource-based view (Haarhaus and Liening, 2020; Schilke *et al.*, 2018;

Hafeez *et al.*, 2002; Breznik and Hirsich, 2014; Torres *et al.*, 2018). Nonetheless, both notions were often criticised in the literature for their static nature (Teece *et al.*, 1997, 2007; Ambrosini and Bowman, 2009; Eisenhardt and Martin, 2000). A further complication to conceptualising a firm's core competence is that it eventually becomes its core rigidities unless continuously refined (Bessant and Tidd, 2017). In fact, many now agree a firm's sustained innovation is stemmed from a firm's ability to develop, refine and reconfigure resources, skills and capabilities (Ali *et al.*, 2021; Barreto, 2010; Teece *et al.*, 2016), which points to the dynamic capability of the firm (Teece *et al.*, 1997; Linde *et al.*, 2021; Torres *et al.*, 2018; Eisenhardt and Martin, 2000; Teece, 2007). The precursors define dynamic capability as "the firm's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments" (Teece *et al.*, 1997, p. 516). Later, Helfat *et al.* (2007, p. 4) provided a comprehensive view that dynamic capability is the capacity of an organisation to create purposefully, extend or modify its resource base. Although a set of research posits refinement of dynamic capability is pertinent to a firm's competitive advantage, the trajectory of the literature now asserts that it is a prerequisite for the development of a firm's core competence (Linde *et al.*, 2021; Schilke *et al.*, 2018; Hafeez *et al.*, 2002; Haarhaus and Liening, 2020). Schilke *et al.* (2018) and Ceglinski (2020) also assert the close correspondence of the two notions and Ghosh and Srivastava (2021) akin dynamic capability to the firm's collective knowledge. Specifically, the volatile nature of the business environment demands a firm's dynamic capability as a relevant source of core competence (Haarhaus and Liening, 2020; Teece, 2007, 2018; Schilke *et al.*, 2018).

Following this, theorists now recognise the salience of dynamic capability in developing a firm's core competence (see Prahalad and Hamel, 1990a, b, 1996; Seddighi and Mathew, 2020; Ceglinski, 2020). Based on the notion that the collective knowledge (Prahalad and Hamel, 1996; Grant, 1996) forms the innovation, Helfat and Raubitschek (2018) see developing, integrating, reconfiguring and modification of existing competencies as a source of sustained competitive advantage. Specifically, Winter and colleagues advocated that "firm dynamics" is key to the continuous refinement and improvement of a firm's competence (Zollo and Winter, 2002). Additionally, Bowman and Ambrosini (2003) proposed four responsibilities of dynamic capability: the reconfiguration of competencies, leveraging competencies, organisational learning (OL) and knowledge integration.

In the light of this, numerous theorists (Wilhelm *et al.*, 2015; Gonzalez and Melo, 2017; Ferreira *et al.*, 2020) associate sensing, seizing and reconfiguring attributes of dynamic capability (Teece *et al.*, 1997) to the development of a firm's core competence. Communiting this, in the study of Polish companies Ceglinski (2020) found that a firm's dynamic capability discovers new opportunities, moulds its existing capabilities and continuously modifies them, which he asserted is pivotal to entering new markets (Linde *et al.*, 2021; Helfat *et al.*, 2007) and value creation (Naldi *et al.*, 2014). Also, this attribute of the firm seeks to explain the inimitability component of a firm's core competence, which is mainly embedded in human beings and exposed via social interactions and is entailed and enhanced by the process of reconfiguration of capabilities (Ghosh and Srivastava, 2021; Salvato and Vassolo, 2018; Zollo and Winter, 2002). Through a careful examination of these propositions, one can identify the heart of the dynamic capability concept as being the flexibility of a firm to either reconfigure or improve existing competencies to form new ones that cannot be easily imitated (Szulanski, 1996; Liebeskind, 1996) or to create new competencies by accessing new exterior knowledge (Haarhaus and Liening, 2020; Eisenhardt and Martin, 2000).

2.1.2 Tacitness of a firm. Many posit that knowledge is the fundamental tenet that generates the inimitability of the firm's core competence concept (Torres *et al.*, 2018; Walker, 2016; Pedler and Burgoyne, 2017). However, the idea of how inimitability can be attained is vaguely conceptualised and expressed in the literature (Ljungquist, 2008). Having said that, synthesising the literature, one could argue that a firm's competitive advantage via

inimitability is not gained from the knowledge resources themselves (Newbert, 2008; Teece, 2007, 2018) but from the firm-specific distinctive capabilities to acquire, deploy, combine and transfer the knowledge (Teece, 2018; Teece and Leih, 2016; Amit and Schoemaker, 1993; Maket and Korrir, 2017; Abel, 2008; Pedler and Burgoyne, 2017).

To guide our discussion, we need to understand the concept of a firm's knowledge resources. According to Wenger (1998), knowledge is classified as explicit, formalised, practised, tacit and socially developed. The latter three characteristics are sticky and difficult to articulate (Nonaka and Takeuchi, 1995; Nonaka *et al.*, 2001a, b; Eisenhardt and Martin, 2000; Asheim *et al.*, 2017; Ghosh and Srivastava, 2021). Recent literature (see Walker, 2016; Ghosh and Srivastava, 2021) categorises knowledge as a) a "thing" (cited in Walker, 2016, p. 116; Leonard and Sviokla, 1998; Abel, 2008; Asheim *et al.*, 2017) or data (big data) that can be stored and transferred (explicit knowledge) and b) "tacit knowledge" or "sticky knowledge" embodied in human beings (Polanyi, 1969; Nonaka and Takeuchi, 1995; Davenport and Prusak, 1998; Tam and Gray, 2016) which is automatic, stuck to the contexts and only exposed and shared in firm-specific social platforms (see the concept Ba, Nonaka *et al.*, 2001a, b; Asheim *et al.*, 2017; Lam, 1998) and therefore inherently difficult to articulate (Munoz *et al.*, 2015; Maket and Korrir, 2017; Reed and DeFillippi, 1999; King and Zeithaml, 2001). This specific characteristic of tacit knowledge creates casual ambiguity, a key to a firm's inimitability attribute (Szulanski, 2003; Ghosh and Srivastava, 2021; King and Zeithaml, 2001; Eisenhardt and Santos, 2000).

Besides, repeated learning is essential for the exposure and transmission of such knowledge (Nonaka and Takeuchi, 1995; Eisenhardt and Martin, 2000; Konlechner and Ambrosini, 2019), and this process within the firm facilitates the perks of "learning by doing" – a key element for the transmission of tacit knowledge and experiential knowledge (Eisenhardt and Santos, 2000; Walker, 2016). Hitherto, what is clear from the literature is that what is important is not knowledge as a resource but rather the firm's ability to create social platforms and "effective systems for knowledge sharing" (Jones and Machperson, 2006 cited in Tam and Gray, 2016, p. 4) to capture and transmit the knowledge embedded in human beings (Walker, 2016; Salvato and Vassolo, 2018; Maket and Korrir, 2017; Abel, 2008; Tam and Gray, 2016; King and Zeithaml, 2001). Although a few authors (Teece *et al.*, 1997; Zollo and Winter, 2002) recognised the salience of dynamic capability, the trajectory of current literature (Ali *et al.*, 2021; Steen *et al.*, 2021; Ghosh and Srivastava, 2021) establishes the nexus between a firm's dynamic capability and inimitability. Taken all together, the above literature (Ghosh and Srivastava, 2021; Ali *et al.*, 2021; Salvato and Vassolo, 2018) explains how the reconfiguration and modification of resources and capabilities spur the nebulous and complex attributes required for a firm's inimitability.

2.1.3 Organisational learning. In their seminal definition, Prahalad and Hamel (1990a, b, p. 6) explain that a firm's core competence is "the result of co-ordination of capabilities" and harmonisation of various streams of technologies and resources; however, the authors fail to unravel the argument further (Ljungquist, 2008). Consequently, many scholars view a firm's core competence as collective knowledge (see Tajeddini and Trueman, 2014; Ghosh and Srivastava, 2021; Zollo and Winter, 2002). For example, Gallon and Stillman (1995, p. 87) posit that a firm's core competence is the "result of the harmonisation of complex technologies". Salvato and Vassolo (2018) and Zollo and Winter (2002) echoed this view. Central to their argument was that the core competence concept is a commitment to working continuously across organisational boundaries to improve the knowledge stock to generate competitive advantage. Despite this, the literature failed to recognise collective OL as a structural function to build a firm's core competence (Hafeez and Essmail, 2007).

Later, Grant (1996) links this collectiveness with the OL of a firm, though the idea can be traced in the works of Pedler *et al.* (1989) and Senge (1990). Eventually, Eisenhardt and Martin (2000) expanded this concept of collectiveness of competence/knowledge into a new domain:

social learning processes (Nonaka *et al.*, 2001a, b). This stance is also reflected in the works of Hafeez *et al.* (2002), who suggest that core competencies result from the integration of an organisation's resources. Explaining such organisation capabilities, they point to the requirement of OL. Many agree that the key functions of OL are to create, acquire, transfer and manipulate new knowledge continuously (Senge, 1990; Yadav and Agarwal, 2016) via integration of resources, technology and culture (Kanchana *et al.*, 2011; Yadav and Agarwal, 2016) and systematic communication and networks and staff training (Machperson and Jayawarna, 2007) at individual, group and organisational level (Odor, 2018; Yadav and Agarwal, 2016).

Earlier it was noted that tacit knowledge does not develop inimitability for the firm; rather, it is developed through its capability to integrate this specialised knowledge. Complementing the works of Kogut and Zander (1992) and Nonaka and Takeuchi (1995), Spender (1996, p. 71) asserts that "collective organisational learning is the social platform" for the development and transmission of tacit knowledge (Ghosh and Srivastava, 2021). Similarly, dynamic capability also requires communication, involvement and working across boundaries, which Hafeez *et al.* (2002) believe is facilitated by the collective learning process of the firm Salvato and Vassolo (2018), Teece *et al.* (1997, 2018). The extant literature recognises this robust relationship between OL and dynamic capability (Teece, 2007; Winter, 2003; Zollo and Winter, 2002; Helfat *et al.*, 2007; Breznik and Hisrich, 2014).

Based on the above observations, the three components need to be tested and hence constitute the formation of the first proposition.

Proposition 1. Dynamic learning, collective learning and a firm's tacitness are the structural components of a firm's core competence.

2.2 Maintenance and refinement of a firm's core competence

Let us admit that a firm's core competence is a theoretical concept, and the only way to measure it is via its output characteristics (Hafeez *et al.*, 2002; Ljungquist, 2008; Seddighi and Mathew, 2020), so does how the concept of tacitness and dynamic capability fit in (Birchall and Tovistiga, 2005; Breznik and Hisrich, 2014). Let us start by asking whether the firm directly invests in developing tacitness, OL and dynamic capability. Our answer will be no, as the literature itself asserts that these capabilities are built via integration over time, not bought (see Zollo and Winter, 2002; Helfat *et al.*, 2007), which requires a learning system. Many scholars now agree that R&D is the in-house learning system that maintains continuous refinement of a firm's core competence (Jaffe, 1986; Coombs, 1996; Antonelli, 2001; Seddighi, 2015; Santamaria and Surroca, 2011). To that end, it is pertinent to address the role of R&D activities in maintaining and refining the structural components of a firm's core competence. Although collective OL is at the heart of the firm's core competence postulation, a few scholars have attempted to evaluate how it can be maintained and its linkage with R&D activities. The earliest proposition on the significance of R&D activities in collective OL was made in the seminal work of Griliches (1979, 1984). Expanding this argument, Belderbos *et al.* (2004a, b) asserts that the R&D activities of a firm act as the guidelines that tell the firm how to design its organisational routines in such a way as to attain and develop new superior knowledge (Pedler and Burgoyne, 2017; Srivastava, 2005; Agha *et al.*, 2012). These redesigned routines further facilitate the technological platform of the firm to endogenise the superior knowledge acquired (Conte and Vivarelli, 2013; Quelin, 2000; Quevedo *et al.*, 2011).

Furthermore, the development of a firm's core competence depends upon how the human resource as the container of tacit knowledge accumulates and enriches knowledge continuously via the learning process (Spender, 1996; Wang and Ahmed, 2003; Tseng and Lee, 2014; Quevedo *et al.*, 2011). In this sense, a firm must focus on not only the expansion of the knowledge embodied in human resources but also the development of social contexts to

expose this knowledge. Following the seminal works of Griliches (1979) and his colleagues (see Griliches and Lichtenberg, 1984; Griliches and Mairesse, 1998), many now argue that the R&D activities of a firm comprise the necessary means for the expansion of such knowledge (Antonelli, 2001; Seddighi, 2015). An alternative reading of the above theoretical review proposes that R&D activities create the firm-specific social contexts required for the tacitness of a firm (Kishmaraja and Aino, 2013; Eisenhardt and Santos, 2000; Antonelli, 2001).

Similarly, Coombs (1996) found that one of the critical responsibilities of a firm's R&D activities is enabling the firm to develop existing competencies and acquire new knowledge and capabilities. Guttel and Konlechner (2007) and Zollo and Winter (2002) echo this view. Given that dynamic capabilities demand continuous refinement, reconfiguration and development, scholars suggest that this remodelling can be attained through the R&D activities (Pedler and Burgoyne, 2017; Eisenhardt and Martin, 2000). However, dynamic capability requires a technological base/an absorptive capacity for acquiring and diffusing new, superior knowledge (Zollo and Winter, 2002). Rodil *et al.* (2015) and Harris *et al.* (2009a, b) highlight the imperative role of a firm's R&D activities in developing such a knowledge base. In a nutshell, Figure 1 highlights the conceptual framework for attaining innovation via the development and refinement of structural components of a firm's core competence.

Indeed, this framework needs to be tested and therefore comprises the following proposition:

Proposition 2. R&D activities of a firm develop the structural components of a firm's core competence.

3. Methodology

An academic questionnaire is used as the key instrument for this study, underpinned by a positivist philosophy to examine the causal linkages between the variables outlined above. Each question is selected and referenced to relevant literature to support its inclusion in the questionnaire (See Table 1).

To examine the role of R&D activities in developing a firm's core competence and thereby developing a coherent model of the firm's innovation and export activities, the following propositions are also transformed into various hypotheses and are then subjected to statistical testing.

Proposition 3. The innovation of a firm is facilitated by its core competence.

Proposition 4. Innovation of a firm is dependent on its R&D activities.

Proposition 5. Exporting activities of a firm is related to its innovation activities.

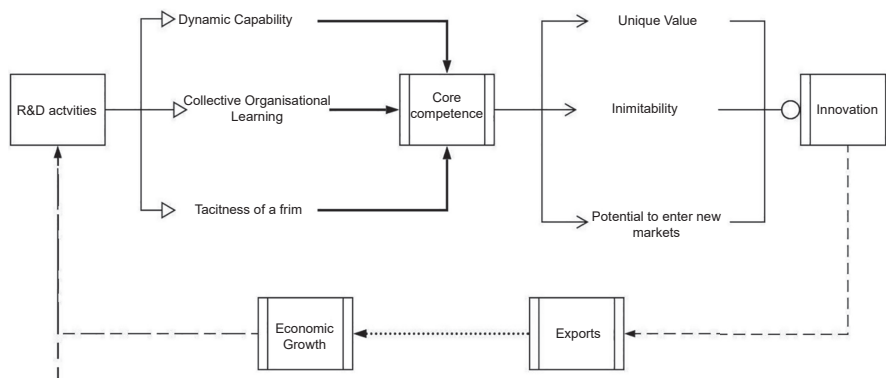


Figure 1. A conceptual framework for the formation of a firm's core competence and its development via R&D for innovation and exporting

Variables	Question	Literature
The core competence of a firm	Does your firm have a core competence on which it concentrates many of its resources/activities?	Prahalad and Hamel (1990a, b, 1996), Bonjour and Micaelli (2010), Seddighi (2015), Hafeez <i>et al.</i> (2002), Srivastava (2005), Ng and Kee (2018), Seddighi and Mathew (2020)
Collective organisational learning	Does your firm have a mechanism for the harmonisation of expertise and integrative social learning process?	Breznik and Hisrich (2014), Eisenhardt and Santos (2000), Grant (1996), Odor (2018), Yadav and Agarwal (2016)
Tacitness	Do people often acquire new ideas from expertise or often learn it via the firm's collective and repeated routines?	Nonaka and Takeuchi (1995), King and Zeithaml (2001), Eisenhardt and Martin (2000), Maket and Korrir (2017), Pedler and Burgoyne (2017), Nonaka <i>et al.</i> (2001a, b), Asheim <i>et al.</i> (2017), Tam and Gray (2016)
Dynamic capability	Does your firm use research and development activities for the continuous development and refinement of its resources and processes?	Eisenhardt and Martin (2000), Bowman and Ambrosini (2003), Teece <i>et al.</i> (1997), Tseng and Lee (2014)
R&D activities of a firm	Does your company use its R&D budget/activities for innovation?	
<i>Informal R&D activities</i>	Does your firm have informal R&D activities?	
<i>R&D enhances and develops structural components of a firm's core competence</i>	Does your company use its R&D budget/activities to develop/enhance its core competence?	Coombs (1996), Schimpf and Binzer (2012), Harris <i>et al.</i> (2009a, b), Quelin (2000), Winter (2003), Zollo and Winter (2002), Antonelli (2001), Seddighi (2015), Pedler and Burgoyne (2017), Rodil <i>et al.</i> (2015)
<i>Innovation</i>	Does your firm have collective research activities/budgets for product/process development	Torkkeli and Tuominen (2002), Huang <i>et al.</i> (2019)
<i>Exports</i>	What percentage of your sales in the last year was exported?	
<i>Constraints on R&D activities of the firm</i>	What is the main constraint on R&D activities and innovation in your company? a) Finance b) Staff c) Technological incapability d) Lack of experts	Seddighi (2015), Conte and Viarelli (2013), Asheim <i>et al.</i> (2017), Belderbos <i>et al.</i> (2004a, b)
<i>Staff turnover</i>	What is your firm's staff turnover per year?	NELEP (2016a, b)
<i>Willingness to co-operative R&D activities</i>	Which of the following would your company like to co-operate with? a. Similar firms b. Universities and research institutions c. Customers If the answer is yes, Is it because, i. It helps co-operation in R&D and innovative activities. ii. It helps in reducing operating costs iii. It enhances better organisational learning	Belderbos <i>et al.</i> (2004a, b), Santamaria and Surroca (2011), Seddighi (2015), Huang <i>et al.</i> (2019)

Table 1.
Academic
questionnaire

An academic survey strategy was used to collect the data from firms in North East England region. The sample frame of the study is tailored by combining both North East of England Process Industry Cluster and North East Chamber of Commerce directories to cover 3,300 production-based firms in North East England. Besides, the minimum sample size is decided as 330 firms to generate a 95% confidence level for various statistical tests (Saunders *et al.*, 2016). That said, given the low response rate of the region, the actual sample size had determined as 1,100 firms using a systematic stratified sampling method. A pilot study among 30 firms was conducted to check whether the firms interpreted the questions listed (see Table 1) as intended and made changes accordingly. Also, an email-mediated questionnaire is employed in this study to reach a large number of firms and their convenience (Frazer and Lawely, 2000). Two rounds of emails were sent due to an initial low response rate and eventually collected a minimum sample size of 330 firms needed for this empirical study. To shed some light on the existence of a potential interaction between each one of the above variables, in the first instance, based on the sample data, a two-factor graphical presentation of the frequency of occurrences will be presented and briefly discussed. These sample results will be then extended to the population of firms in the North East via a series of chi-square tests, and finally, a logit regression model was employed to estimate the conditional probability of the dependant factor, given the input factors. The crucial aspect of this exercise is to establish whether a firm has a core competence based on the existence of several main input factors identified from the literature and can subsequently be developed and refined via R&D to kick-start innovation activities.

4. An analysis of sample data

4.1 A firm's core competence and its input organisational attributes

Examining the linkage between collective OL and a firm's core competence establishes the relationship, which is complemented by the chi-square test indicating (22.044; $p < 0.001$) the statistical significance of the input factor to a firm's core competence. Similarly, a firm's tacitness firm and core competence are again positively related (See Table 2 chi-square – 52.741, $p < 0.000$). In terms of dynamic capability and core competence, their chi-square test (Table 2) rejects the null hypothesis and establishes the statistical significance and role of dynamic capability in building a firm's core competence.

Table 3 captures the results of the logit analysis estimating how strong the links were and the conditional probability of a firm's core competence, given the input factors.

4.2 R&D activities and the structural components of a firm's core competence

As R&D activities play a pivotal role as a source in accessing, developing and forming the firm's competencies (Quelin, 2000; Kishmaraj and Aino, 2013; Coombs, 1996; Tseng and Lee, 2014; Seddighi, 2015; Pedler and Burgoyne, 2017; Zollo and Winter, 2002), we directly asked the firms whether they actively undertake any formal and informal R&D activities. It is interesting to note that of the 330 firms that responded to the academic survey, the majority of the firms (284 firms, 86.66%) affirmed that they had separate ongoing budgets and R&D activities focused on innovation. A few firms (44 firms, 13.33%) reported they did not have

	Input factor	df	Chi-square	Significance value
The core competence of a firm	Collective organisational learning	1	22.044	0.000, $p < 0.005$
	Tacitness of firm	1	52.741	0.000, $p < 0.005$
	Dynamic capability of a firm	1	63.299	$p < 0.005$

Table 2. Chi-square results for the relationships between a firm's core competence and its input factors

R&D funds or activities aimed at innovation. Similarly, across the sample 90.60% (299 firms) engaged in informal R&D activities. Only 9.39% (31) of firms in the sample reported otherwise. To shed some light on the linkage between each one of the key determinants of a firm's core competence and R&D activities, we next looked at the frequency of occurrences of the firm's R&D activities against the frequency of occurrences of each one of these key input factors (See Figure 2) and then extended to the population of firms in the North East via a series of chi-square tests (Table 4) carried out on the null hypothesis that there is no relationship between input factors of a firm's core competence identified above and R&D activities of a firm.

Figure 2 reveals that of the 330 firms reported, 303 firms have OL activities; of these, 90.09% of firms tend to have R&D activities. This observation is complemented by the chi-square test (see Table 4 (50.346; $p < 0.000$). In terms of the linkage between R&D activities and tacitness of a firm of total sample data, 316 firms are successfully using organisational routines and training to transmit the tacit knowledge embodied in human beings. Among these, 87.34% of firms (276 firms) appear to have an R&D budget (10.191, $p < 0.001$). Besides, of the 330 firms that responded, 297 firms believed they had the dynamic capability: 92.59% of them have also undertaken R&D activities.

In contrast, of the 33 firms that failed to have the dynamic capability, 72.72% of them also could not possess R&D activities. Graphically, the firms with dynamic capabilities displayed a solid propensity for undertaking R&D activities, and the relationship is consistent with the chi-square test result (105.633, Sig. = 0.000). Comprehensively, the results appear to support the literature, which highlights the significance and presence of R&D activities in developing and forming the above three key organisational attributes contributing to a firm's core competence.

4.3 A firm's knowledge/core competence level and innovation of firms in North East England

As the core competence of a firm is the key ingredient of knowledge-driven innovation, we next compared the linkage between a firm's core competence and innovation activities of the firm. A total of 290 firms in the sample data reported they had the product and process innovation activities; of these, 96.89% of firms have identified their core competence. Similarly, of these 311 firms having core competence, a significant portion of firms (90.35%) also reported successfully undertaking innovation. Again, these observations from the sample are complemented by the relevant chi-square test (see Table 4, 31.061; $df = 1$; Sig. value = 0.000), which appears to indicate a significant statistical relationship between these two firm's attributes (Hafeez *et al.*, 2002; Srivastava, 2005; Seddighi and Mathew, 2020; Clark, 2000).

Table 3.
Logit analysis results of estimating the conditional probability of a firm's core competence given the input factors

Dependent variable	Independent variable/input factor of a firm's core competence	B (coefficient)	SE	Wald	df	Sig. <i>p-value</i>	Exp(B) (odds ratio)	Probability of core competence of the firm
The core competence of a firm	Collective organisational learning	2.139	0.529	16.359	1	0.000	8.487	96.00%
	Tacitness of a firm	3.232	0.610	28.057	1	0.000	25.333	96.16%
	Dynamic capability of a firm	3.164	0.527	36.115	1	0.000	23.673	96.74%

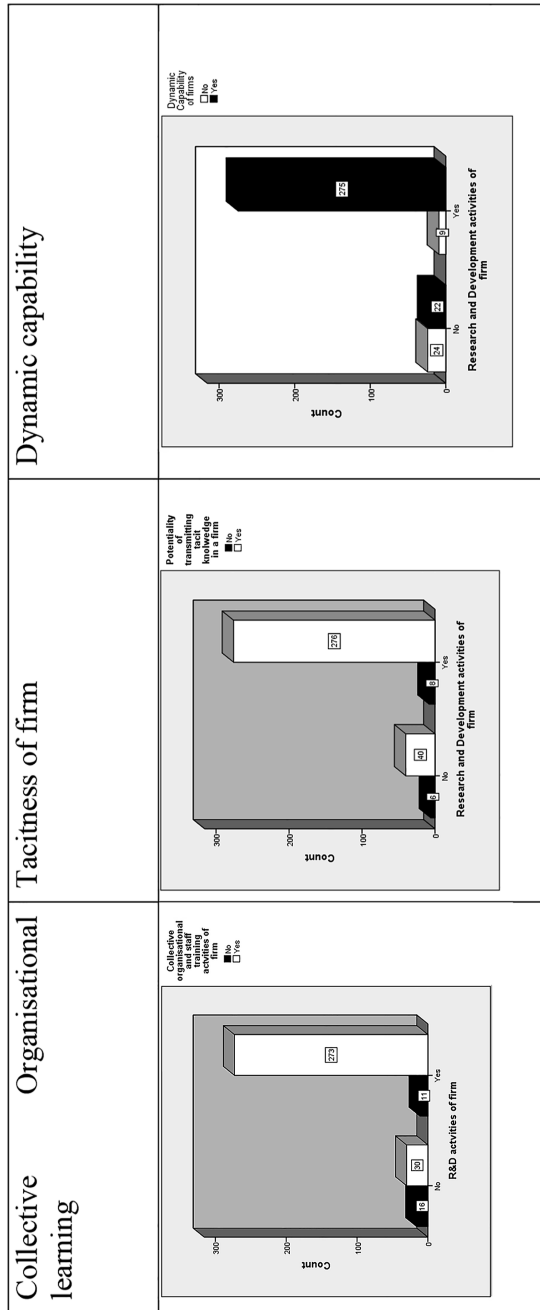


Figure 2. Two graphical between a firm's R&D activities and core competence components

4.4 Exports of firms in the North East region

The linkage between a firm’s core competence, exports and innovation at the firm level is widely acknowledged in the literature (see Love and Mansury (2009) and Ganotakis and Love (2011). In keeping the emphasis on exports, Gourlay *et al.* (2005) infer that exports are strong indicators of the effective commercialisation of production innovation via a firm’s core competence (Seddighi and Mathew, 2020). On this ground, we now focus on the export activities of firms in this region.

Nevertheless, Figure 3 suggests that the majority of the firms in the region (190 firms, 57.6%) do not engage in exports. Moreover, 32.33% (106) of the firms in the sample reported low export rates at less than a quarter of their sales. Only 10.3% (34) of the firms reported having good export rates that accounted for at least a quarter of their sales. However, a handful of the firms (3.6%) had achieved high export rates, as more than 50% of their sales were exported. We next compared whether a firm’s innovation enhances the intensity of the export of firms. The results expose that, in contrast with literature (Grossman and Helpman, 1991; Harris *et al.*, 2009a, b; Ganotakis and Love, 2011; Harris and Moffat, 2015; Rodil *et al.*, 2015; Love and Roper, 2015), there is no statistical linkage seen between innovation and export intensity of firms operating in the region. Nonetheless, we further analysed whether innovation has any role in those who reported they had exports regardless of their export’s intensity. Of the 140 firms reported to have exported, 92.85% of firms had innovation activities. This relationship is statistically complemented by a chi-square test (Table 4, 5.658; df = 1; sig. value = 0.017). As the firm’s innovation is the key element for exports and vice-versa (Clark, 2000), we further categorised firms into processing industry, manufacturing, servicing and engineering industries (Table 5) and analysed their innovation, R&D and export activities.

Looking at the data (Table 5), it is interesting to note that, of the 42 processing firms, 90.47% of firms claimed to have innovation. As was expected, one can see that of these firms, 39 (97.43%) also reported having R&D activities, and this is reflected in their export activities (Rodriguez, 2014). Specifically, 59.52% of processing firms have above 25% exporting of their sales which further points to the linkage between a firm’s R&D activities (Pedler and Burgoyne,

Variables	Organisational attributes contributing to the formation of a firm’s core competence	df	Chi-square	Sig value
R&D activities	Collective organisational learning	1	50.346	$p < 0.000$
	Tacitness of a firm	1	10.191	$p < 0.001$
	Dynamic capability of a firm	1	105.633	$p < 0.000$
	Innovation of firm	1	31.061	0.000
The core competence of a firm				
Firms having innovation activities	Firms having exports	1	5.658	0.017

Table 4.
Chi-square results for the relationship between R&D and core competence components

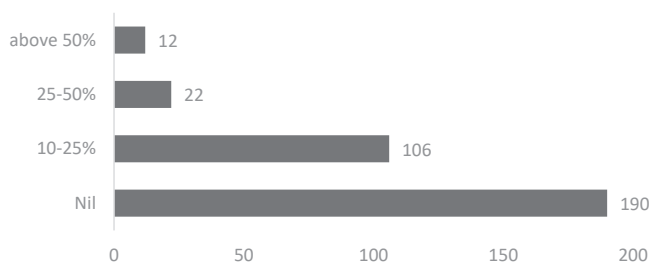


Figure 3.
The export intensity of firms in North East England

	Total number of firms	Reported to have processing/product innovation	R&D		Export intensity	
			Yes	No		
Processing firms	42	38	39	3	Nil	5
					10–25%	12
					25–50%	15
					>50%	10
Engineering firms	68	58	61	7	Nil	34
					10–25%	32
					25–50%	2
					>50%	0
Services industry	149	131	117	32	Nil	131
					10–25%	18
					25–50%	0
					>50%	0
Manufacturing firms	71	63	67	4	Nil	20
					10–25%	44
					25–50%	5
					>50%	2

Table 5. Classification of firms in the North East England region

2017), innovation and exports (Gourlay *et al.*, 2005; Love and Mansury, 2009; Ganotakis and Love, 2011). In contrast, though a significant share of manufacturing (87.5%), engineering (92.06%) and services (87.91%) industries in the region claimed to have innovation, the majority of these firms do not have export activities at all (Table 5). Despite the positive response concerning creation, the data indicate that their respective core competencies need to be further developed and refined, for example, through improving access to a wider variety of markets via targeted R&D activities (Seddigihi, 2015).

One interpretation of the deficiency of exports of firms in the region could be that firms in the region have failed to have continuous and rigorous R&D activities that develop, refine and maintain their core competencies, which have a direct impact on innovation and export activities (Piere-Alexandre Balland *et al.*, 2014; Huang *et al.*, 2019). The results from the firm operating in North East England are consistent with observations of NELEP (2016a, b) and ONS (2018). Examining the forces repressing and impeding the R&D activities of the region, Figure 4 presents the constraints on the R&D and innovation activities of the firms in North East England.

Figure 4 illuminates that nearly half of firms (157 firms, 47.57%) in the region of North East England recognised finance as their key problem for engaging in consistent and

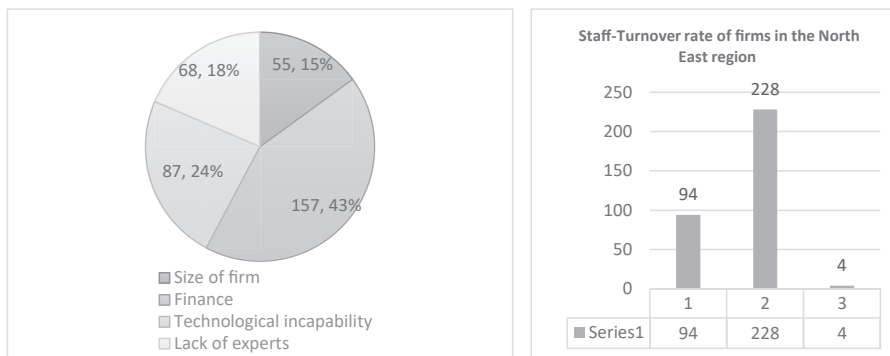


Figure 4. Constraints of firms in North East England

sustainable R&D and innovation activities. A reasonable portion of firms in the region (26.36%; 87 firms) considered technological incapability and lack of experts (20.60%; 68 firms) their key constraints in R&D activities, along with the size of a firm (16.66%; 55 firms). Consistently, more than two-thirds of firms (69.09%) in the region were facing a severe staff turnover problem, which directly threatens the retention of knowledge/core competence and diffusion of knowledge (See Balland *et al.*, 2014). These results are consistent with the observations of NELEP (2016a, b), Round (2016) and ONS (2018, 2019). Against this background, we examined the main sources of the R&D and innovation budgets of firms in North East England, in which the majority of firms (62.7%) depended on their finance for R&D activities and innovation. In sum, 66.9% of firms in the region were dependent on a single source of R&D budget. Conjoining this argument, the data suggest that government funds (16.1%) played only an infinitesimal role in expediting the research and innovation activities of firms in the region. Interestingly, only a minuscule portion of firms reported that they received any income from universities and other research institutions. The underdeveloped core competence and low uptake of R&D and innovative activities in a peripheral region not only affect the dynamic capability of the firm (Huang *et al.*, 2019) but also restrict local firms from taking advantage of knowledge spillovers that occur in leading regions (Asheim *et al.*, 2017; Belderbos *et al.*, 2004a, b).

5. Towards a framework for a firm's innovation operating in peripheral regions

Against this backdrop, a literature stream is growing that postulates that cooperation in R&D activities and collaborative knowledge activities are the smartest and most efficient ways to tackle constraints (Daniel and Huang, 2019; Belderbos *et al.*, 2004a, b; Aslesen and Isaksen, 2007), such as in the fields of finance, risks and technological capabilities (Belderbos *et al.*, 2004a, b; Brandenburger and Nalebuff, 1997; Huang *et al.*, 2019). In line with this, Rodriguez (2014) argues that the linkage between R&D activities and innovation is dependent on Marshall-Arrow-Romer and Jacob's (1970) externalities. His line of reasoning points to the importance of cooperation between firms regarding their R&D activities and the co-existence of firms, which is also labelled as "knowledge networks" (Balland *et al.*, 2014, p. 911) and "innovation eco-system" (Huang *et al.*, 2019, p. 844), for both a firm's innovation and exports (Seddighi, 2015; Seddighi and Mathew, 2020). Ensuining from the works of Krugman (1991) and Makun and Macpherson (1997), without doubt, all these postulations and theoretical tenets (see Asheim *et al.*, 2017; Adner and Kapoor, 2010) single out the importance of cooperation of firms for innovation. There is ample literature arguing the significant role of collaborative R&D and knowledge activities in further accelerating the development of the structural components of a firm's core competence (see Rodriguez and Martinez-Lopez, 2017; Balland *et al.*, 2014; Huang *et al.*, 2019). In fact, in many instances, the development of new or improved products by firms begins with an active search for suitable firms willing to co-operate either formally or informally in R&D activities. Reflecting this, the firms in North East England were asked about their cooperation/willingness to co-operate with similar firms, customers, research institutions and universities.

Figure 5 presents the distribution of firms in North East England willing to co-operate with similar firms, universities and customers. The first striking feature is that the majority of the 330 firms in the sample (62%) were willing to co-operate with similar firms. Among these, 66% (134 firms) stated an interest in working within a cluster of similar firms for the development and refinement of core competencies and R&D activities, which seems to mirror the works of Rodriguez and Martinez-Lopez (2017) and Huang *et al.* (2019). By contrast, we observe that 34% (69 firms) were interested in co-operating with similar firms outside of a cluster. Nevertheless, 38% of firms in the sample had no interest in co-operating with similar firms; unfortunately, the questionnaire did not explore the reasons for non-co-operation.

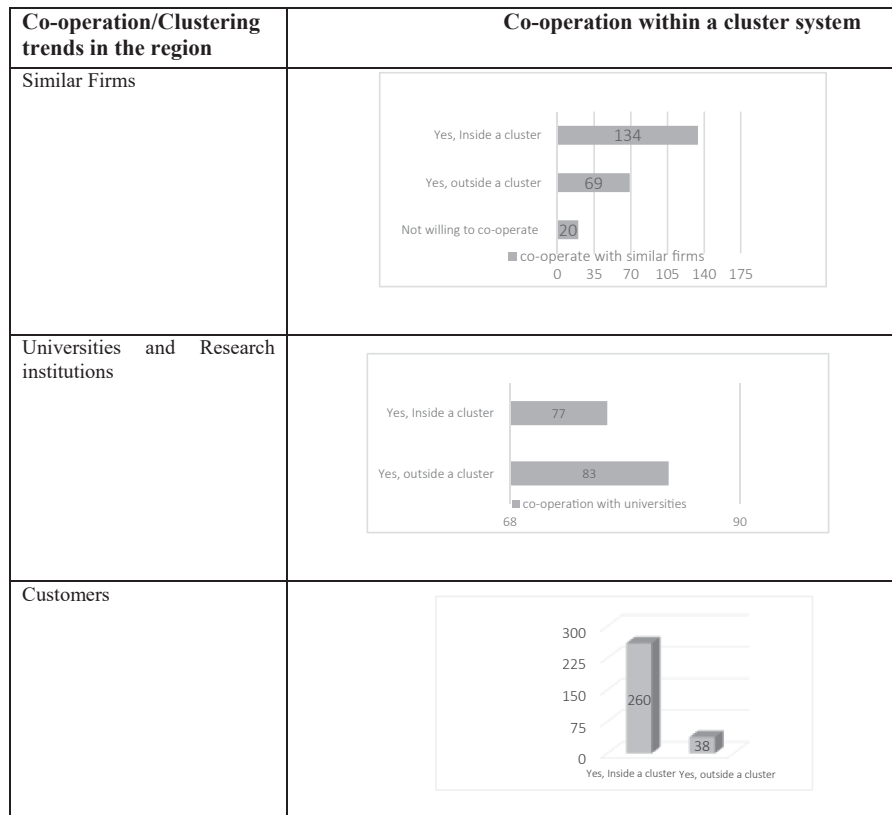


Figure 5. Co-operation and clustering trends among firms in North East England

We then looked at the interest of firms in North East England in co-operating with universities and research institutions.

Interestingly, of the 330 firms in the sample, more than half (52%) were reluctant to co-operate with universities or research institutions. The sample findings of the region appear to contrast with the findings of Bessant and Tidd (2017), Belderbos *et al.* (2004a, b) and Ashok *et al.* (2016). Finally, Figure 5 presents the extensive amenability of firms in this region to co-operate with customers on R&D activities. Of the 330 firms, 298 (90%) were interested in such cooperation. Only a handful of firms were reluctant regarding this approach. Of the 298 firms that were amenable, 87.24% expressed their readiness to co-operate in a cluster system. In contrast to cooperation with similar firms and universities, only 12% of firms were opposed to operating in a cluster system.

Building on this, we examined the rationale for cooperation among firms operating in the region. First, it is evident from the sample data (see Figure 6) that a salient reason for collaboration was to develop a better knowledge-building environment: a prominent factor required for innovation (Asheim *et al.*, 2017). Second, of the 330 firms, 79% (261 firms) were willing to co-operate to enhance their R&D and innovation activities (Huang *et al.*, 2019). Third, more than three-quarters of firms (76.37%) in North East England were willing to co-operate to build an excellent collective OL environment: an influential factor required for developing a firm's core competence (Balland *et al.*, 2014). Finally, 199 firms in the region reported that they would like to engage in cooperation to reduce their costs. Synthesising the above discussion, it is worth proposing the co-operative model (Figure 7) of R&D activities to

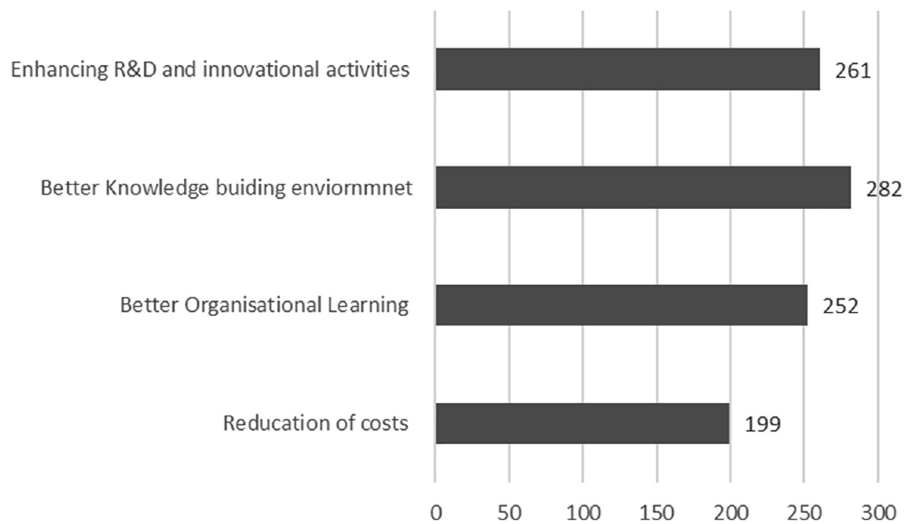


Figure 6.
Rationale of firms in North East England for co-operative R&D activities

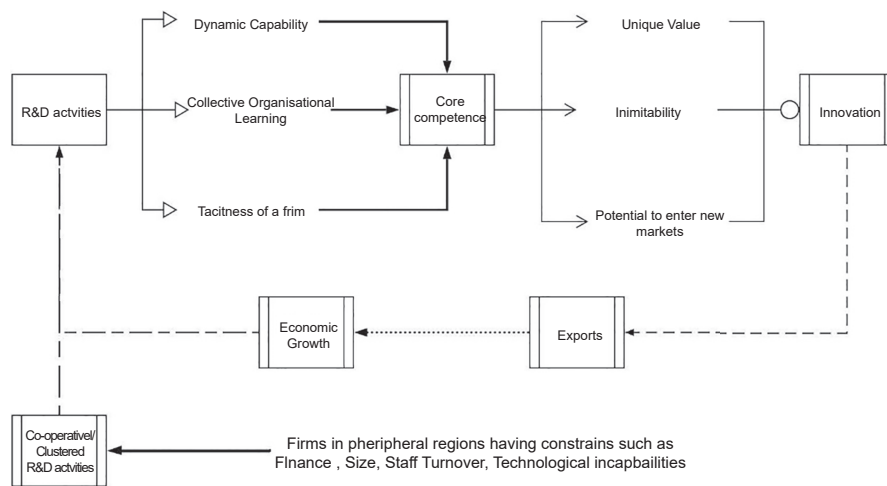


Figure 7.
A cooperative model for firms operating in peripheral regions for knowledge and innovation activities

create innovation and value (Adner and Kapoor, 2010; Huang *et al.*, 2019; Rodriguez and Martinez-Lopez, 2017) for firms operating in peripheral regions.

6. Conclusion

This study examined key structural components of a firm's core competence whose existence and development would lead to innovation, exporting and growth of a firm. Due to anecdotal empirical evidence for the concerned linkage, we collected data from 330 firms operating in North East England. Our study engenders two key significant contributions to the current research. First, our results show that a firm's core competence is fabricated with three fundamental organisational attributes: dynamic capability, collective OL and tacit knowledge.

In our view, this is a remarkable step forward in this field, adding to the literature on core competence and its development, which is still muddled and not fully developed (Ljungquist, 2008). Based on our findings, we recognise that the nexus between these critical attributes that are pertinent to innovation is maintained and enhanced by a firm's R&D activities. It is also found that firms operating in the North East, a peripheral region of England, appear to be significantly constrained in their R&D activities by the lack of finance, technological capability, experts and brain drain.

Second, the study generated empirical evidence linking organisational core competence, R&D and exporting activities. Whereas a surfeit of conceptual formulations identified the salience of OL dynamic capability and casual ambiguity, quantitative evidence on this nexus is still scant. Moreover, we believe this study also corroborated the pivotal role of R&D in developing the above attributes and innovation. Based on these findings, we proposed a co-operative R&D framework to narrow down these constraints to assist firms in developing core competencies for innovation and exporting in a peripheral region. Most importantly, this exercise would assist policymakers in monitoring and framing innovation in this region.

7. Limitations and future research

Though the study collected a large sample of firms operating in the North East England region, this may have affected the generalisability of the results; therefore, expanding the model to additional areas in future would enhance the theoretical understanding of the model. Furthermore, the study suggested a co-operative R&D model for long-term innovation for the firms operating in the peripheral region; however, coherent research, data collection and analysis are required on how these co-operative R&D activities enhance the structural components of a firm's core competence. In particular, future research should explore how the firm's co-operative R&D enables a firm's core competence to explore new markets and increase exports.

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