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**International Opportunity Recognition in UK based Life Science SMEs: A
Dynamic Managerial Capabilities Perspective**

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**Submitted in partial fulfilment of the regulations for the degree of
Doctor of Philosophy**

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Declaration

I hereby declare that this thesis has not been submitted, either in the same or different form to this or any other University for a degree.

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Abstract

The life science industry is characterised by a number of small, interdependent and specialised companies (Powell, White, Koput & Owen-Smith, 2005; Powell, Packalen & Whittington, 2012). Therefore, recognising opportunities for international expansion, to gain knowledge and resources, is a central activity for life science SME owners/managers. While many studies focus upon organisational level capabilities within this context (Jones, Wheeler, Dimitratos, 2011a), little is known about the micro-foundations (Teece, 2007) of the international opportunity recognition process. Life science SMEs can be divided into two main categories, early-stage SMEs (R&D focused), and later stage SMEs (commercialising products and/or services). Drawing upon the theoretical lens of dynamic managerial capabilities, we explore the mechanisms that life science SME owners/managers leverage, at different stages, to acquire specialised technological and market knowledge, during the international opportunity recognition process.

We used a two phase research design, drawing upon a replication logic methodology (Eisenhardt & Graebner, 2007; Leonard-Barton, 1990). Firstly, we used an exploratory case to provide a fine-grained understanding of the mechanisms leveraged when acquiring technological and market knowledge, during the international opportunity recognition process, in a life science SME. In the second phase, we selected 12 further cases, which we analysed using a comparative case study methodology, to replicate and extend our emergent constructs, derived from the findings of the exploratory case (Eisenhardt, 1989; Leonard-Barton, 1990). These cases helped to develop our understanding of the similarities and differences between the mechanisms leveraged by

owners/managers in early-stage and later stage life science SMEs, when acquiring specialised technological and market knowledge, during the international opportunity recognition process.

Three main phases of the international opportunity recognition process; scanning, sensemaking and selection, emerged from our empirical findings. In addition, we shed light upon how the mechanisms, underpinning social and human capital, were leveraged in each phase of international opportunity recognition process, by owners/managers of different stage life science SMEs, when acquiring technological and market knowledge. Finally, we uncovered an association between the type of knowledge acquired, early and later stage SMEs, and the mode of international market entry. Our evidence highlights that life science SME owners/managers can benefit from leveraging their networks to access specialised knowledge, when recognising opportunities for international expansion.

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Table of contents

1.0 Introduction	10
1.1 Introducing the topic.....	10
1.2 The life science industry as a context for international entrepreneurship	11
1.3 Research gap in the existing literature	21
1.4 Research questions	23
1.5 Overview of the chapters.....	25
2.0 Literature review	26
2.1 Introduction	26
2.2 Opportunities	27
2.3 International opportunity recognition.....	28
2.4 The process of international opportunity recognition	31
2.4.1 Phase 1: Identification of international opportunities	33
2.4.2 Phase 2: Evaluation in international opportunity recognition	39
2.4.3 Phase 3: Selection and exploitation in international opportunity recognition	40
2.5 Dynamic Capabilities	42
2.5.1 Micro-foundations	45
2.5.2 Sensing and shaping international opportunities.....	46
2.5.3 Seizing international opportunities.....	46
2.5.4 Reconfiguring international opportunities	47
2.5.5 Human capital in international opportunity recognition.....	48
2.5.6 Social capital in international opportunity recognition	56
2.5.7 Human and social capital in international opportunity recognition	59
2.5.8 Knowledge acquisition in international opportunity recognition	60
2.5.9 Absorptive capacity, routines, the evolution of dynamic capabilities and opportunity recognition in international opportunity recognition	62
2.6 International opportunity recognition in the life science industry	64
2.6.1 Human capital and international opportunity recognition in the life science industry	65
2.6.2 Social capital and international opportunity recognition in the life science industry	68
2.6.3 Technological and market knowledge acquisition in the life science industry	70

2.6.4 Absorptive capacity and international opportunity recognition in the life science industry	74
2.6.5 Routines and opportunity recognition in the life science industry	75
2.7 International entry modes as opportunities for internationalisation in the life science industry.....	76
2.7.1 Partnerships	76
2.7.1.1 Partnerships with large and small companies	77
2.7.1.2 Partnerships with universities.....	81
2.7.1.3 Distribution networks and exports	82
2.8 Summary of the literature.....	84
3.0 Methodology.....	93
3.1 Introduction	93
3.1.1 Overarching research design	93
3.2 Phase 1: Research approach and design.....	95
3.2.1 Research setting.....	96
3.2.2 Measures, level and unit of analysis	97
3.3 Data collection	98
3.4. Data analysis: Thematic analysis.....	106
3.5 Phase 2: Research approach and design.....	112
3.5.1 Measures, level and unit of analysis	115
3.6 Data collection	116
3.7 Data analysis.....	117
3.8 Ethical considerations	125
3.9 Reflection on method	125
4.0 Findings	127
4.1 Introduction	127
4.2 Exploratory case: How life science SME owners/managers recognise opportunities internationally.....	127
4.2.1 Introduction	127
4.2.2 Phase 1: Scanning.....	131
4.2.3 Phase 2: Sensemaking.....	136
4.2.4 Phase 3: Selection	140
4.2.5 The interplay of cognitive and networking capabilities in knowledge acquisition	141

4.3 How life science SME owners/managers recognise opportunities to enter international markets.....	142
4.3.1 Introduction	142
4.3.2 Phase 1: Scanning.....	149
4.3.3 Phase 2: Sensemaking.....	159
4.3.4 Phase 3: Selection	170
4.4 Summary of findings: How life science SME owners/managers recognise opportunities to enter international markets.	172
4.5 Summary of findings: Exploratory case and comparative cases.....	175
5.0 Discussion and conclusions	188
5.1 Discussion.....	188
5.2 Theoretical contributions.....	201
5.3 Implications of research.....	202
5.3.1 Managerial implications.....	202
5.3.2 Policy recommendations.....	203
5.4 Limitations and further research	204
Reference List.....	206
Appendix 1: Example of interview questions: Exploratory case.....	225
Appendix 2: Example of interview guide used: Comparative cases.....	226
Appendix 3a: Examples of conceptual themes from the data: Exploratory case.....	228
Appendix 3b: Examples of conceptual themes from the data: Early-stage SMEs.....	237
Appendix 3c: Examples of conceptual themes from the data: Later stage SMEs.....	248
Appendix 4a: Case-by-case analysis: Mechanisms leveraged in each stage of the opportunity recognition process: Early-stage SMEs.....	259
Appendix 4b: Cross-case analysis: Early-stage SMEs (scanning).....	262
Appendix 4c: Cross-case analysis: Early-stage SMEs (sensemaking).....	263
Appendix 4d: Cross-case analysis: Early-stage SMEs (selection).....	264
Appendix 4e: Case-by-case analysis: Mechanisms leveraged in each stage of the opportunity recognition process: Later stage SMEs.....	265
Appendix 4f: Cross-case analysis: Later stage SMEs (scanning).....	270
Appendix 4g: Cross-case analysis: Later stage SMEs (sensemaking).....	272
Appendix 4h: Cross-case analysis: Later stage SMEs (selection).....	273

List of Figures

Figure 1: The international opportunity recognition process.....	92
Figure 2: The international opportunity recognition process: Exploratory case.....	129
Figure 3: The international opportunity recognition process: Early-stage SMEs	147
Figure 4: The international opportunity recognition process: Later stage SMEs	148

List of Tables

Table 1: Classification of life science firms: Early and later stages	21
Table 2: Sources of data: Exploratory case	102
Table 3: Analytical themes and coding: Exploratory case	108
Table 4: Demographic characteristics of 12 selected cases.....	113
Table 5: Analytical themes and coding: Early-stage SMEs.....	119
Table 6: Analytical themes and coding: Later stage SMEs.....	122
Table 7: Comparison tables: Exploratory case and comparative cases. Phase 1: Scanning (human capital).....	177
Table 8: Comparison tables: Exploratory case and comparative cases. Phase 1: Scanning (social capital)	179
Table 9: Comparison tables: Exploratory case and comparative cases. Phase 2: Sensemaking (human capital)	181
Table 10: Comparison tables: Exploratory case and comparative cases. Phase 2: Sensemaking (social capital)	183
Table 11: Comparison tables: Exploratory case and comparative cases. Phase 3: Selection (human capital)	185
Table 12: Comparison tables: Exploratory case and comparative cases. Phase 3: Selection (social capital).....	186
Table 13: Mechanisms leveraged during the international opportunity recognition process within life science SMEs at different stages	196

1.0 Introduction

1.1 Introducing the topic

The life science industry sector is characterised by a number of small, specialised and interdependent companies (Powell, White, Koput & Owen-Smith, 2005; Powell, Packalen & Whittington, 2012). These organisations may not be located in physical proximity to each other (e.g. in research clusters). This means that life science firms have to engage in establishing local and distant (international) networks (Powell *et al.*, 2012). These networks provide owners/managers with domain specific technological and market knowledge, distinct to their organisations (Dimov, 2007; Park, 2005; Zahra & Wright, 2011). Therefore, the recognition of opportunities for international development is a central activity of life science SME owners/managers (Jones *et al.*, 2011a; Jones, Wheeler, Dimitratos & Vlachos, 2011b). International expansion provides access to useful networks, which enable technological innovation (R&D), and commercialisation of innovations within international markets. Within a small business context, owners/managers play a key role in international opportunity recognition (Gilmore, Carson & Grant, 2001; Hulbert, Gilmore & Carson, 2015). The context and nature of the life science sector can help to shed light upon the process of international opportunity recognition (Dimov, 2011; Welter, 2011).

Specifically, this context is characterised by uncertainty, (due to experimental nature of R&D activities and international market entry). In addition, large sums of investment are often required, and short windows of opportunity to gain a return on

investments, are key factors. We further explore the background and characteristics of this industry context in the forthcoming sections, to set the scene for our research.

1.2 The life science industry as a context for international entrepreneurship

The life science industry emerged in 1970s from the USA, and has since developed into a global industry (Powell *et al.*, 2005; Powell *et al.*, 2012). The industry is characterised by scientific and commercial advances, uncertainty due to technological experimentation, international expansion, and short windows of commercialisation (Warner & Carrick, 2011). It consists of complex networks of organisations, which perform highly specialised activities e.g. universities, other public research organisations, venture capital firms, multinationals and dedicated biotech firms (DBF's) (Powell *et al.*, 2005; Powell *et al.*, 2012). Each firm performs a specific activity, which adds value to innovations, products and/or services. The skills which each organisation possesses are distinctive. By recombining and repurposing the skills gained from strategic alliances, new innovations can be created (Powell *et al.*, 2012).

Life science SMEs are engaged in a wide range of knowledge-intensive and highly specialised activities (Zahra & Wright, 2011), for example, the creation and/or commercialisation of biotechnology, biomedical, nutraceutical and medical devices (Jones *et al.*, 2011a). It can be divided into segments such as the development and manufacture of pharmaceutical products, the development and manufacture of medical devices, and those devoted to life science research only (PwC, 2017). Pharmaceutical companies are the largest segment in the UK life science industry, contributing £15.7bn (52% of total life sciences GVA) in 2015. Second largest are medical technology firms (11.5 bn/38% of life sciences GVA in 2015), followed by pre-commercialisation research

companies (£3.2bn of life sciences GVA in 2015) (PwC, 2017). In our study, we segment life science SMEs into two distinct stages. Firstly, those in the early stages, which focus upon research only. And secondly, later stage SMEs, those which primarily commercialise products and products and services internationally (see Table 1).

Firstly, small and medium sized firms operating in the early stages are characterised by drug discovery and intense R&D activities. These firms are typically backed by venture capitalists. These organisations specialise in technological know-how, and the isolation of molecules which have the potential to create new treatments. Firms in the early stages are typically heavily regulated, and their technology is subject to costly clinical trials.

In contrast, other SMEs specialise in providing commercialisation pathways for technological innovations, in the later stages. These firms specialise in entering international markets in order to commercialise products and services. In many cases, these firms do not require specialised knowledge in the specific technology which they are commercialising, and may draw upon Contract Research Organisations in order to develop the technology for them. Many small firms commercialising products only or products and services, draw upon preventing and managing diseases through commercialising supplements. These areas are less regulated and therefore less costly for small and young firms to bring to the market. Commercialisation and routes to international market entry are often overlooked by firms operating in the life science industry, as the focus is on developing innovative healthcare technology. However, there are big opportunities for growth within this industry through bridging

technological and market knowledge, enabling the effective commercialisation of technological innovations.

Particularly in the life science sector, establishing networks with relevant firms who possess complementary and specialised knowledge, in order to effectively commercialise technological knowledge is important. As suggested by Teece (1986: 285) 'Innovating firms without the requisite manufacturing and related capacities may die, even though they are the best at innovation'. Know-how provides knowledge of how to effectively market, manufacture, and provide after-sales support for products and services. Access to complementary assets makes technological innovations profitable e.g. through competitive marketing.

Owners/managers of life science SMEs may need to source molecules from suppliers, or raw products which are sourced from a specific location. These raw products possess specific characteristics, which can be used for medicinal purposes. In addition, owners/managers may source distributors who understand the implications of the added scientific angle. This enables distributors to effectively market products and services. This is especially true in international markets, as there may be differences in the cultural understanding of products. Distributors interact directly with customers and end users, and therefore play an important part in providing information to life science owners/managers, regarding the use of their products and services. This information can help to better shape the products and services which the owner/manager is providing, through indirect customer feedback.

In addition, university partnerships often provide access to technological knowledge in a specific science-based discipline. This can complement the innovation

being developed by the owner/manager of a life science SME. Partnerships with knowledge-intensive SMEs, universities and larger companies provide both tangible and intangible assets. This can include specialised knowledge (technological or market or both), and access to assets that enable clinical trials (partnerships with larger companies), or access to resources (e.g. specialist equipment needed to analyse materials).

Complementary assets require investment from both the innovator and the provider of the assets. This requires investment from both partners. SMEs are less likely to have relevant specialised assets and have to build them internally, or try to develop partnerships with the owners of these assets (Teece, 1986; Teece, 2007). SMEs can partner with larger, more established companies to sell their products, enabling them to leverage brand confidence. Contractual relationships e.g. licensing technology, with manufacturers and suppliers, reduces risk and cash requirements.

Since the 1970s small biotech start-ups have struggled to bring new medicines or products to the market, due to a lack of necessary skills and resources. This is a problem which many small and medium sized life science enterprises still encounter to this day. In order to attempt to overcome this, life science firms have created elaborate networks, especially with universities and large pharmaceutical companies (Powell *et al.*, 2005). Universities provide access to cutting edge science, whilst large pharmaceutical companies provide marketing power. Establishing an array of networks with different firms helps to overcome the uneven distribution of technological, organisational, and financial resources (Powell *et al.*, 2005). Powell *et al.* (2005) suggest that collaboration is principally driven nowadays in order to establish innovation

networks, R&D collaboration and product development. Establishing networks is especially applicable to life science owners/managers as; 'No single organization has been able to internally master and control all the competencies required to develop a new medicine.' (Powell *et al.*, 2005: 1142).

Nowadays, with technological innovations emerging at an increasing pace, and as the UK life science sector is continuing to grow, there are many opportunities for the creation and growth of small life science firms (Office for Life Sciences, 2018). Most R&D focused pharmaceutical companies are experiencing an increase in revenue and profits, as the industry is recovering slowly from the 2004-2008 financial crisis (Deloitte, 2018). Entering emerging markets is a common growth strategy within this industry, with 8 of the top 20 pharmaceutical markets globally, being in emerging economies (Deloitte, 2018). In particular, the role of small companies providing niche expertise in R&D, is increasingly important to the industry. Less than a quarter of drugs discovered are brought to market by large pharmaceutical companies (Deloitte, 2018).

Central to the growth of small life science firms is partnership formation. Partnerships provide access to technology and expertise, external to the organisation. Life science firms are highly co-dependent upon other firms. The nature of partnerships within the life science industry are shifting from being asset based, to R&D alliances involving academia. These networks provide access to specialised knowledge and technology (e.g. licensing) (Powell *et al.*, 2005; Zucchella & Kabbara, 2011). Partnerships are often based upon technological fit (Teece, 2007). This helps organisations within this sector to share risk, but may also be incentivised by governmental bodies to stimulate innovation. Frequent interaction amongst networks provides a framework for shared

understanding, standards and practices amongst firms (Powell *et al.*, 2012). Life science firms may also anchor themselves to well-connected, larger organisations, which can help to establish legitimacy, expand their industry contacts, and access to resources (Powell *et al.*, 2012). However, larger firms may attempt to govern the activities of smaller companies, shaping the opportunities which they pursue (Powell *et al.*, 2012).

Life science SMEs may also venture abroad to commercialise products and/or services e.g. through distributor networks and direct to customer exports (Zucchella & Kabbara, 2011). Furthermore, there is an emerging trend of increased engagement between organisations and patients in order to clearly understand their unmet treatment needs. This type of engagement can help to enhance the development of products which are useful to patients, improve treatment regimes, and the acceptance of new products and services by customers and regulators (Deloitte, 2018).

In addition, the nature of the setting and business activities which life science SMEs specialise in can help to shed light upon when, how and why owners/managers identify international opportunities (Welter, 2011). The life science industry is moving towards preventing and managing disease, rather than simply creating cures. This is due to an aging population and the rise of non-infectious diseases (Deloitte, 2019).

Powell *et al.* (2012) highlight the importance of government policies in the formation of the industry. Specifically, policies permitting pension funds to be invested in venture capital, stimulated investment in small start-ups in the USA. This, alongside reductions in capital gains tax and the patent reforms (e.g. the US Patent Office expanding patentability to any biological material that required human intervention), increased the potential for IP creation and research into rare diseases. Nowadays, the

global regulatory environment is changing within the life science industry, with a focus upon data integrity, ensuring product quality and patient safety. For example, in Europe, all pharmaceutical and biotechnology companies are required to provide detailed product data for all of their marketed products, under the Identification of Medicinal Products framework.

National attitudes to innovation can also constrain or enable innovation within the life science industry. For example, in the USA there is a liberal market economy where corporate law is more enabling due to flexible governance mechanisms for start-ups. This fosters an attitude of independence towards scientific innovation (Casper, 2000; Welter, 2011). Plans have been set out for the Health and Research Authority in the UK to speed up approvals for clinical trials (Office for Life Sciences, 2018). This could prove beneficial for many small life science companies.

In addition, the UK government launched a ten-year strategy for UK life sciences in 2011, to help SMEs within this industry sector to grow. In 2017, £500 million was invested by the UK Government into the life science industry, under a Life Sciences Sector Deal (Office for Life Sciences, 2018). In 2012, there were 380 pharmaceutical companies based in the UK, employing nearly 70,000 people, with an annual turnover of £30bn. Medical technology and medical biotechnology sectors employed approximately 96,000 people, with a combined annual turnover of around £20bn (HM Government, 2012). In 2015 the UK life sciences contributed £30.4 billion in UK GDP and supported nearly half a million jobs (PwC, 2017). A focus on genomic data and platforms to develop new drugs was the focus of this initiative. UK exports of pharmaceutical products had a value of \$33.3bn in 2016. This was a fall by 8% from a peak of \$36.4bn in

2012, after a rise from \$29.1bn in 2007. UK exports of medical technology products had a value of \$3.8bn in 2016. There was a 7.4% rise in medical technology exports between 2016 and 2017 (Office for Life Sciences, 2018).

The Life Sciences Industrial Strategy (Bell, 2017) highlights that UK based SMEs have great potential in terms of scientific based innovation. However, these companies are often acquired before they are able to grow, reach their potential and establish a manufacturing base. The main factor attributing to this is that many of these firms are funded by venture capitalists and angel investors, which typically expect a return on investment within 5 to 7 years. This does not provide enough time for the business to expand before exit.

In recognition of a lack of funding contributing to many SME and university spin-off companies struggling to move their ideas from concepts to commercialisation, the UK government launched the Biomedical Catalyst initiative. This included a £90 million investment, over a three-year period, to support innovation in the areas of stratified healthcare, regenerative medicine, diagnostics, eHealth solutions and break-through medical technologies and devices (HM Government, 2012). In 2012, £49m was devoted to 64 projects, 40 of these projects were led by SMEs, and 24 were University-led (HM Government, 2012).

In addition, a strategic body for skills in the science industries was developed in 2012 to help develop and implement a tailored mentoring programme for SMEs. This was set up to provide SMEs with management skills to develop their competitiveness. This included sector-specific placements and mentoring, with the aim of increasing the

three-year success rate for SMEs. This was designed to encourage interaction between business, commerce and the NHS.

Furthermore, owners/managers of life science SMEs may be reluctant to enter international markets due to concerns over the protection of their intellectual property (IP). Regimes of appropriability are central to the successful commercialisation of technological innovations in international markets. The nature of the technology and the effectiveness of legal protection mechanisms are central. Protection of intellectual property (IP) depends upon the nature of the technology and whether the appropriability regime is tight or weak. In tight regimes R&D companies can simply license their technology. However, patents can be ineffective as they can be invented around and are ineffective at protecting process innovations. They are also costly to enforce and it can be difficult to prove that infringement has taken place. Trade secrets are an alternative to patents, especially in process innovations, for example chemical formulas (Teece, 1986; Teece, 2007).

In summary, the life science industry consists of a large number of small firms at different stages, which contribute to the sector in specialised ways e.g. R&D and distribution. Table 1 shows the types of organisations which commonly operate within the early stages and later stages. Life science SMEs are co-dependent upon other firms for knowledge sharing and value creation. These interdependent relationships are relevant to the process of international opportunity recognition, e.g. owners/managers access technological expertise from individuals regardless of their location globally and often commercialise products and services in the international markets where they have established networks.

This requires owners/managers of life science SMEs to operate within highly dynamic environments (Carlsson & Dale, 2011). These environments are characterised by significant technological and market uncertainty. Uncertainty arises from the experimental nature of their activities, working internationally and the presence of small windows of commercialisation for their products/technologies (Warner & Carrick, 2011). The acquisition of specialised technological and market knowledge, during the process of international opportunity recognition, helps life science SME owners/managers to augment capabilities instrumental to the identification of new opportunities. However, as highlighted in the sections to follow, little is known about how owners/managers leverage their social and human capital, in order to acquire technological and market knowledge, during the international opportunity recognition process.

Table 1: Classification of life science firms: Early and later stages

Stage	Type of firm/specialisation
Early-stage	Life Science Research (typically for application in agriculture, food and medicine)
	Research and development in natural sciences and engineering (e.g. nutraceuticals)
	Oncology (e.g. research into tumours)
	Pharmaceutical drug discovery (e.g. potential for new drugs)
	Genomics (e.g. stem cells)
	Molecular biology (e.g. research into genes and DNA)
	Bio-engineering (e.g. R&D into supplementary tissues)
Later stage	Pharmaceutical and medical technology manufacture/commercialisation
	Medical devices (e.g. pacemakers)
	Anti-infective (e.g. anti-bacterial solutions)
	Diagnostic tests
	Preventative products (e.g. supplements)

Source: Derived from PwC (2017)

1.3 Research gap in the existing literature

Despite studies in international entrepreneurship growing in number, the field is still fragmented and requires further theoretical and empirical development (Gaglio & Katz, 2001; George, Parida, Lahti & Wincent, 2016; Jones *et al.*, 2011a; Zahra & Wright, 2011). Existing research on life science SMEs is often undertaken at an organisational level (Jones *et al.*, 2011b; Pregelj, Verreynne & Hine, 2011). As suggested by Foss & Klein (2010: 98) ‘the entrepreneurial opportunity, rather than the individual entrepreneur, the start-up company, or the new product, has become the centrepiece of the academic study of entrepreneurship’. This indicates a need for further understanding of the role of the individual when recognising opportunities to enter international markets. In

addition, limited studies explicitly link international entrepreneurship and dynamic capabilities at a managerial level (Andersson & Evers, 2015; Hannibal, Evers & Servais, 2016).

Few studies have highlighted the role of selected micro-foundations in international entrepreneurship. For example, Kaartemo, Coviello & Nummela (2019) highlight the role of networking capabilities and Kevill, Trehan & Easterby-Smith (2017) provide insight into self-efficacy as a micro-foundation. However, existing studies have failed to identify the micro-foundations which life science SME owners/managers activate, during the process of international opportunity recognition, to acquire specialised knowledge. In addition, little is known about the nuances in the process of international opportunity recognition, undertaken by life science SMEs which are in the early stages (R&D focused), and those which are in the later stages (commercialisation), when acquiring specialised technological and market knowledge. This is important as the life science sector is made up of many different, but interconnected firms.

By understanding how life science SME owners/managers in different stages recognise opportunities internationally, we can provide a more detailed understanding of this industry sector. In addition, by understanding how managerial level social and human capital are leveraged to acquire specialised technological and market knowledge, during the process of international opportunity recognition, we can further shed light upon how this helps life science SME owners/managers augment their capabilities, useful in the identification of new opportunities for international expansion.

1.4 Research questions

Existing literature in the field of international entrepreneurship and life sciences has largely focused upon organisational level capabilities (Jones *et al.*, 2011a, 2011b; Pregelj *et al.*, 2011), strategic orientation (Renko, 2011), resource-based perspectives (Warner & Carrick, 2011) and export performance (Ujjual, 2011). Zahra & Wright (2011) highlight the need to advance the field of international entrepreneurship by further examining micro-foundations and by paying more attention to how entrepreneurs create a knowledge base specific to their organisation (Zahra & Wright, 2011). Similarly, Kaartemo *et al.* (2019) study the micro-foundations of network change and stability, using the theoretical lens of various process theories. In addition, Kevill *et al.* (2017) view self-efficacy as a micro-foundation in micro-enterprises. However, less is known about the micro-foundations which underpin the process of international opportunity recognition (Dimov, 2011).

This research explores international entrepreneurship in life science SMEs, using the lens of dynamic managerial capabilities (Adner & Helfat, 2003; Helfat & Martin, 2015; Teece, 2007; Zahra & Wright, 2011). We highlight how SME owners/managers leverage their specialised social and human capital resources when recognising opportunities to enter international markets. We provide a further understanding of the international opportunity recognition process, through combining the existing literature and our empirical evidence.

We use a two phase research design, drawing upon a replication logic methodology (Eisenhardt, 1991; Eisenhardt & Graebner, 2007; Leonard-Barton, 1990; Rowley, 2002). Firstly, an exploratory case provided a fine-grained understanding of the

international opportunity recognition process, within a life science SME context. The exploratory case refined and focused the research questions for the next phase. In the second phase, we then selected 12 further cases to replicate and extend the emergent constructs, derived from the findings of the exploratory case (Eisenhardt, 1989; Leonard-Barton, 1990). These cases helped to extend our understanding of how life science SME owners/managers in the early stages (R&D focused) and later stages (commercialisation), acquired and developed specialised technological and market knowledge, during the international opportunity recognition process.

We contribute to the literature on international entrepreneurship, by investigating the micro-foundations of the international opportunity recognition process. To that aim, we look at the capabilities that life science SME owners/managers, at different stages, leverage to acquire specialised technological and market knowledge. This is uncovered by answering the following research questions;

- How do owners/managers of life science SMEs leverage their social and human capital to acquire and develop specialised technological and market knowledge, during the process of international opportunity recognition?
- How does the process of international opportunity recognition vary, in terms of social and human capital leveraged by owners/managers to acquire and develop specialised technological and market knowledge, in early-stage and later stage life science SMEs?

1.5 Overview of the chapters

The second chapter provides a review of the existing literature on international entrepreneurship and dynamic capabilities. Firstly, we provide an overview of opportunities and present international opportunity recognition as a process involving three main phases: identification, evaluation and exploitation. Next, the literature on dynamic capabilities is reviewed. We then link the literature on dynamic capabilities to social and human capital, and explore how they are leveraged when recognising international opportunities. We then apply these core concepts to the life science industry, and provide insights from recent empirical literature. Finally, a conceptual framework derived from the existing literature is presented. In chapters three and four we present our methodology and findings of an in-depth exploratory case and a selection of 12 further cases, which we analysed using a comparative case study methodology. In chapter five, we discuss our findings and present our theoretical contributions, policy and managerial implications, and possibilities for future research.

2.0 Literature review

2.1 Introduction

In this section, we articulated our literature review into four main sub-sections. Firstly, we revise the core theories on opportunities (Ardichvili, Cardozo & Ray, 2003; Dimov, 2011; McMullen & Shepherd, 2006) and recognising opportunities in international markets, as opposed to domestic ones (Johanson & Vahlne, 1977; McDougall, 1989; Oviatt & McDougall, 2005). Secondly, we provide an overview of international opportunity recognition, as a process. We review the core literature on international opportunity identification (Ardichvili *et al.*, 2003; Dimov, 2011; Shane & Venkataraman, 2000), evaluation (Ardichvili *et al.*, 2003; McMullen & Shepherd, 2006), selection and exploitation (Alvarez & Barney, 2007).

Thirdly, we provide insights into the dynamic capabilities literature, focusing upon micro-foundations (Teece, 2007). Next, we highlight the role of social and human capital in international opportunity recognition. Furthermore, we provide an understanding of the mechanisms which underpin the international opportunity recognition process e.g. alertness, prior knowledge, networks, as being social or human capital resources. Lastly, we apply the core theories addressed in the previous sections, to provide insights into the international opportunity recognition process, within the context of the life science industry. We draw upon recent empirical research in this area to help us to create a conceptual framework for understanding the international opportunity recognition process, within this industry context. We pay specific attention to the social and human capital, which owners/managers within this sector leverage,

during this process. This enables us to pinpoint the mechanisms which are leveraged during the international opportunity recognition process, when acquiring specialised technological and market knowledge, within the life science industry.

2.2 Opportunities

Dimov (2011: 69) defines an opportunity as ‘the perpetuation of a cycle of venture ideas and actions oriented toward the formation and sustenance of market relationships.’ Similarly, Ardichvili *et al.* (2003) suggest that opportunities in their initial stages, are largely unformed, and develop over time. Initially, an opportunity may manifest as an unmet market need, new innovations which have no current market, or new ideas for products and services (Ardichvili *et al.*, 2003). Ardichvili *et al.* (2003) also suggest opportunities may arise from underutilised resources. They propose ‘the application of technology new medicinal compounds may be created without knowledge of the conditions for which the applications might be efficacious’, and label this as a value creation capability (Ardichvili *et al.*, 2003: 108). Similarly, McMullen & Shepherd (2006) view opportunities as acting upon possibilities. Dimov (2011) suggests that opportunities are associated with entrepreneurial behaviour.

In order to incorporate the role of individuals into the opportunity recognition process, the actions of the individual need to be taken into account (Dimov, 2011; McMullen & Shepherd, 2006). As suggested by Ardichvili *et al.* (2003) opportunities are made and not found. Entrepreneurial action involves knowledge and motivation (McMullen & Shepherd, 2006). Aspects such as creativity (Alvarez & Barney, 2007), continuous development (Ardichvili *et al.*, 2003), opportunities not being separate from the individual, their beliefs (McMullen & Shepherd, 2006) and imagination (Klein, 2008),

is central to identification. In summary, opportunities are defined as venture ideas which are modified, possibilities for economic gain, and are refined through action. Individuals' may act based upon what their beliefs about future outcomes are. Having provided an overview of how opportunities are conceptualised in the literature, we can now provide a better understanding of opportunities which are recognised in international markets.

2.3 International opportunity recognition

Opportunities are central to the definition of international entrepreneurship. As suggested by Oviatt & McDougall (2005: 7), international entrepreneurship is defined as 'the discovery, enactment, evaluation, and exploitation of opportunities – across national borders – to create future goods and services.' Typically, the literature on internationalising firms has been divided into two main areas. Firstly, firms which are understood as internationalising incrementally, such as the manufacturing industry (Johanson & Vahlne, 1977). This approach involves entering international markets which are psychically and culturally close, initially through using low commitment modes of international entry, such as exporting (Johanson & Vahlne, 1977). Having gained familiarity with markets close to them, firms move to more unfamiliar markets, after gathering sufficient knowledge.

Secondly, and more recently, firms have been observed to become more accelerated in their internationalisation processes (McDougall, 1989; Oviatt & McDougall, 2005). Competition is becoming increasingly global, as communication, transport and information networks are improving rapidly. Therefore, in order for small firms to be competitive, they are required to enter international markets in the early stages of their growth. Falling trade barriers, de-regulation and emerging economies

facilitate international market entry. However, industry and market considerations can also contribute to internationalisation. Technology-based industries are traditionally international. In the case of high-tech industries, such as biotechnology, firms often internationalise in order to access specialised knowledge of individuals, or to sell products which have a global demand. In addition, domestic markets may be too small, and competitive to grow sales (Leppäaho, Chetty & Dimitratos, 2018).

Often, firms within the technology-based industry sector have small windows of opportunity to enter international markets, as their technology obsolesces (Warner & Carrick, 2011). Products which become accepted as an industry standard will be widely implemented, and stand to make the most gains. Internationalisation may also be driven by the individual owner/manager, their personal ambitions, prior experience and ability to spot opportunities in international markets. High tech SMEs typically enter international markets through leveraging low equity modes such as international partnerships. The transfer of knowledge between partners is a central driver for internationalisation.

McDougall (1989) explores the similarities and differences in the computer and communications manufacturing industry, when considering international vs domestic entrepreneurship. She suggests that firms pursuing international growth pursue broad market-based strategies. This involves developing and managing distribution channels, many customers in diverse market segments, and developing high product visibility. These firms need to secure patent technology and pursue entry modes which facilitate access to numerous markets, at a large scale. McDougall (1989) suggests patent technology was central to success in international markets. Government regulation is

also a factor in internationalisation. Firms may enter international markets in order to seek less regulated markets. However, entering certain international markets may mean an increase in regulation. In contrast, domestic new ventures face intense competition, and pursue specialisation strategies to target niche markets. This demands a close proximity to customers.

Karra, Phillips & Tracey (2008) highlight three capabilities which are important to international new venture success. They highlight that SMEs can gain a competitive advantage through working internationally, in comparison to pursuing solely the domestic market. However, identifying opportunities internationally is different to that of domestic markets. Karra *et al.* (2008) argue that it is more complex as an awareness and understanding of the international market context is needed. They argue that previous experience and knowledge that an entrepreneur has of an international market can help them to spot opportunities, where perhaps others could not. If the opportunity was recognised in the domestic market, the entrepreneur would also require a knowledge of how to translate it into an opportunity relevant to the target international market. Karra *et al.* (2008) suggest that understanding target international markets can be increased through collecting relevant information. Learning by doing and social interaction are posited as key factors in recognising opportunities internationally.

Establishing trusting international networks (e.g. with distributors), can be useful when overcoming language, cultural and other more tacit barriers in international market entry (Karra *et al.*, 2008). Bridging the differences between home and host countries is important. This involves re-articulating business opportunities in national contexts so they are relevant to new customers in international markets. Developing

knowledge of social and cultural aspects of international markets, knowledge of customers and their buying behaviours, customisation of products and services, norms of commercial transactions, and knowledge of the formal and informal regulatory procedures are all key aspects in entering international markets (Karra *et al.*, 2008). Working with key actors in international markets can provide acceptance and legitimacy in target international markets.

International opportunity recognition can be understood as a process. During this process, owners/managers can enhance their dynamic capabilities through leveraging their social and human capital, helping to offset uncertainty when entering international markets. This includes learning through spending time in the international market in order to gain cultural understanding of ways of doing business first hand. In addition, leveraging key contacts can provide further information about the international market. In the forthcoming section we explore the process of international opportunity recognition, as understood within the existing literature.

2.4 The process of international opportunity recognition

Existing studies view international opportunity recognition as a multi-phase process. However, the literature on the opportunity recognition process is largely fragmented. Some authors suggest the process comprises the phases of recognition, development and evaluation (Ardichvili *et al.*, 2003). Others suggest opportunities are recognised through scanning, interpretation and action (Gartner, Carter & Hills, 2003). Within the dynamic capabilities literature, Teece (2007) suggests opportunities are identified through a process of sensing, seizing, shaping, and reconfiguring. Others focus upon the opportunity process as including the phases of identification, evaluation and

exploitation (Venkataraman, 1997; Shane & Venkataraman, 2000). For the purposes of our study we organise the literature into three main areas: identification, evaluation and exploitation of international opportunities, and discuss each phase in turn.

Some authors view the opportunity recognition process as one in which entrepreneurs play an active role (Ardichvili *et al.*, 2003; Dimov, 2011), involving creation and creativity (Alvarez & Barney, 2007; Shane & Nicolaou, 2015). Others view entrepreneurs as being passive in opportunity identification (Kirzner, 1979; Shane & Venkataraman, 2000). Despite this, there are many factors which are core to the opportunity recognition process. We discuss these core factors within each phase of the opportunity recognition process as follows. The identification phase includes factors such as opportunity alertness, (Ardichvili *et al.*, 2003; Kirzner, 1979; Ucbasaran, Westhead & Wright, 2001), scanning the environment, gathering information and speaking to networks (Ardichvili *et al.*, 2003; Dimov, 2011; Gartner *et al.*, 2003).

The evaluation of international opportunities spans the phases between identification and exploitation (Kuckertz, Kollmann, Krell & Stockmann, 2017; Shane & Venkataraman, 2000; Venkataraman, 1997). This includes factors such as assessing feasibility, uncertainty (Keh, Foo & Lim, 2002; Klein, 2008; McMullen & Shepherd, 2006) and strategic fit (McMullen & Shepherd, 2006). The exploitation of international opportunities extends past the opportunity recognition process, and into the phases of opportunity development and refinement (Alvarez & Barney, 2007; De Koning & Muzyka, 1999). The forthcoming sections provide a more in-depth account of each phase of the international opportunity recognition process, and the key factors to consider in each phase.

2.4.1 Phase 1: Identification of international opportunities

From the perspective of entrepreneurial behaviour, Dimov (2011) focuses upon how entrepreneurs do act, as opposed to how they should act. Dimov (2011) defines opportunities as evolving from a raw, untested venture ideas. Opportunities are market orientated, in that they involve social interaction with a range of different actors, which make up the market e.g. buyers and sellers. As suggested by Ardichvili *et al.* (2003), sensitivity to market needs and is central, and chances to better use resources can help in the identification and development of opportunities. Sometimes opportunities can be initial steps e.g. the creation of a website to sell products. At other times, they are more intangible e.g. an idea or intention for action in an individual's mind (Klein, 2008). As ideas reside in an individual's mind, they are invisible to the market until social interaction takes place (Dimov, 2011).

Therefore, in order for an idea to become an opportunity, it must be acted upon. In addition, the series of actions followed must be relevant to the opportunity. For example, in the case of a life science SME, seeking investment for a new idea would be seen as a relevant action. As the idea begins to take form, entrepreneurs then need to create a space in the marketplace, through building relationships with a range of relevant actors e.g. suppliers and customers. Entrepreneurs can become linked with business ideas through a range of pathways e.g. through serendipity and purposeful search.

Through acting (Dimov, 2011; McMullen & Shepherd, 2006), individuals can refine and modify their initial ideas, as they learn through experience. Perception of, and willingness to bear uncertainty are central to action. Owners/managers make

decisions under conditions of uncertainty (Klein, 2008). Knowledge can help to overcome uncertainty, whereas willingness to bear uncertainty is attributed to an individual's motivation (McMullen & Shepherd, 2006). Learning from experience in the market replaces initial assumptions about the future of an opportunity, as entrepreneurs acquire new knowledge. However, not all ideas evolve to become viable opportunities. Dimov (2011) suggests that opportunities, through a series of idiosyncratic actions, simply happen to people.

Furthermore, opportunity identification can be understood in the literature from the perspectives of discovery and enactment. Dimov (2011) suggests that the lines have been blurred when the literature addresses individual level opportunities. For example, Kirzner's (1979) approach has been misinterpreted, as opportunities were not to be perceived as the unit of analysis, but were a metaphor for market equilibrium (Klein, 2008). Opportunities can be understood as judgement (Klein, 2008). This implies that opportunities are not discovered or created, but are imagined by individuals. Furthermore, by viewing entrepreneurs as passive in the construction of opportunities, authors such as Shane & Venkataraman (2000) 'fail to explain the micro-drivers of entrepreneurial action.' (Dimov, 2011: 61).

From an opportunity discovery perspective, Shane & Venkataraman (2000), suggest that owners/managers are separate and passive in the construction of opportunities. From this viewpoint, opportunities are often not created, instead opportunities are assumed to pre-exist within the market (Fisher, 2012; Shane & Venkataraman, 2000). As the market is understood as being analysable, opportunities are identified through using routines, formal data and formal search methods, data

gathering and active detection (Daft & Weick, 1984). The main debate underpinning this theoretical standpoint is that of objective information.

As suggested by Gartner *et al.* (2003: 107): 'Information exists without a context of how and why individuals relate and interact to it'. This places the identification of opportunities upon the owners/managers ability to perceive and discover pre-existing market imperfections. Venkataraman (1997: 121-122) suggests 'the central feature of a market economy is the partitioning of knowledge among individuals such that no two individuals share the same knowledge or information about the economy'. Venkataraman (1997: 121) further sheds light upon objective perspective of opportunity identification, highlighting; 'most markets are inefficient most of the time, thus providing opportunities for enterprising individuals to enhance wealth by exploiting these inefficiencies.' Market equilibrium is unattainable as constant disruptions take place by advancing technology, however 'it is the uncertainty that provides the opportunity for profit in the first place' (Venkataraman, 1997: 124)

In order to discover pre-existing market imperfections, alertness, observation and information asymmetries existing between individuals are important in the identification phase (Gartner *et al.*, 2003). Alertness enables owners/managers identify pre-existing potential market opportunities, which are not visible to those owners/managers who are not alert.

From an enactment perspective (Schumpeter, 1934), Ardichvili *et al.* (2003) propose building a framework for the opportunity identification and development. They suggest that personality traits, social networks and prior knowledge enhance alertness to business opportunities. Alertness is understood as an antecedent to the recognition,

development and evaluation of opportunities. Ardichvili *et al.* (2003) suggest opportunities may be sensed and perceived. Perception includes an individual's sensitivity to the market needs, problems or underexploited technology.

The perception of opportunities depends upon an individual's prior experience, background, genetic make-up, type of information they already possess about markets/technology and the ability of customers to articulate their unmet needs. Opportunities may also be discovered through assessing fit between market need and existing resources. In addition, resources and needs may be re-invented to create new opportunities. This often requires dramatic restructuring of the organisation or re-deployment of resources in an environment of radical technological change. Ardichvili *et al.* (2003) suggest that both the individual and situational differences influence the identification of opportunities. Therefore, understanding opportunity recognition within its context is central (Welter, 2011).

From an enactment perspective, opportunities are not identified as pre-existing in the environment, but are constructed by the individuals involved (Gartner *et al.*, 2003; Weick, 1995). Gartner *et al.*, (2003: 109) further states:

‘Managers construct, rearrange, single out and demolish many “objective” features of their surroundings... The organizing model is based on the view that order is imposed rather than discovered, on the grounds that action defines cognition’ (Gartner *et al.*, 2003: 109).

In the identification phase owners/managers have a generalized aspiration. They leverage existing resources, such as who they are, what they know, and who they know to realise their aspirations (Perry, Chandler & Markova, 2011). Flexibility is central to identification as owners/managers take advantage of serendipitous encounters and

learn by doing (Perry *et al.*, 2011). From this perspective, the market environment is understood as unanalysable. Therefore, in the identification of international opportunities, individual interpretations shape markets, rather than markets shaping interpretations (Daft & Weick, 1984). Opportunities are identified through experimentation, testing, coercion, invention of markets and learning by doing. Owners/managers also use irregular and informal sources of information from external and personal sources (Daft & Weick, 1984). Their activities are largely non-routine (Daft & Weick, 1984) as owners/managers act upon hunches, rumour and chance opportunities in attempting to identify opportunities in the unanalysable market environment.

Alertness, the ability to process information and ability to gather the correct amount of information is influenced by prior experience (Ardichvili *et al.*, 2003). Ucbasaran *et al.* (2001) suggest that entrepreneurs with limited experience may use simplifying strategies to guide their search for information, whereas experienced entrepreneurs may look too narrowly for information due to a perceived illusion of control or subject blind spots. Therefore, prior experience may provide a framework for processing information, and making new linkages between information (Ucbasaran *et al.*, 2001).

In addition, opportunities can be recognised in both planned and coincidental means. Serendipitous encounters and existing networks are viewed as influencing international market entry (Fisher, 2012). Serendipity, or what may be termed coincidences and/or accidental circumstances (Crick & Spence, 2005), whereby opportunities present themselves, can be viewed as an important aspect in international

opportunity recognition, from this perspective. Three central themes of serendipity are defined in the literature. Firstly, temporary (e.g. the right person in the right place at the right time). Secondly, relational (e.g. serendipitous encounters), and lastly, analytical (establishing connections between data and ideas) (Carlsson & Dale, 2011). Ultimately, the owner/manager must decipher, recognise and act upon these opportunities. Preactivity can be understood as the 'ability to identify and exploit opportunities presented in their existent networks and serendipity encounters.' (Carlsson & Dale, 2011: 199).

Studies by Hulbert *et al.* (2015) suggest that an exceptional level of creativity or entrepreneurship is not required in order to identify opportunities, rather innovativeness and opportunity alertness are posited. Timmons (1994) suggests that successful entrepreneurs are opportunity-focused, concentrating upon customer needs and the market. Opportunities are therefore recognised through the coming together of the ideas and creativity of individuals and the market (Timmons, 1994). Karra *et al.* (2008) suggest opportunities are recognised through more structured means of active search for gaps in the market, creativity and imagination. This involves the active reconfiguration of resources to create a new product or service, but also intuitively via fortuitous discovery, drawing upon experience and knowledge.

Despite the theoretical underpinnings of the discovery and enactment perspectives, most authors agree that alertness, strategic thinking and creativity (Ardichvili *et al.*, 2003; Shane & Nicolaou, 2015), prior knowledge (Ucbasaran *et al.*, 2001; Venkataraman, 1997), market research, intelligence gathering (Daft & Weick, 1984), speaking with customers to assess their needs (Ardichvili *et al.*, 2003; Dimov,

2011), knowledge distribution and simplifying strategies (Ucbasaran *et al.*, 2001) are key to the successful identification of opportunities. The forthcoming section provides insight into the existing literature on the next step of the opportunity recognition process, evaluation.

2.4.2 Phase 2: Evaluation in international opportunity recognition

Evaluation is perceived as spanning the phase between opportunity recognition and opportunity exploitation (Kuckertz *et al.*, 2017). The evaluation of opportunities can be informal and formal. Ardichvili *et al.* (2003) suggest that the evaluation of opportunities is often informal or unarticulated. This implies evaluation is an internal cognitive process particular to the individual. Formal evaluation often only takes place when resources are required from external stakeholders. Evaluation includes assessing the feasibility of an opportunity and assessing fit in terms of alignment of capabilities and knowledge (McMullen & Shepherd, 2006). Owners/managers may assess issues such as the alignment of technology with customer need, potential customers, competitors, and similar products in the market, potential market share and size, ability to finance, launch and grow the venture.

Ardichvili *et al.* (2003) suggest opportunity development involves iterative evaluation at different stages. This can lead to the recognition of additional opportunities and adjustment of initial vision. Due diligence is a component of the evaluation of opportunities, especially when deciding to further develop ideas to create or restructure a new or existing business. Ardichvili *et al.* (2003) further suggest that a common strategy to evaluate opportunities is the stage-gate procedure. This procedure suggests that ideas may pass through a gate if they meet the perceived criteria for return

on investment, risk perception, and personal objectives for example. Opportunities which do not pass through may be abandoned or revised. Two main types of opportunity evaluation are summative and formative. Summative evaluation implies that resources are provided so an opportunity may grow to the next phase. Formative evaluation implies the re-directing of opportunities which are under development in real time, in order to maximise their chances of success (Ardichvili *et al.*, 2003).

In the evaluation of international opportunities, owners/managers have been found to draw upon prior experience (Zahra, Korri & Yu, 2005). Owners/managers also assess feasibility to evaluate international opportunities (Keh *et al.*, 2002; Singh, 2001). De Koning & Muzyka (1999) and Keh *et al.* (2002) suggest an evolution of ideas is required before developing a feasible business concept, highlighting the difference between recognising an initial technological innovation and what can evolve to become a viable business opportunity. In addition, Keh *et al.* (2002) highlight uncertainty and perception of risk as aspects that are important to owners/managers, when evaluating the potential of ideas to be turned into opportunities. Owners/managers make judgements and decisions under conditions of uncertainty (Klein, 2008). After several evaluations owners/managers may decide to abandon the idea or re-analyse results (Alvarez & Barney, 2007). Owners/managers are more likely to positively evaluate an opportunity where they perceive less risk. The last phase of the process, selection is explored in the next section.

2.4.3 Phase 3: Selection and exploitation in international opportunity recognition

Opportunities may be selected for exploitation, not pursued or iteratively revised (Ardichvili *et al.*, 2003). Opportunity exploitation is characterised by product or

service development, based upon the recognition of an opportunity (Kuckertz *et al.*, 2017). As suggested by Kontinen & Ojala (2011: 492) 'although opportunities may exist, they can be exploited only if an entrepreneur recognizes the opportunity and understands its value for further business'. During opportunity exploitation owners/managers will have to bear environmental and operational uncertainty (Butler, Doktor & Lins, 2010).

Martelo-Landroguez & Cegarra-Navarro (2014) suggest that once knowledge has been acquired, assimilated and stored, this knowledge must then be transformed and exploited. In short, the knowledge that has been absorbed during the process should be leveraged (Martelo-Landroguez & Cegarra-Navarro, 2014). Exploitation is dependent upon if the firm or owner/manager in our case, can develop a product or service and 'learn how to handle it in the international expansion process' (Mainela, Puhakka & Servais, 2014: 109). The exploitation of opportunities extends past the opportunity recognition process and into the phase of opportunity development and refinement (De Koning & Muzyka, 1999).

Alvarez & Barney (2007) highlight the role of prior experience and knowledge of markets and products as central in the exploitation of opportunities. Specific knowledge and information about an opportunity is important. Superior knowledge of an industry or market or exogenous shocks in the market that created new opportunities e.g. the implementation of a new technology are important. Learning from prior experience through working in the market or industry is also central. Owners/managers need to recognise the distinctiveness of their new product, for example, and know how to launch it into the market. However, when opportunities are created, it is difficult to predict the

type of knowledge which is needed to effectively exploit a new opportunity, as individuals learn through experience (Alvarez & Barney, 2007).

The role of owners/managers in international opportunity recognition is key, as they are the principal decision makers within a SME context. Their prior experiences and existing knowledge can shape the types of opportunities and international markets which they consider for entry. In addition, their networks can influence how they perceive opportunities to expand internationally, and the type of knowledge which is transferred (e.g. technological or market knowledge). Through leveraging these mechanisms, underpinning their human and social capital, such as prior experience and industry contacts, owners/managers can more effectively exploit new international opportunities, learn from their experiences in international markets, and therefore enhance their managerial level and organisational level dynamic capabilities, when recognising opportunities in environments of technological and market uncertainty.

2.5 Dynamic Capabilities

Dynamic capabilities are often used to understand organisational level routines in large companies (Eisenhardt & Martin, 2000; Helfat, 1997; Teece, Pisano & Shuen, 1997; Winter, 2003; Zollo & Winter, 2002). This research uses the theoretical lens of dynamic capabilities in order to shed light upon the micro-foundations of the international opportunity recognition process, (Adner & Helfat, 2003; Basile & Faraci, 2015; Helfat & Martin, 2015; Teece, 2007) in a SME context.

As suggested by Di Stefano, Peteraf & Verona (2010), there is a lack of consensus in how dynamic capabilities are conceptualised and defined. Winter (2003: 991)

understands dynamic capabilities as ‘those that operate to extend, modify or create ordinary capabilities.’ Dynamic capabilities have been defined in three different ways in the existing literature, as highlighted by Easterby-Smith, Lyles & Peteraf (2009). As suggested by Easterby-Smith *et al.* (2009), the definition provided by Teece *et al.* (1997: 516) as ‘the firm’s ability to integrate, build and reconfigure internal and external competencies to address rapidly changing environments’, has enabled authors to create their own interpretations of what dynamic capabilities are.

As suggested by Easterby-Smith *et al.* (2009), Zollo & Winter (2002) view dynamic capabilities as routines that evolve. Zollo & Winter (2002: 339) define dynamic capabilities as the ‘routinized activities directed to the development and adaptation of operating routines’. Eisenhardt & Martin (2000: 1105) view them as processes that vary with market dynamism, defining them as ‘a set of specific and identifiable processes such as product development, strategic decision making, and alliancing.’ They suggest that dynamic capabilities are idiosyncratic in each firm, but that commonalities can also be drawn across firms, referred to as best practice (the most effective way of doing something). From this perspective, dynamic capabilities are understood as equifinal, as managers may start the development of these capabilities at different starting points and follow different pathways to capability development, but end up with the same dynamic capabilities (Eisenhardt & Martin, 2000).

Eisenhardt & Martin (2000) suggest dynamic capabilities vary according to market dynamism. In moderately dynamic markets where there are predictable changes in market environments, competitors and customers for example are well known, capabilities rely on existing knowledge. Within a moderately dynamic market, managers

can use their tacit knowledge to plan their activities, which are usually relatively stable (Eisenhardt & Martin, 2000).

In contrast, when markets are high velocity or dynamic, they are understood as being ones in which changes are non-linear and unpredictable. As suggested by Eisenhardt & Martin (2000: 1111), in dynamic markets, 'market boundaries are blurred, successful business models are unclear, and market players (i.e. buyers, suppliers, competitors, complementers) are ambiguous and shifting'. Dynamic capabilities in high velocity markets are understood as 'simple, experiential, unstable processes that rely on quickly created new knowledge and iterative execution to produce adaptive, but unpredictable outcomes.' (Eisenhardt & Martin, 2000: 1106). Within these environments new and rapid knowledge acquisition, specific to the situation, is central to dynamic capability development.

Dynamic capabilities in uncertain environments are simple compared to those in moderately dynamic markets as they 'keep managers focused on broadly important issues' (Eisenhardt & Martin, 2000: 1111). There are few definitive, but crucial boundary conditions, which enable flexibility whilst maintaining a semi-structure (Eisenhardt & Martin, 2000). This enables owners/managers to focus their attention on information that is important, helping them to make sense of the situation and take action in environments of uncertainty.

Learning leads to the evolution of dynamic capabilities. Eisenhardt & Martin (2000: 1112) suggest dynamic capabilities 'involve the creation of new, situation specific knowledge.' This is gained through experience, leading to rapid feedback. This compensates for limited existing knowledge through gaining relevant situation specific

knowledge quickly. Prototyping and market testing are often a feature of dynamic capabilities (Eisenhardt & Martin, 2000). As new information about a market or technology is received, dynamic capabilities iteratively evolve. In addition, dynamic capabilities rely upon real time information, relationships and intensive communication with individuals involved in the process and the external market (Eisenhardt & Martin, 2000).

A closeness to the market is important to dynamic capabilities as suggested by Eisenhardt & Martin (2000: 1112). 'Real-time information alerts people early on to the need to adjust their actions since problems and opportunities are spotted more quickly than when individuals were more distant from information.' This enables owners/managers to adapt to changes in the market. As suggested by Eisenhardt & Martin (2000) and Teece *et al.* (1997), dynamic capabilities are extremely useful when navigating environments of rapid technological change. Uncertainty and causal ambiguity lessen over time as owners/managers acquire knowledge. However, owners/managers are still required to develop dynamic capabilities to help navigate technological and international market uncertainty.

2.5.1 Micro-foundations

Micro-foundations are understood as the skills, processes and procedures, which underpin organisational level capabilities (Teece, 2007). Teece (2007) suggests that dynamic capabilities can be broken down into three dimensions. These dimensions include firstly, sensing and shaping, secondly, seizing, and lastly, reconfiguring. These dimensions enable adaptation to changing technology and customer opportunities. In the forthcoming sections we provide an understanding of sensing, seizing and

reconfiguring, the implications of these upon international opportunity recognition, and how human and social capital underpin this process.

2.5.2 Sensing and shaping international opportunities

Sensing international opportunities involves gathering relevant information about the environment in which the business is operating. This involves an interplay between human and social capital. Interactions with key actors, such as customers, other firms and universities, can help when broadly searching for opportunities. In terms of human capital, the ability to sense and shape ideas depends upon the existing knowledge of customer needs and existing and novel solutions. Teece (2007) suggests R&D activities can be included as a form of searching for new products.

A clear knowledge of how customers may use products and services increases the likelihood of commercial success. Owners/managers require specific knowledge, creativity and an ability to understand customers and their decision making. It involves interpreting information e.g. the frustration felt by a customer. More information is then acquired about the problem using professional and social contacts. Owners/managers create a hypothesis about how a technology and customer need could evolve, taking into account marketplace responses. This process involves scanning for technological developments and being alert to customer needs. This process is a creative and learning one. Teece (2007) suggests implementing analytical frameworks can be useful when sensing opportunities and threats. The information is then filtered and made sense of. Collecting data, facts and anecdotes can help to test ideas.

2.5.3 Seizing international opportunities

Once an opportunity is sensed it is addressed through creating a new product, process or service. It requires investment in order to be developed and commercialised. Design and performance specification of products, and business model define how an enterprise delivers value to customers, entice them to pay, and produces profits. Owners/managers need to decide the technologies and features they are going to embed into products and services, how the revenue and cost structure meets customer needs, how technology is assembled, identify the target market, and how value is to be captured. Owners/managers make assumptions about customer behaviour, competitors, revenues and costs. A business model is crucial in effectively moving technological innovation to a commercialised product.

Leveraging social capital, particularly customer networks can be central to seizing opportunities as it provides access to understanding the alternatives which customers have in the market, what customers need, and how they would use the product or service. Owners/managers may also leverage supplier and distributor networks to provide an understanding of how and where to source products and potentially distribute them internationally. Aspects such as pricing of products, supply and distribution costs and competitor responses are important (Teece, 2007). In addition, firms may want to outsource technology and not develop it in house, through establishing partnerships. In terms of human capital, partnerships can facilitate the transfer of technological knowledge, and provide opportunities to learn new skills.

2.5.4 Reconfiguring international opportunities

As the organisation or business idea becomes more successful, resources and assets need to be augmented, and evolve in a path-dependent way (Teece, 2007).

Recombining resources and assets enables response to changing markets and technology. Routines provide operational efficiency and continuity until environmental shifts occur. In environments of radical change, for example shifts in science or technology, organisational structures may have to be changed rapidly (Teece, 2007). Regarding social capital, strategic fit needs to be achieved between partners. Particularly in environments of rapid change, partners may need to constantly re-align their ideas and strategies as value is enhanced through co-specialisation (Teece, 2007).

When sensing, shaping, seizing and reconfiguring opportunities, owners/managers leverage their human and social capital. The forthcoming sections provide an overview of the human and social capital leveraged by owners/managers when recognising opportunities to enter international markets.

2.5.5 Human capital in international opportunity recognition

Human capital is widely acknowledged as the knowledge, skill and experience that an individual brings to an organisation. This extends to learned skills, education, training on the job, knowledge acquisition, expertise through prior experience and learning by doing. This includes generic, industry specific and firm specific skills. Managerial cognition can be understood as a human capital resource, as it is developed through the prior experiences of individuals. It refers to the mental processes and maps that guide decision making (Gaglio & Katz, 2001). According to existing literature, managerial cognition has been identified as being important to the motivation for entering international markets, and also in the evaluation and exploitation phases of opportunity recognition (George *et al.*, 2016).

Owners/managers vary in their skill sets due to differing career paths followed. Different biases, education and expertise cause owners/managers to make different decisions (Adner & Helfat, 2003). It is how they leverage these resources as cognitive capabilities, which can lead to company survival and a competitive advantage, when faced with environmental uncertainty. Alertness, sensemaking, pattern recognition, heuristics, prior knowledge of international markets and education have been recognised in the literature as central to international opportunity recognition and are explained in further detail below.

Entrepreneurial alertness is understood as an information-processing skill and a 'cognitive engine driving the opportunity identification process.' (Gaglio & Katz, 2001). Alertness exists pre-opportunity recognition. It is often referred to as heightened awareness, due to an individual's cognitive schema. It includes individual ability to interpret and perceive anomalies in the environment, reassessing situations, rather than following the status quo (Ardichvili & Cardozo, 2000; Gaglio & Katz, 2001). Certain personality traits (e.g. creativity and optimism), relevant prior knowledge and experience and social networks (Ardichvili *et al.*, 2003), heighten alertness.

Alertness is highlighted as a central capability leveraged by entrepreneurial owners/managers, particularly with regard to un-thought of knowledge. Alertness as a cognitive capability enables owners/managers to be open to recognising pre-existing potential market opportunities, which are not visible to those who are not alert. Furthermore, Shane (2000: 449) states:

'Markets are composed of people who possess different information (Hayek, 1945). The possession of specific knowledge allows people to see particular opportunities that others cannot see, even if they are not actively searching for such opportunities. Differences in information lead people to see

different value in a given good or service and offer different prices to obtain it' (Shane, 2000: 449).

Having become alert to an opportunity, owners/managers must then make sense of and interpret this new information to recognize a potential opportunity.

Sensemaking can be understood as cognitive function of owners/managers (Weick, 1995). Individuals enact and create their own environments based on pre-conceptions (Weick, 1988). These pre-conceptions are formed of previous experiences and generalisations. Problems, which are to be made sense of are only understood when faced by individuals and acted upon, as it is difficult to determine an appropriate course of action, as understanding is made easier through action (Weick, 1988).

Making sense of clues and cues perceived by the owner/manager in the environment helps them to interpret potential international opportunities. Weick (1995) suggests sensemaking occurs in a stream of ongoing events. Sensemaking often begins with a discrepant set of cues (Weick, 1995). These cues are often spotted when individuals look retrospectively at previous experiences (Weick, 1995). Sensemaking is used to understand, interpret and give meaning to stimuli (Weick, 1995). In addition, it can include 'the revision of those interpretations based on action and its consequences' (Weick, 1995: 8). This highlights that sensemaking is defined and refined through actions, such as learning by doing and drawing upon previous experiences.

Zahra *et al.* (2005) suggest the information owners/managers may gather from their environments must conflict with their existing cognitive models to trigger that information being processed (Weick, 1995; Zahra *et al.*, 2005). The discord in information spurs owners/managers to make sense of the new information (Zahra *et al.*,

2005). Their ability to make sense of potential opportunities is influenced by their previous experience. However, prior experience in international markets may cause potential opportunities to be overlooked, as familiar clues may not trigger sensemaking (Zahra *et al.*, 2005).

Clegg, Kornberger & Pitsis (2016) suggest owners/managers use sensemaking to provide reasonable constructions and directional guidelines, before pursuing a course of action. They suggest sensemaking is ongoing and therefore changing and fleeting, retrospective and constantly reviewed. Owners/managers may listen to others and try to accommodate it into their familiar existing stocks of knowledge. The aim of sensemaking is to rationalise and simplify the information they have received. As explained by Clegg *et al.* (2016) information is firstly sensed, and then cognitive capacities are used to make a pattern from the information. Cues may help owners/managers to make sense for example their previous experiences or drawing upon the opinions of others.

Baron (2006) views opportunity recognition as pattern recognition in independent events, dependent upon an individual's life experience. Experiences shape cognitive processes and the interpretation of management ideas. Such cognitive processes 'help specific persons connect the dots between seemingly independent events, and the patterns they then perceive in these events may constitute the basis for identifying specific business opportunities' (Baron, 2006: 176). Therefore, 'specific persons then notice these changes and more importantly perceive connections between them', (Ozgen & Baron, 2007: 176). This further accentuates the role of previous experience in international opportunity recognition. Experienced entrepreneurial

owners/managers have richer prototypes than novices, enabling them to draw upon gut feeling and intuition (Grégoire, Barr & Shepherd, 2010).

Owners/managers may draw upon heuristics, or simplifying strategies to evaluate opportunities (Bingham & Eisenhardt, 2011; Keh *et al.*, 2002; Ucbasaran *et al.*, 2001; Venkataraman, 1997) as they find themselves in new or technologically uncertain situations. Heuristics are understood as 'cognitive shortcuts that emerge when information, time, and processing capacity are limited' (Bingham & Eisenhardt, 2011). Bingham, Howell & Ott (2019) suggest that when developing capabilities to internationalise, owners/managers begin with rough and undefined heuristics. As the process progresses, owners/managers gain a further understanding of what tasks to perform and how to perform them. Owners/managers can then assess and implement the cognitive shortcuts which they perceive are most relevant to their activities.

However, these simplifying strategies can lead to cognitive biases, and influence both the information owners/managers acknowledge, shapes their conclusions, and helps them to manage uncertainty (Keh *et al.*, 2002; Venkataraman, 1997). Keh *et al.* (2002) highlight four main cognitive biases as overconfidence, belief in the law of small numbers, planning fallacy and illusion of control. These biases influence upon risk perception, and therefore the evaluation of opportunities. Owners/managers may compare new stimuli, for example a new idea or business opportunity, with prior knowledge in order to make sense of the unknown (Jones & Casulli, 2014).

Cognitive capabilities help in decision-making and information processing. Managers' behaviours are governed by their self-efficacy, which in turn influences their mental models, motivations and perceptions (Zahra *et al.*, 2005). Perceptions determine

owner/manager ability to recognise opportunities. Self-efficacy can be understood as an individuals' belief in their capabilities (Ardichvili *et al.*, 2003; Ozgen & Baron, 2007; Zahra *et al.*, 2005). Self-efficacy suggests that individuals are more likely to behave entrepreneurially.

Furthermore, Lowik, Kraaijenbrink & Groen (2017: 1325) highlight a bisociative cognitive style as important; 'Bisociation is a decision-making style in which individuals use imagination and intuition to seek solutions outside disciplinary boundaries to discover connections that are not readily apparent.' Association is also highlighted as a cognitive style involving 'rational thinking, emphasizing verbal reasoning and articulate expressions of ideas.' (Lowik *et al.*, 2017: 1325). From this perspective, owners/managers look for conventional solutions to problems. Owners/managers typically possess both a bisociative and associative cognitive styles when recognising knowledge that is useful to them (Lowik *et al.*, 2017).

Each manager is defined by previous experiences, equipping them with a range of mental tools and capabilities to recognise opportunities (Ozgen & Baron, 2007: 187; Zahra *et al.*, 2005). Kirzner (1997), Shane (2000) and Venkataraman (1997) state 'different people will discover different opportunities in a given technological change because they possess different prior knowledge' (Shane, 2000: 448).

Within an international market context, Evers & O'Gorman (2011: 551) state; 'An entrepreneur's prior knowledge can explain how they discover entrepreneurial opportunities, including international opportunities', suggesting prior work experience overseas shapes international opportunity recognition. However, findings in a study by Evers & O'Gorman (2011: 567) on the role of prior knowledge in international new

ventures suggests 'entrepreneurs with relatively little knowledge or experience of foreign markets were able to discover international opportunities', indicating that owners/managers do not require an in-depth knowledge of international markets to recognise opportunities in them.

Venkataraman (1997: 122) suggests the role of the individual in terms of knowledge acquisition is determined by 'occupation, on-the-job routines, social relationships, and daily life', in terms of a knowledge corridor. Martelo-Landroguez & Cegarra-Navarro (2014: 3) explain:

'The term "knowledge corridor" exists in accordance with Ronstadt's (1988) corridor principle, which posits that opportunity recognition is assumed to be a function of both a person's stock of knowledge and previous social knowledge (Ronstadt, 1988).' (Martelo-Landroguez & Cegarra-Navarro, 2014: 3).

Education, learning by doing and learning from other actors can potentially broaden what they perceive as feasible as an opportunity (Martelo-Landroguez & Cegarra-Navarro, 2014). Kontinen & Ojala (2011) identified three types of prior knowledge pertaining to opportunity discovery as knowledge of markets, knowledge of ways to serve the markets and knowledge of customer problems. General sources of knowledge in international markets can be acquired easily from media sources (Johanson & Vahlne, 1977; Kontinen & Ojala, 2011), current jobs, work experience and technological knowledge (Kontinen & Ojala, 2011; Park, 2005). In contrast, market specific knowledge is acquired from experience within the market (Johanson & Vahlne 1977; Kontinen & Ojala, 2011). Furthermore, Ardichvili *et al.* (2003) highlight that the activities within the opportunity identification process is effected by the degree of specialised knowledge about market needs and resources.

Previous experiences lead to the accumulation of tacit knowledge. Tacit knowledge is understood as 'informal, inchoate, or obscure kind of knowledge', which is hidden and inaccessible (Cook & Brown, 1999: 384). This fills in the gaps that explicit knowledge alone cannot do, learned through experiences and doing. Explicit knowledge can help to gain tacit knowledge 'tacit skills of an individual can and cannot be tapped for the benefit of the organization' (Cook & Brown, 1999: 384).

Tacit knowledge is central to the knowledge creating process at an individual level. This type of knowledge must be externalised in order to obtain external benefits, for example profit generation (Cook & Brown, 1999: 382). As stated by Peng (2009: 77); 'Tacit knowledge, probably one of the most valuable, unique, hard-to-imitate, and organizationally complex resource, may represent the ultimate dynamic capability a firm can have in its quest for competitive advantage'. Tacit knowledge extends past scientific expertise, to the development of industry and firm specific business knowledge incorporating knowledge of customers, product development process and political connections.

Uncertainty absorption can be understood as a form of tacit knowledge. Owners/managers must be able to absorb uncertainty associated with exploiting opportunities and demonstrate a high level of tolerance to uncertainty (Butler *et al.*, 2010). Butler *et al.* (2010) define uncertainty absorption as being a form of tacit knowledge, which is contextually specific and undispersed. Uncertainty absorption is therefore embedded in the mind of the life science SME owner/manager. Butler *et al.* (2010: 129) suggest that in order to acquire new knowledge 'the mind must assimilate it into a new mental structure, which then must be accommodated with existing mental

structures.’ They note that new ideas are often limited by matching associative concepts in pre-existing mental models.

McMullen & Shepherd (2006) propose a conceptual model relating entrepreneurial action to the willingness to bear perceived uncertainty. In addition, domain specific knowledge (e.g. about a specific technology) is needed to accurately perceive uncertainty and assess if a potential opportunity exists (McMullen & Shepherd, 2006). In the evaluation of potential opportunities, McMullen & Shepherd (2006) conceptualise uncertainty as subjective, suggesting individuals may perceive different extents of doubt in the same situation. Acting upon an opportunity also depends upon motivation (e.g. individual strategy and encouragement from others) (McMullen & Shepherd, 2006). International opportunity recognition is argued ‘to be more complex and to require different knowledge and analytical skills’ (Baron, 2006), due to its dynamic and unanticipated nature (Carlson & Dale, 2011). In the forthcoming section, we explore the role of social capital in international opportunity recognition.

2.5.6 Social capital in international opportunity recognition

Nahapiet & Ghoshal (1998: 36) define social capital as ‘the actual and potential resources embedded within, available through, and derived from the network of relationships possessed by an individual or a social unit.’ From this perspective resources are embedded in social relationships. Resources can be tangible and intangible, such as providing access to equipment and also the transfer and creation of knowledge. Nahapiet & Ghoshal (1998) suggest that social capital facilitates the creation and sharing of knowledge, subsequently adding value to the organisation. Three main attributes of

social capital are highlighted in the existing literature. These correspond to the structural, relational and cognitive dimensions of social capital.

The structural dimension can be understood as a pattern of connections and linkages between actors. Density, connectivity and hierarchy are important measures in the structural dimension. Secondly, the relational dimension is defined as referring to the 'assets which are created and leveraged through the relationships and include attributes like trust, norms and sanctions, obligations and expectations, and identification' (Nahapiet & Ghoshal, 1998: 35). Trust and trustworthiness of ties can be used as governance mechanisms. Lastly, the cognitive dimension involves a shared vision and a set of common values (Nahapiet & Ghoshal, 1998; Tsai & Ghoshal, 1998). Social capital encompasses social ties, trusting relations, and value systems.

Social interaction and trust are important to resource exchange and product innovation. Informal and tacit social relations encourage productive resource exchange and combination and therefore innovation. There is an association between social capital and firm's value creation. Structural dimensions and relational dimensions are linked as social interaction creates trust and perceived trustworthiness. Trust relationships evolve over time from social interaction. As trust grows, both partners share important information as they create a common point of view. Relational and cognitive dimensions are linked through sharing common values. This encourages the development of trusting relationships. Common values decrease opportunism due to harmony of interests. Cognitive and structural dimensions are linked through social interaction. This plays a role in establishing shared goals and values.

Social capital can be internal and external to the organisation. Examples of internal social capital include board members, executive and management teams. Knowledge and expertise of an individual within the organisation can be leveraged. Networks of members internal to the organisation can also lead to establishing networks external to the organisation. Social capital external to the organisation can include personal and business contacts.

Networking, using personal and business contacts, has been highlighted in the literature as facilitating access to information and resources (Adner & Helfat, 2003; Blyler & Coff, 2003; Ellis, 2011; Ozgen & Baron, 2007). External ties in particular can be understood as providing access to 'external resources that firms need in order to operate (e.g., financing)', whilst providing 'information about practices in different firms' (Adner & Helfat, 2003: 1021). Access to external ties arguably improves international opportunity recognition as the owner/manager has access to a wider knowledge base.

Similarly, Zahra *et al.* (2005) and Ozgen & Baron (2007) highlight the importance of networks and industry contacts in opportunity recognition. Social capital can be strong or weak in character. Networking with weak ties provides 'general information that could lead to identifying an opportunity or answer to a specific question' (De Koning & Muzyka, 1999: 11). Strong ties are often durable, reliable and trustworthy and are developed over time (Peng, 2009). They also serve as exchanges of high quality information and can combat opportunism (Peng, 2009). In contrast, weak ties are characterised as being low intimacy and provide wide-ranging information from a

selection of individuals, to provide novel information useful to opportunity recognition (Peng, 2009).

Improving networking capabilities can also provide 'information benefits and to create a pool of potential future resource providers' (De Koning & Muzyka, 1999: 11). Ozgen & Baron (2007) suggest that the larger an individual's networks, the more opportunities they recognise. Ujjual (2011: 229) suggests 'networks facilitate the acquisition of experiential knowledge on foreign markets', especially relevant to new, small ventures, when reducing uncertainty associated with entering international markets (McMullen & Shepherd, 2006).

Pursuing new networks in order to access new international markets is considered a stronger act of entrepreneurship than pursuing already existing international markets and accessing familiar ties (Ellis, 2011). Relational entry modes shed light upon social capital networks and relationships as paramount (Carlsson & Dale, 2011). Carlsson & Dale (2011) highlight three types of relational entry modes: follow the client, alumni-network and piggybacking. Relational entry modes use existing internal capabilities, either of the owners or of managers that work in the organisation, to facilitate entering international markets. In order to expand social ties and networking capabilities attendance at trade fairs is advocated (Ellis, 2011; Pinho, 2011).

2.5.7 Human and social capital in international opportunity recognition

Owners/managers leverage their cognitive and networking capabilities to acquire specialised technological and market knowledge, during the process of international opportunity recognition. Networking provides access to information,

about both technology and markets, whilst cognitive capabilities create biases in the actions taken and shapes decision making (Adner & Helfat, 2003: 1022).

Social ties are highlighted as influencing owner/manager belief systems, particularly with reference to their perception of the environment. This impacts the owners/managers ability to recognise opportunities internationally, as it effects positioning choices and evolution of competition (Adner & Helfat, 2003). Cognitive capabilities are also suspected to influence social ties, and therefore networking capabilities.

Social capital resources affect human capital as they constrain and enable access to and the transfer of knowledge, crucial to the recognition of opportunities. Human capital may also effect social capital, as their reputation may make owners/managers themselves more or less valuable due to their credibility and network connections (Zucchella & Kabbara, 2011). Technological and market knowledge is acquired by leveraging such cognitive and networking capabilities during the process of opportunity recognition in an international context. The forthcoming section provides further insight into knowledge acquisition.

2.5.8 Knowledge acquisition in international opportunity recognition

Knowledge acquisition can assist in the recognition of new opportunities (Yli-Renko, Autio & Sapienza, 2001). In entering international markets, small and new ventures can acquire knowledge that enables them to build skills that can augment existing capabilities (Zahra, Ireland & Hitt, 2000). Knowledge and learning are also important in the identification and exploitation of opportunities, as previous

experiences shape the discovery and development of opportunities (Saemundsson & Candi, 2017).

Yli-Renko *et al.* (2001) highlight that knowledge acquisition from a partner is dependent upon firstly, the existence of knowledge, and secondly, the ability of the firms to assess and recognize the value of the knowledge. Thirdly, there must be repeated and intense interaction, and lastly a willingness between the firms to share information. Therefore, trust and reciprocity, introduction to further networks through existing partners, and the level of social interaction between partners, is highlighted as central to the amount of knowledge a firm can obtain (Pinho, 2011; Yli-Renko *et al.*, 2001).

Existing studies have shown that as relationships develop over time and interactions become more frequent, so does business-specific information exchange (Yli-Renko *et al.*, 2001). In addition, Yli-Renko *et al.* (2001) suggest that this form of interactive learning allows firms to access forms of tacit knowledge, not accessible through trade journals or benchmarking practices.

Technological knowledge is the knowledge required 'to develop and use innovation effectively.' (Zahra *et al.*, 2000: 942). Technological knowledge is concerned with R&D and scientific discovery used to create potentially new product ideas. Universities and research centres are typically sources of such knowledge (Zucchella & Kabbara, 2011). Owners/managers may use technology in new product development, integrate new technology or proactively develop new technology leading to the creation of new product ideas.

Zahra *et al.* (2000) suggest that working internationally can enhance technological learning, helping organisations to develop skills and competencies to gain

a competitive advantage. They highlight that technological learning is chaotic and fragmented, therefore requiring owners/managers to integrate the knowledge they have acquired into their organisation. This involves owners/managers firstly determining what they have learned, evaluating its importance and exploring how the information they have gained can be used (Zahra *et al.*, 2000). The integration of new knowledge can lead to the development of routines.

‘The development of new technological knowledge is important for success in international markets (Bartlett & Ghoshal, 1987). This knowledge influences a venture's ability to adapt its products to local market conditions (Afuah, 1998), capitalize on market dynamism through rapid new product developments (McCann, 1991), and identify emerging technological changes that can influence firm performance.’ (Zahra, Ireland & Hitt, 2000: 926).

Zahra *et al.* (2000) highlight three aspects of technological learning referring to the breadth, depth and speed of technological learning. This refers to the multiple areas a firm may learn new skills, their ability to draw upon new linkages between knowledge bases and how rapidly they acquire new skills.

2.5.9 Absorptive capacity, routines, the evolution of dynamic capabilities and opportunity recognition in international opportunity recognition

Absorptive capacity can lead to the further development of dynamic capabilities. Zahra & George (2002: 186) view absorptive capacity as a ‘set of organizational routines and processes by which firms acquire, assimilate, transform, and exploit knowledge to produce a dynamic organizational capability.’ Furthermore, Eisenhardt & Martin (2000) suggest that repetition is important to the development of dynamic capabilities, as it enhances learning and codification of routines.

Mistakes are important to the evolution of dynamic capabilities. Small failures are highlighted by Eisenhardt & Martin (2000) as being integral to learning and capability development. The pacing of experience is also central to the evolution of capabilities. If

experience occurs too rapidly, owners/managers may become overwhelmed and they cannot translate this into meaningful learning. Infrequent experience can lead to forgetting about what was previously learned. Evolution also depends upon market dynamism. In moderately dynamic environments small variations help to sharpen dynamic capabilities. Within high velocity markets the experiences which owner/managers generalise from and use to develop capabilities is crucial.

Dynamic capabilities differ from existing, operational capabilities as they renew existing routines, causing them to evolve incrementally (Easterby-Smith *et al.*, 2009; Zollo & Winter, 2002). Dynamic capabilities enable organisational change and evolution (Zahra & George, 2002). These capabilities enable the reconfiguration of resources so firms can adapt to changing market conditions and sustain a competitive advantage (Zahra & George, 2002). Eisenhardt & Martin (2000) highlight that owners/managers may link routines and combine capabilities from previous projects or experiences and apply these to new projects. These managers were observed to follow sequenced steps (Eisenhardt & Martin, 2000). This required firstly, basic skills for example single product development skills. These skills are then combined with looking for new product development opportunities and time-pacing skills linking current and new product development (Eisenhardt & Martin, 2000).

Zahra & George (2002) distinguish between a firms realised and potential absorptive capacity. Potential capacity includes knowledge acquisition, whereas realised capacity refers to knowledge transformation and exploitation. Our research focuses upon how knowledge is acquired during the process of international opportunity recognition, by leveraging cognitive and networking capabilities, therefore it focuses upon potential absorptive capacity. Potential capacity provides firms with strategic

flexibility where they can adapt to environmental changes. This is particularly relevant to life science SMEs, as they operate within high velocity environments.

2.6 International opportunity recognition in the life science industry

As we highlighted in the introduction, the life science sector is characterised by a number of small, specialised and interdependent companies (Powell *et al.*, 2005; Powell *et al.*, 2012). Therefore, life science firms establish networks to gain domain specific, specialised technological and market knowledge, distinct to their organisations (Dimov, 2007; Dimov & Shepherd, 2005; Park, 2005; Zahra & Wright, 2011). The mode of international market entry can be viewed as an opportunity for internationalisation, for example through establishing R&D partnerships or distributor networks in order to effectively commercialise products and services internationally.

The industry is characterised by technological and commercial advances, uncertainty due to scientific experimentation, international expansion, and short windows of commercialisation (Warner & Carrick, 2011). Opportunity level attributes such as exit potential and windows of opportunity are influential in the international opportunity recognition process, especially in high technology industries (Jones *et al.*, 2011a; Timmons, 1994). For example, life science SME owners/managers often formulate exit strategies early in the business cycle to maximise profit potential (Peng, 2009).

Timmons (1994) suggests planning is central when achieving exit potential. Exiting pre-grown products or knowledge is acquired over time and firms are usually grown with an exit strategy in mind. This typically follows a 5-year investment plan.

Being able to prove protection of products or knowledge through patents or exclusive distribution rights in certain markets is attractive to potential acquirers (Timmons, 1994). Exit strategies such as selling equity, selling the complete firm and merging are common in the life science sector (Peng, 2009). This provides a return on investment, which is particularly important to shareholders (Timmons, 1994). Life science SME owners/managers may also use this return as an opportunity to create a new venture. Exit facilitates the disposal of resources which no longer provides value to the firm as markets change (Eisenhardt & Martin, 2000). In addition, windows of opportunity have been highlighted in the literature as influential to the process of international opportunity recognition. Ideally, opportunities are recognised as the door is opening and the market is starting to expand and entering a rapid growth phase, not when the door is closing and market demand is shrinking (Timmons, 1994). The forthcoming sections highlight the role of human and social capital in international opportunity recognition, within the life science sector.

2.6.1 Human capital and international opportunity recognition in the life science industry

Within the SME life science industry context, owners/managers leverage their human capital in order to recognise opportunities internationally. As this sector is highly specialised, the role of education is particularly important to the recognition of international opportunities (Clercq & Arenius, 2006; Ramos-Rodríguez, Medina-Garrido, Lorenzo-Gómez & Ruiz-Navarro, 2010). The existing literature has acknowledged that there is a positive association between educational level and the perception of business opportunities. This is attributed to access to various types of knowledge. A large

knowledge base increases the individuals' ability to relate knowledge to potential opportunities (Ramos-Rodríguez *et al.*, 2010).

Dimov & Shepherd (2005) acknowledge the role of human capital in venture capital firms. Similarly, some life science firms are funded by venture capital, and therefore comparisons may be drawn between the two. Investigating the role of education and prior experience of top managers in venture capital firms, they highlight that owners/managers within these firms possess explicit knowledge (acquired in academic institutions) and implicit knowledge, gained through experience in a particular domain. Tacit knowledge is particularly important within these contexts, as there are few people within the organisation who have deal-making and value-adding skills. Typically these individuals have had extensive industry experience before entering the venture capital firm (Dimov & Shepherd, 2005). Dimov & Shepherd (2005) highlight that that sharing of knowledge and experience between partners makes distinct firm-level tacit knowledge. This can also be applied to the life science sector as it consists of complex networks of organisations, which perform highly specialised activities (Powell *et al.*, 2005; Powell *et al.*, 2012).

Dimov & Shepherd (2005) draw a distinction between different domain compartments of human capital as general and specific human capital. General human capital is referred to as overall education and experience, whereas specific human capital refers to the education and experience in a particular domain which provides skills which are directly linked to the activities within a firm (Dimov & Shepherd, 2005). They found a positive association between venture success and specific human capital.

Therefore, as many owners/managers in life science SMEs carry out their own R&D activities, the role of domain specific human capital is extremely important.

In some cases, R&D opportunities may be recognised through experimentation (Teece, 2007). In order to recognise these type of opportunities, within this context, highly specialised skills in science and technology are required. These are often acquired through pursuing a PhD in a scientific discipline. However, as suggested by Park (2005), literature on opportunity recognition in high tech firms has largely omitted the role of technological expertise in the international opportunity recognition process.

In addition to searching for opportunities, focusing upon scientific experimentation, life science owners/managers may decide to commercialise products and services internationally. King & Tucci (2002) found that experience in previous markets encouraged managers in the disk drive industry to enter a new market. Knowledge and experience gained by life science SME owners/managers shapes the capabilities of individuals to recognise international opportunities. Similarly, Nuscheler, Engelen & Zahra (2019) in their study of the human capital of top management teams in new technology-based ventures found the role of prior start-up experience as key to launching new products in order to achieve growth. They highlighted that education could not be a substitute for experience-based learning. In the forthcoming sections, we explore how networks provide owners/managers with domain specific, specialised technological and market knowledge, distinct to their organisations (Dimov, 2007; Dimov & Shepherd, 2005; Park, 2005; Zahra & Wright, 2011).

2.6.2 Social capital and international opportunity recognition in the life science industry

Within the life science industry context, Zucchella & Kabbara (2011: 126) suggest ‘entrepreneurs identify international opportunities through their social network.’ This could be a key reason in explaining why managers in small international firms have been observed to be more proactive in networking (Andersson & Floren, 2011). Access to resources is recognised as a primary motivation for networking and partnership formation in the high technology industry (Nummela & Nurminen, 2011). From a resource-based view, networks can provide access to complementary assets from different types of organisations (Powell *et al.*, 2005; Powell *et al.*, 2012). Networking also provides access to finance and vertical and horizontal integration facilities needed to complete the production of new products (Leppäaho *et al.*, 2018; Nummela & Nurminen, 2011).

Entry mode and international market selection is often driven by networks and knowledge acquisition, in the life science context (Evers & O’Gorman, 2011; Nummela & Nurminen, 2011). Coviello & Munro (1997) explores the impact of networks upon small high-tech, knowledge-intensive firm internationalization processes. They found that formal and informal network relationships impacted upon foreign market selection, entry mode, product development and market diversification.

In addition, Steinmo & Rasmussen (2018) highlight that owners/managers leverage cognitive and relational dimensions when establishing university-industry collaborations. They found that firms which were experienced in collaborating with public research organisations, such as universities, established external collaborations through leveraging principally cognitive dimensions of social capital. These relationships

were re-enforced by leveraging the relational dimension of social capital. In contrast, Steinmo & Rasmussen (2018) found less experienced firms initially based collaborations on the relational dimension of social capital. These relationships were subsequently re-enforced by the cognitive dimension of social capital.

Similarly, in a study of financiers and research institutions, Leppäaho *et al.* (2018) explore the type, strength, locality and importance of national and international network ties to entrepreneurs when internationalising. Finnish and New Zealand entrepreneurs were found to collaborate with domestic and international research institutions. In contrast, Canadian entrepreneurs were found to leverage domestic research institutions. The ways in which entrepreneurs interacted with customers varied also. Canadian biotech entrepreneurs were found to leverage domestic customers. New Zealand biotech entrepreneurs were found to leverage international customer networks, probably due to the small size of their domestic market. In contrast, Finnish entrepreneurs did not focus upon customers, but upon the sales channels and their partners. Venture capitalists were found to have a significant input to the strategic direction of the firm. However, firms which were privately owned were able to decide the strategic direction of their firms. Leppäaho *et al.* (2018) also found that the significance of research-orientated networks decreased, and the role of sales-orientated networks increased over time.

In addition, networks are useful in reducing uncertainty. Because of the risks involved and length of new product development, small biotech firms are unlikely to undergo the process alone. Inputs are frequently required from more scientists and technically qualified people (Nummela & Nurminen, 2011). Pooling resources with

networks, specifically partners, increases success and shores risk (Nummela & Nurminen, 2011). Partnerships are also formed to reduce costs of production and provide accesses to resources and expertise needed for approval processes (Nummela & Nurminen, 2011).

In addition, Bruni & Verona (2009) found that managers also drew upon external ties such as consultancy firms to trace patterns in the industry. Bruni & Verona (2009) highlight that conferences are not only used by those engaged in R&D. They acknowledge that conferences are useful to individuals engaged in business development and marketing as it 'broadens the scope of their market interaction and thus attended seminars and conferences to capture signals from the external environment.' (Bruni & Verona, 2009: 112). Owners/managers of life science SMEs can leverage their social capital in order to gain insights into the specialised technological and market knowledge they require to recognise opportunities internationally. The forthcoming section provides an overview of the empirical findings of existing studies into technological and market knowledge acquisition in the life science sector.

2.6.3 Technological and market knowledge acquisition in the life science industry

Siegel & Renko (2012) highlight the role of technological and market knowledge in opportunity recognition through their empirical study of new biotechnology firms in the USA, Finland and Sweden. Their findings suggested that technological knowledge contributes to international opportunity recognition. They suggest that research activity within these biotech firms helped to generate new technological knowledge, and also enhance absorptive capacity. In order to recognise opportunities internationally, owners/managers need to understand technology and markets. Siegel & Renko (2012)

conclude that both technological and market knowledge is conducive to international opportunity recognition.

In small biotech companies learning and knowledge acquisition occurs at multiple levels. Knowledge can be categorised as being global or local, science-based and business-based. Nummela & Nurminen (2011) highlight partnership formation as a vehicle of learning and access and generation. They highlight that technological knowledge is often acquired globally, whereas business knowledge is often acquired locally, through experiential learning. Knowledge acquisition is important within the life science industry as knowledge develops rapidly and owners/managers must be focused upon new, emerging innovations. Park (2005) suggests specialised technological knowledge is required to help recognise opportunities, as technology is a core component of the opportunity, requiring specialised knowledge to understand it and the associated regulatory frameworks

Yli-Renko *et al.* (2001) and Eisenhardt & Martin (2000) suggest that knowledge acquisition and creation is crucial to high technology firms, as within this fast moving industry, knowledge needs to be constantly replenished. Yli-Renko *et al.* (2001) conclude that social capital may be crucial to long term success within these industries and that the development of social capital networks is actively implemented by young firms to help them acquire new knowledge. Newly acquired knowledge is combined with existing knowledge, leading to the creation of a new idea or business opportunity.

Yli-Renko *et al.* (2001) suggest that social capital facilitates knowledge acquisition, especially in key customer relationships at a firm level. They found that social interaction and network ties are associated with greater knowledge acquisition.

Knowledge acquisition can lead to the development of new products, technologies and commercialization pathways. Yli-Renko *et al.* (2001) suggest building relationships can be viewed as an asset that can be used to acquire and exploit knowledge. They further suggest knowledge can be acquired through knowledge-sharing routines (e.g. attending tradeshow and conferences) and that in order for these relationships to function effectively governance mechanisms need to be built into the relationship.

Zucchella & Kabbara (2011) suggest that within industries such as biotechnology, knowledge advances rapidly and sources of such knowledge are globally dispersed. In order to acquire up-to-date knowledge, owners/managers must draw upon their networks. We have identified two principal types of knowledge acquired by owners/managers of life science SMEs as technological and market knowledge.

Bruni & Verona (2009) highlight the dynamic marketing capabilities in science-based firms. Bruni & Verona (2009) highlight that science-based firms are mainly 'focusing on specific technological know-how and tend to develop and grow by nurturing their technological competence base (Teece, 1982).' However, high technology firms are having problems launching products into the market on time (Bruni & Verona, 2009). Due to this problem, Bruni & Verona (2009) propose that market knowledge is important to creating value in high tech firms, and not only their ability to create new technological innovations.

Bruni & Verona (2009) argue that marketing capabilities help to satisfy existing customers' needs, existing products and distribution channels. In contrast, dynamic marketing capabilities are central to 'releasing and integrating market knowledge that helps firms evolve.' (Bruni & Verona, 2009: 103). Bruni & Verona (2009) found that

market knowledge, particularly of customers and competitors permitted them to infer future market trends and potential impact of the new technological innovation.

Furthermore, the role of key opinion leaders e.g. doctors working in notable medical centres in promoting, legitimising and integrating market and technological knowledge, within larger firms. Bruni & Verona (2009) found that sales and marketing teams were central to accessing market intelligence. This was often derived from previous experience in launching products in international markets and opinions of subsidiary managers, to generate local knowledge.

Bruni & Verona (2009) found market knowledge was most prominent in the initial and final steps of projects. In the early stages of R&D, market knowledge can help to identify support for fast development of the correct molecule. Bruni & Verona (2009) highlight that during clinical trials, the integration of market and technological knowledge starts to occur as clinical trials have to be conducted keeping in mind how it would be used by the customer and appeal to the market.

After products have been approved, market knowledge is associated more with positioning the product in the market. This includes communication and pricing including how to best satisfy expectations of customers. In pricing, knowledge of cost containment policies and reimbursement restrictions is important market knowledge. If products fail to demonstrate it is innovative then it will attain a low reference price and impact upon profitability. The forthcoming section highlights the role of absorptive capacity in international opportunity recognition in the life science sector.

2.6.4 Absorptive capacity and international opportunity recognition in the life science industry

Saemundsson & Candi (2017) highlight the role of potential absorptive capacity in opportunity identification in new technology-based firms. Saemundsson & Candi (2017) support Shane (2000)'s argument that opportunities are shaped by individuals' prior knowledge, which leads to different interpretations and applications of for example product innovations. Saemundsson & Candi (2017) highlight the argument made by Cohen & Levinthal (1989) that investments in R&D and the firms learning ability (absorptive capacity), is central to the external knowledge which they adapt to their needs. Therefore, 'the knowledge that the firm is able to "identify, assimilate, and exploit"' (Cohen & Levinthal, 1989: 569) from the environment is dependent on the knowledge accumulated previously through R&D activities (Cohen & Levinthal, 1990)' (Saemundsson & Candi, 2017: 44). Absorptive capacity therefore influences the ability to take advantage of external information.

Lowik *et al.* (2017: 1319) suggest that individual absorptive capacity at an owner/manager level is 'their ability to recognize, assimilate, transform and exploit external knowledge.' Absorptive capacity of owners/managers is 'a key knowledge management building block for an organization's open innovation practices.' (Lowik *et al.*, 2017: 1319). They found that prior knowledge and network diversity impacted absorptive capacity. In addition, a bisociative cognitive style was found to be the most important factor in absorptive capacity within medium sized firms. They highlight that individuals are the creators of innovations, but are also responsible for knowledge sharing, by choosing to adopt or obstruct knowledge sharing with external sources (Lowik *et al.*, 2017).

2.6.5 Routines and opportunity recognition in the life science industry

Zollo & Winter (2002) suggest that dynamic capabilities are particularly beneficial in technological, regulatory and competitive environments which change rapidly. Within these contexts, such as the life science sector, failure to evolve basic operational routines to track environmental changes would undermine firm survival. Capabilities evolve through learning, and in environments of rapid and unpredictable change, capabilities need to be updated repeatedly (Zollo & Winter, 2002). Learning processes can be passive (learning by doing) or deliberate, involving articulation and codification. Eisenhardt & Martin (2000) suggest that some dynamic capabilities can involve the integration of resources. They use the example of product development routines where managers combine their skills and backgrounds to create new products and services. Dynamic capabilities can involve the reconfiguration of resources also, for example combining existing knowledge gained from previous experiences and networks to create new products.

Dynamic capabilities pertain to the gain and release of resources, for example knowledge creation routines, central to the dynamic pharmaceutical industry, where new knowledge is essential (Eisenhardt & Martin, 2000). Alliance and acquisition routines bring in new resources from outside the firm; 'biotech firms with strong alliancing processes for accessing outside knowledge achieve superior performance.' (Eisenhardt & Martin, 2000: 1108). In the forthcoming sections, we explore the entry modes which life science SME owners/managers can potentially select as opportunities for internationalisation.

2.7 International entry modes as opportunities for internationalisation in the life science industry

A number of options are available to owners/managers when recognising opportunities to operate internationally, from scientific partnerships to direct to customer (often business to business), exports and licensing and royalty agreements. Owners/managers of life science SMEs pursue opportunities to work internationally for two principal reasons. Firstly, to acquire technological knowledge through R&D partnerships to expand scientific exploration, known as exploration partnerships (Nummela & Nurminen, 2011). Secondly, to establish a customer base and/or distributor networks, incorporating direct exports or distribution channels (examination and exploitation partnerships) (Nummela & Nurminen, 2011).

A life science SME owner/manager may also pursue more than one mode of entry simultaneously, for example working to develop scientific R&D with an international university, whilst also exporting products. International research partners and customers within this context are usually other SMEs, large multinational companies or universities. The forthcoming section explores international entry modes pursued by owners/managers of life science SMEs.

2.7.1 Partnerships

Hardy, Phillips, & Lawrence (2003: 323) define collaborations as 'inclusive enough to encompass a wide range of arrangements (e.g., consortium, alliances, joint ventures, roundtables, networks, associations'. As suggested by Phene, Fladmoe-Lindquist & Marsh (2006) and Petruzzelli & Rotolo (2015), R&D partnerships are beneficial to acquiring knowledge and resources, specifically in terms of scientific

innovation. Technology and knowledge transfer through networking is an important factor in international opportunity recognition, especially within life science SMEs (Jones *et al.*, 2011b).

In addition, Petruzzelli & Rotolo (2015) acknowledge that partnerships span both commercial and non-commercial domains in the form of buyer/supplier/competitor relationships and university and research organisations. In some cases these relationships are incentivised by government funding (Dooley & Kirk, 2007). In the case of life science SME owners/managers, partnerships can be viewed as commercial in terms of selling physical products, in and out licensing and royalty agreements, but also non-commercial in terms of technological knowledge acquisition. Owners/managers of life science SMEs collaborate internationally with other small companies, large companies and universities or research organisations which are explored in more detail below.

2.7.1.1 Partnerships with large and small companies

Alliances between larger companies and smaller ones take many forms; contractual and non-contractual agreements, equity swaps, and acquisitions (Arora & Gambardella, 1994). As documented in existing literature, life science SME owners/managers often develop technologies for application in larger firms (Hopkins, Crane, Nightingale & Baden-Fuller, 2013) and are often acquisition targets of larger companies.

SMEs are more agile in terms of strategic change compared to larger companies, largely due to their organisational structure and are also more innovative (Timmons,

1994). In terms of knowledge transfer, Bianchi, Chiesa & Frattini (2009) suggest companies rely on external sources for innovation. Small life science firms often offer larger companies the purchase of an option on a project (Arora & Gambardella, 1994), in contrast to Pisano (1990)'s view of larger firms as initiators. From this point of view, larger companies are relying upon external knowledge generated by SME owners/managers. SME owners/managers may perceive this as an opportunity as they alone do not possess the capabilities to fully develop technological innovations into a commercial end product. Therefore, life science SMEs will often develop technology to a certain point (Bianchi *et al.*, 2009), then exit to a larger company (Timmons, 1994).

Furthermore, working within partnerships means owners/managers can gain insight into the partner firm's current research and product development (Zahra *et al.*, 2000). In addition, Zahra *et al.* (2000) suggest that lower control transactions and modes of international entry for example licensing agreements and exporting provides less of an opportunity for knowledge acquisition as interactions are often short. In contrast, high control transactions such as acquisitions and partnerships require close interaction, providing them with access to different information sources and knowledge. This enables firms to acquire technological knowledge. New ventures which use high-control entry modes are close to the international market and their customer needs enables them to acquire knowledge rapidly.

Risks are highlighted in terms of technological and commercial uncertainty. Uncertainties are derived from constraints on time, finance and technological resources to further develop a project to the clinical trial stage, in order to satisfy regulations. As highlighted by Arora & Gambardella (1994: 95); 'There are instances of a large firm

funding research or entering into joint ventures and then not renewing their commitments after the initial contract expires or selling its stake in the venture.’ However, ‘when SME’s license projects to these partners “the locus of power” still resides with the big pharma’ (Hopkins *et al.*, 2013: 945). Therefore, the literature suggests that when SME owners/managers partner with large companies, it is more likely that the larger company will dominate.

Working internationally is a central activity of life science SME owners/managers (Phene *et al.*, 2006). Alliances are viewed as a strategic method of acquiring ‘specialized assets necessary to take technological developments to the product and market stages’ (Dickson, Weaver & Hoy, 2006: 488). High technology SMEs in particular view alliances as strategic insofar as they provide information exchange, technological transfer and to mitigate risk (Dickson *et al.*, 2006). Similarly, Gilmore *et al.* (2001) suggest SME inter-organisational partnerships provide opportunities to share ideas, knowledge and technology.

Furthermore, ‘collaboration may provide an opportunity for one partner to internalize the skills of the other, and thus improve its position both within and without the alliance’ (Hamel, 1991: 83). Partnerships are central in inter-partner learning, knowledge and skill acquisition across boundaries and therefore is important to international managerial capability development. International alliances are frequently used as a method to compensate for a lack of capabilities in internationally specific skill sets (Hamel, 1991).

Life science SME owners/managers may gain access to skills and knowledge through licensing or pre-assembly agreements. In-licensing agreements provide firms

with research, reducing in-house R&D costs. In contrast, out-licensing refers to a company selling their ideas or results from their R&D activities to create revenue (Zucchella & Kabbara, 2011).

However, simply purchasing R&D does not permit transfer of knowledge or internalisation of skills. Once skills have been transferred, they can be used in different contexts. The internalization of partner skills (Hamel, 1991) is often a motivating factor in international partnerships. However, partners can also be competitors with same ambitions to internationalise, which can in turn cause problems as there exists a 'difficulty of bargaining with a partner who possessed equally ambitious learning goals' (Hamel, 1991: 88).

Despite an open approach to communication with competitors for mutual gains, SME owners/managers are guarded against discussing what they perceive to be important changes such as re-structuring or a change in direction. It is also noted that 'SME owner-managers will be reluctant to expend their personal resources in the pursuit of something which will eventually benefit the entire industry' (Gilmore *et al.*, 2001: 9).

Arora & Gambardella (1994) highlight the role of partnerships and innovation in the biotechnology sector, particularly with reference to external links with small and newly formed research intensive companies and universities who possess complementary resources, leading to the forthcoming discussion of the role of University and SME partnerships.

2.7.1.2 Partnerships with universities

Many life science SMEs are spin-offs from universities, suggesting that universities are not solely institutions responsible for education for the common good, they are also potential drivers of economic performance (Dooley & Kirk, 2007; Santoro, 2000). Dooley & Kirk (2007) highlight university-industry collaborations via four main pathways. These are through research support, technology transfer, knowledge transfer and cooperative research. Life science SME owners/managers source universities and academics based on their scientific expertise, regardless of their location globally. Biotech firms may also in-license from universities, providing them with a source of technology to work with, rather than develop innovations from scratch (Zucchella & Kabbara, 2011).

Dooley & Kirk (2007) and Jacob, Hellström, Adler & Norrgren (2000) highlight a shift from sponsorship to partnership with regards to university-industry partnerships, emphasising mutual benefits such as resource sharing and knowledge transfer within specialised areas. Benefits from the university side of such partnerships include a wider access to funding, rather than from traditional public sources (Dooley & Kirk, 2007). This promotes more financial stability, enabling research to deepen and access to industry compound libraries and equipment. Finally, competitiveness with regards to publicly funded research as suggested by Etzkowitz & Leydesdorff (2000) cited in Dooley & Kirk (2007) insofar as there is a direct university-industry link.

Benefits from an industry point of view in terms of industry-university partnerships include primarily access to high quality, niche technological, codified and tacit knowledge. Life science SME owners/managers can acquire knowledge in an area

in which biotechnology firm is weakest (Dooley & Kirk, 2007). Additional relational benefits include access to human capital, in terms of academics who are aware both scientifically and industrially, who can enhance leads for product development. This results in a competitive advantage and is cost-effective as universities already have the capacity and resources to conduct research (Dooley & Kirk, 2007).

Common obstacles encountered within university-industry partnerships include a conflict in objectives as research and market operate on different timescales and values (Elmuti, Abebe & Nicolosi, 2005). The competing logics within the two sectors see academics keen to publish new findings, conflicting with life science SME owner/manager norms of secrecy to protect IP rights and competitive advantage. Intellectual property (IP) is highlighted as a problem with regards to ownership division and negotiations based on trust. Industry claims that IP from universities is often over-priced and ignores the risks industry is exposed to while commercialising it. On the other hand, universities fear that the industry sector may appropriate technological discoveries in order to generate revenue streams (Dooley & Kirk, 2007).

2.7.1.3 Distribution networks and exports

Life science SME owners/managers may enter foreign markets to establish a direct to customer base, search for and expand distributor networks for products they have developed. Regarding exports, Love & Roper (2015) highlight three principal pathways to gaining international market knowledge. Firstly, being there and gaining local knowledge from networks. Secondly, through openness, purposefully partnering to gain technical knowledge or market understanding. Finally, learning through

experience and activities in export markets, is highlighted as being a method which is more influential to knowledge-intensive SMEs (Love & Roper, 2015).

Knowledge of international markets can be gained through prior international business experiences, experiential learning through trade missions and general objective sources (Spence, 2003). Knowledge gained through experiential learning 'makes it possible to perceive concrete opportunities' (Johanson & Vahlne, 1977) as opposed to knowledge gained through objective sources.

Spence (2003) highlights the importance of experiential international market knowledge acquisition through trade missions upon export success, with acquisition of market knowledge and building of networks as central activities to SME owners/managers when present in international markets. Human capital is highlighted as important regarding owners/managers propensity to export; 'Internationally-minded managers have usually been exposed to foreign environments either by birth, education, or business experience' (Klein, 2008; Spence, 2003: 85). Learning from past experiences, referred to as general export knowledge (Spence, 2003) may shape the modes of entry selected by life science SME owners/managers. Furthermore, regular visits to grow relationships are suggested (Spence, 2003), highlighting the relational element in establishing international ties.

International market knowledge from objective sources include export assistance, market research and market intelligence (Spence, 2003) known as objective export knowledge (Spence, 2003). This contrasts to experiential knowledge acquisition. Useful information about international markets includes the economy, politics, culture, industry, product lines of interest. These can be accessed remotely from published

sources (Spence, 2003). Life science SME owners/managers also cite knowledge of regulations specific to their sector as particularly useful. The acquisition of such international market knowledge before visiting and entering 'facilitates the acquisition of further experiential knowledge once in the country as it makes travelling managers more aware of what to expect from and how to behave appropriately in the target culture' (Spence, 2003: 85).

An option open to life science SME owners/managers is establishing distribution networks, which are also relational in character, as highlighted by Vázquez-Casielles, Iglesias & Varela-Neira (2013). Partnerships are central to maintaining and building agreements. These take the form of networks of key actors (Karra *et al.*, 2008) such as distributors, where life science SME owners/managers can leverage the local international market knowledge possessed by their international partners, such as cultural and regulatory needs, instead of having to develop international market knowledge from scratch (Karra *et al.*, 2008).

2.8 Summary of the literature

Dynamic managerial capabilities is a useful lens to explain the role of life science SME owners/managers in recognising international opportunities, as the life science owners/managers operate under conditions of high technological and market uncertainty. SME owners/managers need to develop dynamic capabilities, which they can leverage in order to recognise opportunities internationally, whilst dealing with this uncertainty.

The life science industry is characterised by a number of small, specialised and interdependent companies (Powell *et al.*, 2005; Powell *et al.*, 2012). Life science SME owners/managers leverage international networks to gain access to domain specific, specialised technological and market knowledge, distinct to their organisations (Dimov, 2007; Park, 2005; Zahra & Wright, 2011).

As the previous review of existing literature has shown, life science SME owners/managers draw upon their social and human capital when recognising opportunities to enter international markets. Our aim is to identify the specific mechanisms which underpin the capabilities activated, in order to acquire specialised knowledge, during the process of international opportunity recognition. In doing so, we will be able to further shed light upon the cognitive and networking capabilities available to life science SME owners/managers in different phases of the process. This will enable us to explore how these capabilities are leveraged during the process, to acquire specialised technological and market knowledge. The conceptual framework presented in the following section is a result of a critical reading of the reviewed literature.

2.9 Conceptual framework

Life science SME owners/managers draw upon their social and human capital and use the capabilities available to them in different phases of the international opportunity process. These capabilities are dynamic in response to the technological and international market uncertainty faced by life science SME owners/managers when recognising opportunities. The conceptual framework illustrates how cognitive and networking capabilities are leveraged by life science SME owners/managers to acquire specialised market and technological knowledge, during the process of international

opportunity recognition. The framework illustrates the main phases of the opportunity recognition process, which have emerged from the existing literature. These are firstly, identification, followed by evaluation and lastly, selection and exploitation. We also suggest some possible outcomes of the process, including entry into a new international market, launch of a new product or service and the evolution of specialised technological and market knowledge.

The process of international opportunity recognition is driven by the life science SME owner/manager, who possesses cognitive and networking capabilities, developed from their prior experience (Shane, 2000; Venkataraman, 1997). These capabilities are the means with which the owner/manager possesses, and begins the international opportunity recognition process of identification with.

In the first phase of the process (figure 1), identification, life science SME owners/managers leverage their human capital. Their cognitive processes are underpinned by alertness to the external environment and an international mind-set. Alertness can include perceiving anomalies in the environment, and reassessing situations, rather than following the status quo (Ardichvili & Cardozo, 2000; Gaglio & Katz, 2001). Exposure to international environments through prior business experience, life experiences and education can also encourage willingness to work internationally, and enhance alertness to new opportunities (Karra *et al.*, 2008; Shane, 2000; Spence, 2003; Venkataraman, 1997).

Tailored international market knowledge is developed through prior experience in international markets, but can also be accessed in the form of objective knowledge from international market research reports and governmental *what to expect* and *how*

to guides. In addition, life science SME owners/managers often possess sector specific technological knowledge displayed during in house R&D activities (Teece, 2007), and often gained through formal education to PhD level in a niche, science-based subject. This enables them to relate their domain specific, specialised knowledge to prospective opportunities (Dimov & Shepherd, 2005; Park, 2005; Ramos-Rodríguez *et al.*, 2010). Purposeful search and experimentation for specific molecules, for example, can lead to the creation and emergence of potential opportunities.

In addition, networking capabilities provide access to strong and weak ties, comprising of personal and business contacts (De Koning & Muzyka, 1999). These prove useful as information sources and access to resources such as finance and transfer of knowledge (Adner & Helfat, 2003; Blyler & Coff, 2003; Ellis, 2011; Leppäaho *et al.*, 2018; Ozgen & Baron, 2007). Interacting with potential customers can also be a source of useful information, as they can communicate their unmet needs (Teece, 2007). Life science SME owners/managers are especially adept at networking.

In addition, networks and industry ties can help in identifying the international markets they enter (Fisher, 2012). New networks may be established through serendipitous encounters (Carlsson & Dale, 2011) and existing ones renewed through attendance at scientific conferences, industry and sector specific trade shows. As suggested by recent empirical studies in the high technology sector (Leppäaho *et al.*, 2018; Steinmo & Rasmussen, 2018), owners/managers may leverage various types, strength, locality and dimensions of social capital (Nahapiet & Ghoshal, 1998), in order to access general and specific technological and market knowledge, within this phase.

During the evaluation phase, life science SME owners/managers leverage their networking capabilities to evaluate and assess the feasibility of a potential international opportunity. Life science SME owners/managers draw upon networking capabilities to mitigate environmental uncertainty and find suitable strategic partners (McMullen & Shepherd, 2006). Leveraging networks helps owners/managers of life science SMEs to draw upon the opinions of key actors, such as clinicians and potential customers (Teece, 2007). This facilitates the bridging of technological and market knowledge, through social interaction (Dimov, 2011; Karra *et al.*, 2008).

Within the evaluation phase, life science owners/managers make sense of the information they have gathered in the previously (Teece, 2007). Cognitively, life science SME owners/managers use heuristics (Venkataraman, 1997) to assess technological and market fit, as what seems to be a good technological idea with regards to R&D exploration, may not be perceived as a profitable market opportunity. This phase involves simplifying the knowledge gathered in previous phase (identification). Owners/managers can then recognise patterns between technological and market knowledge using intuition, imagination and conventional solutions (Baron, 2006; Ozgen & Baron, 2007).

Evaluation in international opportunity recognition is also influenced by characteristics of an international opportunity, for example potential for building assets in terms of IP, measured by patent portfolios, which would be valuable to larger companies who would acquire the SME in during implementation of an exit strategy. Windows of opportunity are also posited as important opportunity level characteristics in opportunity recognition (Warner & Carrick, 2011). From this point of view

opportunities to enter international markets are recognised ideally when demand is rising for a product or service, and not when market demand starts to shrink.

When selecting opportunities to enter international markets, owners/managers draw upon the technological and market knowledge possessed by international partners to help bear uncertainty (McMullen & Shepherd, 2006). They need to understand the value of technological and market knowledge they have received during the process has for furthering their business (Dimov, 2007).

Two main outcomes of the opportunity recognition process are firstly recognition of a potential new market to enter. This can include a new mode of entry, a new market for an existing product or a new technology being released into a new market. Secondly, specialised technological and market knowledge has evolved during this process, however it is the ability of the life science owner/manager to absorb this knowledge which leads to improved future identification of opportunities internationally (Martelo-Landroguez & Cegarra-Navarro, 2014).

The exploitation phase of the opportunity recognition process is post recognition (Shane & Venkataraman, 2000). It includes the pursuit of recognised international opportunities to growth phases and commercialisation. International opportunities recognised may be rejected due to poor alignment in technological fit between partners or due to poor potential development of IP and patent assets in building an exit strategy.

During this process, the cognitive and networking capabilities leveraged by life science SME owners/managers evolve to keep pace with environmental changes both in technological advances and in the market (Eisenhardt & Martin, 2000). From this perspective, opportunity recognition can be understood as an iterative and evolutionary

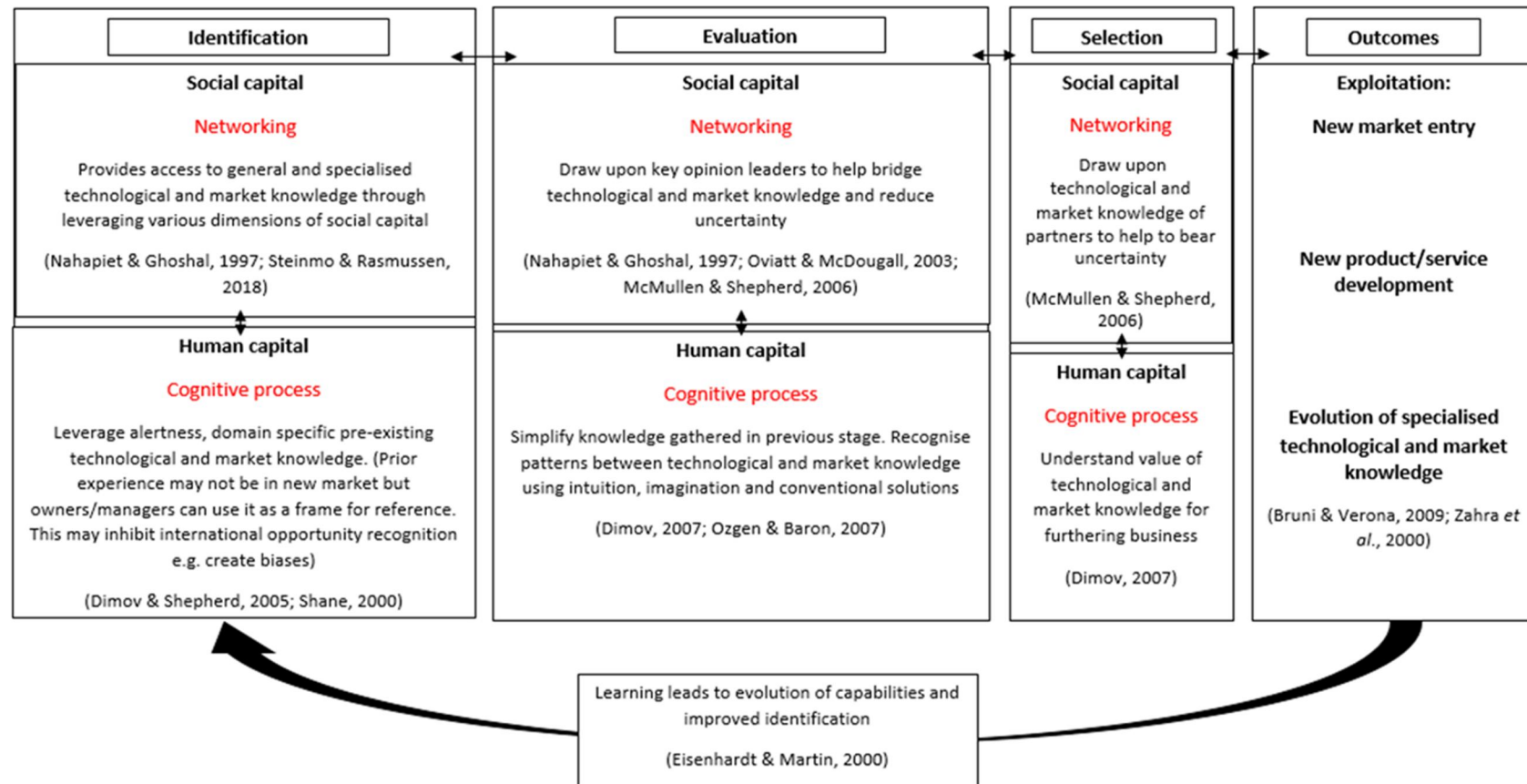
process. Opportunities may be revised, refined and re-evaluated to create a new exploitable opportunity (Ardichvili *et al.*, 2003). Evaluation may encourage the owner/manager to scan for new opportunities.

In summary, the current literature on international entrepreneurship provides a fragmented account of the capabilities leveraged during the process of international opportunity recognition. Authors also acknowledge the role of human capital such as prior experience (Evers & O’Gorman, 2011; Karra *et al.*, 2008; Ozgen & Baron, 2007; Shane, 2000; Venkataraman, 1997; Zahra *et al.*, 2005) and alertness (Gaglio & Katz, 2001) in international opportunity recognition. Existing literature also demonstrates the role of social capital in recognising opportunities internationally such as leveraging networks to identify opportunities (Zucchella & Kabbara, 2011), knowledge and technology transfer (Adner & Helfat, 2003; Blyler & Coff, 2003; Ellis, 2011; Nummela & Nurminen, 2011; Ozgen & Baron, 2007; Petruzzelli & Rotolo, 2015; Phene *et al.*, 2006; Pinho, 2011) and taking advantage of chance happenings (Crick & Spence, 2005). In addition, many of these studies into international entrepreneurship have been undertaken at a firm level (Casper & Kettler, 2001; Jones *et al.*, 2011a; Warner & Carrick, 2011).

There is little insight into the micro-foundations (Felin, Foss & Heimeriks, 2012) which underpin the process of international opportunity recognition (Andersson & Evers, 2015). Our research provides insights beyond anecdotal evidence present in the international entrepreneurship literature. Our individual level study sheds light upon the mechanisms present within life science SME owner/manager capabilities which are leveraged, during the opportunity recognition process, to acquire specialised

technological and market knowledge. We aim to identify and unpack the mechanisms underpinning these cognitive and networking capabilities.

Figure 1: The international opportunity recognition process



Source: Derived from Teece (2007), Dimov (2011), Shane & Venkataraman (2000)

3.0 Methodology

3.1 Introduction

This research used a qualitative approach to explore international opportunity recognition as a process, using the theoretical lens of dynamic managerial capabilities (Bunz, Casulli, Jones & Bausch, 2017; Eisenhardt, 1989; Kaartemo *et al.*, 2019; Yin, 2013). We focus upon how life science SME owners/managers recognise opportunities to enter international markets, in order to gain an empirical insight, and develop our understanding of international opportunity recognition, in context (Dimov, 2011). We do this through viewing international opportunity recognition as an unfolding process, within the life science SME context (Dimov, 2011). Specifically, we aim to contribute to the extant literature on international entrepreneurship, shedding light upon how life science SME owners/managers leverage their human and social capital (e.g. pre-existing knowledge, cognitive and networking capabilities), to acquire specialised technological and market knowledge, during the process of international opportunity recognition.

3.1.1 Overarching research design

We adopted a qualitative case-based approach to develop our understanding of the international opportunity recognition process (Eisenhardt, 1989; Eisenhardt & Graebner, 2007; Yin, 2013). This approach involved using one or more cases to create theoretical constructs from empirical evidence, derived from the cases. The cases provided a rich empirical description and used a variety of data sources. We developed our understanding of the international opportunity recognition process through

recognising patterns within and across cases (Dimov, 2011; Eisenhardt & Graebner, 2007). By recognising these patterns, we were able to understand how owners/managers of life science SMEs recognise opportunities to enter international markets. In our study, we drew upon replication logic (Eisenhardt, 1991; Eisenhardt & Graebner, 2007; Leonard-Barton, 1990; Rowley, 2002), to help us to extend our understanding of the process of international opportunity recognition, through using cases. Each case was used to extend, contrast or replicate our emerging constructs, within the life science SME context (Rowley, 2002). We furthered our understanding of the international opportunity recognition process, through comparing and contrasting data from multiple cases, emerging constructs and extant literature (Eisenhardt & Graebner, 2007; Hannah & Eisenhardt, 2018).

Our research design involved two phases. In the first phase, we used an exploratory case to gain a fine-grained understanding of the international opportunity recognition process, within the life science SME context. The exploratory case helped to refine and focus the research questions for the next phase (Rowley, 2002). In the second phase, we theoretically selected 12 further cases, which we analysed using a comparative case study methodology to test, replicate and extend the emergent constructs, derived from the findings of the exploratory case (Dimov, 2011; Eisenhardt, 1989; Eisenhardt & Graebner, 2007; Leonard-Barton, 1990). Analysing multiple cases helped us to create a more robust and broad understanding of the international opportunity recognition process. Our understanding of the process was grounded in varied empirical evidence (e.g. life science SMEs which were engaged in activities varying from the early-stage R&D SMEs, to those involved in primarily commercialisation) (Eisenhardt & Graebner, 2007). The following sections provide a

detailed description of the two phases of data collection and analysis which we followed during this study.

3.2 Phase 1: Research approach and design

In the first phase, we used a single, exploratory case to understand how technological and market knowledge was acquired by life science SME owners/managers, during the process of international opportunity recognition. This research design was motivated by similar studies which used qualitative, single case settings to uncover empirical evidence of networking capabilities (Kaartemo *et al.*, 2019), and experiential learning (Bunz *et al.*, 2017). We applied their methods of data collection to our study. These included interviews, observations and archival documents provided by the case firm. Similar to studies undertaken by Bunz *et al.* (2017) and Kaartemo *et al.* (2019), we used an inductive, exploratory case design, given the lack of empirical evidence in our area of study (Bunz *et al.*, 2017; Eisenhardt, 1989; Kaartemo *et al.*, 2019; Yin, 2013). This approach enabled us to understand the micro-foundations of the international opportunity recognition process, within the life science SME context (Kevill *et al.*, 2017; Welter, 2011). A more inductive approach also encouraged us not to over-rely upon organisational level theories, which prevail in the existing literature (McMullen & Shepherd, 2006). Our sampling criteria were owners/managers who worked in;

- 1) A SME- by EU definition, less than 250 employees and a turnover of less than of less than 50 million euros
- 2) The organisation was regarded as being within life science sector
- 3) The organisation was UK based and worked internationally

Having identified our research focus as exploring the micro-foundations of the international opportunity recognition process, we selected our case using convenience sampling. Attending a life science orientated network event helped us to identify a suitable case. Attending the event provided us with a preliminary understanding of how life science SMEs may recognise international opportunities in context (Welter, 2011). In addition, it highlighted how owners/managers of life science SMEs leveraged networking events. For example, to present technological findings, and promote their company. Attending the event allowed us to familiarise with the types of issues life science SME owner/managers typically face when working internationally.

3.2.1 Research setting

The selected case organisation, Plant Co, is a UK based micro life science SME, employing five people. It is specialised in the niche area of plant chemicals. Plant Co emerged as an outcome of a research project in a UK university, sponsored by a large pharmaceutical company in 1999. Specialising in isolating unique molecules and compounds, which have potential applications in pharmaceutical, food and cosmetics, Plant Co provides service work for industry and academia on an international scale. Service work is the main source of income. The development of intellectual property (IP) through patenting unique extracts and potential for establishing royalty agreements, especially with larger companies, are also central activities. Owner/manager A at the time of the study was also interested in developing a product side of the business, particularly in the USA, using his existing contacts.

3.2.2 Measures, level and unit of analysis

How owners/managers acquired specialised knowledge, during the process of international opportunity recognition, by leveraging their human and social capital, is the focus of this research (Dimov, 2011). Capabilities were identified through the routines and patterned activities enacted by owners/managers (Easterby-Smith *et al.*, 2009; Eisenhardt & Martin, 2000; Winter, 2003; Zahra & George, 2002; Zollo & Winter, 2002).

In order to identify the micro-foundations underpinning the opportunity recognition process, interview questions centred on what life science SME owners/managers did to recognise opportunities internationally. Human capital was measured by understanding the perceived skills, knowledge and experience of owners/managers and how this helped them to recognise opportunities for international expansion. Similarly, social capital was measured through understanding the types of relationships which were leveraged e.g. strong or weak ties, with who (e.g. other small business owners), the perception of shared visions and goals, and the nature of these relationships (e.g. trust). The life science SME owner/manager was selected as a key informant as he was identified as the individual central to the international opportunity recognition process (Bryman, 2012). This research used both primary and secondary sources of data.

Similar to the approach used by Kevill *et al.* (2017) and Bunz *et al.* (2017), primary sources of data included semi-structured interviews, unstructured interviews and observations of meetings with a business representative and an international partner. Secondary sources of data included documents provided by the focal firm (Rowley,

2002). Documents such as business plans, research proposals, compound libraries, structure reports and documents distributed at network events were used for triangulation purposes.

3.3 Data collection

Data collection lasted for approximately 5 months, spanning from February to June 2015. This approach showed international opportunity recognition as a managerial process (Bryman, 2012; Yin, 2002). This enabled a deeper understanding of how technological and international market knowledge was developed through leveraging cognitive and networking capabilities, during this process. This approach also helped to establish a time order of the process of international opportunity recognition (Bryman, 2012; Bunz *et al.*, 2017).

The primary sources of data were semi-structured, tape-recorded interviews with SME life science owners/managers (see Appendix 1). Interview questions included prior experiences internationally, academic qualifications, how they perceived international opportunities and the extent of current international activities. Semi-structured interviews were chosen as they permitted dialogue to be steered in the direction of the international opportunity recognition process. Owners/managers provided us with verbal descriptions of their intended actions, and shared their visions of their future outcomes (Dimov, 2011). This helped us to understand how the owner/manager generated and modified ideas, within the context. Interview questions were guided by existing literature, providing a firm empirical base for extending our understanding of the international opportunity recognition process (Eisenhardt, 1989).

Open-ended interviews were also used. These were conversational in style and took place in the lab whilst owner/manager A was analysing molecules and in the office with the sales manager whilst they were following up contacts and researching up and coming network events. Collecting data in this way allowed owners/managers to speak freely about the topic to generate more detail (Gilmore *et al.*, 2001). Interviews lasted approximately 1 hour and all were undertaken on-site. Questions evolved as issues specific to the research topic became clearer through data collection (Donnelly, Simmons, Armstrong & Fearne, 2012).

A total 9 trips, totalling 18 hours 45 minutes of observations and interviews, were made on-site, creating approximately 200 pages of transcript in total. Table 2 provides an overview of the data sources used. A total of 10 interviews and casual conversations, from two informants, owner/manager A and the sales manager were conducted. Seven interviews were tape recorded and transcribed and three of which were recorded as personal research notes (approximately 20 pages).

Interviews were structured into three rounds. The first round involved preliminary data collection and sought to establish the international opportunity recognition process. The second round, refinement, sought to enhance the understanding of the international opportunity recognition process, through tracking the progress of potential opportunities. Lastly, round three, sought to validate researcher findings. Interviews recorded by notetaking were analysed alongside tape-recorded transcripts. Interviews were both semi-structured (tape-recorded) and also open and conversational in style (not tape-recorded), enabling a deeper understanding

of the activities involved in international opportunity recognition within the context (Eisenhardt, 1989).

Owner/manager A found that he had many valid and useful technological ideas for innovation, but found it challenging to translate these innovations into a valuable market product. He asked a business advisor from a local governmental body to meet with him in order to try and help to commercialise some of his technology. We were invited to attend three of these meetings. This helped us to understand why the owner/manager A acted in a particular way e.g. to access specialised market knowledge (Dimov, 2011). This enabled us to observe how the domains of specialised technological and specialised market knowledge came together during the process of international opportunity recognition. In addition, this helped us understand how owner/manager A formed relationships, and the implications of these relationships in opportunity perception and modification, in the life science SME context (Dimov, 2011).

Owner/manager A discussed his technology and where he thought potential for an international market product and entry was. The business advisor was able to shed light upon modes of international market entry, and the inherent advantages and disadvantages of entering particular international markets (e.g. African markets). We were also invited to attend a conference call to an international partner. This was a technology-based partnership where both companies were analysing molecules and working with a larger partner. They discussed their findings and issues they had with isolating certain extracts and planned for next steps, in order to finish the project.

In addition to tape-recorded interviews, informal interviews and tape-recorded meetings, documents and personal research notes all formed the corpus of data

(Eisenhardt, 1989; Kevill *et al.*, 2017). The official company website and documents provided by the case organisation (46 pages in total), such as research proposals, business plans and information disseminated at tradeshow, abstracts and technical data such as compound libraries and a company profile provided at a business conference were used (Rowley, 2002). A summary of the data sources are shown in table 2. This, as well as the involvement of multiple informants, helped to further triangulate the data (Eisenhardt, 1989; McKeever, Jack & Anderson, 2015) and provide more details about how owners/managers recognised opportunities internationally (Eisenhardt, 1989).

Table 2: Sources of data: Exploratory case

Round of collection/date of collection	Sources of data	Type of data	Objective of data collection
Round 1: Preliminary data collection (initially establish the opportunity recognition process)	Attendance at workshop	<ul style="list-style-type: none"> • Presentations and networking event directed at life science companies 	<ul style="list-style-type: none"> • Provide overview of how life science SMEs network using events, present findings and company, types of issues they typically face when working internationally
	Archival	<ul style="list-style-type: none"> • Documents distributed at network events 	<ul style="list-style-type: none"> • Provide an introduction to owner/manager A, their research interests and an overview of the aims of the company
	Personal research notes	<ul style="list-style-type: none"> • Personal research notes 	<ul style="list-style-type: none"> • Helped to organise and track descriptive information e.g. research setting, date, time, actions and behaviours observed • Record reflective information e.g. thoughts, ideas, questions, insights and thoughts
On site visit 1: 03/02/2015	Interviews	<ul style="list-style-type: none"> • Interview with owner/manager A • One interview 	<ul style="list-style-type: none"> • Provide overview of company and primary international projects, owner/manager background
	Personal research notes	<ul style="list-style-type: none"> • Personal research notes 	<ul style="list-style-type: none"> • Track research setting, date, time, actions and behaviours • Reflective information, thoughts, ideas, further interview questions
On-site visit 2: 19/02/2015	Interviews	<ul style="list-style-type: none"> • Interview in the lab with owner/manager A • Informal conversation in office with owner/manager B • Two interviews 	<ul style="list-style-type: none"> • Familiarise with daily activities of the company • E.g. how owner/manager A identifies new molecules in the lab/orders inventory • E.g. how owner/manager B uses e-mail to keep in contact with other SMEs
	Corporate archive	<ul style="list-style-type: none"> • Business plan 	<ul style="list-style-type: none"> • Brief plan of future goals e.g. to better develop product messaging (effective product names and benefits of products), who are the key audiences to

		<ul style="list-style-type: none"> Research proposal (A) 	<p>influence e.g. distributors/investors, how to develop marketing and company website</p> <ul style="list-style-type: none"> Highlights health benefits already known about an organic component, but argues that the compounds identified by the company may be responsible for clinical effects
	Personal research notes	<ul style="list-style-type: none"> Personal research notes 	<ul style="list-style-type: none"> Capture views of owner/manager B Track research setting, date, time, actions and behaviours Reflective information, thoughts, ideas, further interview questions
On-site visit 3: 24/02/2015	Interviews	<ul style="list-style-type: none"> Interview with owner/manager A One interview 	<ul style="list-style-type: none"> How the owner/manager works internationally with partners
	Corporate archive	<ul style="list-style-type: none"> Research proposal (B) Research proposal (C) 	<ul style="list-style-type: none"> Draws upon historical applications of plant compounds, highlighting that little is known about specific active compounds (proposed area of research) Provides a summary of preliminary scientific findings, how these could be widely adapted to new health benefitting applications. Proposed further research in this area with a view to potential IP development, licensing and future joint venture partnerships
	Meetings	<ul style="list-style-type: none"> Meeting between owner/manager A and international partner 	<ul style="list-style-type: none"> Progress of joint research project Interpretation of technological data, potential health benefits and international market entry Potential of IP generation and ownership
	Personal research notes	<ul style="list-style-type: none"> Personal research notes 	<ul style="list-style-type: none"> Track research setting, date, time, actions and behaviours Reflective information, thoughts, ideas, further interview questions
Round 2: Refinement (refine	Interviews	<ul style="list-style-type: none"> Interview with owner/manager A One interview 	<ul style="list-style-type: none"> Progress of international opportunities

understanding of international opportunity recognition process) On-site visit 4: 06/03/2015	Meetings	<ul style="list-style-type: none"> Meeting between owner/manager A and business advisor 	<ul style="list-style-type: none"> Clarify business strategy, discuss potential opportunities and directions the company could take
	Personal research notes	<ul style="list-style-type: none"> Personal research notes 	<ul style="list-style-type: none"> Track research setting, date, time, actions and behaviours Reflective information, thoughts, ideas, further interview questions
On-site visit 5: 12/03/2015	Interviews	<ul style="list-style-type: none"> Interview with owner/manager A Informal conversation with owner/manager B Two interviews 	<ul style="list-style-type: none"> Role of networks in recognising opportunities Progress of international opportunities
	Personal research notes	<ul style="list-style-type: none"> Personal research notes 	<ul style="list-style-type: none"> Capture views of owner/manager B Track research setting, date, time, actions and behaviours Reflective information, thoughts, ideas, further interview questions
On-site visit 6: 16/03/2015	Interviews	<ul style="list-style-type: none"> Interview with owner/manager A One interview 	<ul style="list-style-type: none"> Progress of international opportunities
	Meetings	<ul style="list-style-type: none"> Meeting between owner/manager A and business advisor 	<ul style="list-style-type: none"> Regulation in international markets, sourcing reliable supplies of product
	Personal research notes	<ul style="list-style-type: none"> Personal research notes 	<ul style="list-style-type: none"> Track research setting, date, time, actions and behaviours Reflective information, thoughts, ideas, further interview questions
On-site visit 7: 30/04/2015	Meetings	<ul style="list-style-type: none"> Meeting between owner/manager A and business advisor 	<ul style="list-style-type: none"> Potential international marketing strategies Potential partnerships to facilitate marketing strategy
	Personal research notes	<ul style="list-style-type: none"> Personal research notes 	<ul style="list-style-type: none"> Track research setting, date, time, actions and behaviours Reflective information, thoughts, ideas, further interview questions

On-site visit 8: 11/06/2015	Interviews	<ul style="list-style-type: none"> • Interview with owner/manager A • One interview 	<ul style="list-style-type: none"> • Progress of international opportunities
	Public domain	<ul style="list-style-type: none"> • Company website 	<ul style="list-style-type: none"> • Introduction to company, research interests, services provided, news, contacts and applications of research e.g. pharma, cosmetic
	Corporate archive	<ul style="list-style-type: none"> • Structure report and supplementary materials • Compound libraries • Summary of services 	<ul style="list-style-type: none"> • Structure report of organic compounds. Highly scientific report on methodology used to identify compounds within specific organic compounds • Summary of compound libraries. Highlights the non-commercially available compounds, which the company have discovered. Multiple charts and tables demonstrating structural elements of compounds, including compound number, therapeutic area, assay type and plant source • Services available to industry and academia. This includes quantitative analysis, impurity analysis and structural elucidation, for example
	Personal research notes	<ul style="list-style-type: none"> • Personal research notes 	<ul style="list-style-type: none"> • Track research setting, date, time, actions and behaviours • Reflective information, thoughts, ideas, further interview questions
Round 3: Validate findings On-site visit 9: 15/02/2017	Interviews	<ul style="list-style-type: none"> • Interview with owner/manager A • One interview 	<ul style="list-style-type: none"> • Review researcher findings • Progress of international opportunities e.g. status of IP ownership
	Corporate archive	<ul style="list-style-type: none"> • Document distributed at network events 	<ul style="list-style-type: none"> • Showcases area of technological interest of the company and potential health benefits
	Personal research notes	<ul style="list-style-type: none"> • Personal research notes 	<ul style="list-style-type: none"> • Capture views of owner/manager A • Track research setting, date, time, actions and behaviours • Reflective information, thoughts and ideas.

3.4. Data analysis: Thematic analysis

Thematic analysis was used to develop a framework of understanding derived from the empirical data (Braun & Clarke, 2006; Bryman, 2012). Existing literature helped to guide the analysis of collected data (Eisenhardt, 1989; Eisenhardt & Graebner, 2007). We followed Braun & Clarke's (2006) 6 step approach to thematic analysis. This enabled us to identify patterns and themes within the qualitative data (Eisenhardt & Graebner, 2007). Firstly, we became familiar with the data through transcribing all interviews and tape-recorded meetings. This was followed by reading through all the materials (interviews, meetings, personal research notes, official company web pages and documents provided by the focal organisation).

Secondly, initial, first order codes were created (Braun & Clarke, 2006; Bryman, 2012). Coding was guided by existing literature on international entrepreneurship (Eisenhardt, 1989). This involved iteratively comparing codes emerging from the data (for example, purposeful search, serendipity and emergence) to those derived from extant literature (Eisenhardt, 1989; Hannah & Eisenhardt, 2018).

Thirdly, we searched for themes as we noticed relationships between the first order codes. This led to the creation of overarching second order analytical themes. As a series of second order analytical themes were created, broad themes could be established to link these second order analytical theme together. This led to the creation of a conceptual framework comprising of three main phases: scanning, sensemaking and selection, illustrating how the process of international opportunity recognition takes place (McKeever *et al.*, 2015). Themes were iteratively reviewed. This involved going

back to the data and comparing our emerging themes with existing literature (Eisenhardt & Graebner, 2007; Hannah & Eisenhardt, 2018). This process also helped to define and name themes. Finally, the framework was reviewed by owner/manager A to ensure a recognisable representation of the process was created and the findings were written up. Table 3 below shows the progression of first order codes, to the establishment of second order analytical themes leading to the three main aggregate themes of scanning, sensemaking and selection.

Table 3: Analytical themes and coding: Exploratory case

Theme	Second order analytical theme	First order code	Illustrative quotes
Scanning	- Alertness	Purposeful search	... the business is about...finding new compounds (T7)
		Emergence (e.g. uncertainty in experimentation)	... the funny thing is that this extract does the opposite to what [extract A] does (T2)
		Differentiate (e.g. question antioxidants)	We are trying to do things in a different way (T1)
		Opportunistic	We are a little bit too opportunistic and actually that means when you have a good idea, but then something else comes along, which seems a better idea (T4)
	-Pre-existing market knowledge	Previous experience	I have been learning these [legal] things over time, all these types of things (T3)
		Health trends	A lot of it's based on things we might hear on the television for example or we read on the internet about some herbal medicine, that's supposed to be good for treating something (T1)
	-Pre-existing technological knowledge	Academic background	My background was as an academic researcher (T1)
		Identify gap in scientific knowledge	Our analytical skills to identify ingredients and compounds is unique and unparalleled (web 7)
		Scientific publications	The identification of [extracts] is difficult and has only been understood by a limited number of researchers (web 5)
		Traditional applications	Many natural ingredients used in cosmetic products have roots in traditional medicinal plant uses (web 3)
	- Proactive search	Presentations (targeted and non-targeted)	... in fact we are meeting with [large company] at their base to talk about how we might help them with other products (T6)

	Proposal submissions	... we've just put in a proposal ... to get some money to develop some compounds (T6)
- Serendipity encounters	Existing internal and external networks Unplanned encounters (e.g. at network events)	... people hear me talk or they already know about me or they talk to someone else and that's really what we've been, where the service work has been coming from (T3)

Theme	Second order analytical theme	First order code	Illustrative quote
Sensemaking	<ul style="list-style-type: none"> - Discussions with business advisor - Strategic fit/uncertainty reduction 	Business plans	I fished out one of our old business plans, although it doesn't go into a lot of detail (T5)
		International market entry	... outside Europe you could probably, in lots of parts of the world you can sell it as a capsule (T5)
		Potential investment opportunities	... when you make that decision new probably need to stick to it, it is worth going back to fundamentals (T5)
		Regulations	... the claims you make are very different (T6)
		Technology (e.g. provide overview of scientific findings)	... so we've also been looking at this stuff ... we've found some interesting [compounds] in there, including a compound we've already got some patents on (T6)
		Supply chains	... the main problem is getting a reasonably priced supply (T5)
		New networks emerge	... you are more than welcome to go and have coffee with the guy I was talking to (T5)
	- Discussions with existing and prospective partners (SMEs, larger companies and Universities)	Regulatory requirements	... maybe we'll be selling stuff into the United States where you can make claims much more readily (T1)

- Strategic fit/uncertainty reduction	Knowledge of competitors	This is the problem, particularly if you try selling, because there are some big players in this area and you may want to sell your extract that's improved to them, but they may already have an extract they are selling (T1)
	Target international market (not UK)	... selling in Europe with claims is much more difficult than the US so, you could probably sell all of it in the US (T6)
	Understanding of technology (larger companies)	... the pharmaceutical company also say that they have no experience of these types of things and that is seen as a problem for them (T3)
	Deadlines for project submission (missed by partner)	I am coming to the feeling that the European company is just not going to come up with the required information quick enough (T2)
	Leveraging partner knowledge and resources	I mean [individual A] will have much more experience of what the market accepts for an extract (T2)
- Prior experience	Trust (past experience and experience of others)	What we've also learnt from the past is that we need to get money upfront (T7)
- Pattern recognition	Matching technology and application in an international market context (e.g. Europe, USA)	... there is a much bigger interest in active ingredients than there used to be (T7)
- Opportunity level characteristics	Window of opportunity	... timing is kind of important but sort of leading the way rather than following. If you are following then timing is probably more important (T7)
	Exit potential	that is always one of the exit strategies for any company, especially small companies you sell it to some bigger one to actually get something back (T2)

Theme	Second order analytical theme	First order codes	Illustrative quote
Selection	-Pursue	Survival (e.g. brings in cash immediately)	... it's not really the type of work we want to be doing but it brings in some cash (T3)
	-Reject	Misalignment (customer/supplier/partner)	I am coming to the feeling that the European company is just not going to come up with the required information quick enough (T2)
		Spread too thin	... we just aren't enough people we could do all the things we are doing but there just aren't enough people to do it properly without sort of influencing negatively other things we want to do which could be part of the bigger picture (T4)
	-Refine	Return to opportunity at later date	Some projects have been shelved as not bring in money or lack funding to develop further (Researcher deduction 3)

3.5 Phase 2: Research approach and design

In the second phase, we used a deductive approach, drawing upon the findings from the first phase, the exploratory case. In order to build a process model which would be applicable to various life science SMEs, we theoretically selected 12 organisations within the life sciences, in addition to the in-depth exploratory case organisation (Dimov, 2011). This approach was used as the life science sector is made up of many firms, which specialise in either R&D activities (early-stage SMEs) or commercialisation (later stage SMEs). Our research centred upon understanding the nuances between how owners/managers of early and later stage life science SMEs leveraged their human and social capital to acquire and develop specialised knowledge, during the process of international opportunity recognition. In order to further explore this question, we firstly, selected life science SMEs that entered international markets through leveraging technological-based partnerships, which were engaged in the early stages of R&D. Secondly, our sample included life science SMEs in the later stages of commercialisation, who leveraged principally distributor networks. By including life science SMEs which undertook different specialised activities, we were able to create a more robust theoretical framework (Eisenhardt & Graebner, 2007). Table 4 below shows the demographic characteristics of the owners/managers and the firms of the 12 selected cases.

Table 4: Demographic characteristics of 12 selected cases

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
Position	Founders	Founder	Founder and sales director	Founder	CTO	CEO	CEO	CEO	Commercial Director	Director	CEO	Founder
PhD in Scientific discipline	Yes	Yes	No	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Prior experience	Large pharma company	Large/SME consultancy firm	25 years industry / non-life science company	2 years – large company/ 15 years SME	30 years-large company	20+ years	Extensive	20 years – large company	20+ years	Consultancy firm	18 years – large pharma company	Life science SMEs
Date SME founded	2014	2011	2010	2002-2012	2006	2015	2010	2015	2010	2012	2011	2016
Early-stage (R&D focused)	X							X		X	X	X
Later stage (Commercialis e products and/or services)		X	X	X	X	X	X		X			
No. of Employees	1.6	2	5	70	19	3	10	30	15	3	10	6
Principal international markets	Europe, USA, India, China	Europe, Canada	Japan, China	Europe, USA, Scandinavia	Japan, China, USA	Europe	USA, Germany	China, USA, Europe	USA, Europe, Scandinavia, Canada, Singapore	Europe, USA	Europe, USA, India	Singapore

Principal entry mode	P	D/E	D	E	E	E	D	P	E	P	P	P
Type of technology	Develop drugs	Medical devices	Extracts	Micro technology	Micro technology	Drug discovery	Medical devices	Biotech	Biotech	Develop drugs	Develop drugs	Biotech

E=Export

D=Distributor

P= Partnerships. (Partnerships are established with scientific experts/clinicians/ Contract Research Organisations and universities in order to access specialised technological knowledge)

3.5.1 Measures, level and unit of analysis

How owners/managers acquired specialised knowledge during the process of international opportunity recognition, by leveraging their human and social capital, was the focus of this research. In order to identify the micro-foundations which underpinned the opportunity recognition process, interview questions included what life science SME owners/managers did to recognise opportunities internationally. Life science SME owners/managers were selected as a key informants as they were central to the international opportunity recognition process (Bryman, 2012). Semi-structured interviews (Bryman, 2012) were the method of data collection. This research focused upon the managerial level.

This involved identifying the mechanisms underpinning life science SME owner/manager human and social capital. Similar to the previous section, human capital was measured through owner/manager perceptions of their skills, knowledge and experience useful to working internationally. In addition, social capital was measured through understanding the type of relationships, the nature of these relationships, perception of shared visions and goals. Capabilities were identified through the routines and patterned activities reported by owners/managers (Easterby-Smith *et al.*, 2009; Eisenhardt & Martin, 2000; Winter, 2003; Zahra & George, 2002; Zollo & Winter, 2002).

3.6 Data collection

Semi-structured interviews were the method of data collection. This allowed owners/managers to speak freely about the topic to generate more detail, whilst understanding how they recognised opportunities to enter international markets from their perspective (Gilmore *et al.*, 2001). A total of 14 owners/managers participated in interviews, from 12 life science SMEs (see table 4). Interview questions were defined a priori, influenced by existing literature. This provided a firm empirical base for extending our understanding of the international opportunity recognition process (Eisenhardt, 1989). Most interviews lasted approximately 1 hour and were undertaken on site or by phone due to owner/manager time constraints. This created approximately 152 pages of transcripts. Interview questions included prior experiences internationally, academic qualifications, how they perceived international opportunities and the extent of current international activities. Key questions were asked such as 'explain the process you go through to recognise opportunities to work internationally'. Appendix 2 provides an example of the interview guide used.

We selected our cases using theoretical sampling. The selection of multiple cases within each category, (SMEs in the early and later stages) enabled us to replicate the findings in each category. We maximised the variety of firms in this sample in terms of mode of international market entry (e.g. early-stage SMEs which internationalise through leveraging university partnerships, later stage life science SMEs which internationalise through leveraging distributor networks). As suggested by Dimov (2011), each owner/manager provided us with a story about their opportunities within the life science context. This enabled us to identify significant patterns within our data.

The selection of multiple cases also helped us to enhance the generalisability and robustness of the process model we developed, as it was grounded in varied empirical evidence (Eisenhardt, 1989; Eisenhardt & Graebner, 2007; Leonard-Barton, 1990). The selection of multiple cases within the context of the life science sector is particularly relevant, as the industry itself is comprised of complex, interdependent networks which provide R&D, innovation and add value to products.

The inclusion of diverse cases provided a snapshot into the human and social capital leveraged by owners/managers and the type of knowledge acquired, as the nature of their business (e.g. early and later stage SMEs) and modes of international market entry varied. As noted by Jones *et al.* (2011b), new ventures in life sciences are difficult to find using databases, coupled with high mortality rates of established life science SMEs, firms were primarily identified through innovation centres and owner/manager contact networks.

3.7 Data analysis

In the second phase, we organised our findings according to the predetermined conceptual frame, derived from the findings in the exploratory case. This deductive approach enabled us to test the pre-determined process model derived from the findings of the exploratory case (see tables 6 & 7). The analysis of the data within the second phase was formed of two elements.

Firstly, we conducted a within case analysis, elaborating short case descriptions for each of the cases, and then a cross case analysis (Hannah & Eisenhardt, 2018). (See appendix for further details). Undertaking a within case analysis enabled us to identify the unique patterns of each case, before generalising the patterns across cases

(Eisenhardt, 1989; Eisenhardt & Graebner, 2007). This enabled us to gain a rich familiarisation with each case, which helped to accelerate the comparison across cases (Eisenhardt, 1989).

Secondly, a cross-case analysis was undertaken. This approach clearly displayed various cases and the micro-foundations of the international opportunity recognition process that were used to acquire specialised knowledge in each phase, and across different firms (early and later stages). We then identified within group similarities and intergroup differences as suggested by Eisenhardt (1989). This enabled the identification of similarities, in the managerial capabilities, which were leveraged to acquire knowledge across the cases. Comparing and contrasting multiple cases helped to extend and replicate the patterns of the constructs, relationships and logic derived from the empirical findings (Dimov, 2011; Eisenhardt, 1989; Eisenhardt & Graebner, 2007; Rowley, 2002). Undertaking this analysis enabled us to create a reliable understanding of the international opportunity recognition process, which is closely related to the data (Eisenhardt, 1989).

Despite some differences emerging from the exploratory case, SMEs in early and later stages, we uncovered similar patterns and relationships in understanding international opportunity recognition as a process (Eisenhardt, 1989; Eisenhardt & Graebner, 2007). This provided us with firm base for extending our understanding of the international opportunity recognition process, and helped to re-enforce the overarching themes of scanning, sensemaking and selection, as being valid constructs in the process of international opportunity recognition (Eisenhardt & Graebner, 2007). (See appendix 3 for further details).

Table 5: Analytical themes and coding: Early-stage SMEs

Theme	Second order analytical theme	First order codes	Illustrative quote
Scanning	Alertness	Customer need/problem	The market as we define it is often the unmet medical need (C11)
		Emergence	... you come across and opportunity you didn't know was out there (C8)
		Creation	I'd like to think that we create opportunities (C11)
		Purposeful search	... but let's say that there's a particular thing we were looking to do or looking to achieve then the first thing is really to have a business development plan (C8)
	Pre-existing technological knowledge	Scientific literature	... you can come across something either in the media or the scientific literature that seems interesting or useful (C12)
		Academic background (PhD)	I've got a PhD ... in cells (C11)
	Pre-existing market knowledge	Databases/ desk research	... pure desk research just to find out who what when where, when we got a short list of potential locations (C10)
		Previous experience	... worked in large company in the US for several years and getting that international experience helps understand the good side of collaborating across borders and some of the challenges (C11)
	Networking	New and existing networks (e-mails/phone calls)	... these days it's all through talking to people, talk through interaction, talks to colleagues ex-colleagues business contacts people who you've been introduced to (C8)
		Attending conferences	... we stepped into a collaboration that comes out of happening to meet someone at a conference (C11)

Theme	Second order analytical theme	First order codes	Illustrative quote
Sensemaking	Discussions with		
	- Board members/ academics/clinicians	Provide expertise in niche scientific area/ prioritise/strategize	... we do have a scientific advisory board that's international so they are people again that are high level academics, clinicians that consult back into the company (C1)
	- End user customers/investors	Source funding	... we are funded by our customers which is where it is unusual (C12) ... we have to think very carefully about whether or now we can really afford to do something an even if we generate that data is that going to be good enough to get an external, to convince an external investor to actually believe in it with us and take it further (C1)
	Discussions with existing and prospective partners		
	- Universities	Leverage technological knowledge/Provide expertise in niche scientific area	I'm working with 4 overseas universities, on various research programmes of one sort or another (C10)
	- SMEs	Service provision (technological expertise)	We do a hell of a lot of work with other small companies, a lot of the small companies that we work with provide us with extra specific power when we need it (C11)
		Access to research funding	Yea, we do work with several but I try to limit working with other small companies to things that we can do together under research funding (C10)
	- Larger companies	Clinical trials	... our clinical trials are being run by a large international company (C11)
		Regulatory requirements	... a large interest partner, you know they need to have a series of wards that they can treat patients in, they need to have all of the appropriate paperwork behind the scenes (C11)
		Establish working relationship and potential customers	... large pharmaceutical companies who have the money to conduct the really big clinical studies, so it is a question of who is likely to be interested

			in purchasing those types of ... who will be wanting to have those sorts of assets within their portfolio within the next 2-5 years (C1) In the past when I've worked with them it's to sell a technology to them so it's a kind of one off interaction rather than an ongoing interaction (C12)
- Strategic fit	Technological and business fit		Well first and foremost is alignment with any contract, whether it be a research collaboration with a university, a supply from a provider or joint venture deal (C8)
- Uncertainty reduction	Due diligence		... do your homework and due diligence just to make sure what they tell you is correct (C12)
	Pursue multiple programs (C1)		... the way the we defrayed that risk was by having multiple programs (C1)
	Awareness of outside market (C8)		... you know what's happening in the outside markets so you can evaluate what risk the company is carrying vs the opportunities for exit (C8)
- Existing market knowledge	Previous experience		... so part of it is experience I think in business development (C8)
- Pattern recognition	Matching technology and customer need		... when you talk to people who have got experience in the industry you can see it in their face they think this is something, it makes sense (C12)
- Opportunity level characteristics	Window of opportunity		... you tend to find the marketplace and therefore peoples willingness to invest is somewhat trend driven... in two years' time that might have changed (C1)
	Exit potential		... our business is IP generation and then sale (C8)

Theme	Second order analytical theme	First order codes	Illustrative quote
Selection	- Pursue	Practical Profitable Self-select	It comes down to a combination of practicality and profitability, there is absolutely no point in selecting an opportunity that isn't practical to deliver (C11) Self-select, if you do this analysis it becomes obvious (C12)

Table 6: Analytical themes and coding: Later stage SMEs

Theme	Second order analytical theme	First order codes	Illustrative quote
Scanning	Alertness	Customer need/ problem	We saw we could make a social contribution the products we were developing for healthcare met a strong social need (C4)
		Emergence	... small companies have to react, if you don't react, it's your strength, if you don't react to an opportunity you are dead (C2)
	Pre-existing technological knowledge	Scientific literature and conferences	... one of my jobs is to keep abreast of the new papers that come out (C3a)
		Previous experience (career path)	I spent 30 years in a large company. I did a PhD, did a post doc ... then I joined the large company, on the management training scheme (C5)
	Pre-existing market knowledge	Databases	We do have our fingers on the pulse in terms of and again [database] gives us a lot of information about where the growth is (C3a)
		Previous experience (career path)	I used to work in an R&D company (C3a)
	Networking	New and existing networks	Our focus is on, it would tend to be conferences where we know people who are in the industry (C6)
		Conferences/phone calls/ tradeshow/ presentations (C6)	They went to a European tradeshow and from that they got interest from a Chinese company (C5) If I go back to an opportunity pipeline, in our head it is our interaction with the customer through presentations (C6)
		Visits on site to potential customers (C3 and C9)	... their R&D teams who are based in France and more of their manufacturing teams are based in the US on an international basis, talking to both of them, visiting both sites and developing a relationship (C9)

Theme	Second order analytical theme	First order codes	Illustrative quote
Sensemaking	Discussions with existing and prospective partners		
	- Universities	Leverage technological knowledge/ provide expertise in niche scientific area	... you need to reach back into academia and into other small businesses to pull together the bits that you have selected as being optimal, to satisfy the customers' needs (C4)
	- SMEs	Service provision (manufacturing, technological expertise, product enhancement)	... if we want the product enhancement, something the product doesn't have today, or we have to test it to prove that it does such and such a thing you go to a small company who does testing or indeed development and they would do that work for us (C7)
	- Larger companies	Regulatory requirements	... we've picked a 500 billion a year wound care company to distribute our product in Mexico, so they would have in-depth knowledge of how to get through the very contorted approval process that will allow your product onto the market (C7)
		Knowledge transfer/ Establish working relationship and customers	They may also be looking for services so they may be in the drug industry , a research, it can either be a product, research something medicinal or it might be can we work together to see if we can come up with a protocol to make a certain type of cell (C6)
	- Distributor networks/ export to end users	Leverage skills to overcome language and cultural business challenges	If I take Japan as an example, you've got both language challenges and cultural business challenges in there, as a small company we can't put a huge amount of resources into that, so we will find a representative or a distributor in japan, who will find customers for us and they will handle orders on our behalf (C9)
	- Strategic fit/ uncertainty reduction	Technical/business fit	The main thing is a combination of either the right type of customer we are targeting and it's a technical fit really (C6)

		Trust	Well preferably a well-known company, somebody with an international brand that we would be aware of or trust, if you like (C9)
		Discussion with board/investors	... we made sure we had good advisors so that we didn't stumble when it came to regulatory affairs (C3a)
	- Existing market knowledge	Previous experience	... experience helps you to identify is this going anywhere (C5)
	- Pattern recognition	Matching technology and customer need	... if you can provide something that for them [the customer] is an opportunity, then have you as the potential supplier, then that is the opportunity, and then at that point, the technology kicks in (C4)
	- Opportunity level characteristics	Window of opportunity	... for us windows of opportunity are not really that important compared to just doing good business (C5)
		Exit potential	... at some stage it could be that one of those bigger companies decide they want to buy us but that is not something we are actively targeting (C5)

Theme	Second order analytical theme	First order codes	Illustrative quote
Selection	- Pursue	Size of potential market	... we look at market trends, this database is absolutely central to our business everything we do is more or less as a result of the information we are getting from the database (C3a)
		Repeat sales	Its easiest with the customers that are already in place (C5)

3.8 Ethical considerations

All interviews were undertaken following the ethical code of conduct outlined by the university. This involved making all participants aware that they were participating in data collection for a PhD thesis. An overview of the main aim of research, in this case how owners/managers of life science SMEs recognise opportunities to work internationally, was highlighted. Sensitive details, such as the names of individuals participating, companies or other institutions which the participant interacted with were anonymised and made non-traceable. This ensured that there would be no prejudice against the participatory organisations, individuals or affiliated institutions. Participants were made aware and asked permission for interviews to be tape-recorded. When participants declined to be tape recorded, notes were taken.

3.9 Reflection on method

This research followed a qualitative, case-based approach (Bryman, 2012; Bunz *et al.*, 2017; Eisenhardt, 1989; Yin, 2013), providing insights into the role of dynamic managerial capabilities in international opportunity recognition, within a UK based life science SMEs. As we included multiple cases to extend our understanding of the international opportunity recognition process, we could draw upon the replicated relationships which were apparent in most of the cases (Eisenhardt & Graebner, 2007; Rowley, 2002). This approach ensured we could create an understanding of the international opportunity recognition process, which was more robust and generalizable to the life science sector (Dimov, 2011). To a certain extent our findings are also generalizable to all owners/managers, as they also scan, make sense of and select opportunities (Balogun & Johnson, 2004).

Our research design was informed by existing studies, which used qualitative, single case settings (Bunz *et al.*, 2017; Kaartemo *et al.*, 2019). In addition, qualitative studies in international entrepreneurship literature helped to loosely guide the types of questions posed to owners/managers (Eisenhardt, 1989; McKeever *et al.*, 2015). This helped to ensure validity in the findings. A thematic approach to data analysis was guided by existing literature (Bryman, 2012). Data collection and analysis were challenging, demanding time and re-configuration to permit the categories to fit together coherently, whilst providing insight into the capabilities involved in knowledge acquisition in each phase of the process.

In order to further ensure trustworthiness and credibility of data collection, key principles were adhered to in order to ensure the quality of qualitative data collection (Eisenhardt, 1989; Yin, 2013). Validity was ensured through triangulation of multiple sources of information (interviews, observations, personal research notes and documents provided by the organisation) (Yin, 2013). A research team and de-briefers in the form of a supervisory team and member checks by the participating case firm ensured the production of a recognizable reality was created (Yin, 2013).

Lastly, reliability in case-based research (Eisenhardt, 1989; Yin, 2013) was ensured through the presence of an audit trail throughout the research period in the form of original transcripts from tape recorded interviews, personal research notes and documented coding processes (Eisenhardt, 1989; Yin, 2013). The forthcoming section provides an overview of the findings from the first phase of data collection.

4.0 Findings

4.1 Introduction

As highlighted in the previous sections, this research aims to contribute to extant literature on international entrepreneurship (Zahra & Wright, 2011). Using the theoretical lens of dynamic managerial capabilities, we shed light upon the micro-foundations of the process of recognising opportunities internationally (Zahra & Wright, 2011). Specifically, it sheds light upon how owners/managers of life science SMEs acquire specialised knowledge to help them recognise opportunities internationally, by leveraging the mechanisms underpinning their human and social capital.

Our research design involved two phases. In the first phase, we used an exploratory case to gain a fine-grained understanding of the international opportunity recognition process, within the life science SME context. In the second phase, we theoretically selected 12 further cases to test, replicate and extend our emergent constructs, derived from the findings of the exploratory case. The findings from both phases are presented below.

4.2 Exploratory case: How life science SME owners/managers recognise opportunities internationally

4.2.1 Introduction

During the course of a five-month exploratory case to understand how life science SME owners/managers recognise opportunities internationally, a series of themes were identified from the collected data. Our evidence shows the international

opportunity recognition process entails three main phases: scanning, sensemaking and selection.

Underpinning these themes were mechanisms pertaining to human capital, such as alertness to scientific discoveries and prior tacit and codified knowledge. In addition, social capital networks were leveraged to acquire specialised knowledge. This involved leveraging serendipity encounters and existing contacts. Our evidence is presented in Figure 2.

Figure 2: The international opportunity recognition process: Exploratory case

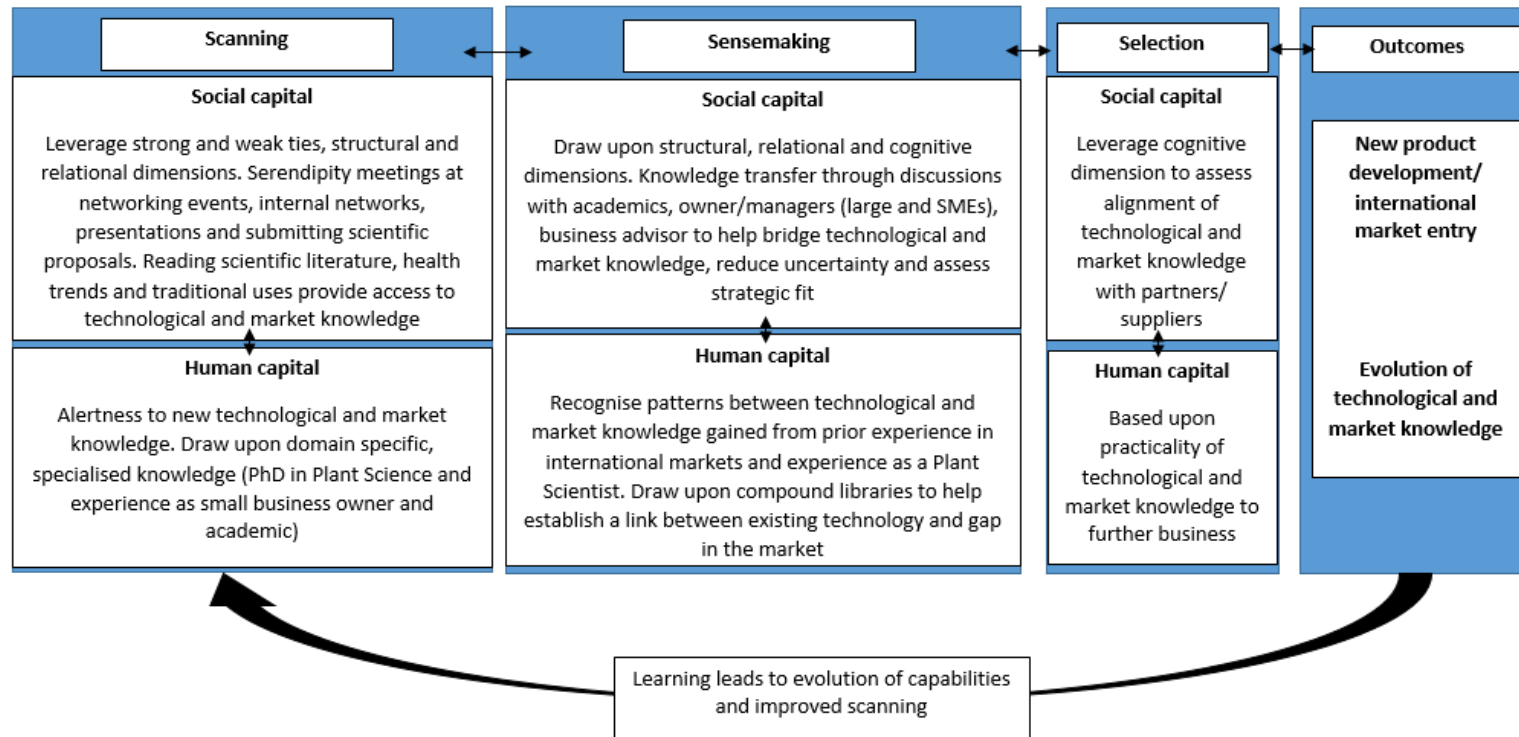


Figure 2 shows the process of international opportunity recognition, highlighting the social and human capital leveraged by the life science SME owner/manager of Plant Co and the mechanisms underpinning them, whilst acquiring specialised knowledge. This view represents three main phases in the process of international opportunity recognition, derived from empirical data collection. These were scanning, sensemaking and selection. In turn, these phases were further divided into the capabilities and underlying mechanisms, which were leveraged during this process, enabling the life science SME owner/manager to acquire specialised technological and market knowledge.

Firstly, owner/manager A of Plant Co was alert to opportunities in international markets. Secondly, owner/manager A made sense of their ideas, and lastly, international markets were selected as potential for entry, based on the survival of the business. Our evidence shows that international opportunity recognition is a dynamic process, due to the technological and market uncertainty faced by owners/managers. The recognition of one international opportunity may also lead to the recognition of another related opportunity, as holding patents can offer protection in international markets for a number of products. Products which were once shelved, could again, become relevant.

The forthcoming section explores the phases of international opportunity recognition, as observed from a case of an owner/manager in a life science SME (Plant Co), engaged in plant science exploration. In particular, this firm focuses on extracts which could provide health benefits. Owner/manager A (the Managing Director of Plant Co) was considering exporting as a potentially new international entry mode for a

product which was still under development. In addition to growing a product side to the business (for example supplements), owner/manager A was also engaged in service work on an international scale (e.g. Japan) and working in international partnerships on sponsored projects, which dominated daily activities.

4.2.2 Phase 1: Scanning

The first phase of the international opportunity recognition process involved scanning. During this phase of the process, social capital (existing networks, serendipitous encounters, proposal submissions and presentations at networking events) and human capital (entrepreneurial alertness and pre-existing knowledge), were leveraged to acquire further specialised technological and market knowledge.

Firstly, owners/managers leveraged existing networks, internal to the organisation. In the case of Plant Co, leveraging their social capital was central to scanning for opportunities internationally. This involved the owner/manager assessing the networks available to them in order to access potential knowledge or resources.

‘...networking is very important in small companies because you can't be everywhere, and what has to happen is people you know contact you. But there are a lot of people out there who don't know, so this networking works very well even if you're not going to work with people that you meet in the network, they may suggest someone else or just back up what you think is a good idea, it's just a way of increasing your influence, without that networking I think you would miss quite a lot of opportunities.’ (T4)

Specifically, owner/manager A proactively drew upon business contacts with a professor at an international medical university. This network was accessed through a member of the internal management team. This relationship was both structural and relational in character. The structural element enabled social interaction with a personal

contact of the business development manager, in order to obtain specialised technological knowledge. As this was an established relationship, it enabled trust. Trustworthiness ensured the sharing of technological ideas and reduced opportunism. The reason for leveraging this connection was to scan for a possible opportunity to develop an international research partnership. This partnership could allow the acquisition of specialised technological knowledge and joint IP development.

In addition, owner/manager A leveraged their existing networks external to the organisation. For example, owner/manager A had meetings in America to discuss potential distribution channels for a product. This highlights a mechanism for prospective market knowledge acquisition.

‘... there's two American companies, but one of them I have known for a long time and they are very keen on me getting together with their sales and marketing team ... they are looking to get new products ... so it could be that we can actually very quickly get developed some products with them...’ (T5).

Owner/manager A leveraged targeted meetings and presentations to engage with multinational companies. These were largely pre-planned through existing networks and involved pitching an idea to senior executives at a larger company. Non-targeted presentations at conferences and lectures also featured. These were relational in character, enabling the communication of general information to a general audience. These events helped to promote the company and establish new international market ties.

Submitting scientific proposals was used to scan for potential partnerships. These included an outline of a scientific idea, a rationale for undertaking the research and proposed outcomes such as IP development. Attendance at networking events

enabled the owner/manager to access new potential networks, for example, customers or distributors, to help grow the product side of the business. Networking re-enforced and developed networking capabilities. Networking facilitated access to individuals, who possessed relevant, specialised, technological and market knowledge.

‘In science what you tend to do is go along with a PowerPoint presentation and that’s what you take and you show pictures of things, you show some data, you explain what the company does’ (T1).

Human capital, in terms of entrepreneurial alertness, existed both in scientific exploration and purposeful search for international markets to enter. Owner/manager A re-assessed and challenged the status quo regarding scientific exploration, leveraging their existing technological knowledge in the area of plant science and extracts.

‘So new things, this is our strategy, not to just follow the pack but to actually ask some questions about does this really explain the activity or not’ (T1).

And in market entry:

‘... we create new ones, but that’s in some ways more of a difficult thing to because many of the things are market driven and, you know, creating a new opportunity is not as easy as following one that is already there, necessarily.’ (T7).

In addition to purposeful search, international opportunities also emerged. A potential opportunity to enter a new foreign market, due to emergent technological knowledge, was explored. The science did not yield an expected result, but could still be used as a new, emergent opportunity.

‘It’s a surprising result that could actually be quite useful, so it is not what we expected but science is like that sometimes’ (T2).

International opportunities emerged through serendipitous encounters. Serendipity encounters were structural in character, as they involved social interaction in order to gain access to general information. An example of how entrepreneurial alertness, technological knowledge and serendipity created potential for the recognition of international opportunities is highlighted below.

‘I’ve been contacted by a company that I met, Company B, one of the projects running out of University A, this company met Company B at one of their annual meetings and this company acts like a, I don’t know if you call them agents or what have you, they go out and find business for other companies and they contacted me because they were going to China and they said they had already been asked by some Chinese companies’ (T6).

Pre-existing knowledge was a salient theme in the scanning phase. Specialised technological knowledge was central to life science SME opportunity recognition as every member of the organisation had technological expertise. Technological expertise was gained through academic education (codified), as in the case of owner/manager A, who had a PhD in Chemistry, gained recognition and awards for research, and a previous academic career as a professor in a university. Technological expertise was tacit, gained by owner/manager A through their prior experience as an academic and small business owner. The business development manager had prior experience in a large pharmaceutical company.

The specialised tacit and codified technological knowledge acquired by owner/manager A was demonstrated in the day-to-day emergence and purposeful search for new plant extracts. Scientific search for new extracts was highly routinized, as time was spent every day by owner/manager A and research assistants in the lab, searching for new extracts or engaged in service-based projects for customers.

Owner/manager A's technological knowledge and academic expertise made him the most effective researcher, adept at finding new molecules of potential interest. For this reason, much of his time, especially during afternoons, was dedicated to scientific exploration. The nature of scientific exploration meant that new extracts could be identified by accident, by doing service work for an international customer, or as part of an international research project. Opportunities were also recognised through purposeful search, inspired by owner/manager A's expertise and previous experience as an academic plant scientist.

In the scanning phase, scientific publications and traditional applications of extracts were coupled with general market knowledge, such as health trends, media and television. Therefore, life science SME owner/manager A leveraged their human and social capital to acquire technological and market knowledge, whilst scanning for potential opportunities.

'So this is using our pharmaceutical knowledge to develop products that you can sell much more readily.' (T1).

Having initially identified a technology (plant extracts) and a potential market for it, owner/manager A typically moved into the second phase of the opportunity recognition process, sensemaking, which typically entailed gathering additional information about their initial ideas and find out whether they could actually open up opportunities.

4.2.3 Phase 2: Sensemaking

The second phase of international opportunity recognition, sensemaking, centred upon owner/manager A's social and human capital. Social capital facilitated knowledge transfer, assessment of strategic fit and was leveraged to reduce uncertainty. Social capital involved strong and weak ties with a range of actors. This included partners, such as academics in universities, contacts in large and small companies, and an external business advisor. Networking with these contacts involved the transfer of specialised technological and market knowledge. Knowledge transfer included knowledge of international markets and technological expertise. For example, knowledge of particular compounds, their properties and how they could be potentially useful in a market context.

Discussions typically took place between owner/manager A, an external business representative and other partners. These discussions dealt with potential ways of business planning, international market entry, investment opportunities, potential for patent protection, suppliers and distributor networks, product marketing strategies, some scientific findings and regulations in international market entry. These discussions helped owner/manager A to gain various perspectives and develop market knowledge.

'... you get opinions from other people, Then you sort of weigh up this one's opinion or someone else's and decide which ones are the right ones to go for' (T4).

In addition, owner/manager A recognised patterns between the existing technology they had developed and potential applications in the international market.

'Well there is this big interest in healthy foods, cosmetics that really work, obviously that's driving our push into the ingredient market' (T7).

Contact with other SME owners/managers, which were more relational in character, enabled knowledge transfer in terms of general market knowledge, for example, a similar company keep them informed about up and coming events and their product lists; ‘... you learn an awful lot from talking with the other small businesses’ (T1). Transfer of technological knowledge between SME and university networks was also central.

‘[University C] ... are interested in actually some library work, they're trying to setup library production which we may get involved in so again that's a collaboration network... they may want our expertise to build library production of natural products, which they don't have any expertise in.’ (T4).

‘So this guy in ... [University B] ... who will do it, his job is writing grant proposals, so he's very good at getting all the information, you know, the up-to-date information on who is developing this drug, who is developing that drug, what's looking good, what isn't’ (T4).

Relationships between life science SME owners/managers can be leveraged to acquire technological and market knowledge. However, as demonstrated above, the transfer of knowledge can also be beneficial to academics within university networks. Academics and universities can benefit from the skills possessed by owners/managers, in our focal company for instance, the development of a natural product library. The owner/manager of Plant Co also leveraged his networking capabilities, involving key opinion leaders e.g. herbalists and a veterinary company, to further evaluate extracts.

Social capital was leveraged to assess strategic fit. In one particular case, strategic fit was missing between international research partners. In one particular case,

a European partner was unable to fulfil conditions to win a project within the set timeframe.

‘I am coming to the feeling that the European company is just not going to come up with the required information quick enough, that is something we will try and pin down today I think’ (T2).

In addition, strategic fit between owner/manager A and a larger company was not aligned due to a misunderstanding in terms of technological expertise and offerings; ‘The pharmaceutical company also say that they have no experience of these types of things and that is seen as a problem for them’ (T3).

Interactions with suppliers enabled owner/manager A to make further sense of international opportunities. This emerged as problems with reliably sourcing product from international supplier networks. Suppliers either charged high prices, had become bankrupt or were found to be substandard; ‘the problem at the moment is getting a reliable source of supply, I think there is a good story but we need to get a good supply’ (T5).

In terms of international market entry, evidence from our exploratory case showed the importance of the target international market in selecting an opportunity to work internationally. A small UK based partner was keen to commercialise products in the UK. However, owner/manager A preferred the US market. Owner/manager A was keen to use their knowledge of competitors and regulatory requirements within their target market to help further exploit the opportunity. This opportunity for collaborating did not progress, as the target market was not international.

Owner/manager A drew upon their human capital, leveraging heuristics, pattern recognition and prior experiences to make sense of technological findings and the international market. Discussing options, in particular with the business advisor during our period of research, helped owner/manager A to simplify the information gathered in the scanning phase. This enabled owner/manager A to further make sense of technological findings and establish a clearer international market need. In addition, the formation of compound libraries helped to further simplify and draw similarities between technology and potential applications within an international market context. As suggested in the compound library created largely by owner/manager A: 'All compounds [are] checked against commercial databases to confirm non-availability from other sources'. This enabled owner/manager A to clearly identify gaps in the commercialisation of newly discovered compounds.

In established partnerships, owner/manager A learnt from partners' prior experiences, their knowledge of IP, the international market and technological knowledge. During a conference call to a small project partner, both individuals suggested drawing upon the prior experiences and international patent knowledge of a multinational partner. This helped to mitigate uncertainty in international market entry: 'I mean ... [individual A] ... will have much more experience of what the market accepts for an extract' (T2).

Prior experience influenced international opportunity recognition, creating cognitive bias. In the case of owner/manager A, key experiences surrounded investment, payment for goods and partnerships with some other small companies.

'What we've also learnt from the past is that we need to get money upfront... we need to make sure we get paid in advance and not just waiting for some

return on the sales cost and it seems to me that this should be possible to do that, otherwise they don't get any.' (T7).

Opportunity level characteristics such as potential for exit, influenced sensemaking. Despite owner/manager A not intentionally growing the business and associated IP specifically to exit, the option was not ruled out.

'... that is always one of the exit strategies for any company, especially small companies you sell it to some bigger one to actually get something back, and then what usually happens is you keep one idea then you start again with another company that you sell off the most of what you have got to someone else who wants it' (T2).

Windows of opportunity were not as important to the owner/manager A, as there were not many other companies in direct competition with them, so the price of new products would not be driven down when competitors come in. The forthcoming section explores the next phase in the international opportunity recognition process, moving from sensemaking to selection.

4.2.4 Phase 3: Selection

In the final phase, selection, opportunities were either pursued, rejected or shelved. International opportunities were selected based upon the practicality of technological and market knowledge to further the business. Specifically, short term company survival was prioritised through pursuing service work internationally to provide an income. This often meant that owner/manager A was engaged principally in the service side of the business, despite wanting to grow and internationalise the commercialisation of products: 'it's not really the type of work we want to be doing but it brings in some cash' (T3). This detracted from the development and planning of a

longer term strategy, prioritising day-to-day survival of the company. Potential opportunities to work internationally were also rejected due to poor standards of compounds being sourced by suppliers, misalignment in international target market and potential product offerings to larger companies and missed project deadlines by partners. The cognitive dimension of social capital, the lack of shared vision and common values, was crucial in selecting international opportunities.

However, opportunities which were recognised but once shelved can become relevant again during the iterative cycle of international opportunity recognition: 'an opportunity might become obvious from something you might have already done, rather than it be a new research project necessarily' (T7). In addition, owner/manager A suggested a barrier to selecting opportunities to work internationally was being spread too thin;

'... we need to try get some more money and I think because we just aren't enough people we could do all the things we are doing, but there just aren't enough people to do it properly without sort of influencing negatively other things we want to do, which could be part of the bigger picture' (T4).

The following section demonstrates the interplay between the previously explored managerial capabilities and provides an overview of the findings from the exploratory case.

4.2.5 The interplay of cognitive and networking capabilities in knowledge acquisition

Human and social capital are leveraged by life science SME owners/managers to acquire specialised market and technological knowledge, during the process of international opportunity recognition. Existing tacit and codified knowledge gained

from prior experiences and education informs how opportunities are recognised. Examples include opportunities being grounded in scientific exploration involving plant extracts, the area of expertise of owner/manager A. Social capital provided access to information in the sensemaking phase. In this phase, scientific ideas were matched with potential commercial applications through discussion with another research intensive, internationally-based business. This, alongside working in projects with universities, small businesses and opinions from a business representative, helped with the acquisition of technological skills and provided insights into market knowledge.

In addition to serving as sources of technological knowledge, discussions with a business advisor helped owner/manager A to acquire specialised market knowledge, specifically with regards to developing a business plan and moving towards a mental model of viewing international opportunity recognition as more market-based activity, rather than pursuing interesting scientific ideas. Prior experiences created biases in market knowledge as owner/manager A perceived certain international markets as being more risky than others are, and decided that if market entry was viable, getting paid upfront was the only option, due to a prior experience of losing both product and payment. The forthcoming sections highlight the findings from the second phase of our data collection. This involved the analysis of 12 comparative cases.

4.3 How life science SME owners/managers recognise opportunities to enter international markets

4.3.1 Introduction

The selection of multiple cases provided us with an understanding of how life science SME owners/managers make decisions about international market entry. In this section, we view the selection of market entry modes as opportunities for internationalisation. Upon analysis, two principal sub-types of life science SMEs, defined by the nature of their business, were identified. These fall within two categories. Firstly, SMEs devoted to early stages of R&D and secondly, SMEs devoted to the commercialisation of products only and products and services (later stage SMEs). Owners/managers within these SMEs were found to pursue partnerships to enter international markets, either through direct to customer exports, establishing distribution networks or working with individuals in universities. These cases enabled us to test, replicate and extend the emergent constructs, derived from the findings of the exploratory case. In addition, an association between the entry mode, nature of the business and the type of knowledge acquired through life science SME owners/managers leveraging their social and human capital, was identified.

The owners/managers of C1, C8, C10, C11 and C12 were identified as working in early-stage life science SMEs. The owners/managers of these life science SMEs focused upon R&D, clinical testing and acquiring technological knowledge and services through CRO's (Contract Research Organisations), universities and larger companies. With this in mind, owners/managers of early-stage companies did not view international markets as being segmented into Europe and USA etc., instead they viewed it as a 'global market' (owners/managers C10 and C11) from which technological expertise could be sourced. Many of the owners/managers in early-stage SMEs were following a pre-determined exit strategy to a large pharmaceutical company. This involved developing technology to fulfil an unmet medical need to a point which larger players viewed it as a valuable

asset. In order to become an attractive acquisition target to larger companies, life science SME owners/managers intentionally engaged in activities to build SME reputation and patents.

Owners/managers in early-stage SMEs formed partnerships with universities and CRO's, in order to source technological expertise and compounds were found to mostly pursue existing networks. Empirical evidence provided by owners/managers C1, C8, C10 and C12 re-enforced this point. Owners/managers of life science SMEs in early stages were found to be more alert to technological discovery, which could potentially be developed into a future product or service, through leveraging the technological expertise of universities and CRO's.

In contrast, companies 2, 3, 4, 5 and 7 were identified as later stage life science SMEs, involved in the commercialisation of products such as medical devices. The owners/managers of these organisations were not engaged in pharmaceutical development. Rather, the owners/managers were on the 'blurry edge', where science could be used to back up claims, or were developing products which did not require intensive regulatory frameworks associated with drug development, involving large scale development pipelines and intensive clinical trials. Similarly, owners/managers of C6 and C9 pursued a dual-strategy model, commercialising both products and providing R&D services to the life science industry.

Owners/managers in the later stages of commercialisation entered international markets primarily by leveraging distributor networks or exported directly to customers. Therefore, international opportunity recognition in these cases meant identifying a customer (principally business-to-business transactions), which they could directly

export products to, or a distributor who could sell products to customers. The owners/managers within this stage may also be open to an exit mechanism. However, activities were not as intentionally and rigidly pre-planned as owners/managers in early-stage SMEs, which developed IP assets solely for exit.

In addition, owners/managers exporting or leveraging distributor networks were more concerned with establishing an international customer base. Customer interactions (both B2B and end user) were most prominent in scanning and sensemaking stages, when entering international markets through exporting and distributor networks. These owners/managers spent time in international markets to develop insights into social and cultural ways of doing business, a deeper understanding of how their product is perceived by the customer, and learn the intricacies of how deals are done e.g. in Japan. Owners/managers who were exporting were more likely to use e-mail and make phone calls to existing and targeted customers, when scanning for international opportunities.

In the forthcoming sections, we identify the similarities and differences in how human and social capital was leveraged in each phase of the international opportunity recognition process, and between early and later stage SMEs. This analysis provides insights into how the mechanisms underpinning human and social capital were leveraged by life science SME owners/managers, to acquire knowledge, during the process of international opportunity recognition. Figure 3 summarises the social and human capital leveraged by owners/managers to acquire and develop specialised technological and market knowledge, in early-stage life science SMEs, during the process of international opportunity recognition. In addition, Figure 4 summarises the

social and human capital leveraged by owners/managers in later stage SMEs, to acquire and develop specialised technological and market knowledge, during the international opportunity recognition process.

Figure 3: The international opportunity recognition process: Early- stage SMEs

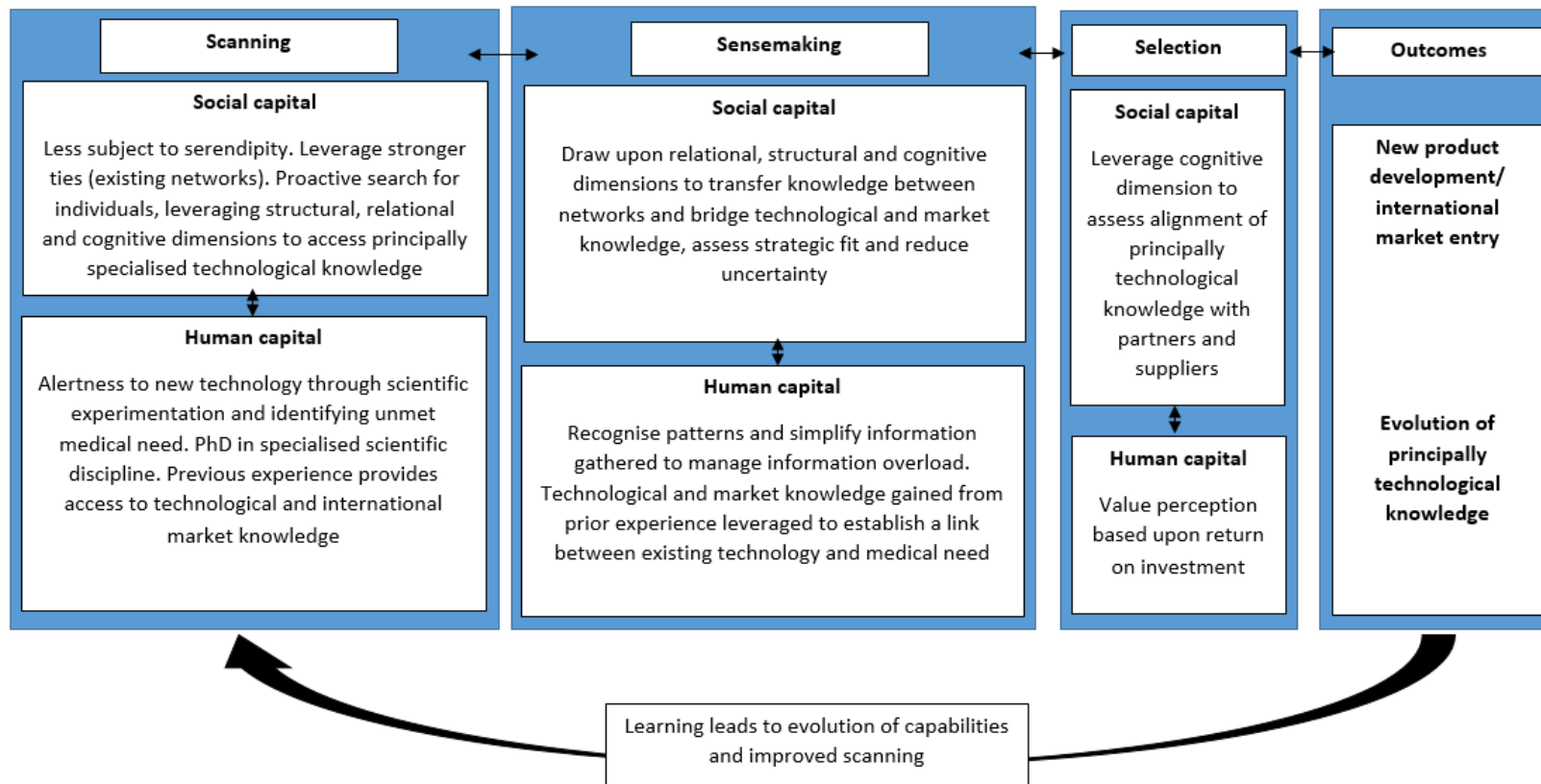
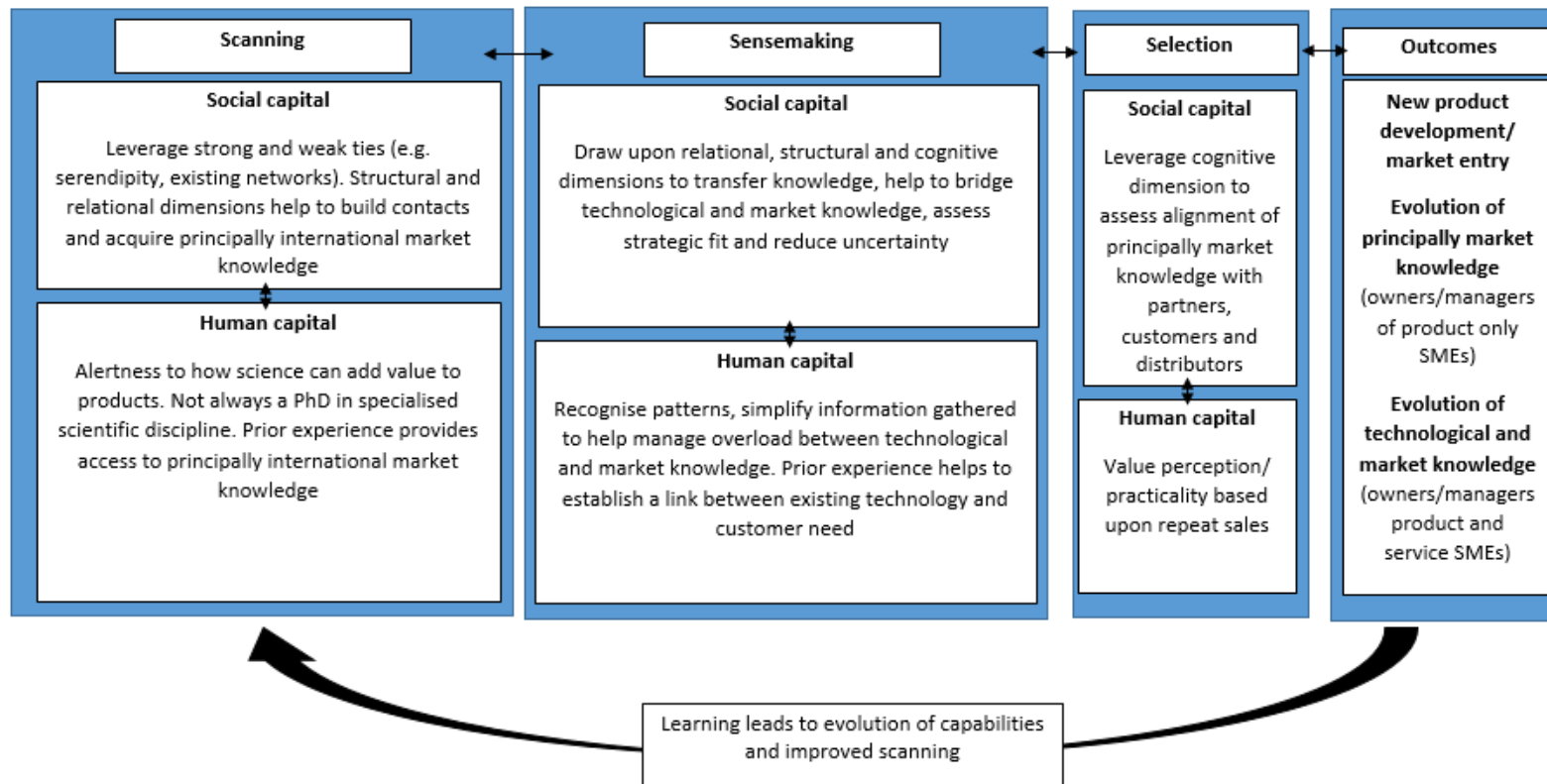


Figure 4: The international opportunity recognition process: Later stage SMEs



4.3.2 Phase 1: Scanning

In the scanning phase of international opportunity recognition, both owners/managers in early-stage and later stage SMEs were alert to identifying new opportunities. Within the early-stage SMEs, the owner/manager of C11 was internationally alert to an unmet medical need; 'the initial driver, really comes from the unmet medical need'. In the early stages of R&D, alertness to ideas in scientific literature and in the media was highlighted by the owner/manager of C12. These activities helped to identify a potential customer problem. In addition, the owner/manager of C12 highlighted the role of confidence (self-efficacy) to work internationally.

The owner/manager of C8 highlighted alertness to the international market as being central to opportunity recognition in early-stage life science SMEs: '...you come across an opportunity you didn't know was out there so one of the themes is being quite aware of what's going on in the industry outside your own four walls.' In addition, the owners/managers of C1 highlighted the emergence of opportunities through scientific experimentation as important to early-stage life science SMEs.

'Sometimes we have opportunities potentially to expand into different areas to expand our expertise or sometimes we see a piece of biology from some of our molecules that give us an opportunity to increase the number of programmes that we would work on.' (Owner/manager, C1).

In scanning for potential opportunities to work internationally the owner/manager of C2, a life science SME in the later stages of commercialisation, viewed opportunities as being recognised through 'signals', 'experience' and 'instinct'. Owners/managers did not have to be 'super smart' but 'be bright enough to see the line

and move to it'. In addition, the owner/manager of C4 leveraged alertness to a technological need for an automated system of data analysis in the life science industry;

'... we wrote a piece of software that enabled them to do that and then interestingly the technology started being adopted by the health systems... for the analysis of genetic abnormalities in patients.' (Owner/manager, C4).

Similarly, owner/manager 3A was alert to adding value to products by using science, stating the company is 'very strong on producing good technical information, to actually demonstrate our products worth'. In contrast, the owner/manager of C7 was alert in terms of product differentiation, concentrating on offering a 'different type of therapy'. The owner/manager of C5 highlighted alertness to acquiring international market knowledge as important to opportunity recognition in life science SMEs in the later stages of commercialisation.

'... we need to understand the market in which we want to get, we need to have an understanding of how our product, how our claims will sit inside that market vis-a-vis competitors vis-a-vis cost, that's the first thing.' (Owner/manager, C5).

Similarly, the owner/manager of C7 was offering a product that was different to that of competitors. Both owners/managers of C6 and C9 were internationally alert and were proactive in expanding their networking capabilities, specifically searching for individuals within large companies who would be interested in their product or service offerings.

In summary, owners/managers of life science SMEs in the early stages were found to be alert to new technology development through undertaking scientific experimentation and identifying an unmet medical need. In contrast, life science SME

owners/managers in the later stages, were more alert to how science could add a unique market perspective to their product, and were keen to establish relationships with larger companies who could help commercialise their products.

Life science SME owners/managers in both the early stages and later stages both leveraged their social capital when scanning for international opportunities. Networking events were more useful to owners/managers in the later stages. Owners/managers of life science SMEs in the early stages were more likely to leverage existing networks and target individuals who possessed specialised scientific knowledge. As illustrated by the owner/manager of C12 (early-stage), 'It's done basically through networks, most of it is networks its people you know or people who know people you know'. Similarly, the owner/manager of C11 (early-stage) spoke to clinicians, patients and customers, whilst also keeping up-to-date with scientific literature and conferences. Likewise, the employees working in C8 (early-stage) were all experienced in the industry and had industry contacts that they could draw upon. The owners/managers of C1 (early-stage) worked extremely closely with investors in scanning for international opportunities as investors were viewed as future customers, looking to acquire the company and its assets in a 3 to 5 year period.

Similarly, the owner/manager of C10 (early-stage) highlighted personal networks as a core component in scanning for opportunities to work internationally; 'in the last 6 months I got 3 opportunities across my desk, directly from personal networks and not from anything else'. It is important to note that owners/managers in early-stage life science SMEs are less subject to serendipitous encounters than those commercialising

products and products and services. Instead, they leveraged existing networks and proactively searched for individuals through sending targeted e-mails.

In contrast, network events and conferences were useful in scanning for potential international opportunities by all owners/managers in later stage life science SMEs (C2, C3, C4, C5, C6, C7 and C9). However, the way in which these events were leveraged to acquire specialised knowledge varied from case to case.

Network events were highlighted by the owner/manager of C2 (later stage) as important in SME development. Events were useful in building a network of industry contacts, facilitating the acquisition of market knowledge. The owner/manager of C2 (later stage) used network events less now as they had built up a portfolio of industry contacts and had become 'too busy' with day-to-day business to attend many events. Similarly, the owner/manager of C4 (later stage) preferred to target specific customers by phone; 'You go to conferences, but ultimately they are all on the phone'. Owner/manager 3B (later stage) attended conferences, but does not 'do a huge amount of that'. The owner/manager of C7 (later stage) was selective about which conferences they attended, using them to develop international market knowledge of 'what is going on in the market place'.

In contrast, the owner/manager of C5 (later stage) attributed entering Asian markets (China and Japan) due to attendance at a European tradeshow, either to 'take a stand', or 'just visit as visitors and go around and actually talk to companies at the exhibition about our product, about our technology'. The owner/manager of C5 (later stage) presented scientific papers, subsequently following up contacts that have been established at these events. In addition, serendipity encounters in the form of contact

from an individual on an internet site led to them becoming part of the distributor network in the case of owner/manager of C7 (later stage). Formal government sources, tradeshow and networks of friends were also highlighted as principal methods of scanning for potential distributor networks by the owner/manager of C7 (later stage).

In addition, owners/managers in the later stages scanned for potential opportunities using existing customer networks and trade organisation membership. This enabled new networks in the life science industry to be made, whilst renewing existing ones, and establishing a potential customer base (owner/manager C9). The owner/manager of C9 targeted specific international forums and conferences to find individuals interested in purchasing reagents. The R&D team within C9 used academic publications to scan for potential opportunities, alongside working closely with academics, classified as 'key opinion leaders' in the USA. These networking capabilities were central to the acquisition of market knowledge during the scanning process.

In the case of owner/manager C6, industry contacts were used to find individuals within R&D discovery teams. The owner/manager of C6 signed up to a database where large companies within the life sciences search for suppliers, so opportunities may emerge from there. In contrast, the owner/manager of C9, it was the contacts of the CEO, which was attributed to the first sales internationally.

In summary, owners/managers in life science SMEs in the early stages were found to be less subject to serendipitous encounters. They principally leveraged existing networks and proactively searched for individuals who had principally specialised technological knowledge, through sending targeted e-mails, for example. As evident from the presented findings, owners/managers of life science SMEs in the early stages

leveraged stronger ties. They were also more likely to leverage relational, structural and cognitive dimensions of social capital in order to acquire principally specialised technological knowledge.

In contrast, life science SME owners/managers in the later stages leveraged serendipitous encounters at network events, for example. Owners/managers of life science SMEs in the later stages were found to attend networking events, such as international forums and leveraged trade organisation membership, to build up their industry contacts and acquire principally market knowledge. They also leveraged networks of friends and existing customer networks. As evidenced from our findings, owners/managers of life science SMEs in the later stages leveraged strong and weak ties (existing ties and serendipity). They were also more likely to leverage the structural and relational dimensions of social capital to access principally international market knowledge.

All owners/managers of both early-stage and later stage life science SMEs leveraged their prior experience in scanning for international opportunities. Specifically, prior experience of technology (scientific expertise/ PhD) and international market knowledge, are two principal types of prior knowledge leveraged during scanning. In terms of education, almost all owners/managers in early-stage R&D life science SMEs acquired specialised technological knowledge through pursuing a PhD in a specific science-based discipline. Their area of scientific expertise was closely related to the area of research within their life science firm. Despite working in an early-stage life science SME, the owner/manager of C10 established partnerships with universities to acquire

technological knowledge, as the owner/manager did not have a background grounded in technological expertise.

In terms of market knowledge acquisition, an example from early-stage life science SMEs, the owner/manager of C12 possessed pre-existing international market knowledge through their previous experience in SMEs developing cell therapy in the UK and US. An understanding of the 'regulatory system', 'approval of products' and 'economic situation' in various countries was important to the owner/manager of C12. The owner/manager of C10 (early-stage) acquired stocks of international market knowledge through previous experience in a consultancy firm and recent international university partnerships.

Both owners/managers in C1 (early-stage) previously acquired international market knowledge, as they had a large pharmaceutical company background. This enabled them to acquire stocks international market knowledge through previous experience, prior to start up. Similarly, the owner/manager of C8 (early-stage) suggested that previously working in a large corporate company for 20 years provided them with an advantage, as they have a better understanding of what is an attractive acquisition target for larger corporations and training in cultural differences.

In addition, investors provided access commercial databases and market knowledge in early-stage life science SMEs in order to offset uncertainty. For example, as suggested by owner/manager C1: 'to look at investment, where it is going, how it's going, how those deals are, which is important to you from a financing perspective'. In addition, the owner/manager of C1 (early-stage) acquired technological and market

knowledge through access to European and US listings of clinical trials, 'to know again where things are'.

Within later stage life science SMEs, some owners/managers had a PhD in a scientific discipline. This enabled them in some cases to develop their own product for commercialisation. In other cases owners/managers did not require a PhD in a scientific discipline, but had extensive experience working in international markets and large companies. For example, the owner/manager of C2 (later stage) possessed specialised technological knowledge, acquired through gaining a PhD in a science-based discipline. Their technological expertise enabled them to build their own prototype technology in a lab, from home. Furthermore, the owner/manager of C2 (later stage) acquired their stock of international market knowledge through previous experience in science-based companies, both large and small, and through running their own consultancy firm and experience in start-up firms. Similarly, the owner/manager of C5 (later stage) had a scientific, academic background with a PhD in a science-based discipline and 30 years' experience in large consumer goods company. Owner/manager 3B (later stage) had a chemistry and agricultural engineering background, experience on EU projects and 25 years industry experience.

In terms of pre-existing technological knowledge, owners/managers C6 and C9, later stage life science SMEs, which provided products and services, both had PhDs in science-based subjects, underpinning the discipline of the life science SME in which they worked. The life science SME owners/managers of companies C6 and C9 developed sector specific and international market knowledge. In both cases, market knowledge was acquired over time, with both owners/managers having 20 plus years commercial

experience. The owner/manager of C6 had experience of 7 years in a pharmaceutical type company, whilst the owner/manager of C9 had gained experience in a small life science enterprise, which was subsequently taken over by large multinational.

In contrast, the owner/manager A of C3 (later stage) did not possess a PhD in a science-based discipline, but used academic papers to acquire technological knowledge, to keep to date with new developments in the area of expertise of the company. Furthermore, the owner/manager of C7 (later stage) did not possess a PhD in a science-based discipline, but had extensive experience in businesses, which worked internationally. In addition, the owner/manager of C4 (later stage) was a mechanical engineer by training, with 2 years' experience in a large company and 15 years in 2 or 3 small start-ups.

However, international market knowledge acquired through previous experience of regulatory and cultural environments within the USA deterred the owner/manager of C2 (later stage) from entering. They perceived the USA to be too high risk in terms of being challenged over patents, with Europe being viewed as an 'easier route'. Similarly, the owner/manager of C4 (later stage) highlighted 'IP risk' as 'problem' in entering the US market, derived from past negative experience. Owner/manager A of C3 (later stage) encountered problems regarding importing cosmetic products, where the ingredients were perceived as food product and a high tariff charge was imposed in entering the South Korean market.

Owner/manager A of C3 (later stage) used industry and market reports to acquire international market knowledge, searching specifically for markets in terms of 'size', 'growth' and the 'biggest manufacturers'. Through spending time in growth

markets such as Japan, owner/manager 3A acquired international market knowledge in terms of stocks of social and cultural knowledge relating to the use of their product:

‘You might think [crops] being a nice healthy food would be well received across the world, in Japan ... there is an aversion to using them because everyone thinks they are gluten or they are going to give some sort of allergenic response.’ (Owner/manager, C3).

Similarly, the owner/manager of C5 (later stage) developed knowledge of commercial deals in Japan by spending time in the country, suggesting a relationship needed to be formed before deals take place. In addition to going, experiencing and trying, the owner/manager of C5 suggested governmental sources of international market information were helpful in initially developing international market knowledge, alongside trade missions and market research. Knowledge of international market in terms of regulatory requirements can shape the mode of entry, for owners/managers of life science SMEs in the later stages. The owners/managers of C5 and C7 (later stage SMEs) required an office in the USA before they could start to sell products into the American market.

In summary, owners/managers of life science SMEs in the early stages, mostly had a PhD in a specialised scientific discipline, related to their firm’s activity. When this was not the case, owners/managers worked in close university partnerships. The owners/managers in early-stage life science SMEs also had prior knowledge of international markets through working in SMEs, consultancy firms, large pharmaceutical companies and working with universities. The type of information about international markets they were most interested in included what made a desirable acquisition target

for larger companies, clinical trial listings, and access to commercial databases, approval processes and the regulatory systems in various countries.

In contrast, owners/managers of life science SMEs in the later stages did not always have a PhD in a specialised scientific discipline related to their life science SME. Although in some cases, where this was the case, the owner/manager could create their own products. In terms of international market knowledge, owners/managers had extensive prior experience, usually working in large companies for 20-30 years prior to start-up. They also learnt from negative prior experiences in international markets. The type of information which was useful to these life science SME owners/managers concerned tariff charges, IP risk, size, growth and biggest manufacturers in target markets, and a cultural knowledge of how products would be used. In order to find out more information about the potential opportunities identified in the scanning phase, owners/managers draw upon their networking capabilities in order to cognitively make sense of them.

4.3.3 Phase 2: Sensemaking

In the sensemaking phase, all owners/managers of life science SMEs in the early stages, simplified and recognised patterns from the information identified in the scanning phase. This was facilitated through leveraging networks, such as partnerships and internal networks. Through leveraging these networks, owners/managers acquired technological and market knowledge, enabling them to link the technology and unmet medical or market need.

‘We tend to look at the market size and the unmet medical need ... sit down how big is the market, does it meet the unmet medical need?’
(Owner/manager, C11).

‘What I usually do is just a small group me and 2/3 people would create a model on a spreadsheet of what this would look like theoretically and we run it out over kind of 10 years and we kind of stress test it what would happen if this ... how would that change the model and that can take a long time? Because there’s so many unknowns and it’s happening over time over probably a 10 year time span so trying to guess what’s going to happen is difficult. And then you try it out on people and it goes through various iterations then eventually it will narrow down to something that seems to make a lot of sense... When you talk to people who have got experience in the industry you can see it in their face they think this is something, it makes sense.’ (Owner/manager, C12).

Social capital e.g. small business networks and consultants were leveraged to acquire international market knowledge. This mitigated uncertainty in entering international markets and helped ‘each other to navigate the complexities of this industry’ (Owner/manager, C11). Principal participants in interpreting potential opportunities were partners working with the owner/manager of C11 (early-stage), gaining information from professional market analysts and clinical groups. Internal networking capabilities of owner/manager C11 (early-stage) featured in interpreting potential opportunities. Principally the management team, CEO and Chief Medical Officer, board and investors were all involved in discussions surrounding potential opportunities to work internationally.

In order to find out more information, owners/managers of later stage life science SMEs leveraged their social capital, gathering opinions of potential partners and customers. This enabled knowledge transfer between owners/managers, partners and customers. In the case of the owner/manager of C2 (later stage), more opportunity was created through interaction with podiatrists, who were the main customers.

‘... we were told sell a device, just the device which makes the holes safely in the ... plate, great, as soon as we sold it to the podiatrists, the users they said

well how do you use it? It's easy you make holes in the, yea but for what, for how many holes, for what drug? For what person, for how long? Really you don't know? Well how should we know it's your product! Good point, yea. So listen, react, so we've created the ... pathway so that's based upon our device as a treatment pathway so now we are supporting our customers who are podiatrists to market a treatment pathway' (Owner/manager, C2).

The owner/manager of C5 (later stage) highlighted clinicians as important in opportunity recognition. Clinicians helped to link technological and market knowledge, reassuring the technology matches their needs; 'in the earlier stages it is often the technical people including clinicians who want to look at the product, want to reassure themselves that what we say about our product is valid'. Similarly, the owner/manager of C7 (later stage) spoke with clinicians who 'prescribe the product'. The owner/manager of C4 collaborates with businesses who are potential future customers.

'I think the opportunity comes from talking to the customer, understanding the business, understanding the pressures they are under, the cost, quality, utilisation, whatever it is, understanding your customer, understanding what it is that is driving them, where their pressure comes from, and what in their terms is an opportunity? Because if you can provide something that for them is an opportunity, then have you as the potential supplier, then that is the opportunity, and then at that point, the technology kicks in.' (Owner/manager, C4).

The owner/managers of C4 and C5 both later stage life science SMEs, highlighted linking together technological and market knowledge to provide technological solutions to customer needs, using their expertise gained through prior experience. Similarly, the owner/ manager of C4 stated 'the opportunity of technology in isolation is so far away from being able to be used by a customer that it's hard to be called an opportunity at all.'

In summary, owners/managers of early-stage life science SMEs leveraged partnerships, consultants, professional market analysts and clinical groups to recognise patterns between technological and market knowledge. In addition, they also leveraged their internal networks such as the management team, CEO, Chief Medical Officer, investors and board members to recognise patterns between technological and market knowledge. In contrast, owners/managers in later stage life science SMEs leveraged their networks with clinicians who used products and potential customers to help recognise patterns between technological and market knowledge.

Both owners/managers of early-stage and later stage life science SMEs leveraged their social capital in order to reduce uncertainty. Early-stage life science SME owners/managers leveraged the opinions of CRO's, scientific boards, scientists, clinicians and academics in universities to reduce uncertainty. In the early-stage life science SMEs, the owner/manager of C10 (early-stage) attempted to mitigate uncertainty of the potential opportunity by carrying out due diligence to validate partner ideas. Similarly, the owner/manager of C12 (early-stage) used due diligence 'to make sure what they tell you is correct', but also drew upon technological and market knowledge in order to draw up legal agreements with partners.

The owner/manager of C12 (early-stage) gained the opinions of others, welcoming negative opinions about their ideas and working through 'no's', as owners/managers can easily become seduced by their own ideas. Similarly, the owner/manager of C8 (early-stage) leveraged the opinions of others, such as the chairperson and executive team when making sense of opportunities. Similarly, the owners/managers of C1 (early-stage) furthered their knowledge of potential

international opportunities, through discussions with CRO's to secure services, legal teams to advise on international law, board members, and the scientific advisory board comprised of academics and clinicians. This helped to offset market and technological uncertainty and simplify ideas. The owner/manager of C12 (early-stage) linked scientific discovery and international market need through using their social capital, comprising of scientists and clinicians, coupled with their human capital.

'So the scientists are telling you what is doable or what can be done now and the clinicians are telling you what they need or what they will need in the future and you are trying to put those two together and fill in the missing bits. So that you can turn something that is doable now into a product that the clinician needs.' (Owner/manager, C12).

The owners/managers of early-stage life science SMEs C11 and C10 were keen to establish a market for their prospective products in terms of estimating potential market size, and what other similar drugs are 'out there' at a similar stage of development. In contrast, the owner/manager of C8 was certain of demand for their potential product, whereby 'the voice of the customer is nowhere near as important in this context as it would potentially be in a slightly more normal pharma business'. In this case, technological knowledge of being able to produce product was more important.

The owner/manager of C10 (early-stage) gained further knowledge of the science and market need, essentially matching science (what can be done) and international market knowledge (e.g. value estimation and costs of production). Drawing upon networks such as contacts within universities and international market knowledge to ascertain key aspects as demonstrated below:

'... freedom to operate ... but the starting price was what is the world market price for this stuff, how much we can sell it for, what volume can we sell and

what's our cost of manufacturing, followed by linking technical knowledge; can it be done?' (Owner/manager, C10).

In contrast, the owners/managers in the later stage life science SMEs leveraged principally customers, distributors and end users to reduce uncertainty. For example, the owner/manager of C7 sold their product to distributors who pay for the products. However, the owner/manager also spoke to the end users (patients) who use the products. Their principal customer is a large 10 to 20 million-turnover company. Through building distributor relationships with the larger companies, the owner/manager of C7 was able to leverage their 'in-depth knowledge of how to get through the very contorted approval process that will allow your product onto the market.' This helped to reduce uncertainty in international markets. Similarly, the owner/manager of C9 highlighted the role of representatives and distributors used in international markets which were 'hard to handle' in terms of language and culture (Japan) and shipping (S. America) to facilitate market entry.

Speaking with networks internal and external to the organisation helped to reduce uncertainty. The owner/manager of C2 (later stage) interacted with board members in order to 'sort out what's important and what isn't'. This helped to simplify and focus issues important to the organisation. Similarly, the owner/manager of C5 also spoke with members of the board about potential opportunities. New and existing networks at conferences (owner/manager C6), talking to customers, developing quotations for products and services and discussing directly with customers helped to further reduce uncertainty. This led to understanding 'how we can best serve [customers]' (Owner/manager, C9).

The owner/manager of C6 (later stage) highlighted the collaborative nature of customer relationships, discussing products and pursuing leads with mainly large company customers and university networks. Speaking with investors, scientific co-founders, shareholders and board members formed part of the sensemaking stage, further enabling the owner/manager C6 to link the technology and market need. In addition, for the owner/manager of C9, trust was an important factor in reducing uncertainty, as the owners/managers preferred to work with larger companies 'preferably a well-known company, somebody with an international brand that we would be aware of'.

In summary, owners/managers in the early-stage life science SMEs reduced uncertainty and simplified the knowledge they received in the prior stage, scanning, through undertaking due diligence about partners ideas, drawing up legal agreements with partners, and gaining opinions of others such as chairpersons, executive teams, legal teams, CROs and scientific board members. In contrast, life science SME owners/managers in later stages of commercialisation reduced uncertainty through speaking with end users, customers and distributors. Leveraging the international market knowledge of distributor networks was central in overcoming obstacles to international market entry, for example cultural and regulatory obstacles. Internally, they also consulted with board members.

Owners/managers of early-stage life science SMEs leveraged social capital to assess strategic fit. This involved assessing whether the opportunity was a good fit for the current nature of their business, through doing a bit of due diligence and trusting partners. The owner/manager of C8 (early-stage) posited perceived technical and

business fit as important. This involved assessing fit with a partner in terms of business objectives being aligned and trust. Similarly, the owner/manager of C10 assessed university partnerships based on technological fit with their business and the universities area of technical expertise. Owners/managers C1 sourced services where molecules needed were in alignment with their R&D activities, as shown in the example below.

‘We’ve purchased some compounds from Europe, and there are various services we currently secure from the US’ (Owner/manager, C1A).

‘One of our key ... models, is run in the US, so one of the key pharmacological assets is run by a group in [the US], they are kind of the world leaders in so we said when we have compounds which are relatively advanced stage then we send them out there, they then test them for activity and their system’ (Owner/manager, C1B).

Owners/managers of C6 and C9 (later stage SMEs) highlighted the importance of assessing strategic fit, agreeing that technological alignment with customers was important; ‘understanding both the customers’ requirements and them understanding what our capabilities are is important.’ (Owner/manager, C9). The owner/manager of C6 highlighted ‘the main thing is a combination of either the right type of customer we are targeting and it’s a technical fit really.’

In summary, owners/managers in early-stage life science SMEs assessed strategic fit based upon technical and business fit, alignment and trust. Similarly, owners/managers in later stage SMEs assessed strategic fit based upon technical fit with customers. Owners/managers of both early-stage and later stage life science SMEs drew upon relational, structural and cognitive dimensions to help the transfer of knowledge, assess strategic fit and reduce uncertainty.

Owners/managers in early-stage life science SMEs leveraged their prior experience and judgement to make sense of potential opportunities. This involved attempting to estimate the likelihood of getting the product to the market and the value of the product in the market. The owner/manager of C11 leveraged their prior experience, in making sense of international opportunities.

‘I think it’s that combination of ensuring that you are still aligned, has the competitive landscape changed significantly, does that change anything, does this mean we still have a valuable proposition if we get it to the market and then tempering that with the reality of are we likely to actually get it to the market knowing what we know now with respect to where it sits in the R&D pipeline. It’s a complicated judgement call sometimes and you are always dealing with incomplete data. But that’s where the experience and judgement come in.’ (Owner/manager, C11).

The owners/managers of C8 and C1 (early-stage SMEs) leveraged their prior experience in making sense of opportunities, as they had previous experience in a company that they plan to exit to. The owner/manager of C12 (early-stage SME) leveraged their prior experiences in managing small life science SMEs. In contrast, the owner/manager of C10 (early-stage SME) drew upon limited experience working internationally in a life science SME, leveraging their previous experience of interactions with international universities.

Similarly, owners/managers in later stage life science SMEs also leveraged their prior experience. For example, owner/manager C2, decided to move from a distributor to a direct sales mode of international market entry.

‘We’ve just evolved from letting our distributor do everything who were the biggest distributor in the podiatry sector, we were letting them do everything but funnily enough they weren’t responding to the market.’(Owner/manager, C2).

Similarly, drawing upon their knowledge of the international markets from prior experience, the owner/manager A of C3 highlighted 'you can't sell these products remotely you have to go and visit the distributor, visit their customers.' The owner/manager of C5 also leveraged their prior experiences in making sense of potential international opportunities.

'... you are always trying to assess the trust worthiness of the customer that you are talking to we've had some meetings in the past with companies ... where they come and they make quite extravagant claims about wanting your product, about what they are going to sell and the values and they are not and of course you decide to keep information limited until such a point in time where it becomes really clear the actual scale of the financial and commercial arrangement.' (Owner/manager, C5).

In summary, owners/managers in the early stages leveraged their prior experiences in large and small companies to make sense of international opportunities. This helped them to assess the potential value and likelihood of a technology being able to move through the development pipeline. In contrast, owners/managers of life science SMEs in the later stages leveraged their prior experiences, both positive and negative, of doing business in international markets.

In addition, opportunity level characteristics influenced how opportunities were made sense of during the process. Return on investment to shareholders and investors was central to life science SME owners/managers in the early stages. Furthermore, windows of opportunity in terms of value inflection points (C11), trends and cycles of new technologies (C12) were noted. In the case of C8, an association between exit potential and windows of opportunity was observed, suggesting exit potential was at its greatest value when entering windows of opportunity.

Opportunity level characteristics such as growth potential for exit and strengthening patents were kept in mind by most of the life science SME owners/managers in the later stages. Although, they had no concrete policy or exit plan as such, but were still keen to develop strong IP and goodwill, so it may be an option in the future.

Owners/managers in the later stages suggested exit was not their main aim. They preferred to expand international sales. Similarly, the owner/manager of C5 (later stage) was not 'targeting' acquisition by larger company, but was concentrating on building export business, internal UK business and shareholder value. Similarly, the owner/manager B of C3 (later stage) stated they were not in the position to exit as there needed to be a valuable 'track record', stating 'we would be selling hope rather than delivery'. Therefore, the owner/manager B of C3 preferred to currently grow the business further. As suggested by the owner/manager of C2 (later stage), knowledge of what 'big players' are looking for in an attractive acquisition was important as exit was an option. In contrast to the majority of life science SMEs in the later stages, the owner/manager of C6 had a pre-planned exit strategy, as the company was venture capital backed.

The owner/manager of C4, a life science SME in the later stages, who already sold their SME to a larger company, cited regulatory requirements and technology as two principal drivers of owners/managers of life science SMEs growing an enterprise for exit. Attaining ISO accreditations can be costly, requiring individuals with specialised knowledge, which are available in larger companies. This alongside technology, which

obsolesces, with the products becoming more about brand and cost reduction, makes it difficult for SME owners/managers to sustain the product that they have grown.

Windows of opportunity were perceived as not as important to some later stage life science SME owners/managers. They suggested that 'there's always opportunity if you are a good company and if you have good products and you're invested in the market' (Owner/manager, C4). The owner/manager of C5 was open to windows of opportunity but suggested 'windows of opportunity are not really that important compared to just doing good business'. In contrast, the owner/manager of C3 (later stage) suggested this was a 'good time for us because they're [Korea] looking for new natural ingredients with proven efficacy'. Similarly, the owner/manager of C9 tried to capitalise upon windows of opportunity for product sales:

'... before it sort of drops off from the news so you have a definite window of opportunity at that point, you can find smaller windows internationally as well. So for instance if you have a different infection coming up for instance in china or south east Asia that is particularly important in that area ... it would be our aim to try and spot that and see if there are any opportunities at that time, so you probably have a window for a year to two years, for most of these things to maximise sales.' (Owner/manager, C9).

Therefore, windows of opportunity were subject to sensemaking by owners/managers of later stage life science SMEs. Some viewed them as important to growing sales within international markets, whereas others were keen to just do good business.

4.3.4 Phase 3: Selection

Owners/managers of life science SMEs in the early stages selected opportunities if the technological and market knowledge gathered in the previous phases was

perceived to be practical and profitable to furthering their businesses. The owners/managers of C1 cited perceptions of quality and cost as principal drivers in selecting CRO's and services. The potential value of the drugs being developed was highlighted as central to selection. Many owners/managers in early-stage SMEs grow their business in order to become attractive targets for acquisition by larger, multinational companies in the future. Providing an attractive portfolio of valuable assets, such as potentially valuable drug development, is a central activity. In contrast, the owner/manager of C12 suggested potential international opportunities 'self-select' during the process of opportunity recognition.

Owners/managers of life science SMEs in the later stages selected opportunities based upon practicality and profitability of technological and market knowledge to further business and alignment of technological and market knowledge with potential and current customers, distributors and partners. The owner/manager of C2 viewed profitability as central, stating 'the size of market' and 'repeat sales' as being motives for opportunity selection. Similarly, the owner/manager of C5 suggested building repeat business through developing more products to suit customers' needs in Japan was easier and preferable to entering new international markets as it is 'long', 'hard' and 'difficult'. Owners/managers of C3 suggested fit in terms of technological expertise as central to the selection of partners providing technical services. In addition, the owners/managers of C3 selected opportunities to enter international markets to grow their business further. Furthermore, owners/managers C6 and C9 posited being paid and investment as important in the selection of international opportunities.

The forthcoming section provides a summary of the findings of how life science SME owners/managers make decisions about entry modes, taking into account the different stages (early and later), entry mode, and type of knowledge acquired, during the process of international opportunity recognition.

4.4 Summary of findings: How life science SME owners/managers recognise opportunities to enter international markets.

Life science SME owners/managers leveraged their human and social capital to acquire technological and market knowledge. In this research, entry modes were identified as potential opportunities for international expansion. Our findings show how the mechanisms underpinning social and human capital were leveraged by owners/managers, at different stages (early and later), during the process of recognising opportunities for international expansion, within the life science context. In addition, we uncovered an association between international entry mode, early and later stage life science SMEs, and the type of knowledge that they acquired.

Owners/managers who were in the later stages (C2, C3, C4, C5 and C7) acquired principally, but not exclusively, market knowledge specific to their businesses. Owners/managers acquired market knowledge by leveraging their distribution networks and direct to customer networks. Owners/managers often did not have a PhD in a specialised scientific discipline, but gained international market knowledge by extensive experience working in companies. Owners/managers in the later stages who provided products and services to the life science industry (C6 and C9) leveraged partnerships with universities, SMEs and larger companies, alongside leveraging distributor networks

and direct to customer networks, to acquire both technological and market knowledge equally.

Owners/managers whose core activities were in the early stages (C1, C8, C10, C11 and C12), acquired principally technological knowledge, through partnerships with universities, other SMEs, and larger companies. In contrast, these owners/managers often possessed a PhD in a core science discipline, providing them with in-depth technological knowledge.

In the scanning phase, all owners/managers, regardless of the nature of the business, leveraged their human capital. This included alertness and prior experience. During this phase, they also leveraged their existing networks to identify new business opportunities. Events were relevant to owners/managers of life science SMEs in the later stages, while they do not seem to be as relevant to those in early stages. In addition, prior knowledge was leveraged during scanning. An association between the type of prior knowledge and the core activities owners/managers was uncovered.

Owners/managers in early-stage SMEs mostly possessed rich technological knowledge. This was derived from a background in science and academia. Many had PhDs in niche scientific areas. Owners/managers in the later stages, principally leveraged pre-existing knowledge of the international market, commonly resulting from 15-20 years previous experience in SMEs or larger firms. Lastly, owners/managers C6 and C9, commercialising products and providing services to the life science industry possessed a high level of knowledge of both the international market and technology. This was gained through a background in science (PhD) and prior experience working in international markets.

In the sensemaking phase, owners/managers, irrespective of being early or later stage SMEs, or entry mode, recognised patterns between existing technology and market need. Within this phase, all owners/managers needed to establish a clearer link between the technology and market. In order to do this, owners/managers leveraged their networks to facilitate knowledge transfer. Owners/managers of firms in the early stages often established partnerships principally with universities, in order to acquire stocks of technological knowledge. Owners/managers in the later stages leveraged their customer and distribution networks in order to acquire international market knowledge. Owners/managers in the later stages, providing products and services, leveraged scientific partnerships and customer networks to acquire technological and market knowledge.

Owners/managers of early-stage life science SMEs selected international opportunities based upon practicality, potential profitability and suggested that opportunities self-selected through following the process. Owners/managers of firms in the later stages of commercialisation selected opportunities based upon repeat sales and market size. The forthcoming section provides a synthesis of the findings from the exploratory case and the comparative cases.

4.5 Summary of findings: Exploratory case and comparative cases

Phase 1: Owners/managers in later stage SMEs are not always required to have scientific expertise in the form of a PhD in a specialised discipline. All owners/managers leverage their prior experiences in large and small companies and as an academic in the case of Plant Co and early-stage C1. All owners/managers are alert to customer needs. The owners/managers of Plant Co and organisations in the early stages leverage their PhD specialisation to fulfil a customer need through R&D activities. Owners/managers in the later stages are more focused upon product development and international distribution.

Owners/managers of early-stage SMEs prefer to leverage existing ties and search for specific individuals who possess the specialised knowledge they require to further their business. In contrast, the owner/manager of Plant Co and later stage SMEs leveraged weaker ties e.g. serendipity encounters at network events. Owners/managers in early-stage SMEs draw upon the cognitive dimension of social capital, as they search for an individual that can partner with them who shares a common view of their R&D activities. Owners/managers of Plant Co and later stage SMEs drew upon relational and structural dimensions when scanning for potential international opportunities.

Phase 2: All owners/managers draw upon their prior experiences in international markets and/or their technological knowledge to help predict future outcomes of their perceived opportunities to work internationally. Similarly, all owners/managers simplify the information they have gathered in the previous phase, in order to help manage information overload. They do this through benchmarking, establishing variables which are important to them (e.g. by prioritising a key target

market and rationalising this choice through reasoning, see exploratory case example). In addition, all owners/managers recognise patterns between technological knowledge and market knowledge. All owners/managers leverage their relational, structural and cognitive dimensions of social capital to facilitate knowledge transfer, assess strategic fit and reduce uncertainty through consulting experts such as industry experts, consultants, business advisors and end users.

Phase 3: Owner/manager A (exploratory case) selected international opportunities based upon the practicality of technological and market knowledge to further business. Alignment with suppliers, potential customers and partners influenced the selection of international opportunities. Owners/managers in the early stages selected international opportunities based upon return on investment. Investors and CRO's played a key role in determining the selection of international opportunities. In contrast, owners/managers in the later stages of commercialisation selected international opportunities largely based upon repeat sales. This was based upon the competency of distributor networks and trusting relationships between existing international customers. The tables below show a summary of the findings from the exploratory case and comparative cases, and provide illustrative quotes to highlight the main findings from our analysis. The forthcoming section provides a discussion of our findings and the contributions of our research to the existing literature.

Table 7 Comparison Tables: Exploratory case and comparative cases. Phase 1: Scanning (human capital)

Human capital	Exploratory case	Early stage (R&D stage)	Later stage (Commercialisation)	Illustrative quotes
Education	PhD in specialised science discipline	PhD in specialised science discipline	PhD not always required in specialised science discipline	<p>'I started off my PhD work ... funded by the medical research council looking for antivirals in plants' (T1, Plant Co)</p> <p>'I've got a PhD ... in cells' (Early-stage, C11)</p> <p>'I came along in 2011 because I've got a chemistry background and I also apparently can sell, which is what my main job is' (Later stage, C3a)</p>
Prior knowledge	Small business owner Academic	Large and small companies	Large and small companies	<p>'My background was as an academic researcher' (Plant Co, T1)</p> <p>'We've both spent our lives in large corporate organisations' (Early-stage, C1)</p> <p>'I spent 30 years in a large company ... on the management training scheme' (Later stage, C5)</p>
Alertness	Leverage PhD to find a novel solution to customer need (not following the status quo)	Address customer need, emergence, creation and purposeful search	Address customer need and emergence	<p>'We are trying to do things in a different way' (Plant Co, T1)</p> <p>'I'd like to think that we create opportunities' (Early-stage, C11)</p>

				'We saw we could make a social contribution to the products we were developing' (Later stage, C4)
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Table 8 Comparison Tables: Exploratory case and comparative cases. Phase 1: Scanning (social capital)

Social capital	Exploratory case	Early stage (R&D)	Later stage (Commercialisation)	Illustrative quotes
Strong and weak ties	New and existing ties (strong and weaker)	Existing ties (stronger)	New and existing ties (strong and weaker)	<p>‘Yes, e-mail, all the time of course yea, contacting mainly people we already know, we do get some new contacts out of that as well.’ (Plant Co, T1)</p> <p>‘I prefer using existing ones because it’s easier’ (Early-stage, C12)</p> <p>‘Quite often, if your network can help’ (Later stage, C5)</p>
Serendipity	Serendipity encounters at network events (temporary and relational)	Targeted search for individuals who possess specialised knowledge	Serendipity encounters at network events (temporary and relational)	<p>‘In that case that work came from the fact that I gave a presentation and this man from the company was in the audience’ (Plant Co, T1)</p> <p>‘not just going out speaking to everyone but really finding people who would fit the bill, almost like job spec.’ (Early-stage, C8)</p> <p>‘They went to a European trade show and from that they got interest from a Chinese company who then wanted to explore taking the products and selling them in China.’ (Later stage, C5)</p>

Dimensions of social capital	Draw upon relational and structural dimensions e.g. trusted relationships provide access to specialised technological and market knowledge	Draw upon relational, structural and cognitive dimensions e.g. trusted relationships and shared vision provide access to specialised technological and market knowledge	Draw upon relational and structural dimensions e.g. trusted relationships provide access to specialised technological and market knowledge	<p>'... there's two American companies, but one of them I have known for a long time and they are very keen on me getting together with their sales and marketing team' (Plant Co, T5)</p> <p>'I have identified people that we can work with and that, they are the ones that actually have a common view of what's important and how to progress things' (Early-stage, C11)</p> <p>'So basically its market research and networking through contacts and key exhibition attendance.' (Later stage, C7)</p>
Main actors (networks)	<p>Events</p> <p>Internal to the organisation</p> <p>Presentations</p> <p>Existing networks</p> <p>Submit scientific proposals</p> <p>Health trends/ traditional uses</p>	<p>Investors</p> <p>Existing networks</p> <p>Conferences</p> <p>Competitors</p> <p>Universities</p> <p>Targeted e-mails/phone calls</p>	<p>Customers (and surveys)</p> <p>Events/trade shows</p> <p>E-mail</p> <p>Industry and market reports/ databases</p> <p>Spend time in international market</p> <p>Government advisors</p> <p>Industry contacts</p>	<p>'... we've just put in a proposal to the ... charity to get some money to develop some compounds that prevent [the disease].' (Plant Co, T1)</p> <p>'It's done basically through networks' (Early-stage, C12)</p> <p>'we do conferences mainly... conferences where we know people who are in the industry' (Later stage, C6)</p>

Table 9 Comparison Tables: Exploratory case and comparative cases. Phase 2: Sensemaking (human capital)

Human capital	Exploratory case	Early stage (R&D)	Later stage (Commercialisation)	Illustrative quotes
Prior experience	Draw upon past experience in international markets and technological knowledge to help predict future outcomes	Draw upon past experience in international markets and technological knowledge to help predict future outcomes	Draw upon past experience in international markets and technological knowledge to help predict future outcomes	<p>'... the idea was to file, not in the UK but in the US. For the very simple reasons that I have previous experience with the US patent office' (Plant Co,T2)</p> <p>'It's a complicated judgement call sometimes and you are always dealing with incomplete data. But that's where the experience and judgement come in.' (Early-stage, C11)</p> <p>'I think one of the key things that came out of this in terms of our experience is all our opportunities were market led' (Later stage, C4)</p>
Heuristics	Simplify information gathered in order to help manage information overload	Simplify information gathered in order to help manage information overload	Simplify information gathered in order to help manage information overload	<p>'I think for our business America is much more important, because as we discussed they are much more open to health products. Europe has been more restrictive' (Plant Co, T4)</p> <p>'...there's various variables and you can make gustomates on them and you run spreadsheets and see if they make sense' (Early-stage, C12)</p> <p>'We attend the ... conferences so we know what is going on in the market place, who our competitors</p>

				are, who's doing good stuff, what results they are getting, then we benchmark our product against what's best in that expert arena' (Later stage, C7)
Pattern recognition	Recognise patterns between technological knowledge and market knowledge	Recognise patterns between technological knowledge and market knowledge	Recognise patterns between technological knowledge and market knowledge	<p>'We are thinking that if we get a retail company set up we can actually market some of these things [extracts] ourselves' (Plant Co, T4)</p> <p>'Ok you know all the fancy words, but is there a market for this?' (Early-stage, C8)</p> <p>'...identifying the market opportunity is first and foremost but then seeing how the technology can be deployed to meet that market opportunity is perhaps really the clever bit.' (Later stage, C5)</p>

Table 10 Comparison Tables: Exploratory case and comparative cases. Phase 2: Sensemaking (social capital)

Social capital	Exploratory case	Early stage (R&D)	Later stage (Commercialisation)	Illustrative quotes
Dimensions of social capital	Draw upon relational, structural and cognitive dimensions to help knowledge transfer, assess strategic fit and reduce uncertainty	Draw upon relational, structural and cognitive dimensions to help knowledge transfer, assess strategic fit and reduce uncertainty	Draw upon relational, structural and cognitive dimensions to help knowledge transfer, assess strategic fit and reduce uncertainty	<p>'I'm planning on going to see them and planning on simplifying the agreements as much as possible.' (Plant Co, T4)</p> <p>'We do have a scientific advisory board that's international. So they are people, again, which are high level academics, clinicians that consult back into the company.' (Early-stage, C1)</p> <p>'...you are always trying to assess the trust worthiness of the customer that you are talking to we've had some meetings in the past with companies ... where they come and they make quite extravagant claims' (Later stages, C5)</p>
Main actors (networks)	Academics Owner/managers of large and small companies	Experienced industry contacts Investors	Customers Distributors Board members	'the extract is also being evaluated by a veterinary company' (Plant Co, T7)

	Business advisor (local government)	Market analysts'/ clinical groups Board members Scientific advisory board (academics/clinicians) Service providers (CRO's) Legal teams Consultants Small business networks	Clinicians (who prescribe products)/ end users Universities Shareholders Other small companies	'consultants and non-exec directors on your board are very useful because they have even more experience' (Early-stage, C8) 'we do end up talking to the patients, so we talk to the end users as it were' (Later stage, C7)
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Table 11 Comparison Tables: Exploratory case and comparative cases. Phase 3: Selection (human capital)

Human capital	Exploratory case	Early stage (R&D)	Later stage (Commercialisation)	Illustrative quotes
Value perception/practicality	Based upon practicality of technological and market knowledge to further business	Based upon return on investment	Based upon repeat sales	<p>'it's not really the type of work we want to be doing but it brings in some cash' (Plant Co, T3)</p> <p>'... which are the ones which are most likely to give us a rapid return on investment' (Early-stage, C11)</p> <p>'It's easiest with the customers that are already in place.' (Later stage, C5)</p>

Table 12 Comparison Tables: Exploratory case and comparative cases. Phase 3: Selection (social capital)

Social capital	Exploratory case	Early stage (R&D)	Later stage (Commercialisation)	Illustrative quotes
Dimensions of social capital	Leverage cognitive dimension to assess alignment of technological and market knowledge with partners, suppliers and potential customers	Leverage cognitive dimension to assess alignment of principally technological knowledge with partners (CRO's and investors)	Leverage cognitive dimension to assess alignment of principally market knowledge with partners, distributors, customers	<p>'So my impression that at the end, with all of the difficulties that we had from the point of view of the extraction, and also with the relationship, although now I think this has been sorted, we know now each other' (Plant Co, T2)</p> <p>'quite often we work within a very high tech space so there may be only a limited number of people with the skill set we need, so our driver in recognising international opportunity will be a uniqueness and a competitiveness of the service that we are looking to acquire.' (Early-stage, C8)</p> <p>'it comes down to experience your own company capabilities, and your assessment of the people you are working with, the messages that you are getting whether they do what they say, its lots of emotional as well as technical skills that you deploy, really to come to that conclusion' (Later stage, C5)</p>

Main actors (networks)	Suppliers Partners Potential customers	CRO's Investors	Customers Distributors/ Partners	<p>'so the main problem is getting a reasonably priced supply' (Plant Co, T5)</p> <p>'our investors are our future customers, if you like' (Early-stage, C1)</p> <p>'We meet distributors at tradeshow... we get a distributor and if they are competent we get them as our distributor in that country' (Later stage, C7)</p>
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5.0 Discussion and conclusions

5.1 Discussion

The aim of our study was to investigate the micro-foundations of the international opportunity recognition process. We looked at the capabilities that life science SME owners/managers, at different stages, leveraged to acquire specialised technological and market knowledge. Previous literature in international entrepreneurship has not provided an account of the mechanisms underpinning the social and human capital of life science SME owners/managers, at different stages, in order to acquire technological and market knowledge, during the process of international opportunity recognition.

In undertaking this study, we provide four main contributions to the literature on international entrepreneurship. Firstly, we contribute to the existing literature by providing a further understanding of the micro-foundations of the international opportunity recognition process. Secondly, we provide a further understanding of how the mechanisms underpinning social capital were leveraged by owners/managers at different stages, during the process of recognising opportunities for international expansion, within the life science context. Thirdly, our study provides an in-depth insight into the mechanisms underpinning human capital, leveraged by life science SME owners/managers at different stages, during the international opportunity recognition process. Lastly, we uncover an association between the type of knowledge acquired and developed, early and later stage SMEs, and the mode of international market entry. Our key findings are presented in table 13.

Our first contribution provides a further understanding of the micro-foundations of the international opportunity recognition process. Despite some nuances present in our findings specific to the life science and high technology context (e.g. bridging technological and market knowledge), our findings can be applied a variety of different contexts. For example, Swoboda & Olejnik (2016) highlight two studies in which scanning is used by owners/managers in large firms. In addition, studies by Zahra (1991) suggest scanning is associated positively with corporate entrepreneurship. Furthermore, Owens, Zueva-Owens & Palmer (2012) highlight that international partner identification within MNEs is both opportunistic and planned. Similarly, our findings demonstrated that life science SME owners/managers scanned for international opportunities, drawing upon both planned and serendipity encounters.

Furthermore, Owens *et al.* (2012) note that strategic and organisational alignment with partners, such as following the same strategic vision, personal rapport between decision-makers, partner attitudes to commitment, and control were all important when evaluating partnerships. Similarly, our findings corroborated this, where technological and business alignment were posited as key elements in making sense of international opportunities. In addition, Balogun & Johnson (2004) highlight the importance of social interaction in sensemaking for middle managers in larger organisations, during a period of organisational change. Similarly, our findings drew upon the role of social interaction when life science SME owners/managers made sense of opportunities to enter international markets.

Our second contribution to the existing literature lies within further understanding how the mechanisms underpinning social capital were leveraged by owners/managers in early and later stage SMEs, during the process of recognising opportunities internationally, in the life science context. In general, our findings highlight the importance of social capital networks in the opportunity recognition process (Ardichvili *et al.*, 2003; Dimov, 2011; Leppäaho *et al.*, 2018; Teece, 2007). Our study demonstrates that life science firms are highly specialised. They co-operate with their social capital networks to acquire domain specific knowledge (Dimov & Shepherd, 2005). This can be in the form of government sources e.g. business advisors which provide access to market knowledge. Academics in universities provide access to specialised technological knowledge, and in some cases access to specialised resources (e.g. equipment used to analyse data). Other firms such as distributors, CRO's and large and small companies also provide technical support and customer opinions. As suggested by Leppäaho *et al.* (2018), we found that universities, research institutions, customers and sales channels were central actors.

Regarding social capital in the life science context, our findings are consistent with Steinmo & Rasmussen (2018). We found that life science owners/managers leverage cognitive and relational dimensions of social capital, when achieving collaborations. In addition, our findings highlight the importance of the different dimensions of social capital leveraged during each phase of the process of international opportunity recognition. When scanning for opportunities for international expansion, evidence from our exploratory case and later stage SMEs suggest that life science owners/managers leverage principally structural and relational dimensions. As the process unfolds, shared goals and vision becomes more important, and opportunities

are finally selected based upon the cognitive dimension of social capital. However, in early-stage SMEs, the cognitive dimension of social capital is important throughout the entire international opportunity recognition process. This could be due to the large sums of investment involved in R&D, pressure to deliver a return on investment and concerns over the protection of intellectual property (IP).

Co-operation between Life Science firm networks shapes the process of recognising opportunities, within this sector, particularly regarding knowledge sharing. We found that alignment with partners and suppliers, in particular, was central to the sensemaking and selection phases of international opportunity recognition (Teece, 2007). Our findings therefore agree with, and extend the arguments presented by Dimov (2011) and Teece (2007), that opportunities involve social interaction with a range of different actors, which comprise the market. Our findings confirm that the principal actors are buyers and sellers, but the involvement of other actors which can provide specialised technological and market knowledge, such as universities and CRO's, are also key.

In some of our cases we found evidence which supported Dimov (2011)'s suggestion that opportunities simply happen to people, through a series of idiosyncratic actions. Evidence from our exploratory case and later stage SMEs, suggest that life science SME owners/managers were found to leverage serendipity encounters, for example chance meetings at conferences and events, which led to the identification of opportunities. However, evidence from the life science SMEs in the early stages, suggested that the identification of opportunities was more focused e.g. looking for specific molecules or targeting specific individuals who had a specialised technological

skill set required by the organisation, like a 'job spec' (early-stage, C8). Despite this, we posit that the opportunity recognition process is enacted by owners/managers, as they create, interpret and act upon opportunities to enter international markets.

Thirdly, our study provided in-depth insights into the mechanisms underpinning human capital which were leveraged by life science SME owners/managers, in early and later stage SMEs, during the international opportunity recognition process. Our findings agree that two types of domain knowledge exist when recognising international opportunities (Ardichvili *et al.*, 2003; Dimov & Shepherd, 2005). Ardichvili *et al.* (2003) suggest that prior knowledge consists of firstly, special interest knowledge and secondly, industry knowledge (market knowledge, knowledge of customers and how to serve them). Similarly, within the context of venture capital firms, Dimov & Shepherd (2005) suggest the presence of domain specific human capital is central to venture success.

Firstly, our findings agree with these studies, as we found that owners/managers in early-stage life science SMEs leverage their specialised technological knowledge to undertake their R&D activities (Teece, 2007). We elaborate upon this perspective to suit our context of the life science industry. Our findings suggest that owners/managers develop or acquire specialised technological knowledge with varying degrees, according to whether they are in the early stages of R&D or later stages of commercialisation. Secondly, we elaborate on the point that owners/managers acquire and develop specialised market knowledge, during the opportunity recognition process. Specialised market knowledge was found to be acquired by principally owners/manager in the later stages. Our findings also agree that the process of international opportunity recognition

enhances learning by owners/managers and leads to the identification of successful future opportunities.

In addition, our findings indicate that owners/managers of later stage life science SMEs do not always require a PhD in a specialised scientific discipline. Rather, they leveraged their extensive prior experience in international markets, gained from working in large and small companies for 20 plus years. Similarly, Dimov & Shepherd (2005) and Nuscheler *et al.* (2019) found that within the context of venture capitalist and technology-based new ventures, that extensive prior industry experience was central to venture success.

Our findings suggest that life science SME owners/managers are alert to both identifying technological solutions to customer problems, but are also alert to the market need of a customer. Therefore, owners/managers within this context are alert to technology and market needs simultaneously. Life science SME owners/managers were found to leverage heuristics to simplify the information they gathered during the process of international opportunity recognition (Bingham & Eisenhardt, 2011). Similarly, we found that life science SME owners/managers in all stages recognised patterns between technological and market knowledge (Baron, 2006).

Lastly, our findings suggested that technological and market knowledge were both required for owners/managers to recognise opportunities (Siegel & Renko, 2012). However, we also found an association between the classification of firms (early or later stage), entry mode and type of knowledge acquired.

As suggested by our findings, life science SMEs to be divided into two principal firm classifications. Firstly, those life science firms which were in the early stages of R&D

and secondly, those which were in the later stages of commercialisation. These firms selected different entry modes as opportunities for internationalisation. Early-stage life science SMEs leveraged university partnerships and principally developed technological knowledge, whilst those in the later stages developed principally market knowledge through entering international markets using distributor networks, for example. In some instances, where life science firms commercialised products, but also undertook service work, they developed both technological and market knowledge. This was achieved through entering international markets through partnerships with universities and distributor networks, for example.

In addition, owners/managers in early-stage life science SMEs were more likely to exit the company after a specified time period. In contrast, owners/managers in later stage life science SMEs were more interested in expanding their customer base internationally. Reports into the funding structure of the life science industry suggest this nuance may be due to early-stage life science SMEs being funded by venture capitalists and angel investors who seek a return on their investment within typically a 5-7 year period (Life Sciences Industrial Strategy, 2019). The funding structure of later stage life science SMEs differs, in that returns received from sales internationally may often re-invested into the business.

In summary, we have provided evidence from our empirical studies which provides a more in-depth understanding of the mechanisms underpinning social and human capital, when life science SMEs at different stages (early and later), recognise opportunities to enter international markets, to acquire specialised knowledge. Largely, our findings concur with previous studies within this context. However, we uncovered

important insights into the mechanisms underpinning this process, regarding early and later stage life science SMEs. The forthcoming section highlights our main theoretical contributions to the existing literature on international entrepreneurship.

Table 13: Mechanisms leveraged during the international opportunity recognition process within life science SMEs at different stages

	Literature	Exploratory case	Early stage	Later stage
Phase 1: Scanning Human capital	<p>Education- difference in education cause owners/managers to make different decisions (Adner & Helfat, 2003) Domain specific knowledge provides skills which are directly linked to the activities within a firm (Dimov & Shepherd, 2005) Prior knowledge- Experience based learning central to success of launching new products (Nuscheler <i>et al.</i>, 2019) Alertness- perception of anomalies in the environment, reassessing situations rather than following the status quo (Ardichvili & Cardozo, 2000)</p>	<p>Education- PhD in science discipline Prior knowledge- small business owners and academic Alertness- Leverage domain specific knowledge in specialised scientific discipline to search for novel solution to customer needs</p>	<p>Education- PhD in specialised science discipline Prior knowledge -Large and small companies Alertness- Leverage domain specific knowledge to address customer need, emergence, creation and purposeful search (goal driven and analytical)</p>	<p>Education -PhD not always required in specialised science discipline Prior knowledge - Large and small companies Alertness- Leverage domain specific knowledge to address customer need and emergence</p>
Phase 1: Scanning Social capital	<p>Weak ties- low intimacy general information (De Koning & Muzyka, 1999) Strong ties- high quality information, durable, reliable and trustworthy and are developed over time (Peng, 2009) Serendipity- opportunities present themselves (Crick & Spence, 2005) Dimensions- Less experienced firms initially based collaborations on relational dimension (Steinmo & Rasmussen, 2018)</p>	<p>New and existing ties (strong and weaker) e.g. networks internal to the firm Serendipity- network events (other owners/managers or potential customers) (temporary and relational)</p>	<p>Existing ties (stronger) Targeted search for individuals who possess specialised knowledge Dimensions- relational, structural and cognitive Main actors- Investors,</p>	<p>New and existing ties (strong and weaker) Serendipity- network events(temporary and relational) Dimensions- relational and structural dimensions Main actors- Customers (and</p>

	<p>Main actors- Industry contacts (Ozgen & Baron, 2007; Zahra <i>et al.</i>, 2005) Universities, research institutions, customers and sales channels (Leppäaho <i>et al.</i>, 2018) Customers (Teece, 2007) International networks (e.g. distributors) useful when overcoming language, cultural and other more tacit barriers (Karra <i>et al.</i>, 2008) Existing networks, partnering and spending time in international markets to gain international market knowledge (Love & Roper, 2015)</p>	<p>Dimensions- relational and structural dimensions Main actors- events, internal, existing networks, proposals, traditional uses</p>	existing networks, conferences, competitors, universities, targeted e-mails/phone calls	surveys), events/trade shows, e-mail, industry and market reports/ databases, spend time in international market, government advisors and industry contacts
<p>Phase 2: Sensemaking Human capital</p>	<p>Prior experience- Alvarez & Barney (2007) highlight the role of prior experience and knowledge of markets and products as central in the exploitation of opportunities Heuristics- cognitive shortcuts (Bingham & Eisenhardt, 2011) but can cause biases (Keh <i>et al.</i>, 2002). Pattern recognition- connect the dots between independent events (Baron, 2006)</p>	<p>Prior experience- Past experience in international markets and technological knowledge help to predict future outcomes Heuristics- Simplify information gathered in order to help manage information overload Pattern recognition- Recognise patterns between technological</p>	<p>Prior experience- Past experience in international markets and technological knowledge help to predict future outcomes Heuristics- Simplify information gathered in order to help manage information overload Pattern recognition- Recognise patterns</p>	<p>Prior experience- Past experience in international markets and technological knowledge help to predict future outcomes Heuristics- Simplify information gathered in order to help manage information overload Pattern recognition- Recognise patterns</p>

		knowledge and market knowledge	between technological knowledge and market knowledge	between technological knowledge and market knowledge
Phase 2: Sensemaking Social capital	<p>Dimensions- cognitive and relational dimensions when achieving collaborations (Steinmo & Rasmussen, 2018)</p> <p>Main actors- Social interaction with a range of different actors, which make up the market e.g. buyers and sellers (Dimov, 2011)</p> <p>Industry contacts (Ozgen & Baron, 2007; Zahra <i>et al.</i>, 2005)</p> <p>Customers (Teece, 2007)</p> <p>Scientists and technically qualified people help to shore risk and expertise for approval processes (Nummela & Nurminen, 2011)</p> <p>Universities help to provide expertise in an area the firm may be weak in (Dooley & Kirk, 2007)</p>	<p>Dimensions- Draw upon relational, structural and cognitive dimensions to help knowledge transfer, assess strategic fit and reduce uncertainty</p> <p>Main actors- Academics, owner/managers of large and small companies, business advisor (local government)</p>	<p>Dimensions- Draw upon relational, structural and cognitive dimensions to help knowledge transfer, assess strategic fit and reduce uncertainty</p> <p>Main actors- Experienced industry contacts, universities, investors, market analysts'/ clinical groups, board members, scientific advisory board, CRO's, legal teams, consultants, small business networks</p>	<p>Dimensions- Draw upon relational, structural and cognitive dimensions to help knowledge transfer, assess strategic fit and reduce uncertainty</p> <p>Main actors- Customers, Distributors, board members, clinicians, end users, universities, shareholders and other small companies</p>
Phase 3: Selection Human capital	<p>Value perception/practicality</p> <p>Understand value of opportunity for furthering the business (Kontinen & Ojala, 2011)</p>	Based upon practicality of technological and market knowledge to further grow business	Based upon return on investment	Based upon repeat sales

Phase 3: Selection Social capital	<p>Dimensions- cognitive and relational dimensions when achieving collaborations (Steinmo & Rasmussen, 2018)</p> <p>Main actors- Industry contacts (Ozgen & Baron, 2007; Zahra <i>et al.</i>, 2005)</p> <p>Customers (Teece, 2007)</p> <p>Venture capitalists- significant input to the strategic direction of the firm (Leppäaho <i>et al.</i>, 2018)</p>	<p>Dimensions-Leverage cognitive dimension to assess alignment of technological and market knowledge with main actors</p> <p>Main actors- Suppliers, partners and potential customers</p>	<p>Dimensions-Leverage cognitive dimension to assess alignment of technological and market knowledge with main actors</p> <p>Main actors- CRO's and investors</p>	<p>Dimensions-Leverage cognitive dimension to assess alignment of technological and market knowledge with main actors</p> <p>Main actors- Customers, distributors/ partners</p>
Outcomes	<p>Evolution of knowledge</p> <p>In order to recognise opportunities internationally, owners/managers need to understand technology and markets (Bruni & Verona, 2009; Siegel & Renko, 2012)</p> <p>Technology is a core component of the opportunity (Park, 2005)</p> <p>Knowledge needs to be constantly replenished in fast moving industries (Eisenhardt & Martin, 2000 and Yli-Renko <i>et al.</i> 2001)</p> <p>Knowledge acquisition can lead to the development of new products, technologies and commercialization pathways (Yli-Renko <i>et al.</i>, 2001)</p>	Evolution of technological and market knowledge	Evolution of principally technological knowledge	Evolution of principally market knowledge *

	International market entry Establish R&D partnerships and a customer base and/or distributor networks (Nummela & Nurminen, 2011; Petruzzelli & Rotolo, 2015)	International market entry- R&D partnership formation with research institutions /supplier/distributor/ customers	International market entry- R&D partnership formation with research institutions	New international market entry/ growth of international sales
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*In some cases where owners/managers commercialise products and offer service provision, they acquire and develop both technological and market knowledge equally

5.2 Theoretical contributions

In undertaking this study, we have made four main theoretical contributions to the existing literature. Our main contribution lies within understanding the micro-foundations which underpin the international opportunity recognition process. We also provide three context specific contributions, grounded in the life science industry context. These are outlined in the points below.

- We contributed to the wider literature on international entrepreneurship and dynamic capabilities by identifying the micro-foundations which underpin the international opportunity recognition process.
- We provided a further understanding of how the mechanisms underpinning social capital were leveraged by owners/managers at different stages, during the process of recognising opportunities for international expansion, within the life science context.
- We provided an in-depth insight into the mechanisms underpinning human capital and how they were leveraged by owners/managers within the life science industry context, at different stages, during the international opportunity recognition process
- We extended the understanding of technological and market knowledge acquisition and international opportunity recognition within the life

science industry. We expanded upon this point by providing an in-depth understanding of early and later stage life science SMEs, the type of knowledge principally acquired, and the type of international opportunity recognised, as an international market entry mode.

Having highlighted our theoretical contributions, we also provide insight into the managerial implications of our research, policy recommendations, limitations to our study and potential for further research within this context.

5.3 Implications of research

Our research highlights important theoretical and practical contributions. Our research has provided a theoretical contribution to the understanding of international opportunity recognition, as it identified the specific mechanisms activated by life science SME owners/managers, at different stages, during this process, when acquiring specialised technological and market knowledge. Furthermore, our research provides managerial implications and potential recommendations for policymakers.

5.3.1 Managerial implications

Our analysis demonstrated the importance of the mechanisms underpinning life science SME international opportunity recognition, when acquiring specialised technological and market knowledge. By unpacking these mechanisms embedded in human and social capital, we can draw life science SME owners/managers attention to the types of activities which they can build upon and leverage to acquire specialised knowledge.

Our evidence has shown that networking events are useful to owners/managers in the early stages of their company development. Attending these events can help them to establish networks and provide sources of technological and market knowledge, which can be leveraged in the future. Networks also influence international market entry, as SME owners/managers leverage their existing contacts. Owners/managers should leverage serendipity encounters (e.g. at events, via e-mail) in order to extend their networks, provided they are in alignment with the products and services which they offer.

5.3.2 Policy recommendations

This research could help to inform public policy, especially regarding SME internationalisation. Despite export 'how to' guides and basic information regarding export markets being useful to SME owners/managers in the early stages of venture development, public policy should be more focused upon providing information according to owner/manager experience and interest (Potter, 2017).

As suggested by Potter (2017) SME support should be less generalised and more targeted to the SMEs requiring assistance. As highlighted by Potter (2017) SMEs in early stages of international market entry could benefit from the use of 'how to' guides. More experienced SME owners/managers may require more tailored assistance to address specific issues, such as access to funding for marketing new products. From this point of view, assistance may be better geared towards working directly with life science SME owners/managers, in order to understand how they make decisions about international market entry.

Government policymakers often view barriers to SME internationalisation as being due to internal capabilities (e.g. lack of time, personnel training), information (e.g. unfamiliar exporting procedures, foreign business practices) and finance (inability to employ experts) (Potter, 2017). However, through working more closely with owners/managers policymakers can identify key issues which are specific to the sector and the organisation. Through better understanding the mechanisms underpinning the process of SME international opportunity recognition, policymakers can provide further support such as sector-specific conferences and meetings. This would enable SME owners/managers, with varying levels of experience, to share their knowledge and provide a platform for discussion of key issues.

As an example from our research, life science SME owners/managers could benefit from further training on methods of how to protect their intellectual property (IP) when entering international markets. As life science SMEs grow and commercialise, further training of how to effectively market new products in international markets would also be useful. In conclusion, a more tailored approach to the development of public policy could prove beneficial to life science SMEs, when recognising opportunities internationally.

5.4 Limitations and further research

During the course of this research, we contributed to the existing literature on international entrepreneurship by extending our understanding of the international opportunity recognition process. Specifically, we provided a further understanding of the micro-foundations of the international opportunity recognition process, within our context of life science SMEs. As discussed in previous sections, our findings may well be

generalizable to other industry contexts. However, we acknowledge the limitations to our study. For example, future research could provide further insights into how entry modes are developed over time, using a longitudinal case design, as our study was set within a limited timeframe. In addition, further research could extend our study by exploring the importance of outcomes in the exploitation of international opportunities, as our study does not focus upon the impact of learning from failure and success, when recognising opportunities to enter international markets. Furthermore, we noted from our findings that SME owners/managers were often involved in many daily activities simultaneously, from managing expenditure, to business planning, giving presentations and networking with potential buyers and suppliers. Our study does not fully explore the role of cognitive overloading upon owners/managers, and how this impacts upon their ability to recognise opportunities to enter international markets. These limitations to our research could provide useful directions for future research into the international opportunity recognition process.

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