An investigation into the development of the Absorptive Capacity of manufacturing SMEs

ABSTRACT

To sustain their competitive advantage in a highly competitive landscape, SMEs, in spite of their limited resources, need to effectively learn. The ability to access and successfully use knowledge is at the heart of Absorptive Capacity. The main purpose of this empirical study is to investigate the importance of Awareness as an antecedent dimension of the concept of Absorptive Capacity of manufacturing SMEs from aerospace and advanced engineering industry in the UK. The study will also attempt to explore the impact of Awareness on the other dimensions of Absorptive Capacity. Awareness is related to the importance, motivation and interest of learning and innovating. Our study, which focuses on internal processes adopts a mixed method approach and is based on the data collected from 43 SMEs. Our finding suggests that Awareness as an antecedent dimension can play a vital role in helping SMEs to improve their knowledge-based resources through changes within their internal organisational and cognitive processes.

Key Words: Absorptive Capacity, Manufacturing SMEs, Awareness, Cognitive Domain, Affective Domain, Internal Processes.

1. Introduction

Small and medium-sized enterprises (SMEs) play a significant role in economic development by being one of the major contributors to the economic growth. However, in the current economic climate of intense competition, SMEs are striving hard to compete and achieve a sustainable competitive advantage. They are increasingly challenged to effectively respond to the high variability of consumers' demands and expectations (Fornasiero and Zangiacomi, 2013). In spite of their well-recognised expertise, specialisation and flexibility, SMEs have unique characteristics and limitations which impede their capacity to up-to-date their learning (Strobel and Kratzer, 2017; Rangus and Slavec, 2017; Gray, 2006). The survival of SMEs depends, to a large extent, on their capacity to effectively learn (Onkelinx, Manolova and Edelman, 2016; Burcharth, Lettl and Ulhøi, 2015; Rezaei, Ortt and Trott, 2015) and share their high level of tacit knowledge (Kang and Lee, 2017; Knoppen, Sáenz and Johnston, 2011) in order to better respond to their rapidly changing manufacturing operations (MacBryde, Pato and Clegg, 2013) and environments (Raymond et al., 2016; Eisenhardt and Martin, 2000). It is therefore critical that SMEs improve their knowledge-based resources which are seen as the main asset for growth (Rangus and Slavec, 2017; Valentim, Lisboa and Franco, 2016; Onkelinx, Manolova and Edelman, 2016; Fornasiero and Zangiacomi, 2013).

The ability to access and effectively use knowledge is at the heart of Absorptive Capacity (ACAP) (Cohen and Levinthal, 1990) which offers important insights into the influence of prior knowledge on learning processes (Zahra, Filatotchev and Wright, 2009). The development of this prior relevant knowledge can help develop new cognitive skills needed to effectively search, acquire, understand, transform and exploit new knowledge that can provide SMEs with a sustainable competitive edge (Cohen and Levinthal, 1990; Zahra and George, 2002; Zahra, Filatotchev and Wright, 2009; Ishii, 2013; Valentim, Lisboa and Franco, 2016).

ACAP is described as complex (Burcharth, Lettl and Ulhøi, 2015), spanning different areas of management (Volberda, Foss and Lyles, 2010) and involving interactions between different organisations (Liu, 2015) throughout their value chain and networks (Fornasiero and Zangiacomi, 2013; MacBryde, Pato and Clegg, 2013). This implies the necessity to use different theoretical approaches in order to better comprehend the development of ACAP (Volberda, Foss and Lyles, 2010). Early articles, including the work of Cohen and Levinthal (1990), have placed a significant emphasis on the links between ACAP, learning, innovation, and performance of firms with a greater emphasis placed on R&D which can be more difficult to recognise within a large number of manufacturing SMEs (Dreyfus, 2008). This vindicates the importance of ACAP being studied from the lens of innovation management (Peeters, Massini and Lewin, 2014). Our paper is therefore influenced by Birkinshaw, Hamel and Mol's (2008) conceptualization of management innovation involving organisational change that can lead manufacturing SMEs adopting and integrating new ideas within their internal practices, processes and structures aimed at improving their ACAP. These internal factors which are linked to SMEs leadership and human resources management (Eisenhardt and Martin, 2000) can play a significant role in the development of the level of awareness and ability to learn. Human resources management practices, which can influence the motivation and interest to learn, are described as having a positive impact on the development of ACAP (Onkelinx, Manolova and Edelman, 2016; Volberda, Foss and Lyles, 2010).

Our approach is also informed by theoretical developments highlighting a stronger link between ACAP and Organisational Learning (Scuotto, Del Giudice, and Carayannis, 2017; Yoo, Sawyerr and Tan, 2016; Gutiérrez, Bustinza and Molina, 2012; Knoppen, Sáenz and Johnston, 2011; Volberda, Foss and Lyles, 2010; Zahra and George, 2002). This link to organisational learning motivates our decision to include in our investigation the theoretical framework of intra and inter-collaboration as well as the relational perspective on learning.

However, it is worth noting that learning in the context of these forms of collaboration is complex and not easy to achieve (Liu, 2015).

In addition, most of the existing literature on ACAP does not sufficiently acknowledge that there are firms such as SMEs which may not possess the required skills and competencies and organisation to help them successfully acquire and use external knowledge (Burcharth, Lettl and Ulhøi, 2015; Rezaei, Ortt and Trott, 2015).

This paper proposes to explore this under-researched area related to the capacity of aerospace manufacturing SMEs to enhance their ACAP. It intends to investigate the role of Awareness as a means to help SMEs improve their knowledge-based resources and overcome their main constraints.

The paper intends to achieve its objectives by addressing the following research questions:

RQ1 What are the key characteristics specific to SMEs which affect the development of their ACAP?

RQ2 Can the development of the ACAP of SMEs be influenced by an emphasis placed on Awareness as an antecedent dimension?

RQ3 How does Awareness affect all the dimensions of ACAP both in the Cognitive and Affective Domain?

Unlike a significant number of studies on ACAP which are essentially conceptual and quantitative (Knoppen, Sáenz and Johnston, 2011; Volberda Foss and Lyles, 2010), this empirical investigation adopts a mixed approach with a strong qualitative contribution in order to gain a better understanding of the impact of Awareness and key organisational factors of SMEs on the development of their ACAP.

RQ1 and RQ2 will be addressed through a comprehensive literature review and the evidence drawn from the qualitative data due to the exploratory nature of the research questions. RQ3 which is explanatory in nature will be addressed through the evidence drawn from the quantitative data. It will also be supported by the evidence from the qualitative data.

The remainder of the paper comprises of four further sections. Section 2 is devoted to the development of our theoretical framework. Section 3 exposes the research methodology. The findings reporting the outcome of qualitative and quantitative studies are analysed and discussed in Section 4. Finally Section 5 concludes the paper.

2. Theoretical framework development

2.1. Key characteristics of SMEs that can affect the development of their ACAP

SMEs are not 'little big' businesses (Gray and Mabey, 2005). They have unique characteristics that can exert a significant influence on their management. SMEs have notable strengths that can help them achieve and sustain innovation and competitive advantage (Land and Gaalman, 2009). These strengths include: creativity because of their smaller size; dynamic behaviour; more focused and specialised business offering; speed, flexibility and entrepreneurial (Rezaei, Ortt, and Trott, 2015); direct and informal communication system facilitating exchange of information; effective in utilising external networks (Massa and Testa, 2008; Arend and Wisner, 2005) and developing contracting relations; flatter structures (Sivades and Dwyer, 2000) and a great operational expertise and customer knowledge (Dahl and Moreau, 2002).

There are, however, other characteristics of SMEs which can impede their ability to learn and innovate. SMEs are found to be less able to exploit innovation (Strobel and Kratzer, 2017; Burcharth, Lettl and Ulhøi, 2015; Albors, Sweeney and Hidalgo, 2005) and often have weak or unstructured decision making processes (Salles, 2006). Their limited managerial, human

and financial resources (Rezaei, Ortt and Trott, 2015; Fornasiero and Zangiacomi 2013) can often lead to a greater level of reliance on knowledge from external sources and the difficulty to conduct R&D activities (Bianchi et al., 2010). These constraints can also engender weak external contacts (Burcharth, Lettl and Ulhøi, 2015; Srinivasan, Lilian and Rangaswamy, 2002) and underdeveloped education and training. In addition, SMEs are often described as being driven by short-term goals and lacking formal systems, procedures, rules and organisational routines (Strobel and Kratzer, 2017). SMEs may not have the explicit knowledge management systems to support their innovation processes (Gray, 2006). They are also found to be reluctant to delegate authority (Rangus and Slavec, 2017) and over-involved in operational level decisions (Sethi, Smith and Park, 2001). Owner managers of SMEs are presented as reliant on direct authority and high levels of informality. Most SMEs are also described as dependent on tacit form of knowledge which is often difficult to capture and disseminate (Knoppen, Sáenz and Johnston, 2011).

This can significantly demotivate staff and prevent them from many learning opportunities. It can influence and shape both extrinsic and intrinsic motivation of staff in their ability and enthusiasm to learn and share learning which is paramount to the success of ACAP (Rangus, and Slavec, 2017; Aribi and Dupouët, 2015; Hotho, Becker-Ritterspach and Saka-Helmhout, 2012).

The above theoretical discussion which, clearly highlights the criticality of resources availability for SMEs to manage change and strengthen their knowledge base and innovative capacity (Peeters, Massini and Lewin, 2014; Burcharth, Lettl and Ulhøi, 2015; Strobel and Kratzer, 2017), forms the basis of our first proposition.

Proposition 1: *Key characteristics of SMEs such as resource constraints and lack of appropriate organisational and cognitive routines impede the development of their ACAP.*

2.2 The development of the ACAP in SMEs

The concept of ACAP embodies the firm's ability to absorb and put to use new knowledge through a set of organisational routines and processes (Sciascia et al., 2014). It is described as a complex social process (Liu, 2015), a multidimensional construct (Sciascia et al., 2014) and mainly consisting of four main separate dimensions (Acquisition, Assimilation, Transformation, and Exploitation) (Zahra and George, 2002). Each dimension plays a different but complementary role in producing a dynamic organisational capability (Ferreras-Méndez, Fernández-Mesa and Alegre, 2016; Jiménez-Barrionuevo, García-Morales and Molina, 2011; Sciascia et al., 2014).

Acquisition is related to the capacity of the firm to explore, identify and secure new and externally generated knowledge that is critical to the firm's operations. It includes effective search strategies and access to potential sources of new knowledge (Ferreras-Méndez, Fernández-Mesa and Alegre, 2016; Camisón and Forés, 2010) as well as sufficient prior knowledge to make a value judgement on which new knowledge can be acquired or ignored (Noblet, Simon and Parent, 2011). This may also include aspects of relationship management competencies involving the building and maintaining of trust with a wide range of potential knowledge sources (Yoo, Sawyerr and Tan, 2016; Jiménez-Barrionuevo, García-Morales and Molina, 2011; Fornasiero and Zangiacomi, 2013; Rezaei, Ortt and Trott, 2015). Network ties are seen as critical to a firm's capacity for search ability and knowledge acquisition (Scuotto, Del Giudice, and Carayannis, 2017; Aribi and Dupouët, 2015). This is particularly important for SMEs which are more likely to look for knowledge beyond their boundaries because of their resource constraints (Lambert and Schwieterman, 2012; Onkelinx, Manolova and Edelman,2016; Yoo, Sawyerr and Tan, 2016). However, networks per se are not always found to be useful and research suggests opposing views on the impact of networks on

learning (Liu, 2015). As Srinivasan, Lilian and Rangaswamy (2002) claim, networking does not always help SMEs in upgrading their knowledge base.

The ability of SMEs to explore and accommodate new ideas and approaches, can significantly gain from the development of networks underpinned by solid relational and collaborative principles of trust and reciprocity (Scuotto, Del Giudice, and Carayannis, 2017; Aribi and Dupouët, 2015; Knoppen, Sáenz and Johnston, 2011; Rezaei, Ortt and Trott, 2015). It, thus, involves specific resources and competences which are not always available within SMEs (Rezaei, Ortt and Trott, 2015).

Acquisition is also affected by internal factors such as the low level of resources and the lack of formal cognitive and organisational structures and processes which characterise a larger number of SMEs (Bianchi et al., 2010; Flatten et al., 2011; Burcharth, Lettl and Ulhøi, 2015).

Assimilation is defined as the capacity of the firm to integrate new knowledge into pre-existing knowledge schema (Noblet, Simon and Parent, 2011) and to communicate it across the organisation (Jiménez-Barrionuevo, García-Morales and Molina, 2011). Its success depends on the ability to develop organisational and cognitive routines and processes that can help SMEs analyse, interpret, understand and internally disseminate the newly acquired knowledge (Flatten et al, 2011; Knoppen, Sáenz and Johnston, 2011; Ferreras-Méndez, Fernández-Mesa and Alegre, 2016). This implies creating new skills and unlearning in order to fill in existing gaps in dealing with new requirements This will for instance include communication skills to effectively disseminate the new knowledge (Camisón and Forés, 2010) and shift the focus of learning towards organisational learning (Hotho, Becker-Ritterspach and Saka-Helmhout, 2012). This adaptation or developmental process can be long, demanding and costly (Burcharth, Lettl and Ulhøi, 2015).

In addition, organisational learning, which is a social process (Hotho, Becker-Ritterspach and Saka-Helmhout, 2012), is contingent on a network of intra- as well as inter-organisational relationships that develop over time between individuals and organisations (Volberda Foss and Lyles, 2010; Aribi and Dupouët, 2015; Scuotto, Del Giudice, and Carayannis, 2017). However, the lack of such relationships in a great number of SMEs (Bianchi et al., 2010) impedes the circulation and sharing of knowledge within the whole organisation (Bozbura, 2007; Strobel and Kratzer, 2017). Most knowledge is often stored in the minds of the owner-manager and/or key employees.

The **Transformation** dimension reveals the ability to internalise and convert the acquired new knowledge into new cognitive structures (Zahra and George, 2002; Todorova and Durisin, 2007). This includes the ability of the organisation to recognise two different sets of information and knowledge and then combine them to arrive at a new schema (Greve, Engelen and Brettel, 2009). One of the key objectives of this dimension is to connect this new knowledge to the needs and context of SMEs by making it less conceptual and more practical and useful (Aribi and Dupouët, 2015).

The success of Transformation requires significant competencies in restructuring, modifying and preparing knowledge for further applications (Flatten et al., 2011) through novel combinations or interpretations (Noblet, Simon and Parent, 2011). This involves the reallocation of new resources and setting up of new management and organisational practices. Transformation, which is also complex, risky and costly, can be jeopardised by the resources constraint of SMEs and the poor management and development of their education and training programme (Burcharth, Lettl and Ulhøi, 2015; Peeters, Massini and Lewin, 2014).

Exploitation indicates the extent to which the organisation incorporates the assimilated and transformed knowledge into its operations (Zahra and George, 2002). This contextualised

knowledge can help SMEs understand and address the complexity and requirements of their environment (Aribi and Dupouët, 2015) and design new routines (Greve, Engelen and Brettel, 2009) which can lead to individuals changing their behaviour and adopting actions and attitudes conducive to innovation and performance improvement (Akyuz and Erkan, 2010; Jiménez-Barrionuevo, García-Morales and Molina, 2011). The successful exploitation of knowledge is also associated with the adoption of a long-term and prolonged process of investment and knowledge accumulation (Greve, Engelen, and Brettel, 2009) rather than a short-term and unstructured way to learning that a large number of SMEs seem to be embracing (Bozbura, 2007). Transformation is also affected by organisational factors such as incentive systems, organisational structures, leadership and governance (Hotho, Becker-Ritterspach and Saka-Helmhout, 2012; Fornasiero and Zangiacomi, 2013; Rangus and Slavec, 2017).

The development of these four key dimensions of the ACAP is a complex and risky endeavour. Its success is significantly dependent on a combination of resources, procedures, processes, cognitive structures, leadership and organisational routines (Bianchi et al., 2010; Peeters, Massini and Lewin, 2014; Burcharth, Lettl and Ulhøi, 2015) that may be lacking in SMEs.

The above discussion insinuates that social interaction (Todorova and Durisin, 2007; Scuotto, Del Giudice, and Carayannis, 2017) and organisational processes (Hotho, Becker-Ritterspach and Saka-Helmhout, 2012; Dada and Fogg, 2015; Rangus and Slavec, 2017) play a critical role in the development of ACAP (Volberda, Foss and Lyles, 2010).

It also implies that the four dimensions of ACAP can be considered as parallel, as well as related to each other rather than just a discrete and linearly subsequent capacity (Todorova and Durisin, 2007). This view is echoed by Sciascia et al. (2014) who argue that SMEs, with

poor acquisition and assimilation of external knowledge, will have difficulties in successfully transforming the acquired knowledge to better address their needs. This is bound to imply some blurring and overlapping of the boundaries between Assimilation and Transformation (Todorova and Durisin, 2007) as well as between other dimensions of the ACAP.

2.3 Impact of Awareness upon the development of ACAP in SMEs

The criticality of Awareness in the development of ACAP and more particularly in SMEs is well acknowledged but insufficiently explored (García-Morales, Ruiz-Moreno and Llorens-Montes, 2007). Zahra and George (2002) argue that awareness of the value of new external knowledge has often been included within the core model of ACAP. Most of the literature has placed a greater emphasis on networks as a means for SMEs to raise awareness and to absorb new knowledge (Halila, 2007; Scuotto, Del Giudice, and Carayannis, 2017; Kang and Lee, 2017). Networks, as already discussed, are important but they are only a first step in the absorption of external knowledge. A greater commitment of individuals and organisations are needed for these networks to affect positively the development of ACAP (Todorova and Durisin, 2007). This explains our objective to explore the importance of Awareness as an antecedent dimension of the concept of ACAP which focuses on the generation of interest and motivation to learn that can help SMEs address the main barriers to the development of their knowledge-based resources and performance (García-Morales, Ruiz-Moreno and Llorens-Montes, 2007; Dreyfus, 2008).

The merit of Awareness was highlighted by Cohen and Levinthal (1990) who suggest that awareness consists of two elements. The first element is described as external awareness and is essentially aimed at recognising the value of learning and innovation as a means to improve the organisational performance and achieve competitive advantage. The second element is presented as the internal awareness which is more related to the importance,

motivation and interest of developing an organisation's capacity for learning and innovating (Rangus and Slavec, 2017; Minbaeva et al., 2003). It also includes initiative (Dreyfus, 2008), championing, and clear cognitive strategies (Hayton and Kelley, 2006). Our views on the awareness dimension are influenced by the work of Minbaeva et al. (2003) who emphasise the importance of combining both the ability and the motivation and interest to learn, to work cooperatively and to innovate. This research, which supports the criticality of awareness in the development of ACAP in SMEs, intends to empirically investigate the impact of the Awareness as an antecedent dimension on the development of Absorptive Capacity (both within the Cognitive and Affective Domains).

Bloom et al.'s (1956) work on learning objectives in the Cognitive and Affective Domain are at the core of our application of the concept in this paper. The concept of learning objectives is derived from the domain of cognitive psychology and is a well-established approach to understanding levels of skills, knowledge and attitudes demonstrated within a competency (Krathwohl, 2002).

In considering the Cognitive Domain, that of knowledge and knowledge processing, Bloom's Taxonomy identifies six objectives that may be viewed as broadly hierarchical; *Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation* (Bloom et al., 1956).

The Affective Domain recognises the extent to which a topic or competency has been internalised by the learner with five ordinal points, from *Receiving, through Responding, Valuing, and Organising, to Characterisation by a value or value complex* (Krathwohl, Bloom, and Masia, 1964, pp.176–185).

In our research, the Cognitive Domain is mainly focused on the ability to process knowledge in order to appropriately exploit it. Whereas the Affective Domain describes the extent to

which the organisation has a level of commitment towards gaining value out of new and external knowledge (Minbaeva, 2008).

We therefore suggest the following propositions on the significance and impact of Awareness on both the Cognitive and Affective Domain which will be later tested by the qualitative and quantitative analysis.

Proposition 2 (P2): *Awareness positively influences a firm's ACAP in Cognitive Domain. This influence will be examined within each key dimension of ACAP*

P2.1: *Awareness positively influences the Acquisition capacity of SMEs*

P2.2: *Awareness positively influences the Assimilation capacity of SMEs*

P2.3: *Awareness positively influences the Transformation capacity of SMEs.*

P3.4: *Awareness positively influences the Exploitation capacity of SMEs*

Proposition 3 (P3): *Awareness positively influences a firm's ACAP in Affective Domain. This influence will also be explored within each key dimension of ACAP*

P3.1: *Awareness positively influences the SME's organisational alignment towards acquiring new external knowledge*

P3.2: *Awareness positively influences the SME's organisational alignment towards assimilating new external knowledge into existing cognitive structures*

P3.3: *Awareness positively influences the SME's organisational alignment towards transforming new external knowledge and existing internal knowledge into new cognitive structures*

P3.4: *Awareness positively influences the SME's organisational alignment towards exploiting new external knowledge through changed products, processes, procedures, cultures, etc.*

The conceptual framework drawn from our extant literature review and the above formulated proposition is shown in Figure 1.

[Insert Figure 1 here]

3 Methodology

The approach, adopted in our empirical investigation and aimed at assessing the main competences of each the elements of the ACAP of SMEs (including Awareness), is essentially based on Bloom's taxonomy of Learning Objectives (Bloom et al., 1956; Krathwohl, 2002). It is often described as a framework for classifying statements of what we expect or intend learners to learn as a result of a learning situation (Krathwohl, 2002). The exploratory and explanatory nature of our research questions paved the way to employ a mixed method approach where both qualitative and quantitative tools are utilised. The triangulation of these two methodologies overcomes the weaknesses associated with the individual methods.

3.1 Data collection

The qualitative data was collected through a number of semi-structured interviews with owners/managers or other senior directors which lasted up to two hours. A total of 117 SMEs involved in aerospace and advanced engineering industry and based in the South West of England were approached. However, only 43 agreed to participate in this research. Interview data was coded to be further analysed by quantitative means. Figure 2 shows the different stages followed in this research.

[Insert Figure 2 here]

3.2 Content analysis

The semi-structured interview data were firstly processed by means of the content analysis technique as suggested by Guthrie et al. (2004). It involves codifying quantitative and qualitative information into pre-defined categories in order to drive patterns in the presentation and reporting of the information. This research also followed a grounded theory approach to analyse the qualitative data by reducing raw data into codes and concepts that are designed to stand for categories.

3.3 Coding strategy

The interview records were initially open coded exploring the broad topic of innovation, learning and absorptive capacity. We then employed selective coding to explicitly test the model of ACAP. For each of the dimensions, we used two ordinal scales to code the data. The first ordinal scale which investigates the Cognitive Domain was a 6 point score (Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation). The second scale, which examines the Affective Domain, was a 5 point score (Receiving, Responding, Valuing, Organising, and Characterisation).

Each interview was reviewed against these scales and statements were selected that supported a point on one or other scale. Where multiple statements were found that could be contributing towards an individual capacity, the highest score only was counted. Thus for each company, we identified 10 statements that were coded; two statements for each of the five capacities to cover Cognitive and Affective domains. Example statements can be found at Appendix A.

3.4 Quantitative analysis

The 43 manufacturing SMEs were rated across each of the six dimensions in the Cognitive and five dimensions in the Affective Domains based on the information gathered during interviews. The coded data was then subjected to statistical analysis. Correlation and regression analysis was performed to identify the extent of linkages between each of the dimensions. To further test the strength of the relationship between these dimensions, path analysis modelling was applied. Path analysis is an extension of multiple regressions, aimed at providing estimates of the magnitude of hypothesised causal connections between sets of variables (Shah and Goldstein, 2006). Since the sample size of the data is small, the path analysis finding has been just used as a guiding point to support our findings. The next section will discuss the findings of the qualitative and quantitative data in detail.

4 Findings and discussion

4.1 Qualitative findings

The data collected for the absorptive capacities was coded and analysed under the Cognitive and Affective Domain. This analysis shows that in all cases, there were supporting statements within Bloom's Learning Objectives. This suggests that in considering the capacity for firms to undertake or benefit from innovation, the ACAP dimensions are a useful approach and that the Bloom schema is an applicable framework for analysis.

The analysis of our qualitative data failed to identify statements suggesting that firms in our sample attained the highest levels on the Cognitive Domain for Assimilation or on the Affective Domain for Acquisition. No firm scored universally high, or low, on all the dimensions across all the competencies.

Appendix B shows the scores for all 43 manufacturing SMEs in the Cognitive and Affective Domains. The scores show that within many companies there are both high and low scores

(e.g. Firm 25). This range of scores within a single firm reflects the constraints on manufacturing SMEs, meaning that they cannot devote significant resources to everything, regardless of how highly they may value them. This also makes sense with the tendency for firms to report Assimilation more highly than Transformation. This, as highlighted in our first proposal and our theoretical discussion (Bianchi et al., 2010), can be explained by a low level of resources, competencies, procedures, and processes that can affect the SMEs ability to transform and fully exploit the acquired knowledge (Mosey, Woodcock and Clare 2003; Bianchi et al., 2010; Strobel and Kratzer, 2017). The progression towards the critical dimensions of Transformation and Exploitation can also be associated with short term approaches to learning (Sciascia et al., 2014; Burcharth, Lettl and Ulhøi, 2015).

Our analysis shows that whilst there is one firm that rated highest on Transformation, more firms tended to score more highly for Assimilation than Transformation. Most of the firms in this study have developed out of a core engineering innovation or competency, usually embodied within the owner/manager. As suggested by Durst and Wilhelm (2012) this knowledge and competency are hardly captured and shared by the whole organisation.

Qualitative data also showed that most companies scored more highly on Assimilation over Transformation, both on the Affective and Cognitive dimensions. It is worth noting that those companies which scored highest on the Affective Dimension for Awareness (Firms 19, 23, 27, 30, 41), had an almost exact balance in the scores between Assimilation and Transformation (with the notable exception of Firm 41) (see Appendix B). This can suggest that this group of SMEs is more aware of the importance of assimilation and transformation and their impact on the successful development of a resources based capability.

For those which have not scored high on Awareness on the Affective Domain, they made statements that indicated they were organising their business structures around the assimilation of new external knowledge.

"*Design and manufacture is carried out in-house to ensure product fitness for purpose and quality*" (Firm 28)

Others such as Firm 26, claimed that they were allocating resources to the assimilation and transformation of new external knowledge.

"*Investing many years in product development*"

In contrast they were merely paying lip-service to transforming their knowledge structures "*Attended a Microelectronics iNet*[1] *event on* micro-electro-mechanical systems" (Firm 28), or responding to the potential benefits of transformation but without allocating any resources, e.g. "*lack of in-house electronics knowledge to support innovation*" (Firm 26).

In a similar fashion on the Cognitive domain, companies gave statements indicating that they were analysing and improving their processes and methods for assimilating new external knowledge e.g. "*processes exist within the company to encourage innovation and incorporate new ideas into new products*" (Firm 27). There were also statements indicating that they were at least applying good practice from elsewhere e.g. "*Lean process improvement programmes have started and manufacturing efficiencies are improving, with Manufacturing Advisory Service (MAS) providing support for the last 18 months*" (Firm 19) . In contrast they tended to only acknowledge that transformation of knowledge structures might be a good innovation practice or demonstrate some understanding of this without making any statements to the effect they were putting that understanding into practice as illustrated in the following.

[1] The iNet events were part of the iNet projects which were funded by the European Regional Development Fund. Their main objective was to help manufacturing SMEs from the South West of England improve their innovative capacities

"… *old attitudes resist progress in some areas*" (Firm 16).

On the whole, there is a good qualitative alignment between the Cognitive Domain and the Affective Domain. Firms tended to focus on higher levels of competence and capacity for Assimilation of new external ideas with existing internal cognitive structures than on transforming those cognitive structures in the light of external new knowledge. There does appear to be some mismatch with firms suggesting they were more organised around Acquisition and Exploitation than perhaps was evidenced by their processes and processing.

There is clear evidence from the above analysis to support again our first proposition. The development of the ACAP of most SMEs of our sample is affected by their low level of resources, competencies, procedures and processes.

There is also strong evidence from the qualitative data which clearly supports Proposition 2 and Proposition 3 which suggest that Awareness is a key dimension influencing positively both Affective and Cognitive Domain.

4.2 Quantitative findings

The coding scores for each of the five dimensions covering Cognitive and Affective Domains were analysed using SPSS20. To explore the relationships between Awareness and the four dimensions of ACAP, we first carried out the correlation analysis for the Cognitive Domain (Table 1). The analysis for the Cognitive Domain shows a significant correlation between the main dimensions except no correlation was evident between Assimilation and Transformation. The lack of correlation between Assimilation and Transformation supports the literature that considers these to be parallel rather than sequential, dependent dimensions (Todorova and Durisin, 2007).

[Insert Table 1 here]

The correlation analysis shows that Awareness affects Acquisition; Assimilation; Transformation; and Exploitation as significant and positive correlations were evident (Table 1). This provides support to Proposition 2. The correlation analysis also supports P2.1 to P2.4 by showing positive correlations between Awareness and the other dimensions. To further verify the correlation findings, we applied regressions. The regression analysis shows that all these four dimensions explain about 72% variance (Adj. R^2 value) of Awareness.

However, the correlation finding of the Affective Domain was in contrast to the Cognitive Domain (see Table 2). Most of the dimensions were not significantly correlated except for the correlation between Acquisition and Transformation (.357) significant at 0.05 Level. The analysis partially supports Proposition 3 as Awareness was found to be correlated only with Acquisition (.674) and Transformation (.581) significant at 0.01 Level, hence, supporting P3.1 and P3.3. To further cross verify the findings of the correlation, regressions analysis was conducted. Regression findings showed that all the four dimensions of ACAP explained around 58.6% (Adj. R^2 value) variance in Awareness, thus indicating that there is a relationship between Awareness and the other dimensions. Further regressions were performed between Acquisition, Transformation and Awareness and the outcome showed the two dimensions of ACAP explain majority of the variance, i.e. 56.6% of variance (Adj. R^2 value), thus supporting the correlation findings. It can therefore be suggested that the quantitative data confirms the difficulties that SMEs encounter in the development of their ACAP and support Proposition 1 which is essentially investigated through the use of qualitative data.

[Insert Table 2 here]

First, these findings suggest that the Affective Domain is difficult to assess through the use of semi-structured interviews and could be better considered over time where patterns of

behaviour may be more sensitive than snapshot statements. Affective Domain, which is more related to behaviour, motivation, interest, attitudes and identification is quite complex and needs to be further investigated through qualitative approaches. The findings also suggest that the need to acquire and exploit new ideas may be an assumed capacity and thus was not seen as something that needs to be explicitly referred to. As there was a need to decide between Assimilation and Transformation as two distinct dimensions because of resources constraint, those internal decisions were externalised and expressed in a form that could be captured in interviews.

To further verify the findings for the Cognitive Domain, we applied path analysis technique which is an extension of the multiple regressions. The outcome of the path analysis for Cognitive Domain further supports for proposition P2 (P2.1-P2.4) by showing that awareness is positively correlated to all the dimensions of the absorptive capacity. The fitness of the path analysis model is presented in Table 3 that are within the acceptable ranges. To cross verify the findings for the Affective Domain, path analysis model was constructed. The outcome of the path analysis modelling reinforces the assertion of the correlation analysis that Awareness was only positively linked with acquisition and transformation since the best fit model did not show any linkages with assimilation or exploitation. The fitness indices of the path model for the Affective Domain are shown in Table 4, where all the indices are within the acceptable ranges.

[Insert Table 3 and 4 here]

In summary, both the qualitative and quantitative analysis show that, within our sample of manufacturing SMEs, there is clear evidence of interest in acquiring new knowledge from external sources and attempts to assimilate this knowledge in order to improve their competitive advantage. However, there is also some evidence of a lack of interest and/or

ability in internalising and converting the acquired and assimilated new knowledge into existing new cognitive structures in order to contextualise and better use the assimilated knowledge as suggested by Flatten et al. (2011). This can be explained by the limited or even lack, of prior competencies to fully convert and exploit the acquired knowledge. This, as suggested by the literature review and our first proposition, can be caused by the limited human, management and financial resources, undeveloped education and training, and lack of normal systems, procedures, processes and organisational routines.

Both the qualitative and the quantitative analysis also prove the merits of Awareness and its impact on the development of the ACAP, as highlighted by Propositions 2 and 3. Awareness can be developed and sustained through organisational rearrangements (Knoppen, Sáenz and Johnston, 2011; MacBryde, Pato and Clegg, 2013) and human resources management practices (Volberda, Foss and Lyles, 2010; Rangus and Slavec, 2017).

In addition, the quantitative findings show that the extent of the impact of Awareness on the other dimensions varies between the Cognitive and Affective Domain. As suggested by Proposition 2, for the Cognitive Domain, Awareness is found to significantly affect Acquisition; Assimilation; Transformation; and Exploitation for Cognitive Domain. However, for the Affective Domain (Proposition 3), the impact of Awareness is only limited to acquisition and transformation.

5. Conclusions

In spite of major resources constraints and limited management practices which can affect the adoption and integration of new knowledge, this paper recognises the crucial need for SMEs to reposition themselves by effectively developing their knowledge-based resources through appropriate organisational changes, human resources management practices, and collaboration in order to effectively meet the challenges of the changing and innovative

manufacturing sector. To address this complex and under researched area, our theoretical approach has been influenced by the work linking ACAP with organisational learning, innovation and performance. Our study, which places a greater emphasis on internal organisational and cognitive process, has been informed by the theoretical framework of intra- and inter-collaboration as well as the social perspective of learning. This has led to our paper contributing to the theoretical discussion on ACAP and extending the current theory by empirically showing Awareness as an antecedent dimension of ACAP which can enable SMEs to improve their knowledge based resources.

The research has shown some evidence of prior knowledge and interest to acquire and assimilate new knowledge. However most of the SMEs investigated seem to be unprepared to effectively internalise and convert this acquired new knowledge into existing new cognitive structures in order to better exploit it.

In line with our theoretical discussion, our empirical findings suggest that for most SMEs, the development of their ACAP is affected by their resources constraints and inappropriate organisational and cognitive routines (RQ1). We argue that most SMEs need to review and adapt their organisational processes, structures, culture, incentives scheme, leadership and social interactions in order to ensure a strong motivation and commitment to learn through the establishment of long term and trusted relationships with their partners. These relationships are crucial and can help SMEs acquire external resources and knowledge. However, this can be difficult as it requires time, resources and commitment for the development and implementation of innovative managerial and leadership approaches.

Adopting and institutionalising new organisational and cognitive processes, mechanisms, structures and procedures complemented by a strong level of interest, motivation and commitment to learn and collaborate can foster the development of culture and behaviour to

share, communicate and, chief of all, transfer individual learning into the organisational learning.

Our research has reviewed and examined the relevance to manufacturing SMEs of the four main known dimensions of the ACAP. It has explored the merits of Awareness as an antecedent in the development of the ACAP of SMEs (RQ2). Awareness focuses on the generation of interest and motivation to value external knowledge in order to better understand how SMEs can adopt new management practices and processes which can help them identify and deal with the main enablers and inhibitors to the development of their knowledge-based resources. Awareness is found to be significantly impacting Acquisition; Assimilation; Transformation; and Exploitation for Cognitive Domain. As to Affective Domain, Awareness is only affecting acquisition and transformation (RQ3).

Exploring how SMEs can effectively develop their ACAP in order to enhance their innovative capacity and competitiveness is of unquestionable interest to policymakers and managers since SMEs are viewed as the drivers of the economies of most countries. A greater understanding of the key determinants of the development of ACAP can inform policies aimed at better supporting and assisting SMEs. Owner/Managers ought to be more equipped and dedicated to transform their management style and introduce appropriate changes conducive to commitment, engagement and motivation to learn and to share learning. In terms of managerial and policy implications, it is imperative to acknowledge that the survival of SMEs is dependent on the acquisition of external knowledge through collaboration. The successful use of this external knowledge is associated with the need for SMEs to develop more formal systems, procedures, rules and routines which can help them mitigate their weaknesses and foster the motivation and interest to collaborate and value learning and innovation.

The use of mixed method approach was useful however, the study demands further verification of the findings through more empirical data. The current study was based on the qualitative data and analysis of the coded qualitative data into numerical form. Future research direction should therefore focus on gathering empirical data through a survey questionnaire. This will provide strong support for the existing findings and also enhance the generalisability. The rich data set collected through the questionnaire would help us to further test and verify the proposed propositions, some of which remained unanswered in this study. We applied structural equation modelling on small data sets to cross verify the correlations and regression finding. However, structural equation modelling works best with large data sets hence, more data points will also improve the validity of the findings. In addition, the data collection and analysis on Awareness was essentially focused on identifying and assessing the SMEs' interest to acquire new knowledge from external sources as a means to improve the organisational performance and achieve competitive advantage. The internal Awareness which is more related to the importance, motivation and interest of developing an organisation's capacity for learning and innovating was not sufficiently investigated. Future research should aim to capture empirical evidence pertaining to internal Awareness. The role of ACAP in developing innovative capability of SMEs could also be a focus of the future research agenda. Further research on the interplay between Awareness, organisational changes and social capital within manufacturing SMEs should also be encouraged in order to better comprehend the main conditions for the development of organisational learning as a key pre-requisite for ACAP, innovation and competitiveness.

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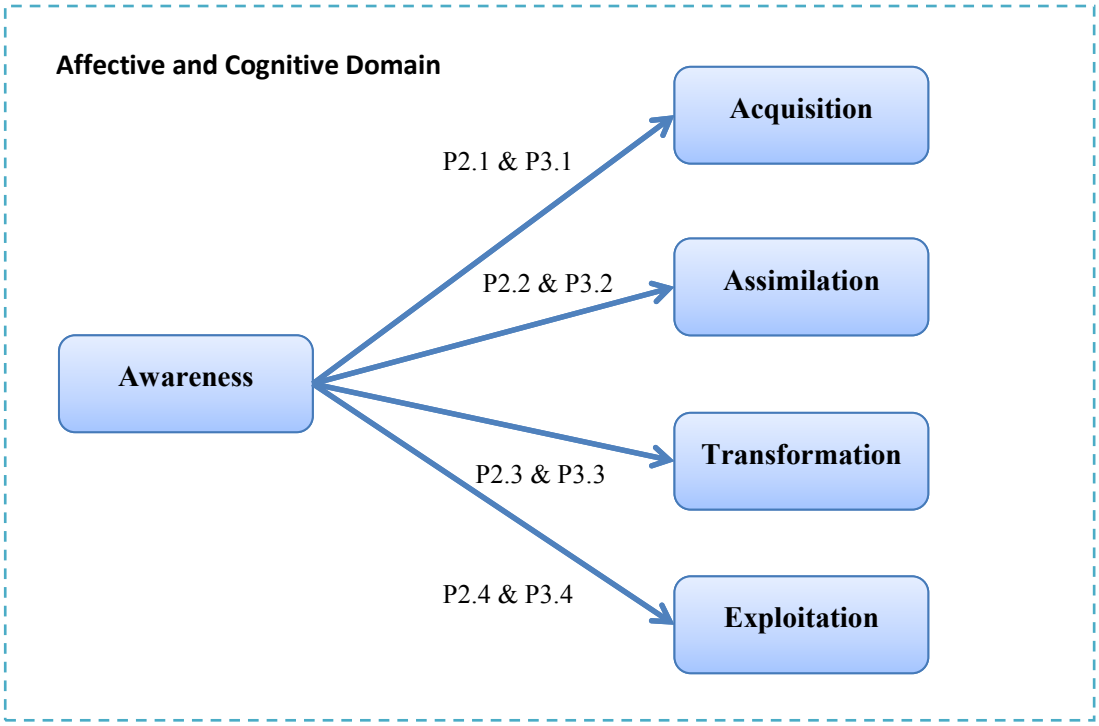

Figure 1: Conceptual Framework

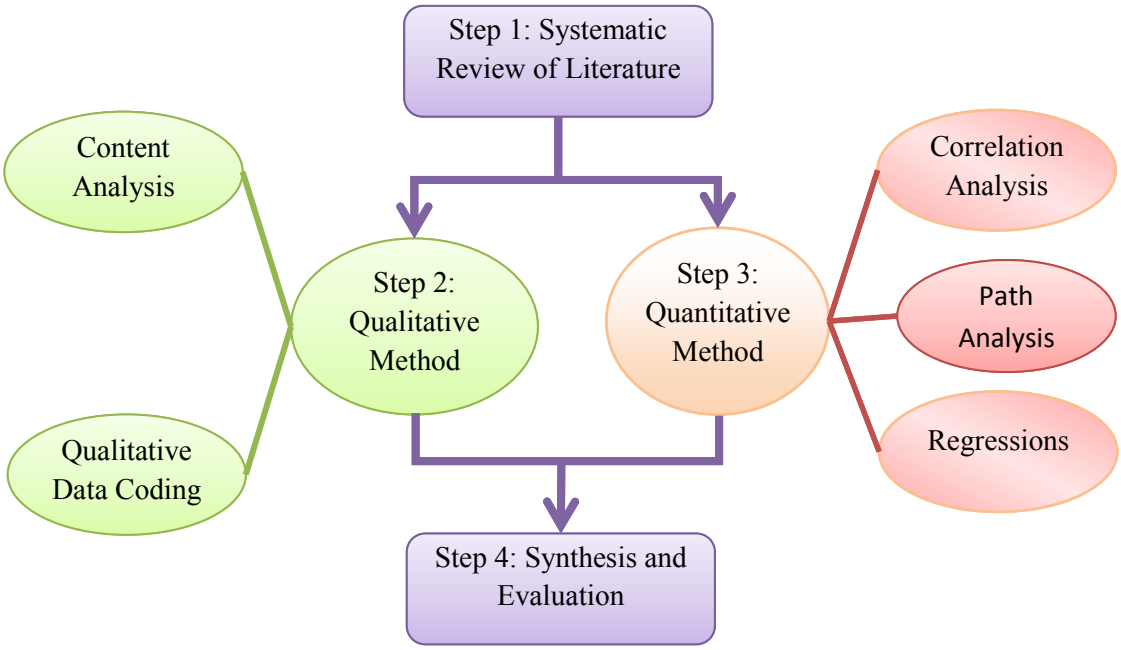

Figure 2: Research Steps

Table 1: Correlations findings of Cognitive Domain

Cognitive Domain	Awareness	Acquisition	Assimilation	Transformation	Exploitation
Awareness	1				
Acquisition	**.561****	1			
Assimilation	**.400****	**.374***	1		
Transformation	**.584****	**.425****	.080	1	
Exploitation	**.407****	**.467****	**.399****	**.371***	1

****. Correlation is significant at the 0.01 level (2-tailed).**

***. Correlation is significant at the 0.05 level (2-tailed).**

Table 2: Correlations for Affective Domain

Affective Domain	Awareness	Acquisition	Assimilation	Transformation	Exploitation
Awareness	1				
Acquisition	**.674****	1			
Assimilation	.546	.399	1		
Transformation	**.581****	**.357***	-.159	1	

Exploitation	.148	-.026	.114	.031	1
****. Correlation is significant at the 0.01 level (2-tailed).** ***. Correlation is significant at the 0.05 level (2-tailed).**					

Table 3: Path Analysis Fitness Indices (Cognitive Domain)

Model	NFI	GFI	IFI	RMSEA	CFI
Best Fit model	**.986**	**1.000**	**1.000**	**.000**	**1.000**

Table 4: Path Analysis Fitness Indices (Affective Domain)

Model	NFI	GFI	IFI	RMSEA	CFI
Best Fit model	**.986**	**.981**	**1.006**	**.000**	**1.000**

Appendix A: Examples of statements and their coding
1-11 “Innovation is not a current priority” Firm 3 1-15 “The leadership team understands how to create a culture of creativity and innovation in all areas of the business and leads by example.” Firm 27 1-01 “No strategic plans or budgets are established to drive innovation” Firm 9 1-06 “The company manufactures own brand products that are designed and developed in-house, providing opportunities for product and market diversification. Two new products were introduced last year.” Firm 19 2-11The leadership team do not feel that the company would benefit from collaboration with an academic institution or commercial partner.” Firm 9 2-14 * “Have used Bournemouth University to provide support with innovation and ideas. Have joined inventors clubs to stimulate ideas.” Firm 8 2-01 “Limited engineering knowledge outside current product” Firm 26 2-06 “Historic links with Staffordshire University...In discussions with Exeter and Plymouth Universities.” Firm 16 3-11 “They have not tapped into the full range of support from other Solutions for Business and generally look after themselves.” Firm 43 3-15 “Invested many years in product development. Reputation for being inventive and supportive in engineering solutions” Firm 26 3-01 “Lack of good processes when committing to the introduction of new ideas will continue to drain resources without improving sales and profitability” Firm 8 3-05 * “Effective processes exist within the company to encourage innovation and incorporate new ideas into sales, marketing, design and manufacture.” Firm 11 4-11 “Not interested at this moment in time in any university participation.” Firm 7 4-15 “Ambitious and innovative design team for such a small business.” Firm 25 4-01 “Existing … expertise is not a natural platform for innovation into high-technology areas and considerable new skills would need to be brought into the business.” Firm 10 4-06 “As a small business the capacity for horizon scanning is limited. In the main part this involves identifying when key customers, mainly in the aerospace sector, are planning their new product development cycles. As a new aeroplane can have a significant life-cycle, being

involved at the specification phase can aid longer term involvement in manufacturing and servicing." Firm 41

5-11 "Senior leadership admits to bad habits – pursuing technical interest rather than commercial potential." Firm 13

5-15 "The business measures performance using a balanced set of Key Performance Indicators that drive management decision making." Firm 11

5-01 "The leadership team is uncertain about how to create a culture of creativity and innovation in all areas of the business." Firm 9

5-06 "The business measures performance using a balanced set of Key Performance Indicators" that drive management decision making" Firm 19

* No company was scored in the top category.

Appendix B: scores for all 43 companies in the cognitive and affective domains

	Cognitive Domain				
Firm	Awareness	Acquisition	Assimilation	Transformation	Exploitation
1	4	1	2	4	4
2	5	3	5	2	4
3	1	2	4	2	3
4	4	2	4	2	2
5	2	1	3	2	4
6	2	2	3	2	3
7	5	3	3	1	3
8	1	4	1	1	2
9	1	2	2	2	1
10	5	2	3	1	3
11	5	3	5	2	4
12	4	4	5	2	5
13	5	3	3	4	2
14	3	1	4	2	2
15	3	2	4	2	3
16	5	6	4	2	4
17	1	2	3	1	3
18	3	4	4	2	2
19	6	5	5	5	6
20	4	3	3	2	3
21	4	4	4	1	4
22	1	3	3	1	3

23	5	5	4	5	4
24	1	2	3	2	4
25	5	3	3	5	2
26	2	1	4	1	2
27	6	6	5	5	5
28	3	4	4	2	4
29	4	4	4	3	4
30	5	5	4	4	4
31	4	3	3	4	4
32	1	2	3	1	3
33	3	2	4	2	2
34	5	3	2	2	3
35	2	2	2	3	4
36	5	3	3	5	4
37	3	2	3	2	4
38	3	2	3	2	2
39	3	2	3	1	4
40	1	2	3	1	3
41	5	4	3	6	4
42	4	3	2	4	3
43	3	3	3	4	4

	Affective Domain				
Firm	Awareness	Acquisition	Assimilation	Transformation	Exploitation
1	1	2	3	1	3
2	4	3	4	2	3
3	1	1	3	2	2
4	2	3	4	1	3
5	1	1	3	1	4
6	2	2	2	1	2
7	3	3	4	1	3
8	4	4	2	2	2
9	3	1	3	1	3
10	3	2	3	2	2
11	4	3	4	4	5
12	3	3	4	2	4
13	4	3	3	4	1
14	2	1	4	2	2
15	3	2	4	2	2
16	4	3	4	2	4
17	1	2	3	1	3
18	4	3	3	1	2
19	5	4	4	4	4
20	3	3	4	2	4
21	3	3	3	2	2
22	1	1	4	2	4

23	5	4	3	4	2
24	4	3	2	1	2
25	4	4	3	5	1
26	1	2	5	1	1
27	5	4	3	4	4
28	2	2	4	2	4
29	4	3	4	2	3
30	5	4	3	2	4
31	4	3	2	4	2
32	1	2	3	1	2
33	2	2	3	2	2
34	3	2	2	2	3
35	1	2	3	1	3
36	4	3	3	4	3
37	3	4	3	3	2
38	1	1	2	3	2
39	2	3	4	2	3
40	2	4	3	1	3
41	5	3	2	3	4
42	4	1	2	3	4
43	2	1	1	3	4