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## **OPPORTUNITY RECOGNITION BY INTERNATIONAL HIGH TECHNOLOGY START-UP AND GROWTH PHOTONICS FIRMS**

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**Abstract:** For high technology firms that depend on foreign markets from the outset, identifying opportunities is a matter not only of business development but of survival. This study contributes to the opportunity recognition literature by exploring the paths taken by these international entrepreneurs to find opportunities in foreign markets. Moreover, it examines the paths of firms at different lifecycle stages. Based on in-depth interviews with 5 start-ups and 5 growth firms in Canada specialized in photonics, this research delves into both the personal characteristics of the entrepreneurial teams and the methods they use to find international opportunities. The sources they use as well as the actions undertaken are examined and compared. The practical goal is to identify path components which may be adjusted in start-up firms to improve the probability of finding and developing fruitful opportunities.

**Keywords:** opportunity recognition, international business development, high-tech SME, start-up, growth firm, international entrepreneurship, network, prior knowledge, previous experience, alertness, activeness, spin-off

## 1 Introduction

Since the 1990s, a growing body of research has explored dimensions of international entrepreneurship, including the characteristics and motivations of these entrepreneurs, the entry modes they use, factors leading to early internationalisation and its advantages, the process of internationalisation, and performance correlates (Jones *et al.*, 2011; Mainela *et al.*, 2014; Coviello, 2015). Entry into foreign markets extends the client base with the objective of increasing sales volume (Paul and Wooster, 2008). For high technology small and medium enterprises (HTSME) that produce and sell products for which domestic demand is limited or non-existent, an international orientation is crucial for survival and long-term growth (Fryges, 2009). These firms are therefore characterized by a business model in which internationalisation plays a key role.

Furthermore, high technology firms often possess breakthrough scientific knowledge and have or are in the process of developing cutting-edge technologies based on this knowledge. Potential applications of this knowledge and technology in the marketplace must first be discovered and the technology must be adapted or created through research and development (for example, pilot projects to apply the technology within a specific industry). In this way, high technology firms transform their technology into solutions for industry, government, and/or consumers. Moreover, in spite of discovering promising technology, survival of high-tech firms must find and exploit their innovation strategy quickly. Failing to do so may allow competitors to enter the market (Park, 2005). While rapid strategy deployment and revenues and/or financial support are obviously important factors in their survival, finding opportunities for concrete applications of technology is at the heart of initial success, and continuing to find new opportunities (new markets for technology applications or new applications of technology to solve market problems) is essential to business survival and growth. Without appropriate opportunities to allow them to propose new solutions and to prove the utility of their technology, these firms have no way to generate revenues.

Currently, there is a gap in the literature to help understand how high tech firms “discover” such international opportunities, especially in a B2B context, or whether opportunity research strategies differ for firms in the start-up phase and those in the growth phase. Therefore, to contribute to the current discussion in the opportunity recognition literature, this research will focus on opportunity recognition practices of both start-up firms and growing firms.

The sector of application is high technology firms specialized in photonics technologies who are involved in international markets. These technologies promise to increase precision and productivity in the industrial and commercial sectors, sometimes at lower cost compared to older methods. They are also capable of generating innovative products for long-awaited solutions. Given the nature of many photonics applications, domestic markets typically present limited demand, leading start-up photonics firms to embrace foreign markets from the outset. The photonics sector may in this sense be considered similar to other high-technology industries where continual opportunity recognition is imperative for success and growth, and global markets are essential.

An exploratory multiple-case study of 5 start-ups and 5 growth-stage firms from Canada, specialised in photonics, has therefore been conducted. For a start-up, finding the first opportunity may or may not lead to market success; furthermore, even initial market success may not necessarily lead to market expansion. Since opportunity recognition represents the crucial foundation for market success, it makes sense to examine the sources and practices of these firms.

The approach of this research and its major contribution to the opportunity recognition literature is the investigation of the similarities and differences in the opportunity search and recognition paths employed by both start-up and growth firms (i.e., those that have succeeded in growing and expanding their markets) in high technology international entrepreneurs. The practical goal is to identify path components which may be adjusted in start-up firms to improve the probability of their future success.

The following sections will present a review of the literature dealing with international entrepreneurship, and the concepts of opportunity and opportunity recognition. The pertinent constructs are used to propose a model of opportunity recognition (Figure 1). The specificities of internationalized high tech SMEs are also presented to situate opportunity recognition within the context of their reality. After presentation of the methodology and the findings, the discussion summarizes the patterns observed. Conclusions, limits to the generalisation of results, future research directions, and managerial implications are given.

## **2 Literature review in international entrepreneurship**

The following sections aim to conceptually identify elements of opportunity search and recognition in internationalised high-technology SMEs according to their lifecycle stage. These elements are then summarised in a model of opportunity recognition (Figure 1)

### *2.1 Opportunity*

Opportunity is central to the entrepreneurship definition as proposed by Shane and Venkataraman (2000: 218): «The field of entrepreneurship is defined as the scholarly examination of how, by whom, and with what effects opportunities to create future goods and services are discovered, evaluated and exploited.» Internationalisation is also opportunity driven (Zahra *et al.*, 2005). It is not surprising, therefore, to see opportunity dimensions in the definition of international entrepreneurship: the “discovery, enactment, evaluation, and exploitation of opportunities - across national borders - to create future goods and services” (Oviatt and McDougall, 2005: 540). Entrepreneurs must then recognise opportunities and act on them by deploying the resources they control to establish viable businesses (Di Gregorio *et al.*, 2008). Ellis (2011: 101) extends the notion of international opportunity beyond the creation of future goods and services by including the opportunity to serve new foreign customers in new markets: “...the chance to conduct exchange with new partners in new foreign markets, including foreign intermediaries or foreign customers”. Opportunities are first recognised, or discovered, their feasibility is evaluated, and

then they are exploited (Ardichvili *et al.*, 2003). For the purpose of this article, only the recognition of opportunities will be analysed for a sample of firms for which international opportunities are a natural part of their existence.

## 2.2 Opportunity recognition

Opportunity recognition relies on prior knowledge, alertness, and activeness, as well as entrepreneurs' existing ties, which may be either social or business related (Kontinen and Ojala, 2011). **Prior knowledge**, contributing to industry- and market-specific opportunity recognition, refers to ways to serve markets and awareness of customers' problems (Shane, 2000; Ozgen and Baron, 2007). Although knowledge may be more general, as coming from media and education, experience-based knowledge is emphasized since successful high-tech firms usually have a founding team aware of the importance of an international presence. The complementarity of their team members in terms of experience leads to the firm's high growth, notably in expanding markets (Kaczmarek and Ruigrok, 2013). Their knowledge and their **vision** are key to recognition of international opportunities. Entrepreneurs' **alertness** comes from their high intelligence, creativity, and optimism (Ellis, 2011). Furthermore, Kontinen and Ojala (2011) suggest that the **active role** of entrepreneurs in opportunity seeking through personal contacts is more beneficial than the identification from public information.

## 2.3 Opportunity Recognition Methods

Opportunity recognition methods have been identified in previous studies. Ellis (2011) has categorised recognition methods either as tie-based (through social or business networks) or non tie-based. **Tie-based sources** such as mentors and informal industry ties are more beneficial than family and friends, who normally lack industry-specific knowledge. Prasantham (2006) noted that foreign network relationships provide opportunities, information, and advice. A large proportion of firms use their network for knowledge about international markets to improve their international competitiveness and performance. (Johanson and Vahlne, 2003; Kenny and Fahy, 2006; Loane and Bell, 2006). Moreover, information abundance favours entrepreneurs' ability to recognise opportunity, which in turn contributes to increase the entrepreneur's ties (Kontinen and Ojala, 2011). However, relying only upon networks may also be accompanied by constraints. In his study, Ellis (2011) found that only 40% of opportunities identified by his sample firms were the result of ties. Furthermore, tie-based opportunities were found to be constrained in terms of geographic, psychic and linguistic distance, suggesting that networks are bounded by communication horizons. There is therefore a need to balance the benefits from ties and overcome their constraints (Hohenthal *et al.*, 2003) and, in the case of internationalisation, to search for a mix of opportunities presented by the network as well as those resulting from serendipity (Spence, 2003). These authors include in opportunity recognition the initial step of opportunity search. However, the use of networks (tie-based) , accompanied by opportunity seeking (non tie-based methods), may provide the better fit to reduce risks (Mort and Weerawardena, 2006).

Non-tie based methods may compensate for limited networks as a major source of international opportunities for SMEs (Kontinen and Ojala, 2011). They include structured search methods through formal sources and data collection, fair-based

methods (exhibitions, conventions, trade missions), and advertising based methods such as corporate websites (Ellis, 2011). Coviello (2006) emphasizes that professional forums and trade exhibitions are not only sources of information but provide high potential for developing network ties, while Spence and Crick (2006) suggest that events play a more important role than suggested in the literature.

Once founders recognise opportunities, they must also be sufficiently knowledgeable and motivated to exploit them (McMullen and Shepherd, 2006). The repetition of this opportunity cycle sums up in entrepreneurial learning (Chandra *et al.*, 2012). Entrepreneurs improve their ability to identify and develop better and more diverse opportunities over time. Failures also contribute to learning about opportunity space, prior relationships, and prior accumulation of resources. Thus, firms seize smaller opportunities at their initial stage, and then shift to larger ones as their capabilities, resources, networks, and international entrepreneurship intentionality increases. Their market commitment follows their market learning. As experience increases, search for opportunities and their evaluation are formalised (Varis *et al.*, 2005). It follows that as the internationalisation process becomes systematic with formal planning, including long-term objectives, the firm's performance improves in terms of market shares, number of markets, and developed competencies (Yip *et al.*, 2000). At this point, networks must be managed accordingly with firm's products, resources, and requirements (Ruokonen *et al.*, 2006). Firms must strike a balance between strategy-making and responding opportunistically to new possibilities that emerge through these relationships (Prashantham and Berry, 2004). Based on the discussion above, different stages of growth may be expected to lead to more formalized behaviour related to the activities which generate opportunities as the firm advances from start-up to growth.

#### 2.4 Specificities of high technology SMEs

High tech SMEs generally focus on niche-oriented markets; international presence is therefore essential to register sufficient sales to cover R&D investment before the product becomes obsolete (McDougall and Oviatt, 1996; Lindqvist, 1997; Preece *et al.*, 1998; McNaughton, 2003; Nummela, 2004). Moreover, high tech SMEs are particularly represented in international entrepreneurship because of their intensive growth and their simultaneous operations in a wide number of countries (Kuivalainen *et al.*, 2004). It is therefore not surprising that most studies in international entrepreneurship observe high technology SMEs (Jones *et al.*, 2011). Even though international new ventures are not all exclusively in high tech industries, their knowledge intensity increases their propensity to internationalise (Harveston *et al.*, 2001). Furthermore, those that register high performance have a high percentage of international sales (Feesser and Willard, 1990). The earlier firms go to foreign countries, the better their knowledge intensity, and the faster they deploy internationally (Autio *et al.*, 2000). Furthermore, many modern high tech SMEs exploit knowledge-based innovations. These firms are typically "temperamental, capricious, and hard to manage" and are subject to special challenges due to long lead times, casualty rate, and unpredictability (Drucker 1985).

Furthermore, in an industrial context, high tech SMEs are not alone; rather, they are part of an ecosystem, or network, of social and industrial relations including, for

example, clients, providers, competitors, family, and friends. These relations are beneficial resources for obtaining information and overcoming barriers to export (Ibeh and Kasem, 2011), to dealing with a lack of resources, and to increasing a firm's credibility, its internationalization, and its marketing capabilities (Mort and Weerawardena, 2006). According to Fernhaber and Li (2010), international exposition of high tech SMEs is initially furnished by informal networks represented by the firm's close environment, then by formal alliances. Trade shows and seminars, public relations and word of mouth are also good vectors to optimize the industrial firm's network (Altshuler and Tarnovskaya, 2010).

More formally, high-technology firms often form clusters which allow them to reach a critical mass in order to share knowledge as well as attract potential clients and partners. The cluster may include a science park where interrelations between actors may allow new opportunities to emerge through synergy (Jimenez-Zarco *et al.*, 2013). Universities and incubators often play a catalyst and accelerating role for both the creation, growth, and survival of high-tech firms (Sa and Lee, 2012). They also offer great networking possibilities to establish collaborations with other organisations internationally (Carayannis and von Zedtwitz, 2005).

Businesses participate in a cluster to take advantage of the quality of available resources, reduce the costs of transactions and benefit from the transfer of knowledge that fosters the development of new and creative ideas (He and Fallah, 2011; Lamprinopoulou and Tregear, 2011). Being part of a cluster provides access to common resources, interactions with neighbouring businesses as well as a sense of confidence that improves business transactions (Gnyawali and Srivastava, 2013). Clusters also stimulate innovation through their competitive environment. Studies have shown that businesses that belong to a cluster experience stronger innovation development and more rapid growth than independent businesses (Menzel and Fornahl, 2010; Boschma and Fornahl, 2011). In high-technology industries, innovation clusters are characterized by heightened mobility of resources, increased velocity of business development, and an affinity for collaboration (Engel and del-Palacio, 2009). Clustering also allows participants' firms to reduce legitimating expenses, to charge premium prices and position itself on the higher end of a market and thus facilitate the finding (or "being found" by) customers. Firms in a cluster also have more access to a specialized labour force, a scientific infrastructure, and the informal network of firms within their cluster (McHardy *et al.*, 2005). Clustering favours relationships that facilitate and accelerate innovation and entrepreneurship within itself and around the world (Saxenian, 2006; Engel and del-Palacio, 2009). New knowledge available in a region and its surrounding areas induces and facilitates new firm creation, with the intra-regional effect being stronger, and even more so in high-tech industries (Lee *et al.*, 2013). McHardy *et al.* (2005) have shown that cluster externalities have a positive impact on the internationalization process of firms within the cluster. In the internationalization process of high tech firms, the relationship is stronger when network relationships existed before the inception of the international technology alliance, allowing trust-building and behavioural monitoring (Lew *et al.*, 2013). In an international context where regions are competing for resources, regional industrial identities influence the attraction and retention of resources (Romanelli and Khessina, 2005). A cluster's reputation has a positive impact on its stakeholders: it unites them around a unique identity to achieve a common goal; it facilitates their internationalization; it demonstrates a social responsibility effort; it helps attract

human resources, new members, and capital investments (Lundequist and Power, 2002; Spence and Essoussi, 2010; Andersson et al., 2012). Such capital investments in the commercialization of new technologies could also depend on the investment cycle and the availability of capital in the venture industry (Nanda and Rhodes-Kropfa, 2013).

In brief, membership in a cluster favours opportunity recognition and exploitation because of the network they offer to firms, both locally and internationally, as well as the constant interaction and collaboration between members (Arikan, 2009; Manning *et al.*, 2010; Alberti *et al.*, 2011; Felzensztein *et al.*, 2012).

(Figure 1 about here)

Figure 1 regroups the constructs from the international entrepreneurship literature related to opportunity recognition, discussed above. Previous research on high-technology SMEs active in B2B markets suggests that this general model may be applied to their specific industrial contexts. Figure 1 suggests that the characteristics of founding entrepreneurs of high technology firms that led them into the entrepreneurial endeavour (prior knowledge, alertness, activeness) may continue to assist them in recognising, or identifying, market opportunities for the firm. In addition, opportunity search may lead to opportunity recognition. The model suggests two sources of opportunities: tie-based methods (business and social networks) and non tie-based methods (concrete search on the part of the firm or serendipity). The methodology below aims to shed light on the applicability of this model in the specific domain of high tech SMEs specialized in photonics. Our general research question can be divided into four sub-questions.

For internationalized HTSME

1. Do certain characteristics of the entrepreneurial team (prior knowledge, alertness, activeness) influence opportunity recognition?
2. Do tie-based sources of opportunities (social networks and business networks) influence opportunity recognition?
3. Do non tie-based sources of opportunities influence opportunity recognition?
4. Are start-up firms different from growth firms in their characteristics or their practices related to opportunity recognition?

The methodology below was designed to respond to these questions.

### **3. Case study methodology**

This study aims to deepen our understanding of how high tech SMEs recognize international commercial opportunities. Such a «how» question can best be answered by qualitative research (Eisenhardt, 1989; Yin, 2003; Zou and Ghauri, 2010). Coherent with the recommendation of Rialp *et al.* (2005) in their thorough review of research on born globals, the present research is based on a case study approach. Furthermore, Eisenhardt (1989) recommends the use of multiple case studies, from four to ten, for analysis of a process to ensure sufficient data without creating overload during analysis. Multiple case studies permit the development of richer



insights and a more in-depth understanding (Yin, 2003). We therefore use multiple case analysis and present below a description of the research method pursued to validate the theoretical framework in Figure 1. Since national culture and the particular technological domain could influence firms' behaviours (Oviatt and McDougall, 1997; Knight and Cavusgil, 2004; Manolova and Manev, 2004), we focus on a unique country, cluster, and a unique technological domain. Data collection and analysis for each case followed the same protocol. In this research, the unit of analysis is the internationalized high-tech SME which is in line with our research questions.

### *3.1 Research settings*

The context chosen for this study is the photonics industry, because it deals with applications of fundamental scientific advances, which can be a major factor for socio-economic development. In a broad sense, the definition of photonics relates to the generation, control, detection and processing of light for the purposes of transmitting information and data (Frietsch and Grupp, 2006). Optical technology is a so-called "enabling" technology that serves as input for other technical applications and products. Its use has become popular with the advent of lasers, fibre optics, LEDs, and optoelectronics, among others. Photonics is an important, strategic industry with applications in many high-technology products and markets (Hendry *et al.*, 2000). It is characterized by large numbers of high-technology SMEs concentrated in regional clusters spread around universities and research centres (Pereira and Plonski, 2009) and engaged in symbiotic relationships with multinational firms. The characteristics of the industry favour strong international relationships (Hendry *et al.*, 2000). Reputation is a very important competitive dimension in photonics-related industries (McHardy *et al.*, 2005).

The dependence of these firms on opportunity recognition and the importance of photonics to industrial productivity and growth make it an ideal candidate for the study of international entrepreneurship. 38 photonics clusters have been identified worldwide (SPIE, 2012). For the present study, both samples were chosen from the Quebec City Photonics Cluster (Canada).

The Quebec City Photonics Cluster regroups 35 firms in the photonics sector identified from the database of the Quebec Ministry of Finance and Economy which may be categorized into North American SCIAN codes 334511, 334512, 339110. The cluster also includes a scientific park, an incubator, a University, a national institute, 18 research chairs and groups, 5 research centres, and laboratories in that field. The sector employs 3,000 people of which 800 are dedicated to research. Firms register a total of 400M\$ CAD (approximately \$310M USD) in revenues, of which 85% is generated by exports.

Since the research aims to identify international business development activities, and more specifically, opportunity recognition, at different lifecycle stages, cases were chosen among independent firms based on their stage of development (Stake, 1994; Perren and Ram, 2004): five start-up firms and five growing firms. A high-tech start-up was defined as an independent firm manufacturing a product, with 10 or less employees, registering less than \$5 million in annual revenues. A high-tech growth firm was identified as an independent firm, manufacturing a product, having between

11 and 250 employees, registering less than \$25 million in annual revenues. The age of the firm is reported in the profile of respondents; however, age was considered with caution since in high technology firms, the delay between the foundation date of the firm and the first sale may be quite long (Drucker, 2015). All firms were involved internationally.

Following those criteria, sample firms were chosen from the Quebec City photonics cluster using the governmental database, in collaboration with the regional economic development agency. Coviello and Jones (2004) support the use of judgment sampling when sample criteria are well specified. A non-random sampling is also suitable for extending theoretical knowledge according to Eisenhardt (1989).

### *3.2 Data collection*

To allow triangulation to ensure the validity of the study and to obtain a more comprehensive and accurate view of the topic, data were collected from multiple sources: secondary information and semi-structured interviews with the two groups of entrepreneurs. Moreover, industry reports and industry experts were consulted to validate our understanding of industry dynamics. Both data collection instruments were submitted to three economic development counsellors specialized in photonics to validate the pertinence and the clarity of the questions. They were then pretested on a start-up and a growing firm. Their comments were taken into consideration in the final version of data collection tools.

First, a descriptive portrait was prepared for each respondent firm using secondary data from publicly available sources: company website, government databases, media coverage. Information retrieved included: names of the entrepreneurial team, their previous experience, foundation year of the firm, spin-off or not, actual development stage, number of employees, revenues, clients, and international presence. This information was then validated by the key informant at the end of the semi-structured interviews.

Second, face-to-face semi structured interviews of 120 minutes were held with key decision makers (founders or CEOs) in each of the 10 firms. An interview guide structure enabled comparison within and across groups. Questions were related to the following topics: the background of the founding team, the creation of the firm, its internationalisation process and actual presence, and its learning. All interviews were recorded with the respondent's permission, immediately transcribed verbatim, verified by the principal researcher who conducted the interviews, and coded using QDA Minor by two independent coders. Inter-coder reliability was verified by a coding exercise, occasional differences were discussed, and modifications were made to the coding key. Inter-coder reliability is perceived as a useful measure of the quality of research (Perreault and Leigh, 1989; Kolbe and Burnett, 1991).

The data were then organized and analysed using a widely-adopted matrix approach (Mort and Weerawardena, 2006; Child *et al.*, 2009). Such categorization enabled within-group comparisons (start-up or growth) to discover consistent patterns (Yin, 2003) as well as inter-group comparisons. Inter-group comparisons were later performed and compared to the extant literature to identify both conflicting and corroborating frameworks. As suggested by Eisenhardt (1989) and Mort and

Weerawardena (2006), inconsistencies may point to propositions that could explain the data and opportunities to uncover deeper meaning.

### *3.3 Case study description*

Figure 2 presents the profile of sample photonics firms, 5 start-ups and 5 growing firms, in terms of origin (spin-off or not), founding team's previous experience, types of clients, number of employees, revenues, percent of export sales, number of countries for international sales and number of continents involved. All firms demonstrate very high export intensity (% of export sales) of 80% to 100%. All five start-up firms in the sample sell their products to private firms. In the growth sample, only four first sell to private firms. One start-up and one growth firm sell to public laboratories as well. The only "distinguishing" characteristics between the groups at the time of the study are -- aside from those related to case selection (for example, firm were 4 to 8 years old for the start-up group and 11 to 23 years old for the growth group) -- that growing firms have greater revenues, and sell to a larger number of foreign countries (median of 29 compared to 5) on more continents (median of 4 compared to 3). These differences are to be expected for growing firms. Firm S2 was still considered a start-up even though it was 8 years old because it was founded while the entrepreneur was still at university; therefore, the activity was not full time at inception and the product not completely ready for market until three years later. Start-up case 5 was retained in the start-up sample in spite of the number of employees being somewhat higher than the other cases in this group; based on its age and revenues, the industry expert consulted readily classified this firm as a start-up.

(Figure 2 about here)

## **4 Case findings**

To add depth to the realities of our respondents, findings are at times accompanied by citations from interviews.

### *4.1 Prior knowledge and experience*

Before founding their respective firms, the entrepreneurial teams in the study had a wide range of previous experience. Almost all founders had a scientific degree either at a master's or doctoral level. Three firms were created during (S2) or immediately after (S4, G3) the founders completed their degrees. One of these founders did his studies in another country (S4). Three entrepreneurial teams (S1, G1, G5) had only been working as scientists before launching their businesses; only one of these (G1) also had experience presenting the technologies developed at his public laboratory to organisations in foreign countries.

Two teams (S3, S5) had combined experience in research, in the industry, and internationally. Two others (G2, G4) had members who had worked only in the industry before starting their firm; one of the team members of firm G2 had experience in international sales and marketing.

In addition to the founding team's knowledge and experience, firms which were spinoffs (S1, S3, S5, G1, G5) sometimes benefited from the incumbent organisation's resources and networks.

«When the firm was launched, two-thirds of the products were already commercialised by INO (National Optics Institute). There was already business being done, and the clients came back. We just had to continue the business, to contact the actual clients, to send a press release. So there was already a flow of business development.» (S3)

#### *4.2 Alertness to opportunities*

Being alert to opportunities does not necessarily require structured research, but rather openness to possibilities that may result in new clients or new markets for the firm. An alert entrepreneur observes the firm's environment with an inquiring mind, an optimistic perspective, accompanied by creativity in integrating new information. Thus, a growth firm mentions "being informed" as an important element to interpret requests from potential clients and spot new potential markets. For example, being alert to legislation may play in favour of the new technology.

In addition, the popularity of industry events and the use of networks, to be discussed later, show the importance for entrepreneurs to be informed of competitive offers and customer needs.

While some start-up entrepreneurs mention information that most likely comes from being alert to what is happening in the industry, locally and internationally, others do explicit search for opportunities through events related to product use:

“There is a Canada-Chili agreement that will really decrease customs duties; therefore, that will help us” (S4).

#### *4.3 Activeness*

Activeness in using personal contacts for privileged information, as well as using public information also characterizes entrepreneurs who actively provoke meetings with potential clients. These actions were observed in both start-up and growth firms.

“I didn't really need a network of contacts. For the contact, you pick up the phone and you call... So you navigate, you go get the person. You put someone in sales and you have salespeople who open the doors and will talk to people. Emails – today people are swamped, but not too many telephone calls. So the idea is to say “Listen, I will be coming through your city; I'll stop to see you.” (G4)

The practices observed among respondent firms lend positive support to research question No. 1: Do the characteristics of the entrepreneurial team (prior knowledge, alertness, activeness) influence opportunity recognition?

#### *4.4 Tie-based and Non Tie-based Methods*

##### *4.4.1 Tie-based Methods*

Social networks are not specifically mentioned by study participants. However, business networks are sources of opportunities. A start-up firm used its contact with a local firm that has opened a market in another country to discuss the potential market for their own technology in that country (S1).

Direct referral by important clients, also viewed as part of a firm's network, is not only a chance to obtain new clients; it is also an attempt to gain credibility in the perception of those potential clients:

“Everything works by referrals. Having our multinational client helps us quite a bit. If you succeed in being a good supplier, people will refer you. Our international expansion is due to our multinational client. We could become a “must” for all their suppliers. The biggest challenge is credibility. We must be reliable to the thousandth of an inch. To have sold and installed a machine for the multinational firm is a selling point.” (S2)

Another type of networking is with employees in the potential client's organisation or through distribution partners who will champion the product internally.

“There are two doors: either the direct entry – find someone in the agency who is capable of being your champion, who believes in your product and is ready to sell it inside ...or the indirect entry by a systems integrator, who already has contracts with the agency, who is ready to push.” (S1)

The older, more experienced growth firms are able to draw upon their previous contacts from industry or research experience to further develop their networks and to remain informed of activities in the industry worldwide. For example:

“People who are in companies today are the people who were in universities 20 years ago...Those people went all over the world, and so I know people all over the world who work in fibre optics...we talk, we see each other. I am able to know a bit of what is going on the United States; there are others in Asia and others in Europe...By this network, we are able to know what's happening.”(G5)

However, this same entrepreneur suggests that due to the globalisation of the industry, established networks may be insufficient to remain fully informed:

Respondents also value networks of foreign representatives (agents, distributors) to increase either the efficiency or rapidity of the start of sales efforts or to build and maintain relationships with clients in non-English speaking countries where the relationship vendor-buyer is essential to successful business:

“Our sales representatives meet clients. They build the network of contacts... when the time comes for him to work with the final customer (in Asia), because of the language barrier, he is there. It is a relationship that he already has, and it's difficult (for us) to become closely acquainted with those people, especially in Asia.” (G2)

The multinational character of clients, or partners of another nature, may in itself be a source of contacts through that organisation's global network:

“It is sometimes those networks that dictate the market where we should go. Because sometimes, by accident, we find a good prospect in our network of contacts.” (G3)

Even contact with a potential client who does not purchase the product is used to network with potential new clients in that firm's network:

“Often a particular client is not interested, but he knows someone else in his market that is. Word of mouth works.” (G4)

Going even further, one growth firm collaborates with important “non clients” to evaluate their experience with competitors' products. These collaborative efforts open doors that allow the firm to develop its network.

In addition, similar to firm S1, growth firm G4 emphasizes contacts with employees in the buyer's organisation to be informed of the firm's needs.

To research question No. 2: “Do tie-based sources of opportunities (social networks and business networks) influence opportunity recognition?” results suggest that it varies among respondent firms, depending on its stage in the lifecycle. This will be presented with results related to research question No. 4 and discussed more in depth in the Discussion section.

#### *4.4.2 Non Tie-based Methods*

##### *-Formal search methods.*

Start-ups appear to rely on non-tie based methods as do growth firms. Formal opportunity search is fairly easy for one growth firm:

“There are an enormous number of study reports, so you can identify pretty well which firms are working in the area. Then you know who does what and which (of them) are potential clients for your products.” (G5)

Growth firms also confirm formal opportunity search methods using public information and particularities of clients' situations:

“We look for places where there are problems of security, of attacks, among others. (The firm sells a security product.) (G1)

Search methods also include the use of indicators that may be correlated with the need to purchase the firm's products:

« We look for national R&D budgets and we start there. But if we are in a country that has none they won't have the budgets to purchase our product. So we established a correlation between certain indicators: defence budgets, other budgets, and we can see where it's happening. We see them in the area that concerns us: who is participating in conferences, who are the players?» (G2)

*-Fair-based methods (trade shows, exhibitions, trade missions, conventions).*

A particular type of non-tie based opportunity search/identification is fair-based methods: trade shows, exhibitions, trade missions, conventions. These appear to be popular ways to generate interest and leads, to meet potential clients, to explain and show the firm's technology, to speak to industry groups about the scientific advances of the firm, and also to generate sales.

Trade events may be an important source for start-up firms to make contacts and to build its network. Some start-up firms are quick to point out the value of fair-based methods for opportunity identification and actual business development. One participant indicates the importance of impressing organisations which can subsequently specify its technology when ordering from suppliers:

“We go to about 15 trade shows per year. We choose to present at the trade fairs where we can find our final clients and the representatives of the transportation ministries, so they will order our products from their suppliers.”  
(S3)

Yet another start-up firm explained its initial experience with the value of trade fairs, indicating that he was invited to participate in a trade show with another firm and found a client who had been searching for such technology for a long time (S1).

Growth firms appear to be more strategic when it comes to fair-based methods. They emphasize the importance of making effective use of events: meeting people, targeting and visiting clients, maintaining relationships and requiring the presence of its sales representatives at expositions (G1, G3, G5).

In addition, some emphasize the importance of demonstrating the advantages of their technology solutions and providing added value to their presence at trade events:

“Presentations and demonstrations certainly help. We went to France, Australia, Germany, Italy, England, and Spain to show the capabilities of this technology. It is performance that we show them. We take videos and we do PowerPoint presentations that we standardise, but that we change very often.”  
(G1).

Another strategy is acquiring membership in well-known organisations in the industry where potential clients are present. As a member of such organisations, the firm is automatically informed of the organisation events, allowing them to give conferences with the aim of increasing their notoriety (G3).

*-Advertising-based methods (including corporate websites).*

Advertising in magazines and/or trade shows, apart from the firms' websites, is used by only two start-up firms (S4, S5). Firm S4 points out the effectiveness of its advertising but admits that its efforts in this sense are limited.

With the exception of one start-up firm, websites are not well developed by the start-up group:

“Our website is more like a business card to present our products” (S3).

Growth firms, however, appear to more proactively use websites as a communications tool, for brand-building activities, and to track web activity to see the “reach” of their site.

“We were among the first to develop a website; we coded it by hand in HTML. We were really early on the Internet. The website has brought us a lot of visibility.” (G4)

“Employees go see a client with the product, take measures, write a scientific article that is easy to understand, or more commercial, and we put it on our website. We have produced about 10 very specific application notes so far. We also use a sort of portal for photonics in which we publish, and that works well. Once a month, the coordinator analyses the traffic on the website to determine where the activity and the requests come from. We presently have requests from Latin America that we never had before.” (G2)

Some growth firms actively cultivate their relationships with potential buyers and regularly communicate with them via publications. For instance, one firm does systematic distribution of communications to a database of contacts:

“It’s a lot of “attack”: branding, newsletters and scientific articles that we publish. We sometimes publish articles in specialized journals. Our contacts are in our database. When we do newsletters, we distribute them -- we automatically have our network.” (G3).

Growth firms also explicitly aim to build image and credibility through scientific publications and presentations of scientific advances:

“We still publish articles and send scientists to present the results of their work as well. We are careful about what we publish, so that also contributes to build the image that there is expertise in the company. I think it’s important. (G5).

#### 4.4.3 *Serendipity*

Both groups also benefit from client-initiated demand, or serendipity. However, such demand may be the result of previous efforts to make known the technology and its potential applications (advertising, the firm’s website, publication of articles, exhibitions at trade fairs...):

“We have had a lot of demand during the past year through Internet and email.”(S5).

“There were people who were looking for this type of technology... They requested we go to do a demonstration.” (G1).

No participants mentioned criteria used to evaluate opportunities, but one firm highlighted the global nature of opportunities, implying the importance of each opportunity that presents itself to the firm.



To research question No. 3 “Do non tie-based sources of opportunities influence opportunity recognition?”, our response is “yes”. Firms’ practices support the use of a variety of tie-based methods aimed at recognising opportunities.

Finally, to research question No. 4 “Are start-up firms different from growth firms in their characteristics or their practices related to opportunity recognition?”, our response is that there are similarities and differences. However, similarities are often superficial when practices are analysed for their level of sophistication. The Discussion section below delves more deeply into this and provides a summary of patterns observed.

## 5 Discussion

### 5.1 Opportunity recognition supported by the characteristics of the entrepreneurial team

**Prior knowledge.** First, case analysis demonstrates that the founding teams’ prior knowledge is not different among start-ups or growth firms. However, those that had members with experience in the industry were indeed aware of customers’ problems and possessed a network of contacts, one of which had experience at the international level (Shane, 2000; Ozgen and Baron, 2007). This appears more important in the opportunity recognition process than the complementarity of the founding team per se. Furthermore, in addition to the founding team’s previous experience proposed by Kontinen and Ojala (2011) and Kaczmarek and Ruigrok (2013), a key element to the opportunity recognition process is being a spin-off. The incumbent organisation contributes to the new business in terms of ties but sometimes also in terms of market knowledge and international presence. Therefore, industry experience in photonics of at least one of the founding team members and being a spin-off facilitate opportunity recognition.

According to the literature, alertness and activeness are also part of a founding team’s entrepreneurial characteristics.

**Alertness.** Being alert to opportunities for study participants led to comments concerning being informed either by the network or public information. One growth firm is alert to the global environment to facilitate interpretation of information and unsolicited contacts (G1). Two start-up firms are alert to particular markets (S1) and potential product-related events (S1, S4). Both types are equally valuable since they answer to different needs which would be a complementary explanation to the findings of Kontinen and Ojala (2011).

**Activeness.** One start-up and 4 growth firms demonstrate activeness by provoking meetings with potential clients. These actions do appear to be directly classified by participants as tie-based and non tie-based methods which relates to Evers (2011) market-oriented activities (to be discussed below).

Founding team’s characteristics therefore do appear to continue to contribute to the firm’s growth through opportunity recognition, especially when the firm is a spinoff. This seems to be amplified by the B2B context of the photonic technologies sectors.

## 5.2 *Opportunity recognition through tie-based methods*

This study uses Ellis (2011) classification of opportunity recognition methods. Results trace a portrait of both start-up and growth firms building and exploiting business networks for opportunity recognition.

Spin-off firms (either start-up or growth firms) benefit from the incumbent's network and sometimes even sales. No start-up firm mentioned commercial opportunities arriving through either existing social or business networks. Two firms do, however mention attempts to obtain information from a local contact (S1) or through potential referrals from collaboration with an important client (S2). Most of their network building is through non tie-based methods.

Meanwhile, some growth firms do rely on past acquaintances or an existing network prior to the firm foundation. In addition, they make important efforts to build their networks and to stay informed. They recognise the value of a local representative's cultural knowledge and existing network, especially in countries where vendor-client relationship building is difficult due to language barriers yet essential to business success (G3, G2). They do not hesitate to use local partners to request referrals or market information (G3). Growth firm G3 is particularly active in developing collaborations, seeking collaborations even with clients who have purchased competitors' technologies. They realize the potential to test and compare their technology with competitors' products in the client's environment, admitting that such collaborations may lead to referrals. Finally, similar to S1, they acknowledge the potential of networking with employees of a potential client's firm to develop a supporter inside the client's firm.

Therefore, although start-up firms are involved in certain tie-based activities to identify opportunities, growth firms are more active and somewhat more rigorous in their opportunity recognition methods as expected by Varis *et al.* (2005). The more limited financial resources of start-up firms may partially explain this result. In the photonics sector, perhaps due to the often complex nature of products and their application to client's operations, start-up firms require only a few initial clients to test and validate the application of the technology. Existing social and business networks are perhaps too embryonic or too general to be useful to suggest opportunities.

## 5.3 *Opportunity recognition through non tie-based methods.*

Formal search methods, fair-based methods, and advertising are recognised ways to find opportunities, to incite interest in a product, or to communicate with potential and actual buyers. Ellis (2011) classified them as non tie-based methods.

**Formal search methods.** Some start-up firms do mention the use of formal opportunity search. They survey events which are related to the use of their product or technology (S1, S4) and sometimes are informed about the most important market for their technology (S1). In contrast, growth firms appear to survey more specific customer need areas: problems with security (G1), technological catch-up in emerging markets (G2), or indicators of activity correlated to use of their technology (R&D budgets, national policies)(G2).

***Fair-based methods.*** Fair-based methods, however, are popular with start-ups to build their networks (S1, S4, S5) as observed by Kontinen and Ojala (2011) and to actively influence end buyers who may then recommend their technology within their organisation (S3). On the other hand, growth firms appear to use these events more strategically. They point to the importance of presenting and demonstrating the performance of their technology and the use of videos and take-home slide presentations (G1). Growth firm G3 assures that their presentations provide added scientific value based on in-house or client-based work.

***Advertising based method (including corporate websites.*** Advertising and websites are not methods that are very developed by start-up firms. Only minimal efforts were observed. Conversely, growth firms have more well-developed strategies related to advertising and to the use of corporate websites. These include publications (G2, G3, G5), newsletters sent to the firm's network (G3), and explicit efforts toward branding/image building (G3, G5). Corporate websites are also exploited (G1, G2, G4), with one firm publishing very specific application notes on its website and measuring web traffic to identify the location of visitors (G2).

#### 5.4 Serendipity

Both groups also benefit from serendipity in the form of unsolicited demands and legislation that opens a market for the firm's product.

Figure 3 below sums up patterns observed in the characteristics and the practices of for start-ups and growth firms related to opportunity recognition.

(Figure 3 about here)

The patterns in Figure 3 suggest that start-up HTSMEs are indeed less sophisticated than growth firms in terms of opportunity recognition as defined in this study. This may be due to the very nature of the start-up stage, characterised by lack of experience and limited resources, both financial and human. For example, even though knowledge of both categories of firms were equivalent prior to founding, growth firms have acquired experience and industry, market and internationalization knowledge in their first years, contributing to the development of their ability to recognize opportunities. However, both groups share the same international vision.

Limited resources can severely hinder the activities of start-ups. Advertising and the development and maintenance of a website, active participation in trade shows, scientific conferences and industry events require constant investments of time and money. In addition, start-up firms are smaller, begun with only a limited number of employees. These are typically engineers specialized in the technology which they hope to exploit. Their initial efforts are most often focused on understanding the technology, discovering its first commercial applications, and/or working with its first clients to adapt the technology to the clients' technology and particular need, sometimes by the use of prototypes and pilot studies. The activities listed above require the firm to slow or pause its scientific and development activities, since the same employees are responsible for both.

It is therefore not surprising that their efforts are minimal in the beginning and that they privilege trade events where they can obtain maximum exposure while testing the reaction of potential buyers. Trade event participation may also lead to a serendipitous encounter, suggesting a new application or prospective market. The frequent use and enthusiasm of growth firms for these methods of identifying opportunities is an indication that they are worth the investments made in them.

In addition, it is not a given that entrepreneurs embrace or understand the importance of advertising, promotion, and relationship marketing in general from the beginning of their commercial adventure as observed by Evers (2011). Growth firms, with their superior workforces, have undoubtedly assigned dedicated employees for some of these activities, or even specialists. Start-ups must therefore develop their opportunity recognition strategy within their resource constraints. Assigning responsibility for opportunity recognition on at least a part-time basis may be a first step toward this end. For growth firms, the next stage would be opportunity evaluation and results measurement as predicted in the literature (Ardichvili *et al.*, 2003; Oviatt and McDougall, 2005; Di Gregorio *et al.*, 2008; Chandra *et al.*, 2012).

## **6 Conclusion**

There are significant implications for research and management resulting from the exploration of opportunity recognition practices by international high-tech start-up and growth photonics firms. From a research point of view, this paper makes an important contribution to international entrepreneurship literature by exploring a fundamental concept of business development activities -- international opportunity recognition -- within the context of internationalised high tech SMEs. We applied a multiple case study methodology to deepen our understanding, delving into the practices of five start-up and five growing Canadian photonics firms. HTSMEs recognise opportunities by using both tie and non-tie based methods, thereby multiplying potential opportunities. Opportunity-related practices do not differ significantly between start-up and growing firms. However, growing firms in general are more active and most have a more reflective and at times a more objective-oriented approach. Analysis of data and information gathering through their networks and through fair-based methods is generally more systematic and purposeful.

This paper provides entrepreneurs with some useful insights regarding characteristics of entrepreneurs of both start-up and growing high-tech firms, as well as their ability to combine tied and non-tied bases methods in the search for international opportunities.

At the start-up stage, when at least one of the founding team members has previous industry experience internationally, he/she is more likely to understand information in the environment and its value for potential business. Activeness should be carefully nourished, since personal contacts such as classmates, previous colleagues, and participants at industry events were mentioned by growth respondents as sources of privileged information and potential clients. Younger firms are also encouraged to more systematically consult public information and to use it creatively, since it has been shown that some growth firms' managers have developed the ability to recognise opportunity by staying informed, not only about scientific or industry

knowledge, but also through current events in the international and business environments.

Previous experience in the industry also provides an important advantage in terms of the business network. However, for spinoffs, the incumbent's network of contacts may compensate for the absence of industry experience by acting as a source of opportunity transfer. Therefore contacts with and from the seminal organization (university, public laboratory, incubator or firm) must be nourished. Localisation in a cluster and a scientific park favour local networking which has been shown to contribute to firms' internationalisation in a B2B context. Respondents have emphasized the importance of meeting people to generate leads and to maintain relationships, as well as to demonstrate their technology and to learn first-hand about potential customers' needs.

The present study has different implications for opportunity recognition of the two categories of firms concerned. Managers of internationalised start-up firms have to first build their network abroad to be known. Non-tie based sources of opportunities such as fair-based methods and advertising-based methods, including scientific publications in academic journals, are crucial. After formal search for potential clients, they have to show boldness by making direct calls to provoke meetings. Foreign representatives may help, but courtesy visits are still in order. Once a firm has closed its first client, the firm may ask for direct referral by the client either inside its own multinational or to external organizations. The analysis suggests that it is of key importance to balance these two methods to fully benefit from their network but not constrain themselves by it.

At the growth stage, entrepreneurs have learned, gained in experience, and developed both social and business networks. Personal contacts with actual clients are crucial to maintain the relationship and to be informed of their needs. Growth firms emphasize live customer service 24/7 through an employee. Although they generally use the same methods as start-ups, our study offers some evidence that growth firms are more focused, plan non tie-based methods more strategically and are therefore more efficient at recognizing an opportunity event. For example, they choose specific events to attend, proactively obtain the list of event participants, and explicitly target potential clients during the event. They are able to qualify opportunities. They advertise through internet to their contact database to demonstrate their credibility. They use e-marketing more systematically. As experience increases, search for opportunities is formalised. Lessons for start-ups from these findings are that they must more formally plan their opportunity search and recognition methods, as well as build their resources and networks. This will permit them to develop their opportunity recognition skills.

This paper has limitations that call for future research. First, expanded work in terms of number of firms, diversity of industries, and country of origin should be undertaken. In our study, the homogeneity of the cluster environment of all respondent firms may have had an impact on our results. Second, complementary methodologies such as longitudinal studies of the same sample firms from their incubation to their own growth stage could bring new insights into the evolution of their business development capacity. Comparative studies between high-tech industries and then between high-tech and low-tech industries could help researchers to understand the potential of generalisation of the findings. Future studies could also

address the next step of opportunity recognition by examining the strategies that link opportunities to development, through R&D and sales and marketing strategies, including the sales process in a B2B context. Finally, the impact of different opportunity recognition paths could be measured with respect to successful opportunity development and performance.

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Figure 1 Opportunity Recognition

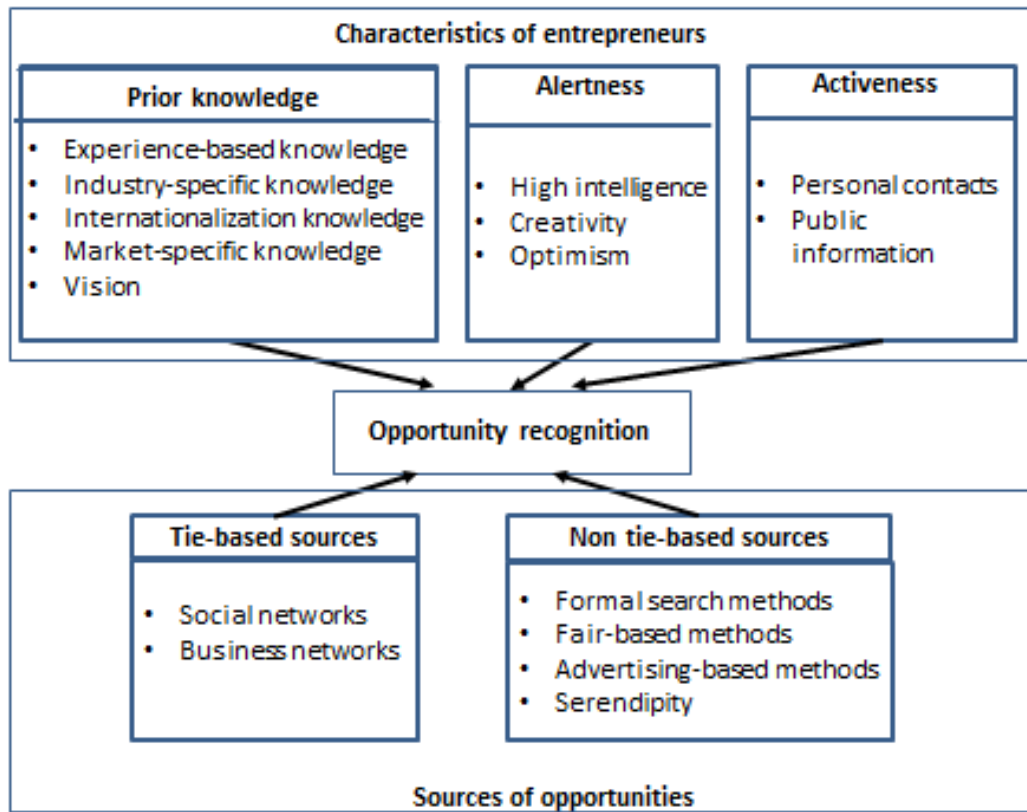


Figure 2: Sample Profile

Stage	Age of firm	Spin-off	Founding team's previous experience	Type of clients	No. of employees	Revenues (CAD)	Export intensity (%)	No. of countries of international sales	No. of continents
<b>Start-up</b>									
S1	5	Yes	Research	Government, Firm	1-5	≤100k	100	5	3
S2	8	No	No	Firm	1-5	100k-249k	100	3	2
S3	4	Yes	Research, industry, international	Government Firm	6-10	2M-2.9M	90	6	4
S4	4	No	International training	University, Firm	1-5	250k-499k	90	11	4
S5	5	Yes	Research, industry, international	Public laboratory, Firm	11-25	1.5M-1.9M	85	2	1
<b>Growth</b>									
G1	11	Yes	Research, international	Government	11-25	5M-9.9M	100	29	4
G2	13	No	Research, industry, international	Firm	26-50	5M-9.9M	80	49	5
G3	21	No	No	Firm	100-250	10M-24.9M	85	7	3
G4	23	No	Industry	Firm	51-100	5M-9.9M	100	35	5
G5	14	Yes	Research	University, Public laboratory, Firm	26-50	5M-9.9M	90	5	3

**Figure 3: Patterns observed**

<b>Concepts</b>	<b>Start-ups</b>	<b>Growth firms</b>
<b>Characteristics of entrepreneurs</b>		
<b>Knowledge</b>	Limited	Learned from their start-up stage
<b>Alertness</b>	Mentioned more often its importance	Plays a secondary role
<b>Activeness</b>	In development	Stronger ability to convert alertness to actions
<b>Sources of opportunities</b>		
<b>Tie-based</b>	Slowly develop their business networks by referencing and using their local network to obtain information	Intensively rely on their foreign representatives, maintain previous contacts, and collaborate
<b>Non-tie based</b>	<p>Survey general events and market information</p> <p>Use fair-based methods for general visibility</p> <p>Minimal advertising efforts</p> <p>Few serendipity events reported</p>	<p>Formal opportunity search of customers' needs</p> <p>Use fair-based methods to demonstrate their credibility, target and efficiently meet potential clients</p> <p>Well-developed strategies, explicit efforts, and multiple tools</p> <p>Few serendipity events reported</p>