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Such collaborations allow firms to imbibe innovative measures that many at times are beyond their individual capacity but becomes accessible through collaborations. Where MNEs are able to engage in collaborative innovation partnerships, SMEs by virtue of their small size, moderate revenue, and organizational capabilities are not so strongly positioned (Van de Vrande et al. 2009). These firms would significantly benefit from innovation-focused collaborations.

This exploratory paper investigates the barriers to collaborative partnerships in small firms in two case-study sectors. Drawing upon data from 25 semi-structured interviews, this article sheds light on the barriers to the adoption of open innovation practice and explores the drivers of innovation in SMEs.

To this end, our findings indicate that while inter-firm innovation collaboration within the industry sector is inexistent, firm collaboration across the supply chain; suppliers and customers, is a common feature. Our results also show that knowledge of capabilities and trustworthiness are important in
innovation collaboration decision. This study offers preliminary evidence of a relation between inter-firm innovation collaboration, knowledge of capability and trustworthiness.
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1. Introduction
The development of innovative strategies that encourage collaboration with other firms external to an organization is fast becoming fashionable in the business world and is a growing area of research in the academic environment (Chesbrough 2003, Gambardella and Panico 2014 and West et al. 2014). This innovation model embraces both the inflow and outflow of innovation, allowing in-house developed expertise and novelty to be exploited outside the firm whilst also exploiting external knowledge inside the firm. This is termed Open Innovation (OI) and the concept has gained increased popularity from the early 2000s based on the work of Chesbrough (2003a, 2003b, 2006).

Even as the concept of OI is trending in research studies and is gradually being integrated into business strategies, studies have shown that large firms tend to be more strategically inclined to adopt innovative practices and engage in collaborations compared to their SME counterparts (Vossen 1998 and Xiaobao, Wei and Yuzhen 2013). This has been attributed to the established structure, high capital investment, high capability, experience, and large risk management portfolio that distinguishes large firms from small firms (Berends et al., 2014, Hall et al. 2016, Van de Vrande et al. 2009). These constraints to SMEs, slow down the wider adoption of innovative strategies that can generate productivity gains required for continued technological and economic advancement (Rosenbusch et al. 2011; Saluja 2012). In order to close this widening innovation gap, it is imperative that barriers to innovation collaboration in SMEs are investigated and strategies to overcoming them explored. While many studies on innovation collaboration have focused on the use of quantitative techniques, in order to gain an in-depth knowledge of how industry CEOs and decision makers perceive innovation and factors that encourage or debar its adoption, the qualitative technique is our preferred method of choice for this study. Apart from the benefit of providing a better understanding of the research study from the perspective of the respondent, adopting a qualitative technique within the phenomenological framework is an effective way of obtaining industry-specific information about experiences, opinions, behaviours and values of the case-study industry sectors (Creswell 2013, Maxwell 2013, Starks and Trinidad 2007 and Tracy 2013).

Here, we investigate the barriers which prevent or restrict the formulation of innovation partnerships by SMEs in two UK industries – foundries and metal forming. We focus on informational market failures which may mean that firms aspiring to develop innovation partnerships may lack an understanding of the capabilities of potential partners, their trustworthiness and/or their ability to structure an innovation partnership. Our objective is to identify key issues prior to a more in-depth quantitative survey covering the two sectors and we focus on three research questions (Hewitt-Dundas and Roper, 2018): How are innovation partnership/collaboration perceived in the metal forming and foundry industries? Does insufficient information on partners’ capabilities influence decisions to embark on innovation collaborations in the metal forming and foundry industry? How does access to information on potential partner’s trustworthiness influence collaboration innovation in the metal forming and foundry industry?
2. Literature Review & Research Questions

2.1 Innovation Collaboration

The concept of innovation extends beyond discovering new products and processes but encompasses developing new markets, new sources of supply and firm re-organization (Schumpeter 1934). It extends beyond the R&D department of a firm to encompass users, suppliers and consumers across all sectors and institutions (OECD 2005). The Oslo manual defines innovation under two categories; product and business innovation (OECD Oslo Manual 2018). This definition captures a comprehensive range of achievable changes in a firm’s activities due to innovation adoption and caters for almost all, if not all possible offshoots of innovation at the firm level. However, for the purpose of this study, a simple definition of innovation will be adopted; which is the discovery, development, application, and exploitation of a new idea, technique, formula or process (Dodgson et al. 2008 and Van de Vrande 1986).

There has been increasing interest in innovation and constraints to its adoption in both small and large firms (Hewitt-Dundas 2006, Kratzer 2017, Spithoven et al. 2012, Van de Vrande 2009). This is because, despite the benefits associated with innovation, many organizations are still lagging behind in the innovation quest and are missing out in accruing direct and indirect benefits of innovation. Adopting an innovative stance in terms of products, processes or both can cause firms to be competitively positioned as well as pioneer new opportunities in the marketplace (Gunday et al. 2011). As such, innovation has been linked to performance improvements across organizations (Gunday et al. 2011, Hewitt-Dundas 2006 and Xiaobao et al. 2013).

Despite this, there is a significant disparity in innovation and productivity between the most productive frontier firms and other more domestically-oriented ‘non-frontier firms’ (OECD 2015). This type of disparity is most evident between large firms and SMEs. Reasons attributed to this phenomenon are centered on the often established structure, high capital investment, high capability, experience, and a large risk management portfolio that distinguishes large firms from smaller firms (Berends et al., 2014, Hall et al. 2016, Van de Vrande et al. 2009). These constraints to SMEs, slow down the wider adoption of innovative strategies that can generate productivity gains required for continued technological and economic advancement (Rosenbusch et al. 2011; Saluja 2012).

2.2 Innovation Collaboration Barriers in SMEs

Despite the benefits associated with innovation, the type of industry and size of firm (Van de Vrande et al. 2009) influence its level of adoption. This is because factors such as industry type (manufacturing or service) and firm size (SME or MNE) are important indicators as to the type and level of innovation a firm engages in (Hassan et al. 2013, Parida et al. 2012 and Terziovski 2010).

Many scholars (Spithoven et al. 2012, Cassiman and Veuglers 2002, Chesbrough 2003, 2006) suggest that organizations should adopt an open approach to its innovation practice, with evidence suggesting that firms are already in transition to a more open approach (Chesbrough 2003 and Poot, Faems and Vanhaverbeke 2009). This “openness” to ideas is termed Open Innovation (OI); where innovation is shared and exchanged across individual firms (Reed,
Barnes and Jessup 2012). It encourages firms to look beyond internal R&D and embrace both external and internal innovation sources (Freel and Robson 2017). OI is defined as “the use of purposive inflows and outflows of knowledge to accelerate internal innovation and to expand the markets for external use of innovation respectively” (Chesbrough et al. 2006: 1). This definition described as technology ‘exploration’ (inflow) and ‘exploitation’ (outflow) (Lichtenthaler 2008) initiates the back and forth flow of innovation between a firm and external sources; other firms, research institutes, universities, consultancy organizations, and other sources of knowledge. This contradicts the old innovation model where firms own, generate and develop new knowledge within their R&D unit and this new innovation is hoarded and guarded closely by such firms (Van de Vrande 2009) to maintain a competitive edge (Gunday et al. 2011 and Lichtenthaler 2016). This practice - which is termed Closed Innovation - is less fashionable as more firms are increasingly relying on supply chain elements, sub-systems and external firms for the development of their technological know-how, products, and services (Almirall and Casadesus-Masanell 2010).

Whilst manufacturing is an attractive sector for innovation adoption, research has shown that innovation strategies in large firms differ from that in SMEs (Vossen 1998 and Xiaobao, Wei and Yuzhen 2013). This notwithstanding, SMEs are beginning to adopt OI as the practice is increasingly becoming widely accepted across different industry size with medium-sized companies leading in this regard (Van de Vrande et al. 2009). This trend is not surprising, as an increasing number of SMEs are focusing on external means of innovation to facilitate knowledge diffusion and enhance their technological expertise (Xiaobao, Wei and Yuzhen 2013). Encouraging SMEs in this regard is a welcome development as SMEs play an integral part in the economic development of many nations, developed economies inclusive (Danis, Chiaburu and Lyles 2012 and Kongolo 2010).

SMEs have been described as the lifeline of the European Economy (European Commission 2018) and as such, the clamor for continuous creation of innovative solutions and a platform for harnessing available solutions via partnerships continue to gain momentum in the business and academic community (Van de Vrande et al. 2009). This has led to calls for SMEs to focus on innovation collaboration. Research by Trianni et al. (2014) indicated that SMEs are on the lookout for energy efficient solutions via their energy, equipment and technology suppliers. How much information is available or accessible for such SMEs is however debatable as a study by Thollander and Ottosson (2014) on energy management practices in the Swedish foundry and paper industries showed that half of the foundries and one-fifth of the paper mills investigated were deficient in their long-term energy plans. While this is not encouraging, it is neither surprising as it is increasingly becoming obvious that in order for SMEs to transition to technologies and practices that are efficient, it is imperative that a new approach is adopted. This should imbibe innovative measures that many at times are beyond the shores of small firms but may be accessible through collaborations with forward-thinking innovative firms (Trianni et al. 2013).

This brings the discussion back to the potential missed-opportunities that have prevented many SMEs from developing partnerships that studies have shown to be beneficial in no small way. The irony in these cited studies is not uncommon (Hewitt-Dundas and Roper 2018,
Spithoven et al. 2012 and Trianni et al. 2013). Oftentimes, where a business need is established, especially in relation to innovation, many firms find it difficult to harness possible accruable benefits in collaborative partnerships that ordinarily have the potential of providing long-term solutions that can result in efficient and reduced cost processes (Chesbrough 2010). Nonetheless, it is clear that the transition to a more sustainable production will require substantially different, that is, innovative technologies and practices than those in use today., when considering energy-efficient technologies and energy management practices,

The need for innovative practices in the foundry and metal casting sectors has been highlighted in various studies (Euskalduna 2014, Thollander and Ottosson 2014, Trianni et al. 2013 and de Jong et al. 2009). In order for SMEs in these sectors to derive meaningful benefits from available technological competencies, it is necessary to identify firstly that there is a knowledge gap and a strategic need to be met, source and select a matching innovation collaboration fit and over time, reassess and reshape the ensuing partnership (Hewitt-Dundas and Roper 2018).

3. The Case-Study Sectors

Two sectors were examined in this study. The UK foundry sector and the metal forming sector.

3.1 Foundry Industry

Despite the longevity that epitomizes the industry, the business of profitably managing a foundry evidenced by long-term growth remains challenging and can be tough even in this time and age (Swartzlander 2012). Across the globe, the foundry industry is primarily categorized as an SME due to the high percentage of firms with few employees. About 80% of foundry firms have a workforce of fewer than 250 employees (Holtzer et al. 2012). About £1.9Billion.

Of the over 40,000 foundries across the globe, the UK has a population of about 480 foundries, 16,000 employees and an annual revenue of about £1.9Billion (Casting Industry Census 2017). The sector primarily caters for the automotive, defense, engineering, infrastructure, and the construction markets. It also provides raw materials for other industries such as electronics, medicine, and aviation industries (Casting Industry Census 2017).

3.2 Metal Forming Industry

The UK metal forming sector is responsible for the manufacturing of fasteners, pressings, and forgings (CBM 2018). Comprising more than 400 firms, the sector produces about 1.3 million tonnes of metal products each year to meet the UK market demand and exports (Carbon Trust 2011)

Like its foundry counterpart, the sector plays a key role in the automotive industry and across the manufacturing sector in general (CBM 2018). The sector is also not without its own millennial challenges. In recent years, the metal forming industry has become competitive (Galdos et al. 2017). With the increasing need for specialized products using new metals and alloys, there is a growing need for the optimization of already established metal forming processes for the making of high-value metal products that can compete with products made from less expensive metals and polymer materials (Misiolek 2017). Technical challenges ensue
especially when considering material behavior, quality and process forces for product requirements centered on complex and flexible designs (Neugebauer et al. 2011).

4. Methodology
4.1 Research design

This research study investigates current innovation practices as well as drivers and barriers to the adoption of open innovation in SMEs, specifically in UK foundries and metal forming firms. It also examines how trust and knowledge of a potential partner’s capabilities influence a firm’s decision to collaborate. The study adopts a qualitative approach as the first stage of a sequential (QUAL/QUAN) mixed-methods analysis (Creswell and Creswell, 2017). In this approach, qualitative data on a relatively uncharted phenomenon is collected and analyzed prior to quantitative data collection and analysis. The qualitative component in this mixed-method typology is an initial exploration stage aimed at identifying variables, constructs, taxonomies for quantitative study (Tashakkori and Teddlie 1998).

The use of more than one method (qualitative and quantitative) to study a phenomenon is becoming increasingly popular, as many works have recommended its adoption in research studies (Bryman 2016, Creswell and Creswell 2017, Crewsell and Plano Clark 2011, Onwuegbuzie and Leech 2005 and Ostlund et al. 2011). The exploratory mixed-method is particularly beneficial as a technique for evaluating management concepts by harnessing the strengths of each individual research approach, allowing the clarification of results from one method by the second method, as a basis for more robust and generalizable outcomes, and with the potential of informing policy design (Tashakkori and Teddlie 1998).

The selection of the sequential exploratory mixed method reflects the overall objectives of this study. That is, understanding what firms describe as innovation and efforts towards innovation, how firms perceive open innovation, and the drivers and barriers that influence its adoption. Furthermore, this study seeks to examine the role of trust and knowledge of capabilities on a firms’ decision to collaborate. Thus, exploring how lack of information on the trustworthiness and capabilities of a partner influences their decision to engage in partnerships and the effects on the types of partnerships in which firms engage.

The qualitative technique, which serves an exploratory function in this study, is a primary data collection methodology and is designed to provide a rich and holistic insight into innovation collaboration and its influencing factors (Tracy 2013).

4.2 Questionnaire Design

In this study, the qualitative research instrument employed is the use of semi-structured interviews. Hence, the interview progressed with the use of a list of pre-determined questions to articulate the perception and views of business owners and managers in the case-study sectors. The interview questions were on innovation, open innovation practice, factors influencing its adoption as well as their views on the trust and knowledge of capabilities as factors that may stimulate or hinder them from entering into innovation partnerships.
4.3 Sampling and Interview Process

This study was conducted in partnership with two trade associations for the case-study sectors; Cast Metal Federation (CMF) and the Confederation of British Metal Forming (CBM). In selecting respondents for the interview, the CMF and the CBM acted as a link to firms in the sectors.

A purposive sampling strategy was adopted in this study. This provided the benefit of a comprehensive investigation by speaking to those in the capacity of providing detailed and perceptive information on the phenomenon being studied (Guest, Bunce and Johnson 2006). Firms registered as members of the CBM, CMF were notified of the research study, and participation request sent via email and associations’ monthly newsletter. A mix of SMEs, MNEs, and suppliers to the case study sectors were interviewed to allow for a detailed and comparable study outcome. A total of twenty-one face-to-face and four telephone interviews was conducted. Based on the conversations and data set, we observed that theoretical saturation occurred within the first fifteen interviews at which stage, responses from respondents were being replicated.

4.4 Data Analysis

Prior to data analysis, all recorded interviews were transcribed verbatim. The analysis of the data was conducted following guidelines proposed by Thomas (2006) and Lorelli et al. (2017). The following five steps were followed in analyzing the data:

Step 1. First, we read through the transcribed data as a first read through. Reading of fields notes was done at this stage alongside the transcribed data. The data was also cleaned in the process for easy readability and understanding.

Step 2. The text was read thrice as a way of identifying emerging themes and development of information-rich categories to describe the evolving outcome (Kaplan and Maxwell 1994).

Step 3. Using the NVivo software, the interview transcripts were coded into nodes. More codes were added to the codebook as the text was examined in detail. In analyzing the text, both the manifest and the latent content were considered. To test for reliability of the developed codes and the process, sections of the transcript were given to two independent researchers to code. These were then compared with codes we had generated for the sections. This evolved a high degree of similarity, indicating that the codes were representative of participant responses.

Step 4: Categories and themes were afterward created from developed codes by the merging and classifying of similar patterns. This involved the development of sub-themes representing ideas from the text.

Step 5. The final step was an iterative process which involved continuous revision of categories and further clarification of sub-topics using research questions.
5. Results

5.1 Demographics

In this exploratory study, twenty-five interviews were conducted across the UK metal sector to provide answers to the research questions for this study; specifically in the metal forming and metal casting sectors. Suppliers to these industry sectors were also interviewed. Interviewees comprised of CEOs, Managing Directors, and Managers working across roles focused on innovation, R&D, business development, market expansion, and product and process development. All participants had a portfolio of years of experience in the industry sectors and worked in capacities that made them knowledgeable to provide answers to the interview questions and insight into the study. The number of firms that participated in the casting, forming and supply sectors were 13, 8 and 4 respectively (see Figure 1).

![Figure 1: Number of Firms Interviewed Across Industry Sector](image)

Firms interviewed varied in age (years of existence) and size; across small (10 to 49 employees), medium (50 to 249 employees) and large (more than 250 employees) firms (see Figure 2).

![Figure 2: Firms interviewed by Industry Sector and Size of Firm.](image)
The ages of participating firms varied across industry sectors. Nine of the firms have been in business for over 40 years, seven for less than 40 years and only two have been operating for less than 20 years (see Figure 3).

**FIRMS INTERVIEWED BY SECTOR, SIZE & AGE**

![Graph showing firms interviewed by sector, size, and age](image)

**Figure 3: Firms interviewed by Industry Sector, Size, and Age of Firm.**

All participating firms had an annual turnover of over one million pounds, with 13 firms earning above nine million and twelve firms earning less than nine million (see figure 4).

**Number of Firms Interviewed by Industry Sector & Annual Turnover**

![Graph showing firms interviewed by industry sector and annual turnover](image)

**Figure 4: Firms interviewed by Industry Sector and Annual Turnover**

5.2 Research Question 1

How are innovation partnership/collaboration perceived in the metal forming and foundry industries?
5.2.1 Definition of Innovation

The data reviewed how industry executives define innovation. In this context, it explored the manner industry executives perceive innovation as a concept. Its meaning, description, and adoption in business. Five main definitions evolved for the term innovation based on interview responses. These are; creation of new products, novelty or finding a new alternative, significant step change, solving problems and technological breakthrough. From the data, significant step change, solving problems and finding new alternatives emanated as the meaning of innovation with majority of respondents in the casting sector defining innovation in these context respectively. In the metal forming sector, defining innovation as ‘finding new alternatives’ emanated as the main definition adopted by majority of respondents in this sector. For suppliers to these industry sectors, it was interesting to see that their definition of innovation leaned towards the creation of new products and technological breakthrough.

Similarly, a comparison of interview responses on innovation definition based on firm size indicates that majority of medium-sized firms (50 – 249) define innovation as significant step change and technological breakthrough respectively. However, in small firms (10 – 49 employees), defining innovation as the creation of new products and finding new alternatives emanated with the as the most frequently used definition

Participant 3A, who is an R&D manager in a medium-sized metal casting company defined innovation as “... solving problems, if you’re innovative you’re either coming up with a product which is better than somebody else’s product because it solves a problem or you are looking at your process and you’re trying to do things differently to solve a problem”.

Participant 10A, who is an executive director of a medium-sized casting company defined innovation as “achieving technical improvements, pushing the boundaries of what processes are capable of, improving technologies that are already existing. So, yes, technical improvements”.

5.2.2 Motivation for Innovation

The data reviewed the driving force for innovation in the case-study sectors. Five main motivators emanated from the data, these are; spreading risk, customer demand and market expectation, process improvement, growth and sales and remaining competitive. Exploring these five innovation drivers based on the size of the firm, remaining competitive, spreading risk and growth and sales emanated as the most mentioned innovation motivators in small firms. While customer demand and market, expectation came top on the list for large firms. In medium-sized firms, meeting customer demand and firm growth are the leading innovation motivators.

Participant 11A, a business development manager in a medium-sized metal casting company indicated that without innovation, “....you can’t compete on price, as it were, so you’ve got to compete in different ways, through technology and offering something different”.
Participant 19A, a managing director in a small-sized metal casting company stated that “Innovation! It is the only reason we are here...”.

5.2.3 Current Innovation Practice & Partnerships

Using the data, current industry practice on innovation and types of innovation partnerships embarked upon by the case-study firms were explored.

5.2.3.1 Current Innovation Practice

In order to understand the current innovation practice in the case-study industry sectors, it was important to examine how firms approached and engaged in the concept. Analyzed interview responses showed that the case study firms innovated in seven (7) main ways. These are via; In-house R&D, Customer Involvement, Supplier Involvement, R&D Outsourcing, External Companies, University Involvement, and Employee Involvement.

Across these practices, In-House R&D evolved as the most frequently adopted practice in the metal forming sector with 13 respondents stating that the development and expansion of their firm’s innovation portfolio can be credited to in-house capabilities. A similar inference can be drawn for medium-sized and small firms across the industry sectors based on firm size where in-house R&D emanated as the most frequently adopted innovation practice. Furthermore, customer involvement, supplier involvement, and R&D outsourcing evolved as current innovation practices in the casting sector with 10, 6 and 4 respondents identifying with these practices respectively.

Participant 21A, a site manager in a small-sized metal casting company stated, “...we have a small team and our R&D is just in-house. We have quite a number of clever people here, so we make up the R&D team”.

Participant 10A, a managing director in a metal casting company stated, “Suppliers, play a key role in terms of developing innovative, developing new technologies and applying them to what we are doing here, then yes we have been pretty effective in dealing with suppliers”.

5.2.3.2 Innovation Partnerships

Further to the current innovation practice in the sector, it was important to understand definitively, types of collaborations that characterized the case-study industry sectors. Responses confirmed the existence of five innovation partnership types in the case-study sectors.The five main partnership types that emanated from the interview are; partnership with universities, research centers, trade associations, external partners, and within supply chains. In each of the 21 firms across the metal forming and casting sectors that participated in the interview process, the adoption of two or more of the identified partnerships was evident and already a part of the business strategy. Furthermore, innovation collaboration within the supply chain evolved as the most beneficial collaboration across both industry sectors.

A probe into the existence of innovation partnerships between firms within the industry sector showed that firms within the same industry sector did not collaborate in the context of developing new inventions or creating new products.
Further exploration of innovation partnerships within the supply chain across participating firms showed a two-directional trend; collaboration with customers, collaboration with suppliers and collaboration with customers and suppliers.

**Participant 8A**, a managing director in a medium-sized metal casting company stated, “We do some collaboration through the trade association championing health and safety group so that we can keep everybody safe, we’re very open with sharing practices there …”.

**Participant 10A**, a managing director in a medium-sized metal casting company stated, “We work pretty closely with our suppliers and our customers. We do a lot of innovation work with our customers, where they come to us with a design of a product and we find a better way of making it for them. We prototype it for them and we improve it, so we do a lot of work on that”.

### 5.2.4 Barriers to Innovation Collaboration

Nine main factors emerged from the analysed interview responses. These are; risk, firm size, time constraint, trust, IP ownership, knowledge, availability of fund, corporate culture, and competitive environment. Other factors mentioned by interviewees are insufficient government support, concepts non-existent, skills, proximity and the technical-academic gap.

Of all the nine main identified factors, market competitiveness emanated as the most mentioned barrier to innovation collaboration across the industry sectors and based on firm size. Respondents that answered in this context iterated that collaborating with another firm especially in the same sector and manufacturing similar products was not a realistic nor practical alliance as market survival depended on originality and to a high extent, a level of competitive edge over other firms. Where this is inexistent, then the firm losses its selling strength. As an offshoot of this factor, firms tend to be secretive and do not share their expertise. According to respondents from the metal casting sector, this barrier has historical overtones and is a characteristic feature of the industry.

The data shows that lack of trust is a mitigating barrier to collaboration. Where respondents indicated that trust is an integral element for any collaboration to occur, relationships leading to trust however is built over time and requires some form of initial risk to embark on such in the first instance. Recourse to Non-Disclosure Agreements (NDAs) is common practice in managing such risks by sector firms. However, this was deemed fallible and therefore, does not completely eliminate the risk factor.

Financial constraints and size of firms emerged as barriers to innovation collaboration. These two barriers though separate, are interlinked. SMEs are characterized by small and medium firms, some of which are family firms, with lower financial capabilities compared to their large counterparts. This characteristic influences financial investment that can be set aside for such risk-prone collaborations. Respondents further mentioned that the need to reduce risks or
spread risk may influence the type of innovation strategy that firms adopt and this to a certain extent is a limitation to collaborations in the industry sectors, especially in SMEs.

Insufficient knowledge on the capabilities of a potential innovation partner is a deterrent to collaborations. Knowing the processes, technical expertise, reputation and the added value the collaboration will be bringing to the partnering firms act as decision indicators for collaboration. Inaccessibility to these information reduces the possibility of a collaboration taking place.

**Participant 19A**, a director in a small-sized metal-casting company stated, “they don’t like to tell you nothing. Up until really recently, if I went to another foundry I wouldn't be allowed to walk around because I am a foundryman...... So, would I work in collaboration with other companies? I would love to, but I can't find anybody that particularly wants to collaborate with us”.

**Participant 3B**, a director in a small-sized metal-forming company stated, “you know, the sector we are involved in is fiercely competitive and nobody really wants anybody else to know what they are doing. It’s a major constraint to having any kind of partnerships”.

**Participant 5A**, a technical manager in a metal casting company stated, “you certainly need to know a bit about what their business is, and that would definitely be an influencing factor really as to whether that would be the right partner or not if you’ve got a choice of course...... Yes, I think when a problem comes up, it’s not the first thing we think of...”.

**Participant 3A**, an R&D manager in a medium-sized metal casting company stated, “as an SME, time, money, resources, brain power you know, they are all working against us”.

**Concluding Statement on Theme – Barriers to innovation Collaboration**

Analyzed data identifies nine main key barriers to innovation collaboration in the case-study sectors. Based on firm size and across the two study sectors, market competition, trust, IP ownership and management, size of firm, knowledge, and financial and time constraint are leading barriers to innovation collaboration. These factors hinder the adoption of partnerships as a means of stimulating innovations by overcoming capability, skill, expertise limitations that characterize individual firms. Thus, preventing firms from harnessing the synergistic potentials of partnerships that encourage the creation of novel techniques and solutions.

**5.3 Research Question 2**

Does insufficient information on partners’ capabilities influence decisions to embark on innovation collaborations in the metal forming and foundry industry?

**Themes**: Knowledge of Capabilities, Information Sources, What to Know

**5.3.1 Knowledge of Capabilities**
Data explores how having a detailed knowledge about a potential innovation partner’s capabilities influences the decision to collaborate across firms in the case-study industry sectors.

Responses showed that knowing more about the capabilities of firms and their innovation efforts and innovation strategy has a positive influence on the decision to collaborate. Of all respondents spoken to, only one respondent indicated that not knowing more would not be a deterrent to a decision to collaborate. Other respondents iterated that knowing more about a potential partner is essentially an important preliminary condition for partnership consideration. Knowledge about capabilities encompasses skill sets, expertise and all other competencies resulting in the creation of goods and services. For each of these respondents, knowing about the firm’s expertise, reputation, business strategy, and past projects, can act as a stimulus for collaboration when an opportunity or a need for such arises. However, many of the firms iterated that the possibility of such occurring was not very likely as firms are secretive, and as such are prone to keep such information to themselves so as to minimize the prospect of giving out their competitive advantage. In the interviews, the data reveal that in as much as currently, inter-firm innovation collaboration is non-existent, improvements in the level of openness and knowledge of capabilities can encourage firms to engage in collaborations.

Participant 5A, a technical manager in a medium-sized metal casting company stated, “I mean we get to know enough about people, we know very little about a lot of the potential collaborators we have had in the past. ....It’s a bit like speed dating, you find them in an event, you swap business cards, you go and have a meeting. ....So would it influence our decision to collaborate? No. That’s what, if the concept of a collaborative venture is agreed then you go and find out who your partners and you tend to make that work. It tends not to be the other way round”.

Participant 21A, a site manager in a small-sized metal casting company stated, “... I guess you do not always know what people can do. There is a company called XYZ doing all the printing and mould and I did not know what they could do. Then I went to their facility and saw all their machines and they have newer bigger machines. It was more of an eye-opener and you can see what's available and what they can do”

Participant 11A, a manager in a medium-sized metal casting company stated, “Yes, knowing more about capabilities is important. I mean often you do not know exactly what such a partner may be able to offer or what technology or understanding or knowledge they may have behind them. So I think the more information you have up front, the better equipped you are to make a decision as to whether that's something or a route you want to go down”.

Participant 3B, a director in a small-sized metal-forming company stated, “Knowing about capabilities is crucial. It goes back to something that is common across firms in the sector, you don’t really know what they’re up to or what kind of things they’re working on. So you can not make a judgment as to how relevant it might be, for us to try and engage with them”.
5.3.2 Information Sources

This theme explored information sources currently being used for acquiring knowledge about capabilities of a potential collaborative firm. Four key sources emerged from participant responses and these are; exhibitions/conferences, internal research, supply chain and trade associations.

The interview data reveal that firms in the case-study sectors would endeavour to do some background investigative research before entering into any form of collaboration even with supply chain firms. Also, respondents emphasized that they proactively seek new businesses, product and process innovations, and even new alliances that can be of interest or better still beneficial in improving market growth, competitiveness and the overall attainment of their business development strategy. Responses also indicated that supply chain partners and trade associations are useful sources of information as they can act as pointers to industry expertise especially as they tend to have a more comprehensive knowledge of the proficiencies of individual firms. Although the dynamics of this description is slightly more suitable for trade associations by virtue of them acting in the capacity of umbrella bodies, supply chains fit into this description as they can also be regarded as a repository of information on capabilities by virtue of multifarious interactions that tend to characterize supply chains in the sector.

Participant 7B, a director in a small-sized metal forming company stated, “Within the industry, with the different sectors, we get a lot of literature sent to us of what is new. So we are constantly reviewing you know what’s out there either by search engines or by exhibitions”.

Participant 10A, a managing director in a medium-sized metal casting company stated, “I suppose exhibitions and conferences are pretty good. Trade journals, word of mouth, through networks like CMF, they’d be our main sources of information”.

Participant 8A, a managing director in a medium-sized metal casting company stated, “So I think when you've got a supplier that has got a range of technologies, seeing all of it in one go is the right way to digest it and understand exactly how you can use them”.

5.3.3 What to Know

This theme examined specific information that would be beneficial in making decisions on collaboration. Five main fields of necessary to know information emanated across interviewed firms and these are; product and process type, quality standards, reputation, what can be offered, and case-study and past project.

Ten respondents emphasized that knowing a potential collaborator’s product and process type was of utmost importance for any form of collaboration consideration to take place. According to them, this would lay to rest any form of misconception or bias on the alignment of their processes with the potential partner as well as identify immediately if it was even necessary to consider further engagements. Also, a good knowledge of a potential collaborator’s quality standards, competence and certifications are essential for collaboration considerations as this shows earnest commitment to high standards and assurance that the firms business strategy takes this seriously.
Fourteen respondents mentioned a reputation as an important element for collaboration consideration. In this context, respondents emphasized that opinions about the potential firm speak volume about character and what the firm stands for. Thus, knowing about the firm and references from trustworthy sources within the business community as well as friends and family are essentially important for collaboration considerations.

As a follow-up to a firms' reputation and quality standards, presenting evidence in form of case-studies and past project is fundamental, to show the level of expertise and achievement of project objectives against set goals and standards by the firm. This is necessary to emphasize the reliability and credibility of the firm. In the same vein, knowing what can be offered in all entirety and what to expect from the collaboration if it does happen can act as a defining feature as to the possibility of a collaboration or not.

That being said, where these identified necessary-to-know information for collaboration considerations can be a catalyst as identified by respondents, they can also act as a hindrance to collaboration consideration in instances where knowing more about the potential partner may negatively influence the decision to collaborate and instilling doubts on the unlikelihood of a successful and beneficial collaboration.

Participant 15A “…..it could be financial information that we would need to see, that they have got the financial standings to be able to see the project through or that you know maybe the type of projects that they’re looking to embark on are too big for them as an organization, so, understanding the financial implications for that particular company”

Participant 19A “…..understanding their process would reveal what they need. Now, that means they've got to let us in ...so we can, in detail, look at what they're doing and see where we could work together to solve something that we both need”

Participant 8A “….. what they can bring to the party really. What they think the potential applications are within our company”.

5.4 Research Question 3
How does access to information on potential partner’s trustworthiness influence collaboration innovation in the metal forming and foundry industry?

Themes: Influence of Trust, Assessing Trustworthiness

5.4.1 Influence of Trust

This theme explored the influence of trust on the decision to develop new collaborations. Analyzed responses indicate that trust is important in making decisions regarding collaboration. Trust is regarded as a key determining factor in the decision to pursue or pull back from any form of business relationship. Results from a word query on trust (see figure 20) show that the concept is very important to interviewees.

All respondents indicated that for any form of collaboration to kick-off, there has to be some level of trust. Across the sectors, the use of NDAs (Non-Disclosure Agreements) are common and these are adopted to ensure that collaborative firms do not give away confidential information. This is especially useful when the collaboration is in its infancy and for burgeoning
inter-firm relationships. NDAs are the most basic contractual agreement adopted in the industry.

Furthermore, responses indicated that there is always some element of risk when it comes to trust. This is because trust can never be fully ascertained and oftentimes, depending on one’s “guts feeling” in business is necessary. Four respondents stated that there had been times where this had gone wrong and they had to count their losses because a collaborative firm did not keep their part of the deal. The data also indicates that trust to a certain extent has to be established on a personal level, as it is dependent on the leading face of the organization. In this regard, individuals representing the potential collaborative firm largely has to be trustworthy for there to be a collaboration. However, assessing the level of trustworthiness of such individuals is largely dependent on the relationship that can only be developed over time.

Participant 19A, “...and there has to be that trust. With trust then comes the more, with the more comes more trust if you see what I mean....It is a spiral that builds... So there has to be a lot of trusts”.

Participant 23A, “I think you have to go into these things with a degree of trust but it’s, it’s clear that sometimes individuals within collaborations can matter. Individuals within the teams can matter, so it is important that trust is established on a personal level”.

Participant 6B, “Yes, definitely, trust is very important because I wouldn’t like my contact to give my idea to somebody else because we could potentially lose the business. So trust is very important, this is why NDAs come into it”.

5.4.2 Assessing Trustworthiness

This theme examined how respondents evaluate trust. It explored how respondents would gauge the trustworthiness of a new partner. Results show that respondents assessed trust in eight ways. These are via; relationships, assessments, reputation, recommendation, willingness to protect data, NDAs, financial stability and willingness to protect data. Of these eight mentioned trust measurement techniques, relationship, use of NDAs and reputation were the most mentioned by respondents.

A comparison based on firm size showed that, SMEs measure trust based on all aforementioned ways except, willingness to protect data. Two respondents from MNEs mentioned measuring trust based on a firm’s readiness towards data protection.

Respondents indicated that conducting audit assessments and visiting firm sites prior to and during business engagement especially on the supply side is basic industry practice that has proven useful in assessing trust. Assessing trust in this manner enables the establishment of rapport across collaborating firms as well as provides a medium for a better understanding of processes and services offered. This provides a first-hand look into adopted industry standards, what should be expected from the firm, alignment of interests and how the firm and its management comports itself and does business.

Meeting and building a relationship is the most adopted technique for assessing trustworthiness across respondents. According to respondents, it forms the backbone for any
form of long-lasting business relationship. This is because it can either “make or mar” the development of a potentially beneficial relationship as it defines if a relationship will progress further or otherwise. It is the first step to “breaking the ice” between firms and based on the initial perception of firm representatives at the meeting, a decision on trust is made. That is if the other party can be trusted at all or not.

How financially viable a potential collaborator is, also play a role in how it is perceived in the context of trust. Respondents indicated that prior to any form of collaboration, especially for major projects, financial checks are conducted to establish the financial standing of the other firm. This is done to ascertain that the firm can be trusted before making financial commitments to such business partnerships. This is also necessary to ensure that the other party was not “biting more than it can chew” and has the financial standing to see the project through.

The use of NDAs as a statutory contractual document for assessing trust facilitates the setting up of a formal agreement between collaborating firms as a starting point to prevent the divulgence of confidential information or technical know-how to a third party. Respondents mentioned that this is adopted in many if not all their business engagements and this includes across the supply chain as well. Building on trust from this point onwards thus relies on how both parties proceed in the partnership, coupled with experiences and lessons learned in the journey. Despite the legality surrounding NDAs, respondents iterated that sometimes, it does not act as a deterrent to some firms breaking the confidentiality pact and disclosing information.

Openness to communication by sharing information influences how a firm is seen as being trustworthy. Respondents cited this in two contradictory manners. Where being open to sharing information can be a plus, by showing that the firm is ready to engage and is transparent in its business dealings, sharing data succinctly can also imply that the firm cannot be trusted with confidential information. Thus, indicating that, there is a mixed feeling, across interviewed firms, on openness to sharing information as a measure for assessing trust.

The kind of image or value system a firm portrays or known for also influences how such a firm is perceived as being trustworthy or otherwise. The reputation of a firm according to respondents is reflected by and is largely a product of its interactions across the business community, supply chain, community, and the public domain. Relying on this as one of the ways of measuring trustworthiness is usual practice in the case-study sectors. Respondents iterated that conducting a detailed research on the potential collaborative firm could be done via internet searches, business networks, trade associations, and other available information sources. Similar to reputation, respondents take into consideration recommendations and references from business networks, friends and family in assessing the trustworthiness of a firm.

A firm’s trustworthiness is also assessed by its willingness to protect data and most especially IP. How seriously IP is regarded in the partnership and how much knowledge they are willing to make available to other firms or establishments outside the partnership. This was particularly raised as an issue when collaborating with universities who oftentimes find
themselves at crossroads between making known and being recognized for their novel accomplishments on one hand and keeping the innovation within the partnership on the other hand.

Participant 6B, “Find out who their customers are as well because that’s just as important these days for your credit insurance, there’s actually who they are and what, what financial stability they’ve got”.

Participant 15A, “We would need to see financial information. We need to see that they have got the financial standings to be able to see the, projects through or that ....maybe the type of projects that they’re looking to embark on are too big for them as an organization, so, understanding the financial implications for that particular company”.

Participant 2B, “We visit and conduct assessments around the facility, especially with our suppliers, the kind of standard things really”

Participant 5B, “Also their openness in sharing information and data with us is very important.....it would show that they take it seriously, they’re protecting their data, then you would feel they could protect yours”.

Participant 11A, “It is through open dialogue, so sharing of information to start off with before even a collaborative framework is put into place... is how open they would be to sharing information with us”

Participant 20A, “For me personally, going to meet them individually and gauging from the personality. I suppose within our industry, you were almost able to find somebody who could refer. So yes, I think the main one would be face-to-face”.

6. Discussion & Conclusion

This study has explored the views and experiences of firms in the UK foundry and metal forming sectors on innovation collaboration and the role of trust and knowledge of capabilities in the decision to collaborate. The results provide insights into how innovation is defined by SMEs, confirming some of what is already known. While the definitions of innovation that emerged in this study are keeping with past studies, an interesting finding from was that most of the interviewed CEOs and managers linked innovation to their positioning in the supply chain suggesting a link between innovation and business strategy (Teece 2010). Our results on firms’ motivation for undertaking innovation are consistent with some of what has been found, while at the same time yield new findings. These findings suggest that the main innovation motivators in small and medium firms in the case-study sectors are the need to spread risk, remain competitive, increase sales revenue, process improvement and meeting customer expectations. Remaining competitive, however, emerged as the overriding motivation for innovation across SMEs studied (Gunday et al. 2011).

As indicated in the introduction section of this paper, OI is characterized by the inflow and outflow of knowledge between firms. Our findings show that many of the firms engage in in-house R&D tending to keep their innovation within the boundaries of the organization. This is the single most common innovation practice across analyzed firms. Other innovation practices engaged in by firms are collaborations with customers and suppliers. Many of the participants
viewed innovation collaboration with customers as crucial to improving sales and maintaining their customer base (Flynn et al. 2010 and Oke et al. 2013). Outsourcing of R&D was also mentioned as a common innovation practice. Findings indicate that firms tend to source knowledge for innovation within the boundaries of the organization as the first point of call. When the need arises to find creativity outside the boundaries of the firm, firms were more comfortable sharing knowledge and liaising with supply chain partners. As a last point of call, firms would rather outsource to meet the required innovation or R&D need.

Our research focused on understanding the perception of firms on innovation partnerships and how firms undertake the practice. Our results show that innovation collaboration is relevant and existent in the case-study firms. However, the innovation strategy adopted by firms span across mainly five types of collaboration and these are; collaboration with universities, trade associations, supply chain partners, external partners, and research institutes. Thus, an interesting finding from this study is the absence of inter-firm collaboration within the individual industry sectors. That is, firms did not collaborate with each other at the innovation level. Many of the respondents indicated that the practice was simply non-existent in the industry sectors. The main reason for this non-practice was attributed to the competitive market. Thus, firms perceived such collaboration as a catalyst to losing their competitive edge that has been instrumental to their sustenance and performance within the industry sector. This indicates that competition is a factor that deters innovation collaboration between firms within the industry sector (Reed, Storrud-Barnes and Jessup 2012).

Apart from competition, which emerged as the most mentioned innovation collaboration barrier, our findings show that firms were reluctant to engage in partnerships for a number of other reasons. One of these is risk. Many respondents indicated that they would rather invest in an already proven technology rather than a completely radical new idea that has not been proven and with the possibility of failing. Thus, preferring to invest within the boundaries of the “known” rather than the “unknown”. Risk as a barrier extends beyond a limitation to the adoption of OI, but rather a limitation for innovation as a whole. Firms tend to weigh the investment for innovation as against the possible benefits or losses if the innovation does not yield expected benefits or is never introduced to the market. This cost-benefit analysis and the associated risk determines the innovation strategy of a firm and the approach to innovation. Where it would be expected that sharing the risk of innovation with a partner might be a motivation for innovation collaboration, findings from this study suggest otherwise.

In addition, resource constraints, the size of the firm, IP ownership and protection, corporate culture, and time constraint, were all mentioned as barriers to innovation collaboration. These barriers are consistent and confirm past findings on the topic (Hewitt-Dundas and Roper 2018, Vrande et al. 2009, Xiabao, Wei and Yuzhen 2013).

Our findings also indicate that a lack of trust or openness is a factor that discourages firms from engaging in innovation collaboration. Many respondents stated that there was a high level of secrecy and lack of trust across the case-study sectors, making it difficult for such collaborative relationships to occur. Trustworthiness plays a key role in the decision to collaborate. This confirms past findings on the role of trust in innovation collaboration (Hewitt-Dundas and Roper 2018). Furthermore, respondents indicated that the lack of knowledge of the
capabilities of firms across the sector was a hindrance to firms embarking on collaborations. This barrier prevents firms from utilizing available knowledge and creativity from other firms, as there is a lack of awareness of the various possibilities that can be offered.

Knowledge of capabilities of a potential partner was further explored in our second research question. This evolved how insufficient information on capabilities influenced the decision to collaborate. Our findings indicate insufficient information on a potential partner deters firms from collaborating, thus confirming findings by Hewitt-Dundas and Roper (2018) on market failures and OI. Firms that know more about a potential partner may decide to collaborate. Indicating that, knowledge of a potential partner’s capabilities has a positive influence on the decision to collaborate.

In knowing the capabilities of a potential collaborative partner, the majority of the respondents identified four main information sources, and these are; Exhibitions and conferences, internal research, supply chain partners and trade associations. The use of exhibitions and industry focused networking events for sourcing for knowledge of expertise and capabilities is a common and established practice in the industry sectors. In this regard, such events create an avenue for making contact with firm representatives and can mark the beginning of a new relationship alongside exposure to innovative knowledge.

Firms also conduct research themselves to find out about the potential partner. This is a deliberate attempt to know more about the firm by sourcing for useful information that on the surface allows them to know what the firm does and their track record. Whilst also providing insightful details into what the firm stands for, their business integrity, capabilities and expertise, and the financial resource available to such firms.

Supply chain partners are also important information resource in this regard. This is because supply chain partners, especially suppliers tend to be knowledgeable about the capabilities of many other firms in many sectors because of their role in the supply chain, which affords them the opportunity to interact with a vast array of firms within and outside the industry sectors. Similarly, trade associations due to their role as an overseeing body for specific industry sectors tend to know about what member firms do and their processes. Although the level of information accessible to trade associations is largely dependent on what the member firm wants them to know, it however still serves as a good starting point for knowledge of capabilities.

Our results also show that specific information such as product and process types, quality standards, reputation, what can be offered and past projects are the main information that firms would like to know prior to making decisions to collaborate. Firms indicated that knowledge of these is important to determine if further discussion is necessary or not. Thus, where knowing more can potentially lead to the possibility of a collaboration, it also can lead to negative outcomes such that discussion on collaboration is not explored further and the alliance fails to proceed.

Our third research question explored the influence of knowledge of a potential partner’s trustworthiness on the decision to collaborate. Results indicate that trust is essentially important in the decision to collaborate. There was a common consensus across all
respondents with regards to trust being crucial to collaboration consideration. Our findings show that knowing more about the trustworthiness of a potential partner can positively influence the decision to collaborate. Being able to trust a potential partner was deemed more important than setting up NDAs and contractual agreements (Wang et al. 2008). This confirms one of the market failures on OI by Hewitt-Dundas and Roper (2018). There is however also a level of risk when taking the first step towards collaboration as the majority of respondents indicated that trust grows over time and develops as a relationship is built. Thus making many firms stay on in relationships with long-term business associates such as supplier relationships as they are often reluctant to engage new firms for “fear of the unknown” and inability to take the first “leap of trust”.

Trustworthiness was evaluated in eight ways. Thus, apart from relationships and NDAs, our findings show that firms assess trustworthiness by a combination of other ways. Hence, trustworthiness is assessed visits and conducting assessments; reputation; recommendations from dependable sources such as family, friends and business network; a firm’s willingness to protect data; the firm’s financial standing; and a firm’s openness to sharing information.

As stated in earlier sections, this exploratory study is a first part of a sequential exploratory study. This would be followed by a quantitative study to investigate the generalisability of findings for future policy design.
Key References


