AEGIS

Advancing Knowledge-Intensive Entrepreneurship and Innovation for Economic Growth and Social Well-being in Europe

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Abstract	In the context of this deliverable we use the large dataset of the AEGIS survey work in order to empirically test the applicability of the dynamic capabilities concept in newly-established firms which in their majority are micro and small ones. We also study dynamic capabilities not only in high-tech sectors but also in the context of low and medium-low tech ones as well as in the service sector. Moreover, we attempt to link the dynamic capabilities notion with that of knowledge-based entrepreneurship by examining whether dynamic capabilities' development is differentiated on the basis of their knowledge seeking activities, knowledge assets and innovative performance. Last but not least this study offers the opportunity to test the applicability of dynamic

capabilities in different national contexts as our sample frame includes firms established in ten European countries of differing sizes and varieties of capitalism.

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1. Introduction

In the last decade dynamic capabilities and their role in firm strategy, value creation and competitive advantage have attracted a great deal of interest among scholars (e.g. Teece et al., 1997; Eisenhardt and Martin, 2000; Winter, 2003; Teece, 2007; Helfat et al., 2007).

In their seminal contribution, Teece et al. (1997) argue that dynamic capabilities enable organizations to integrate, build, and reconfigure their resources and competencies and, therefore, maintain performance in the face of changing business environments. The notion of dynamic capabilities was subsequently refined and expanded (e.g. Eisenhardt and Martin, 2000; Zollo and Winter 2002; Teece, 2007; Helfat et al., 2007 among others). However, a concise and comprehensive definition of dynamic capabilities has not been reached yet.

In addition, the debate about dynamic capabilities has reached a point where theoretical arguments should be further complemented by relevant empirical work. Overall, their empirical investigation is rather limited and mainly based on case studies, with most theoretical arguments pending empirical confirmation. In particular, dynamic capabilities have been mainly associated with large, well-established companies operating in high-tech sectors and single national contexts (especially large, developed countries). This stems from the fact that large firms are generally considered as more eligible for the empirical study of dynamic capabilities because it is assumed that their size ensures an adequate organizational structure and the required resources to develop and exercise dynamic routines. On the other hand, high-tech sectors are thought as synonymous to rapidly changing environmental conditions and therefore are considered as a suitable context for studying dynamic capabilities whose essence is related to change.

However, new firms often face resource base weaknesses and are confronted with subsequent performance loss if these weaknesses are not dealt with. It is necessary for entrepreneurs to create and adapt the resource base of the new firm. (Garnsey, 1998; West and DeCastro, 2001), and therefore newly-established companies have to demonstrate dynamic capabilities to reconfigure or modify their resource base as required. Furthermore, a changing business environment should not be exclusively associated with high-tech sectors as it can also exist and play a significant role in low and medium-technology industries especially in the midst of the financial crisis that most European countries are right now experiencing. In addition, dynamic capabilities may be beneficial to the firm in both high and low levels of environmental change and therefore play an important role even in less dynamic environments (Helfat et al., 2007; Easterby and Smith, 2009; Eisenhardt and Martin, 2000; Protogerou et al., 2011). Finally, it would be important to test and confirm the applicability of the dynamic capabilities concept in multiple national contexts exhibiting different constraints and characteristics (Easterby-Smith et al. 2009).

In the context of this deliverable we use the large dataset of the AEGIS survey work in order to empirically test the applicability of the dynamic capabilities concept in newly-established firms which in their majority are micro and small ones. We also study dynamic capabilities not only in high-tech sectors but also in the context of low and medium-low tech ones as well as in the service sector. Moreover, we attempt to link the dynamic capabilities notion with that of knowledge-based entrepreneurship by examining whether dynamic capabilities' development is differentiated on the basis of their knowledge seeking activities, knowledge assets and innovative performance. Last but not least this study offers the opportunity to test the applicability of dynamic capabilities in different national contexts as our sample frame includes firms established in ten European countries of differing sizes and varieties of capitalism.

The paper is structured as follows. First, we give some theoretical background on the dynamic capabilities in newly-established firms and in different sectors. This is followed by a description of our research method, including the sample, the measures, and the analysis, and the presentation and discussion of our findings. The paper ends with the drawing of some conclusions.

2. Theoretical Framework

2.1 Dynamic capabilities in different sectors

In the context of this deliverable we adopt the definition given by Helfat et al. (2007) who define dynamic capabilities (DCs) as "the capacity of an organization to purposefully and systematically create, extend or modify its resource base"(p. 4). The firm's resource base includes tangible, intangible and human assets such as includes labor, capital, technology, knowledge, property rights, and also the structures, routines and processes that are needed to support its productive activities (i.e. organizational structures and capabilities). "Creating" a resource includes all forms of resource creation, such as obtaining new resources through acquisitions and alliances, as well as through innovation and entrepreneurial activity. "Extending" their resource base may result in promoting growth in an ongoing business. "Modifying" their resource base includes any reaction to change, e.g. response to external environment changes.

Almost by definition, theoretical and empirical research on dynamic capabilities has been mainly focused on high-technology industries (especially in manufacturing) presupposing that high-tech environments are characterized by rapid technological change. However, it is also suggested that dynamic capabilities can be also useful in environments which are not characterized by rapidly evolving conditions (Eisenhardt and Martin, 2000; Helfat et al., 2007). More specifically, according to Eisenhardt and Martin (2000) dynamic capabilities can vary with market dynamism. When markets are moderately dynamic, they are to be found in routines that are complicated, detailed, and analytic processes to produce mainly predictable outcomes, but in highly dynamic environments they are simple, experiential and unstable processes that rely on quickly created new knowledge to produce adaptive but unpredictable outcomes.

In a relatively stable environment, although external changes occur they are to a large extent predictable and incremental and the rate of change is low, compared to that experienced by firms operating in more dynamic environmental contexts. In moderately dynamic markets we would presume that the firm's resource base remains essentially the same. However, although the extent of change would be rather limited there would still be some need to adapt or continuously improve the existing resource base in order that resources maintain their value. For example, a successful brand name might be constantly updated to sustain its value over time, albeit the basic brand continues to be stable. Under these circumstances dynamic capabilities do not transform the firm's resource base but they support its adaptive change through small and incremental improvements. This suggests that dynamic capabilities do not only have a role in rapidly changing environments but they can also be of value in less dynamic contexts where they can be understood as detailed and analytic processes that rely on existing knowledge to effect incremental change (Protogerou et al., 2011).

Yet, which business environment can be characterized as "stable" or even as "moderately dynamic" today? Helfat and Peteraf (2009) argue that the oil industry, which is normally classified as a low-medium tech (LMT) sector, is far from "stable", since it "*has endured large* *price swings and several rounds of consolidation since the mid-1970s*". Although mature, traditional industries are not dynamic by definition (Sciascia et al. 2009) they are characterized by environmental hostility and are also subject to major changes. Globalization and trade liberalization have raised interesting new problems and significant challenges for them, delineating a vulnerable, volatile and rapid changing environment. Mature industries can even create environmental dynamism through cumulative knowledge which can provide options to expand to new markets and businesses (Penrose, 1959; Wall et al., 2010), since this is the only way to survive.

It's also worth mentioning that a new research stream tries to explore dynamic capabilities within the crisis *extreme* high-velocity environment (Colombo et *al*., 2010; Simon, 2010) which can a have a major impact on both high and low-tech sectors. For example, Colombo et *al.* (2010) tested a sample of 114 Italian high-tech entrepreneurial ventures and found that DCs enable them cope with the crisis, since they have a positive impact on firms' growth performances

Therefore, although all the above indicate that dynamic capabilities can play a role in more mature, traditional industries there is limited empirical research on the dynamic capabilities' existence and role in low-tech firms either in their start-up stage or later on in their lifetime. Helfat (1997) was perhaps one of the first scholars to engage a medium-tech industry in her research and confirm R&D as a dynamic capability in the U.S. petroleum industry. Since then a stream of empirical research has been slowly emerging trying to capture the impact of dynamic capabilities in LMT sectors (see Table 1). These research efforts, both qualitative and quantitative, address several issues such as the relationship between dynamic capabilities and firm performance, the role of DCs in achieving competitive advantage at the international level and their impact on innovative performance and change capability. In addition, some of the studies included in Table 1 explain how dynamic capabilities are actually developed and manifested in medium and low-tech industries mostly in cases of internationalization (Evers, 2011; Kuuluvainen, 2011; Quentier, 2011). Karagouni and Kalesi (2011) building on qualitative data from knowledge-intensive firms active in the food industry, showed that low-tech companies basing their strategy on knowledge intensiveness and innovation develop relatively strong dynamic capabilities in order to gain competitive advantage.

Table 1: Empirical studies on DCs referring to LMT sectors

Study	Type	Sample	Subject
Intra-sectoral studies			
Abro et *al* (2011)	comparative analysis	2 textile manufacturers in Pakistan	explore relationships between the leadership decisions and dynamic capabilities of leveraging ICT for sustained competitiveness.
Chirico (2007)	qualitative	2 case studies in the beverage sector	impact of dynamic capabilities on entrepreneurial performance
Evers (2011)	qualitative	3 case studies from seafood industry	examines international new ventures operating in a traditional low technology sector
Grande (2011)	longitudinal study	3 Norwegian new ventures in the agricultural sector	explores the impact of dynamic capabilities in creating new profitable ventures
Kuuluvainen (2011)	case study	a Finnish SME in the forestry sector	the role of dynamic capabilities in international growth
Karagouni and Kalesi (2011)	qualitative	4 case studies from the food sector	explore the applicability of DCs in knowledge-intensive companies active in the food sector
Quentier (2011)	in-depth analysis	3 cases of highly export Brittany ventures in the global seafood industry	examine how such companies develop competitive advantage at international level
Salvato et *al* .(2003)	in-depth empirical analysis	2 medium –sized Italian project-oriented firms	micro-processes and roles that form DCs
Inter-sectoral studies			
Borch and Madsen (2007)	explorative study	235 Norwegian LMT SMEs	DCs that facilitate innovative strategies in SMEs (mainly micro and small)
Protogerou et al. (2011)	survey work	271 Greek firms of various manufacturing industries	explore the direct or indirect relationship between DCs and performance at differ levels of environmental dynamism
Rafailidis and Tselekidis (2009)	Empirical research	37 Greek SMEs of 4 medium -high industry sectors	relationships between the enabling mechanisms of dynamic capabilities and innovativeness and change capability
Spanos and Lioukas (2001)	survey work	147 Greek firms from various (mainly LMT) manuf. industries	relative impact of industry vs. firm-specific factors on performance
Telussa et *al.* (2006)	longitudinal database	354 low and medium –tech firms up to ten years old.	association between dynamic capabilities and new firm growth,

The empirical studies aiming at the examination of the applicability of the dynamic capabilities framework in the services sector is also relatively limited, while the majority of these studies is qualitative and built on case study work. Table 2 presents a summary of both qualitative and quantitative studies examining DCs in the service sectors. They mainly explore the existence and role of dynamic capabilities in the specific sector and examine the impact of DCs on performance innovation or intermediate outcomes and scope of services.

Table 2: Empirical studies of dynamic capabilities in services

Study	Type	Sample	Subject
Alvarez and Merino (2003)	quantitative	77 Spanish savings and loans institutions	the organizational evolutionary processes dependent on environmental dynamism
Doeving & Gooderham, (2008)	quantitative	254 Norwegian authorized accountancy practices	DC impact on the scope of services
Ellonen et *al*. (2009)	qualitative	4 publishing companies	link DC portfolios and innovation outcomes
Fischer et *al*. (2010)	inductive data inquiry	13 firms of capital goods industries with different sizes and in two countries (Switzerland and Germany)	explore how DCs shape the way in which service business is developed
Jantunen (2005)	survey	217 Finnish manufacturing and service organizations (from both low and high tech industries)	explores the effect of an entrepreneurial orientation and a firm's reconfiguring capabilities on international performance
Lampel and Shamsie (2003)	Empirical / archival	400 films (U.S. motion picture industry), 1941–1948	Antecedents and characteristics of DCs
Marcus & Anderson (2006)	empirical survey	108 grocery chains from U.S. retail food industry in 1997	characteristics of DCs and intermediate outcomes
Pablo et al. (2007)	Field	One regional health authority in Canada	characteristics of DCs
Salunke et *al*. (2011)	multi-case field study	13 national and international project-oriented service firms	build a theoretical framework of innovation-based competitive strategy in project-oriented service firms by drawing on the DC based view of compet. strategy
Tsekouras et *al*. (2011)	qualitative	3 case studies in the tramp shipping sector	relationship between innov. activities and DCs

Zúñiga-Vicente & Vicente-Lorente (2006)	archival study	134 Spanish banks (1983–1997)	performance outcomes

In sum, our literature review indicated that despite the substantial body of work on dynamic capabilities, the DCs approach have so far been developed and empirically examined in the context of high-tech organizations (especially in high-tech manufacturing). Only lately research effort has been put to relate the concept of dynamic capabilities to LMT and service sectors. As a consequence the empirical studies trying to capture the nature and role of dynamic capabilities in these sectors are still rather limited and therefore the potential to examine them through the lens of the DCs approach remains largely unexplored.

2.2 Dynamic capabilities and newly-established firms

Thus far, the literature on dynamic capabilities and their development has been mainly focused on large and established firms (McKelvie and Davidsson, 2009). One of the few exceptions is Helfat et al. (2007) which suggest that the dynamic capabilities concept can apply both to newly-formed as well as to established firms, however, they point out that almost by definition new ventures "typically develop fewer patterned forms of behaviour that underpin a capability".

New firms are usually micro or small ones, encountering resource base weaknesses therefore they must demonstrate dynamic capabilities to reconfigure their resource base as needed (Telussa et al., 2006), but this assumption is still empirically unexplored. A small but growing body of empirical research highlights the way dynamic capabilities relate to the performance, survival and growth of new firms (e.g. Arthurs & Busenitz, 2006; Zahra & Filatotchev, 2004; Grande, 2011), while in their grand majority involve high-tech sectors. For example, Stam et *al*. (2007) examined the impact of dynamic capabilities on high-tech start-ups' growth, resulting to initial R&D activities and inter-firm alliances as the dynamic capabilities most likely to accompany growth. The authors noted that in newly-established firms, attempts to sustain and renew capabilities do not at first take the form of routines, but of trial and error efforts, for instance at R&D and alliances. Boccardelli and Magnusson (2006) use the dynamic capabilities framework of strategy trying to investigate how firms go about to match their resource bases with opportunities in the marketplace in the Swedish mobile Internet industry. They suggest the single entrepreneur as a source of dynamic capabilities, arguing that "dynamic capabilities can exist already at the outset of a venture, then however residing primarily in the few individuals constituting the entrepreneurial team and not always throughout the organization".

Research also suggests that dynamic capabilities are important for the evolution and successful entry and survival of new firms especially in international markets (Sapienza et *al.*, 2006; Sapienza et *al.*, 2010; Jantunen et *al.*, 2005). Zahra et *al.* (2006) adds that the skills and competencies that "these firms have, must be upgraded and new dynamic capabilities must be built to ensure successful adaptation for growth".

Some researchers also address questions on the existence and importance of dynamic capabilities for the creation and evolution of new ventures. Newbert (2005), for example, based on a study of 817 US nascent entrepreneurs, sees firm formation process as a dynamic capability, defined as the "organizational and strategic routines by which firms achieve new resource combinations".

While literature review indicates that the majority of existing empirical studies examining the link between dynamic capabilities and new firms are focused on high-tech sectors, a few researchers choose to explore this relationship in traditional sectors. For example, Telussa et al. (2006) analyzed the association between dynamic capabilities and new firm growth, using a sample of mostly low and medium-tech firms. Questioning the origins of dynamic capabilities in new ventures of traditional sectors (up to 10 years old), Karagouni (2011) proposed that entrepreneurial capabilities such as bricolage and improvisation as important antecedents of dynamic capabilities.

There is also a small number of studies that neglect or use their own definitions for high and low-technology industries. Stam and Wennberg (2009) covered the first six years of the life course of micro firms investigating R&D as a major and representative dynamic capability but without using the official OECD definition. They measured the technological basis of the firm's product instead. McKelvie and Davidsson (2009) applied the dynamic capabilities argument to new firms using a mixed sample of manufacturing, service and trade firms.

So far, the limited but gradually increasing research on DCs regarding newly-founded firms is evident through a number of empirical studies, which indicate that new ventures need dynamic capabilities in order to survive, grow and thus enhance the potential for innovative entrepreneurial activity. This growing interest imposes the need for more empirical research to address the issue of the creation and importance of dynamic capabilities for the creation and evolution of new ventures.

2.3 Dynamic capabilities and firm size

Considering the huge volume of literature on dynamic capabilities the relationship between dynamic capabilities and firm size remains unsatisfactorily explored and understood. In general, scholars have paid attention mainly to large, multinational firms (e.g. Teece, 2007; Pitelis and Teece, 2010; Zollo and Winter, 2002, Dunnung and Lundan, 2010, Kale & Singh, 2007) while limited research has addressed SMEs (Spanos and Lioukas, 2001; Jantunen, 2005; Borch and Madsen, 2007; Rafailidis and Tselekidis, 2009; McKelvie and Davidsson, 2009; Paun et al., 2010; Foss et al., 2010; Wang and Shi, 2011; Abro et al., 2011; Salvato, 2003) or micro firms (Telussa et al., 2006; Doeving & Gooderham, 2008).

Few studies have explicitly investigated which sizes of firms are more likely to benefit from dynamic capabilities. Caloghirou et al. (2004), for example, attempted a first approach of the size question, considering the impact of firm-specific assets and capabilities on both SMEs and large firms. Borch and Madsen (2007) focused on small and micro firms in low-tech and medium-low industries to explore dynamic capabilities that facilitate innovative strategies. Yet, the literature on DCs and SMEs still remains rather limited and under-developed.

It is worth mentioning that while Telussa et *al.* (2006) focused on micro firms, McKelvie and Davidsson (2009) excluded them from their sampling frame, claiming that “they may not adequately reflect the theoretical entity ‘firm’ that dynamic capabilities theory makes statements about”. Such statements arise many questions on the existence and role of dynamic capabilities in the vast group of micro-enterprises. Whilst over 99% of all enterprises in Europe are SMEs, 90% of SMEs are actually micro-enterprises - with fewer than 10 employees - and the average company has just five workers. However, these micro-enterprises account for 53% of all jobs in Europe, so their importance to the European economy is enormous.[1]

Moreover, no studies have focused on SMEs within less dynamic industries. This, contrasts with empirical evidence: although characterized by a growing concentration level, traditional LMT

[1] http://ec.europa.eu/enterprise/policies/sme/promoting-entrepreneurship/crafts-micro-enterprises/

industries comprise mainly small firms. However current trends in the study of dynamic capabilities seem to disregard this vast section of economic activity.

It is evident that further research of dynamic capabilities in SMEs is necessary and of great importance especially nowadays, since the pressures of increasing globalization and rapid technological and socioeconomic changes have major impacts on small and medium-sized firms, arising quite different issues than those of interest to large organizations. Consequently, the need of establishing theoretically and empirically sound recommendations and policies on the creation and sustainment of strong competitive advantages is vital for the vast majority of the European business ecosystem.

3. Methodology

3.1 The sample

The AEGIS questionnaire was filled in by 4,004 firms after a telephone interview with one of the form founders in ten European countries, namely, UK, Germany, France, Italy, Sweden, Denmark, Greece, Portugal, Croatia and Czech Republic. The total response rate of the survey was 31.2%, but rates ranged within countries from 19.5% in the UK to 63.9% in Croatia.

The firms that participated in the survey were by definition young firms i.e. they were established between 2001 and 2007. Table 1 presents a distribution of firms in terms of their year of establishment. The average firm age is 7.1 years (min: 4; max: 11 years). By the time the survey was carried out (late 2010 – beginning 2011), firms established in 2007 have been in operation for about 4 years, and therefore it can be assumed that they have managed to exceed the critical time for survival.[2]

Table 1: Firms and year of establishment

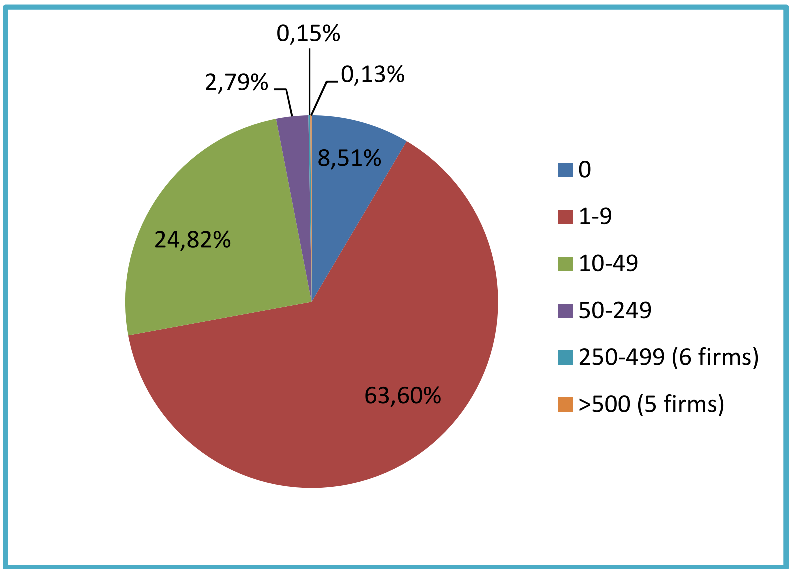
Year of establishment	No of firms	% of firms
2001	1071	27%
2002	151	4%

[2] Bygrave W.D & Hunt, S. (2004), “Global Entrepreneurship Monitor 2004, Financing Report”, Babson College and London Business School

2003	503	13%
2004	510	13%
2005	458	11%
2006	832	21%
2007	479	12%
Total	4004	100%

Figure 1 shows that the majority of firms (63.6%) in the AEGIS sample are micro firms in terms of full-time employees, i.e. they employ up to 9 full-time persons, while 8.51% of firms reported that they have no employees (excluding founding team). 88.4% can be qualified as small firms because they employ less than 50 persons, at the same time only a very small share of them can be regarded as large or very large firms (0.28%).

Figure 2: Distribution of firms in terms of full time employees (N=3973)



The selection of the sectors covered in the AEGIS survey follow the rationale that has been developed in the AEGIS proposal and cover most of the high-technology manufacturing sectors, along with some medium-tech sectors, some low-technology manufacturing sectors (as classified by OECD) and Knowledge Intensive Services (KIBS)[3]. More specifically, the selected sectors covered in the survey and the firms that have responded in each sector are presented in Table 2.

[3] For a first approach on KIBS please check on http://www.eurofound.europa.eu/emcc/publications/2005/ef0559en.pdf

Table 2: Distribution of the AEGIS survey firms by sectors

Selected Sectors	NACE rev. 1.1 code	Number of firms
High-technology manufacturing sectors		
Aerospace	35.3	1
Computers and office machinery	30	20
Radio-television and communication equipment	32	35
Manufacture of medical, precision & optical instruments (scientific instruments)	33	67
Pharmaceuticals	24.4	
Medium-high technology manufacturing sectors		
Manufacture of electrical machinery & apparatus	31	45
Manufacture of machinery and equipment	29	201
Chemical industry (excl pharma)	24 (excl. 24.4)	51
Total		**420**
Low-technology manufacturing sectors		
Paper and printing	21,22	618
Textile and clothing	17, 18, 19	209
Food, beverages and tobacco	15,16	297
Wood and wood products	20	122
Manufacture of furniture	36.1	111
Medium-low manufacturing sectors		
Basic metals	27	31
Fabricated metal products	28	214
Total		**1602**
KIBS sectors		
Telecommunications	64.2	24
Computer and related activities	72	518
Research and experimental development	73	71
Other business services activities	74.1, 74.2, 74.3, 74.4, 74.5, 74.8*	1369
Total		**1982**

*Selection of most 4-digits sectors. Only some 74.87 (other activities) excluded

3.2 The variables

The questionnaire used to conduct the AEGIS survey contained a large number of questions pertaining to venture characteristics, competitive behaviour, market environment, and performance. For the needs of the present deliverable we are focusing on the variables used to capture the dynamic capabilities of newly-established firms, namely new product development capability, technical and market adaptation capability, networking capability and capability to participate in collaborations, while each of them was measured with specific items. Firm founders were asked to indicate in a five-point scale the extent to which the particular capabilities were present/developed in their firms.

New product development capability

New product development (NPD) is considered to be a key source of competitive advantage and a strategic function of the organization which constitutes a major requirement for success (Teece, 2007). In today's competitive environment, firms have to cover latent needs, find new markets for novel products and diversify their markets adapting to specific needs of different customers.

Product development is a dynamic capability that stems from the knowledge of the firm and leads to innovation and adaptation to the market (i.e. entrepreneurial performance). Especially, in rapidly changing environments, when a firm’s products go, for instance, out of fashion, it is of vital importance to develop a product development process to acquire, exchange, transform and at times shed resources in order to create new products according to the changing demand of customers. In this way, change is promoted and value creation can be generated and competitive advantage can be achieved.

New product development capability has been tightly connected to dynamic capabilities. For instance, Eisenhardt and Martin (2000) identify new product development routines, among the important elements (microfoundations) of dynamic capabilities. Empirical evidence also suggests that dynamic capabilities are associated with high product quality and fast-cycle time (Henderson & Clark, 1990; Iansiti & Clark, 1994) or even new niche markets. Teece (2007) involves NPD in his microfoundations as an important success factor. He claims that the search activities that are relevant to “sensing” can be a “form of ‘search’ for new products and processes”. In a recent study, Pavlou and El Sawy (2011) relate a firm's sensing capability to the technical and marketing dimensions of new product development.

Altogether, a new product development capability enables firms to better satisfy existing and potential customers' current and future needs, to better serve these needs and create new market niches as well as new business ecosystems.

Firm founders were asked to indicate in a five-point scale the degree to which new product development capability was attained in their firms. It was measured with three items: capability to offer novel products/services and capacity to adapt the products/services to the specific needs of different customers and market niches.

Sensing capability (market and technical adaptation)

Following Teece's terminology, sensing capabilities denote the firm's activities in scanning and monitoring changes in operating environments and identifying new opportunities. Sensing is an inherently entrepreneurial set of capabilities that involves exploring market and technological opportunities, probing markets, and listening to customers.

In order to measure the ability to spot, interpret, and pursue opportunities in the environment regarding market adaptation, Teece's (2007) relevant elements of sensing capability were engaged after being translated in more specific activities. Thus, customer feedback and processes of market- shift recognition are engaged to identify new market segments and changing customer needs and to assist rapid responses. Market knowledge is regarded as knowledge related to customer and competitor domains (Danneels, 2002; Bruni and Verona, 2009) and sensing embraces understanding, generation and respond to market intelligence (Pavlou and El Sawy, 2011) by observing, counteracting and capturing opportunities. Firms tend to observe sectoral markets and collect information and knowledge on competitive moves, outstanding products, novel promotion methods and other relevant best practices in order to adopt, change and respond, altering or even creating novel competitive advantages. Most interestingly, empirical research has shown that market adaptation in young firms can take place without any related change in the firms' technological resources indicating that a significant factor at this stage is the flexible use of resources in searching for an appropriate match between resources and market opportunities (Boccardelli and Magnusson, 2006).

However, sensing entails also processes to acquire knowledge about, and understand technology developments in its business environment. An organization that has a high level of technology sensing capability will continually scan for information about potential technological opportunities and threats (Srinivasan et al., 2002) and respond to technological changes in its environment. Organizations develop systems and infrastructure such as formal technical and engineering departments to select and understand new technologies, and direct internal R&D. R&D activities are more likely to accompany growth in general, as well as especially for new firms (Stam et. al, 2007). The authors noted that in new and young firms, attempts to sustain and renew capabilities do not at first take the form of routines, but of trial and error efforts at R&D and alliances.

Teece (2007) states that R&D can itself be thought of as a form of ‘search’ for new products and processes. Yet technical adaptation extends to a blending of R&D with design and market oriented dimension needed to proceed with seizing and communication of products/services to markets. Design-making invites enriched perspectives of sensing results and constitutes an important but not always necessary complement to the achievement of competitive advantages or product internationalization.

In order to explore the “double face” of sensing capability, founders were asked to indicate in a five-point scale the degree to which market and technology-oriented sensing capabilities were available in their firms, discussing several items for each of them. Market adaptation was captured by questions on adaptation of best practices, response to competitive moves, and customer feedback, recognition of shifts in markets, consideration of the consequences of changing market demand and capturing of new opportunities. Technological adaptation was measured using three items, namely the existence of formal R&D and technical departments and the importance of design activity.

Networking capability

Networking refers to the formation of mutually beneficial personal or business relationships to expand and accelerate the acquisition of useful resources and skills. These resources include the exchange of information and knowledge, as well as the discovery and control of opportunities and it is also extended to various types of financial and institutional support.

Enterprises search not only the core but also the periphery of their business ecosystems by embracing potential collaborators which can be customers, suppliers, and producers of complementary products or even competitors. Especially in KIE, firms recognize opportunities for profitable exchanges of knowledge and technology, identify the relevant knowledge sources or partners (Birkinshaw et al., 2007; Carlsson et al., 2009), and develop different network types in order to sense market and technology opportunities. Networking can therefore be considered as a necessary (though not sufficient) condition for the existence of a sensing dynamic capability.

Knowledge acquisition, through networking, was positively related to new product development, technological distinctiveness, and sales cost efficiency (Yli-Renko, et al.,2001). Besides R&D and NPD, networking enhances the capturing of novel technologies and production methods, the access to skilled human capital, and supports innovativeness.

Networking is shown to influence the viability and development paths of new firms. R&D networking has been found to affect the early life course of high-tech firms (Stam and Wennberg, 2009). Yli –Renko et al (2001) have studied networking of young technology-based firms regarding their customer relationships in the UK, while O' Gorman and Evers (2011) draw on the network perspective of new venture internationalization.

Networks have been found important for firms to create competitive advantages (Dahl and Pedersen, 2004; Littunen, 2000). Common goals are shared by network members regarding markets, market shifts and customer needs, for example information sharing including competitor activities as well, and the establishment of best practice techniques in advertising and promotion.

Nevertheless, incentives for participating in networks can also be of economic nature such as financial assistance in loans or fund seeking or can start from the idea of "safety", whereby associated firms are able to reduce uncertainty resulting from legal and other institutional issues related to new markets and access of new distribution channels or even export potential.

For the purpose of the present research networking capability was operationalized by operations regarding market processes such as collecting information about competitors, accessing distribution channels, exploring export opportunities, advertising and promotion. Regarding the technology side of the networking capability we employed variables assessing the network's impact on the development of new products/services, the management of production and operations, as well as the easy access to skilled personnel. Finally in order to catch the economic and more generic value of networking we used variables assessing networks' assistance in obtaining business loans and attracting funds or providing support on legal issues.

Participation in Collaborations

Collaborations assist firms to use efficient and cost effective ways to access additional or complementary resources that can speed up progress and advance set targets. Firms develop various types of collaborations according to what they want to attain: share the costs of R&D development, introduce new products in global markets, minimize costs, develop sales or gain access to rare or expensive resources. Therefore whatever the form, alliances are an important vehicle for dynamic capabilities and the achievement of sustainable competitive advantage.

Lambe et al. (2002), in alliances ''the firms pool their resources in an effort to achieve mutually compatible goals that they could not achieve easily alone''. A frequent type of collaboration which has gained considerable attention is strategic alliance. A review of the literature reveals a list of benefits derived by strategic alliances, such as enhancement of market power (Kogut, 1991), new competencies (Baum & Oliver, 1991) efficiencies (Ahuja, 2000) and access to new, rare or critical resources, skills and capabilities (Rothaermel and Boeker, 2008).

Especially R&D and technical cooperation agreements have become a strategically important part of business decision making in many industries in recent years in both high and low tech sectors. They include any agreed-upon cooperative R&D or technology arrangement between firms, such as joint ventures, consortia, technology partnerships and informal networking arrangements. Such collaborations are often considered decisive for the creation of industry-standard platforms and technological innovations (Nacamura, 2003). Regarding R&D, nowadays, outsourcing has also become a common practice (Grimpe and Kaiser, 2010). Contract R&D serves as an instrument to access knowledge resources that may subsequently be redeployed with existing resources in a way superior to a competitor's deployment (Barthélemy and Quélin, 2006; DeSarbo et al., 2005)

Contractual forms of collaboration include also licensing agreements which, in contrast to strategic alliances, introduce rather passive relationships. They define the nature and scope of the intellectual property or product that is licensed, and mostly refer to “licensing-in” technology, that is technology developed by another.

The various types of collaborations appear to play a special role when new firms try to develop competitive advantages. New product development (NPD) and market introduction, although crucial for high technology new firms' successful performance, can be costly and time consuming processes with uncertain outcomes and this according to Haeussler et al., (2010), constitutes a major reason for the employment of strategic alliances. Collaboration is important for startups to gain the knowledge necessary to develop or acquire the capabilities needed for NPD, R&D, innovation, design, manufacturing, or even technical services (Haeussler et al., 2010; Stam et al., 2007; Park et al., 2005) as well as to gain higher rates of growth (Stearns, 1996).

Within the present research firms’ collaborative activities were operationalized using four variables: participation in strategic alliances, agreements regarding R&D, technical cooperation and licensing.

All multi-item scales pertaining to dynamic capabilities were tested following Confirmatory Factors Analysis (CFA) in order to confirm that particular items relate to a specific dynamic capabilities construct. Therefore five different dynamic capabilities constructs or composite variables were produced. All of these composite variables were constructed as averages of multi-item Likert-type scales, where higher numbers pointed to a “higher quantity” of what was measured. Annex I presents all relevant CFA details. As shown there, all multi-item scales representing dynamic capabilities were reasonably valid and reliable.

4. Empirical results and discussion

4.1 Dynamic capabilities-Descriptive statistics.

Table 3 presents the descriptive statistics (mean values) of the dynamic capabilities constructs (please see Annex for a presentation of the items used to generate each construct) and provides a first indication of their development and use within the newly-established firms of our sample.

Table 3: Descriptive Statistics

	N	Mean	Std. Deviation
Sensing capability: Market adaptation	4004	**3.77**	0.88
Sensing capability: Technical adaptation	4003	2.48	1.14
New product development capability	4004	**3.71**	0.82
Networking capability	4004	2.94	0.88
Participation in collaborations	4004	1.87	0.84

In general, market-sensing capabilities can be considered as key resources for creating sustainable competitive advantage. Descriptive statistics indicate that the firms of our sample have developed to a relatively large extent market adaptation capabilities in order to explore market opportunities, probe markets, and respond to customer needs. Overall, market adaptation appears to be important for most companies, regardless sectors.

It is rather interesting the fact that while the market sensing side seems to be vital for firms and is assessed as important clearly ahead of other capabilities (M=3.77, SD=0.88), the technological side is lagging even behind NPD and networking capability (M=2.48, SD=1.14). This finding can be attributed to the fact that the firms of our sample are new, while the majority of them (63.6%) are micro companies with a limited resource base at this stage of their life which perhaps does not allow for the addition or subtraction of technology-related resources.

NPD capability has been identified as an important capability and success factor by many scholars such as Eisenhardt and Martin (2000), Teece (2007), Pavlou and El Sawy (2011). For the firms of our sample the importance of this capability (M=3.71, SD=0.82) appears to be equally important with that of market adaptation. It seems that newly-established firms consider new product development capability as an important way to exploit market opportunities and capture markets by introducing new or improved products.

The mean value attributed to the networking capability construct (M=2.94, SD=0.88) indicates that the firms of our sample do not consider networking activities among their top priorities. This may be initially attributed to the age of these companies[4]. Although an impressive line of research has documented the wide-ranging effects of networking, new firms seem not to exploit to a large extent network relations that both provide and shape opportunities. That can be due to limited social and business capital during the first years, lack of trust to bigger companies or introversion which depends on both national and sectoral contexts. The diversity of our sample allows for assumptions to be made relating the technology and knowledge level, the sectoral and national context, as well as the company's age with the tendency to develop networking. We would expect high-tech and more knowledge-intensive firms to draw more upon networking capabilities than low-tech and less knowledge-intensive ones. This is however a matter of more elaborate analysis which will follow.

Although firms demonstrate a moderate interest at networking (M=2.94, SD= 0.88), the descriptive results indicate that they don't participate or participate to a limited extent in technological collaborations (M=1.87, SD=0.84). This may be attributed to their limited resources, lack of trust and sometimes lack of clear goals and objectives due to newness. Furthermore, owing to the fact that the specific collaborations study have a strategic orientation it is more likely that young firms develop technology cooperative strategies and thus decide to get involved in such collaborations later on in their lifetime

4.2 A proposed taxonomy of firms in the AEGIS sample[5]?

In the theoretical framework of the AEGIS project it is clearly stated that knowledge-intensive entrepreneurship is associated with four basic characteristics: it concerns new ventures; new ventures that are innovative; new ventures engaging in activities that are knowledge intensive; and finally, new ventures that are not to be found only in high-tech industries (they may well be

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[4] Network content (inter-personal and inter-organizationanl relationships) changes throughout the lifetime of an entrepreneurial venture. During the early phases of a venture's life entrepreneurs are particularly concerned with building personal networks in order to overcome the liability of newness, to mobilize necessary resources such as information and knowledge and promote the emerging business. More strategic networks emerge later in the life of the firm when issues such as growth and profit making arise. Once the operating foundation has been established the entrepreneur/founding team becomes more aware of the strategic aspects of the networks which tend to consist of relations with customers, suppliers or competitor organizations and can be important conduits for information and know-how (Schutjens and Stam, 2001; Lechner and Dowling (2003).

[5] This part of the deliverable relies heavily on empirical work undertaken by the LIEE/NTUA team in the context of Deliverable 2.3.2. In D.2.32 one can find detailed information on the variables used, their measurement and the cluster analysis performed to identify different types of knowledge-intensive ventures.

active in industries with medium or low-tech characteristics). The first and last conditions characterising a KIE venture are satisfied a priori in the AEGIS sample. Table 1 and Table 2 (see Sample section) indicate that the collected data regard new ventures and that these ventures are sampled from a wide array of both high-tech and low-tech industries. We therefore need variables for the remaining two conditions: knowledge intensive activities and innovation performance in order to be able to identify KIE ventures. The following Table (column 1) presents our choice of variables.

As it can be seen from Table 4, four classes of variables were employed as distinguishing features of KIE. Variables representing knowledge-seeking activities and innovation performance represent obvious choices. Knowledge-seeking activities are related to specific linkages that can act as sources of information and knowledge for the young firm. They can be either external (industry, scientific institutions, other open sources) or internal to the firm (in-house R&D) and they can also be related to participation in collaborative R&D (nationally or EU-funded). Innovation performance is measured using a set of variables measuring whether the responding firm introduced product, process or other types of administrative innovations as well as whether the firms utilized various means to protect their intellectual property during the last three years. Finally, in innovation performance measures we included the radicalness of product innovation as an ordinal variable taking the values of 0 (= no innovation); 1 (= new-to-firm); 2 (=new-to-market); and 3 (= new-to-world product innovation).

The remaining two groups of indicators are “initial conditions” and “human capital and innovation input”. Beginning with “initial conditions”, average educational attainment of the founding team can be thought of as representing the initial stock of knowledge founders bring with them when starting the venture. The percentage of funding coming from venture capital may be seen to reflect the quality or ingenuity of the original idea that led to the formation of the venture. One would normally expect that, ceteris paribus, the higher the contribution of venture capital the higher the originality and innovation potential of the firm. Taken together, these two variables may be argued to represent the “initial” knowledge capital available to the venture at start-up. As regards the next four variables, the positive role of human capital (i.e. percentage of employees with advance qualifications) and of R&D intensity as inputs for knowledge creation and innovation is self-evident.

We therefore argue that, taken as whole, knowledge-seeking activities, initial conditions, and human capital, as operationalized in the AEGIS survey, reflect what might be understood as the venture's *knowledge assets*. Naturally, we do not pretend that these are the only, or even the best, measures that could be used as indicators of "knowledge intensity"; we simply contend that, within our particular context and data at hand, they represent reasonably faithfully the latent concept of interest. As regards innovation performance, the variables presented in the Table are fairly standard. Taken together they capture various dimensions of innovation performance, including product, process and administrative innovation, and patenting as well as less formal methods of intellectual property protection. With the variables shown in the Table, we have 3,226 firms with complete data.

In order to determine whether there it exists a meaningful grouping in our observations on the basis of their similarity in knowledge assets and innovation performance as reflected by the (binary) variables identified above we performed Kmeans cluster analysis. Kmeans is a partition method that attempts to break the observations into a distinct number of non-overlapping groups (clusters). Upon inspection, we decided that the most meaningful grouping in our data is given by the 3-cluster solution. All variables included in cluster analysis are binary including those that were originally measured as continuous or in a 5-point Likert scale[6]. The descriptive statistics on each of the three groups are given in columns (2) to (4). Column (5) gives the sample means. As the variables used in cluster analysis are binary, numbers in each column represent the percent of firms within each group that score one in any given variable.

As can be seen from the Table, we distinguish between "followers", "all-around innovators" and "world-class product innovators". The "followers" group is the most highly populated in our sample (i.e. 2012 firms). Its main characteristic is that none of the means of the variables used in cluster analysis is greater than the respective sample average.[7] There is nothing extraordinary about this group of firms, hence the name "followers". For example, only 44% of firms belonging into this group have introduced product innovation in the last three years compared to

[6] Detailed information on the cluster analysis methodology followed and the results obtained can be found in Deliverable 2.3.2.

[7] Note that in the Table, means are highlighted when they are greater than the overall mean. Also note that because variables are binary their means represent the percent of firms *within each group* that score one in any given variable.

100% for both remaining groups. Apparently, followers do engage in knowledge-intensive activities and innovation, but they clearly lag behind firms in the other two groups.

"All-around innovators" (AaIs) are distinguished by their balanced emphasis on knowledge seeking activities (both in-house and from external sources), on new-to-market product innovation, and on process *and* administrative innovation. Interestingly, initial knowledge stock, as reflected in founders' average educational attainment, does not seem exceptional; only 20% of these firms report founders with graduate degrees or higher compared to 57% in the last group. All-around innovators also do not patent as much as world-class innovators, and more generally they do not emphasize much intellectual property protection, again as compared to the last group, except for lead-time advantages.

In contrast, new-to-world product innovation, IPR protection, and knowledge creation stemming from highly educated founders and human capital seem to be the distinguishing marks of the last group, hence the label "world-class product innovators" (WcPIs). It is interesting to note that in this group, firms depend mainly on in-house knowledge creation and less so on knowledge from external sources (the latter characterizing AaIs). It is perhaps no coincidence that this group is the least populated in terms of number of firms: 487 compared to 727 for AaIs innovators and 2012 for the "followers".

In sum, based on the abovementioned results one could say that *two types of knowledge-intensive ventures can be traced in our sample*. The first, shows a more balanced emphasis on different dimensions of innovation and relies mainly on external knowledge seeking, while the second emphasizes new-to-world innovation based on in-house knowledge which in turn draws from high quality human capital (both in terms of founders and workforce).

Table 4: Cluster analysis results

(1)	(2)	(3)	(4)	(5)
KIE variables	**Followers**	**All-around Innovators**	**World-class product Innovators**	**Total sample**
Knowledge-intensive activities				
Knowledge/External-Industry (0/1)	0.428	**0.642**	0.279	0.454
Knowledge/External-Science (0/1)	0.0586	**0.186**	0.0657	0.0883
Knowledge/In-house R&D (0/1)	0.415	0.736	**0.706**	0.531
Knowledge/External-Open sources (0/1)	0.177	**0.421**	0.240	0.242
Knowledge/Participation in collaborative (0/1)	0.0686	**0.241**	0.117	0.115
"Initial conditions"				
F-team avrg edu attainment (0/1)	0.249	0.199	**0.567**	0.285
% capital from venture capital (0/1)	0.0119	0.0165	0.0678	0.0214
Human capital & Innovation "input"				
%ft employees:Graduate degree (0/1)	0.124	0.0578	**0.246**	0.127
%ft employees:PhD degree (0/1)	0.0611	0.116	**0.246**	0.101
Employee training (0/1)	0.360	**0.600**	0.464	0.430
RD intensity (0/1)	0.167	0.470	**0.548**	0.293
Innovation performance				
Introduced new goods/services last 3 years	0.440	1	1	0.651
New-to-firm (0/1)	0.206	0.283	0.168	0.218
New-to-market (0/1)	0.178	**0.476**	0.433	0.284
New-to-world (0/1)	0.0567	0.241	**0.398**	0.150
Introduced process innov last 3 years	0.350	**0.817**	0.292	0.446
Introduced logistics innov last 3 years	0.275	**0.795**	0.113	0.368
Introduced innov in support activities last 3 years	0.406	**0.935**	0.331	0.514
Improved knowl mngnt systems last 3 years	0.414	**0.869**	0.417	0.517
Changes in management structure the last 3 years	0.258	**0.583**	0.228	0.327
IPR last 3 years:patents	0.0263	0.213	**0.304**	0.110
IPR last 3 years:trademarks	0.117	0.519	**0.536**	0.271
IPR last 3 years:copyrights	0.0721	0.311	**0.405**	0.176
IPR last 3 years:confidentiality	0.134	0.642	**0.932**	0.369
IPR last 3 years:secrecy	0.0557	0.510	**0.799**	0.270
IPR last 3 years:lead_time	0.138	**0.757**	0.692	0.361
IPR last 3 years:complexity	0.0885	0.612	**0.704**	0.299
Observations	**2012**	**727**	**487**	**3226**

4.3 Two-way analysis of variance

In order to test the impact of the different types of ventures in terms of their knowledge intensity (KIE type) as well as the effect of different sectors on dynamic capabilities we have employed two-way analysis of variance[8]. This technique allows us to examine the individual and joint effect of sector and KIE type (independent variables) on one dependent variable, namely product development capability, technical adaptation, market adaptation capability, networking capability and participation in collaborations.

Cluster analysis results in the previous section indicated that the firms of our sample can be differentiated according to their knowledge-intensiveness and innovation capacity as "world-class innovators" and "all-around innovators" while there is also a large category of firms that were proved to be "followers" in terms of their knowledge seeking activities, innovation performance, human capital and innovation input, and "initial conditions" (educational level of employees and venture capital funding). Furthermore, we follow OECD's sector classification presented in detail in the section related to the presentation of the sample i.e. high-tech and medium-high manufacturing, low and medium-low tech manufacturing, and KIBS (knowledge intensive technology business services, knowledge intensive market services).

First it was tested the impact of KIE type and sector on product development capability. There was a statistically significant main effect for KIE type [$F(2, 3208)=73.164$, $p<0.01$]. Post-hoc comparisons[9] indicated that the firms characterized as "all-around innovators" and "world-class innovators" have a significantly different mean score from firms characterized as "followers". This practically means that knowledge-intensive firms appear to develop superior product development dynamic capabilities compared to "followers". Furthermore, "all around innovators" seem to develop product development capabilities to a higher degree than "world class innovators". However, the main effect for sector [$F(5, 3208)=2.128$, $p=0.59$)] and the interaction effect of sector and KIE type [$F(10, 3208)= 1.471$, $p=0.144$] did not reach statistical significance.

Our findings suggest that the knowledge-intensive firms of our sample have developed to a greater extent their product development capabilities compared to the group of "followers". This finding may be related to the fact that the first two groups have developed more intensive knowledge-seeking activities than firms characterized as "followers" and in consequence they might have developed to a greater degree their capability to sense latent needs, develop novel

[8] The two-way analysis of variance results can be found in the Annex II.

[9] Post-hoc comparisons included Tukey HSD and Games-Howell test. The mean differences between pairs of groups are significant at the 0.05 level.

products and services and promote them into the market. Most interestingly empirical analysis indicated that "all around innovators" develop and offer novel goods and services to a higher degree than "world-class innovators". This finding may be attributed to the fact that "all-around innovators" are more extrovert in terms of the mechanisms they use to collect new knowledge and information and perhaps have the possibilities to identify more rapidly new product development opportunities compared to "world-class innovators" which mainly rely on their own resources (R&D efforts and patenting activity). Sector classification does not appear to have a significant effect on product development capability. This finding indicates that the specific capability is equally important across sector groups because of its decisive importance for creating and sustaining competitive advantage.

A two-way ANOVA was conducted that examined the effect of KIE type and sector on the firm's capability to adapt to market changes. There was a significant main effect of KIE type on the firm's capability to sense changes in market and consumer needs [$F(2, 3208)=37.576$, $p<0.001$]. Post-hoc comparisons indicate that there is a statistically significant difference in the means of firms considered as "followers" and the other two KIE groups. This an expected result as "followers" have developed to a lesser extent the required knowledge assets that would enable them to better understand and respond to market transformations In addition, "all around innovators" appear to adapt more easily/ to a greater extent to market changes than "world class innovators" possibly as a result of their ability to rely more on the use of external knowledge sources to capture value and mobilize resources in order to address market opportunities and achieve competitive advantage.

The Levene's test of equality of error variances has a significant value which suggests the variance of our dependent variable (market adaptation) is not equal across the groups examined. In such a case it is suggested that a more stringent level for evaluating significance level (e.g. 0.01) is set for evaluating the two-way ANOVA results (Pallant, 2001). Therefore we assume that the main effect of sector is not significant and thus there is no significant difference in market adaptation across groups [$F(2,3208)=2.654$, $p=0.021$]. The same applies for the interaction effect of sector and KIE type [$F(2,3208)=1.971$, $p=0.033$]. This finding indicates that the ability of a firm to sense market and customer needs and seek to respond to them is an important dynamic capability which may affect the competitive advantage of young firms irrespective of their sector classification.

The two-way ANOVA results testing the impact of KIE type on the firms' capability to adapt to technical changes indicate that there is a significant main effect [$F(2,3208)=153.136$, $p<0.001$]. Post-hoc tests reveal that the mean scores for "world-class innovators" and "all-around innovator" groups are significantly different from the "followers" group indicating that that the first two groups have developed technical adaptability to a greater extent than the less knowledge-intensive group. This finding may be related to the fact that “world-class” and “all-around innovators” are involved more intensively in activities that allow them to acquire knowledge and understand technology advancements better than “followers”. The main effect for sector is also statistically significant [$F(2,3208)=16.950$, $p<0.001$]. Post-hoc comparisons identified significant statistical mean differences among groups and more specifically showed that the high-tech group of firms has developed technical adaptability to a greater extent than low-tech firms and KIBS. This may be attributed to the fact that high-tech firms should be able to continuously scan for information about potential opportunities and threats as they are usually active in dynamic environments where rapid response to technological changes is vital for their survival and growth.

The two-way ANOVA results show a significant effect for KIE type on networking capability [$F(2,3208)=72.648$, $p<0.001$]. Post-hoc comparisons indicate that “world class innovators” and “all-around innovators” have a significantly different mean score from “followers”, while “world class” and “all around” innovators also exhibit significantly different means themselves. More specifically, knowledge-intensive firms tend to be more involved in different types of networks through which they can gain more resources than their less knowledge-intensive counterparts. This finding results from the fact that knowledge-intensive firms have also developed more advanced knowledge-seeking capabilities which practically allows them to participate more easily and efficiently in different types of interpersonal and inter-organizational networks. Furthermore “all-around innovators” appear to develop a more intensive networking activity than “world-class innovators” due to the fact that they follow a different innovation model i.e. they innovate primarily based on their external knowledge-seeking activities as opposed to the group of “world-class innovators” which base their innovative capacity mainly on their internal new knowledge generation ability.

In addition, there was also a significant main effect of sector on networking capability [$F(2,3208)=10.141$, $p<0.001$] Post-hoc tests reveal that either low or high-tech manufacturing firms appear to be more involved in networks than KIBS. However, we should note that this is perhaps a counterintuitive finding which would require further research e.g. taking also into account the heterogeneity of the KIBS firm group.

Finally the results of the two-way ANONA conducted to examine the impact of KIE type and sector on a firm’s capability to participate in collaborations indicate that there was a statistically significant main effect for KIE type [$F(2, 3208)=120.844$, $p<0.001$]. Post-hoc tests indicated that “world class’’ innovators ($M=2.2$, $SD=0.81$) and “all around innovators” ($M=2.31$, $SD=0.81$) have a significantly different mean score from “followers” ($M=1.64$, SD=0.71). Therefore, knowledge-intensive firms seem to get more involved in different types of formal technological agreements than those characterized as “followers”. This finding is clearly related to the fact that knowledge-intensive firms (see cluster analysis results in Table 3) use science partners as sources of knowledge in a greater extent than “followers”, furthermore they are more innovative and use intellectual property protection methods in a higher degree than their less-knowledge intensive counterparts.

There was also a significant main effect of firm sector on the participation in collaborations [$F(2, 3208)=19.060$, $p<0.001$] which practically means that overall if we ignore whether a firm is knowledge-intensive or not, its capability to form collaborative agreements is influenced by the sector it belongs to. Post-hoc comparisons confirm that the means of low-tech and medium-to-low-tech companies are significantly different than those of medium-high, high-tech firms and knowledge-intensive business services ($p=0.05$). More specifically, firms that belong to low and medium-tech sectors seem to participate less in collaborative agreements compared to high-tech firms and KIBS. This finding can be attributed to the fact that newly-established firms engaged in high-tech manufacturing and KIBS are more prone to form technological collaborative agreements to share knowledge and expertise or mitigate risk and share expenses because of the technological content and complexity of the products they are offering.

5. Concluding remarks

In this paper we have attempted to empirically explore the applicability of the dynamic capabilities concept in a large sample of newly-established firms using the large dataset of the AEGIS survey. In order to measure dynamic capabilities we have used five constructs: product development capability, market adaptation, technical adaptation, networking capability and capability to form collaborative technology agreements.

Our findings suggest that new entrepreneurial ventures do develop specific dynamic capabilities although their degree of development appears to differ in accordance to the firm’s knowledge-intensiveness and their sector of economic activity.

In general, the young firms of our sample, which in their grand majority are micro and small firms, have developed to a larger extent dynamic capabilities related to new product development and market adaptation while they have built up to a smaller degree capabilities related to changes in technology and technology collaborative agreements. This result may be attributed to the fact that at this stage of their life young companies are more focused onto scanning business environment, addressing customer needs and introducing new product offerings matching in this way their resources with market requirements. However, due to their liability of newness and limited resources their effort related to adapting their technologies (radical change in their resource base in terms of acquisition or transformation) is less intensive indicating they are more likely to adopt an altered use of existing resources in order to address changing circumstances at the market side.

It is important to note that our findings indicate that NPD and market sensing capability are equally important in both high-tech and traditional mature markets as they are both considered as important drivers for sustaining profitability and business growth. It is rather sensible that especially new companies that are striving to earn and keep a piece of the pie by creating or entering markets invest on and develop both market sensing and NPD capabilities. Shorter life cycles of products and the aggressiveness of global markets intensify strategies of all types of companies towards translating market messages into new products ready to entice customers.

However, our findings also suggest that high-tech manufacturing firms have developed technical adaptability to a greater extent than low-tech firms and KIBS. This may be attributed to the fact that high-tech firms should be able to continuously scan for information about potential opportunities and threats as they are usually active in dynamic environments where rapid response to technological changes is vital for their survival and growth. Furthermore, firms that belong to low and medium-tech sectors participate less in technology collaborative agreements compared to high-tech manufacturing firms and KIBS. This finding indicates that participation in specific collaborative agreements is significantly related to the technological content and complexity of the products offered.

Our findings also suggest that the more knowledge-intensive firms, i.e. firms that have more knowledge assets and exhibit better innovative performance (characterized as ‘world class innovators’ or ‘all around innovators’) have developed to a greater extent all types of dynamic capabilities compared to their less knowledge-intensive counterparts, i.e. ‘followers’. Therefore it appears that a firm’s increased knowledge resources and endowments (i.e. knowledge-seeking activities, human capital and innovation inputs) support the creation and further development of dynamic capabilities which in turn may help the new firm survive and grow.

In sum, our findings empirically support the assertion that dynamic capabilities can be present in newly-established firms that in their majority are micro and small firms. The degree of DCs development is dependent on the firm knowledge base suggesting that knowledge assets and human capital are important for DCs creation and further nurturing. DCs also exist in low-tech firms although capabilities such as technical adaptation and technology collaborative agreements are present in a smaller degree compared to high-tech firms. Last, but not least our empirical analysis was applied to a large number of firms operating in ten European countries and therefore confirmed the generalizability of our results in different national contexts.

6. References

Abro Q. M. M., N. A. Memon, P. I. A. S. Arshdi, (2011), 'Dynamic Capabilities and Firm Performance: A Case of Two SMEs in Pakistan', *Mehran University Research Journal of Engineering & Technology*, Vol. 30, No. 3, [ISSN 0254-7821]

Alvarez, V.S. and Merino, T.G. (2003), "The history of organizational renewal: evolutionary models of Spanish savings and loans institutions", *Organization Studies*, 24, 1437–1461.

Ambrosini V, Bowman C, Collier N. (2009), "Dynamic capabilities: an exploration of how firms renew their resource base", *British Journal of Management* **20**(S1): S9–S24.

Arthurs, J.A., and Busenitz, L.W., (2006), "Dynamic Capabilities and New Venture Performance: The Moderating Effects of Venture Capitalists", *Journal of Business Venturing*, 21, 195-215.

Barthélemy, J. and Quélin, B. V. (2006). 'Complexity of outsourcing contracts and ex post transaction costs: an empirical investigation'. *Journal of Management Studies*, 43, 1775–97.

Baum, J. & Oliver, C. (1991) "Institutional Linkages and Organizational Mortality.", *Administrative Science Quarterly*, 36: 187-218.

Boccardelli, P. and Magnusson, M. G. (2006) "Dynamic Capabilities in Early-Phase Entrepreneurship", *Knowledge and Process Management*, 13 (3), pp. 162-174

Borch, O. & Madsen, E., (2007), "Dynamic capabilities facilitating innovative strategies in SMEs", *International Journal of Technoentrepreneurship*, 1(1), 109-125

Birkinshaw, J., Hamel, G., & Mol, M. (2008)" Management innovation", Academy of Management.", The Academy of Management Review, 33(4): 825

Bruni, D. S., Verona, G., (2009) "Dynamic Marketing Capabilities in Science-based Firms: an Exploratory Investigation of the Pharmaceutical Industry", *British Journal of Management* 20, pp.101–S117.

Caloghirou Y., (2004)" Firm-specific effects on performance: Contrasting SMEs and large-sized firms", *European Management Journal*, 22(2): 231–243

Chirico F., (2007) "The value creation process in family firms. A dynamic capabilities approach", *Electronic Journal of Family Business Studies (EJFBS)*, Vol. ½, pp.137-167

Colombo M. G., E. Piva, A. Quas, C. Rossi-Lamastra, (2010), Dynamic capabilities during the global crisis: evidence from Italian New Technology Based Firms. Available at SSRN: http://ssrn.com/abstract=1722507 or doi:10.2139/ssrn.1722507

Danneels, E. (2002), 'The dynamics of product innovation and firm competences,' S*trategic Management Journal*, 23(12), 1095–1121.

Dahl M.S.. Pedersen C.O.R. (2004), "Knowledge flows through information contracts in industrial districts: myth or reality?", *Research Policy*, 33. p. 1673-1686

Deeds, D.L., DeCarolis, D. and Coombs, J. (1999) "Dynamic capabilities and new product development in high technology ventures: an empirical analysis of new biotechnology firms", Journal *of Business Venturing*, 15, 211–229.

DeSarbo, W. S., Benedetto, C. A., Song, M. and Sinha, I. (2005), 'Revisiting the miles and snow strategic framework: uncovering interrelationships between strategic types, capabilities, environmental uncertainty,and firm performance', *Strategic Management Journal*, 26, 47–74

Di Stefano, G., M. Peteraf and G. Verona (2010), 'Dynamic capabilities deconstructed: a bibliographic investigation into the origins, development, and future directions of the research,' *Industrial and Corporate Change*, e-pub ahead of print, doi: 10.1093

Doeving E & P. Gooderham, (2008), “Dynamic capabilities as antecedents of the scope of related diversification: the case of small firm accountancy practices”, Strategic *Management Journal, Vol.*, **29**: 841–857

Drnevich, Paul L.; Marino, Louis D.; and Withers, Michael C. (2008) "How do firms leverage innovation-capabilities for repeat innovation?”, Frontiers *of Entrepreneurship Research*: Vol. 28: Iss. 19, Article 8.

Dunning, J. H. and S. M. Lundan (2010), ‘The institutional origins of dynamic capabilities in multinational enterprises,’ *Industrial and Corporate Change*, e-pub ahead of print, doi:10.1093/icc/dtq029.

Easterby-Smith, M. A., M. A. Lyles and Peteraf (2009), ‘Dynamic capabilities: current debates and future directions,’ *British Journal of Management*, 20, S1–S8.

Eisenhardt, K. M. and J. A. Martin (2000), ‘Dynamic capabilities: what are they?’ *Strategic*

Management Journal, 21(10–11), 1105–1121.

Ellonen HK, Wikström P, Jantunen A (2009). Linking dynamic capability portfolios and innovation outcomes. *Technovation*, 29:753-762.

Evers, N. (2011), "International new ventures in low-tech sectors - a dynamic capabilities perspective", *Journal of Small Business & Enterprise Development* (forthcoming)

Fischer T., H. Gebauer, M. Gregory, G. Ren, E. Flesch, (2010), “Exploitation or exploration in service business development? Insights from a dynamic capabilities perspective”, *Journal of Service Management*, Vol. 21 No. 5, pp. 591-624

Foss L., T. Iakovleva, J. Kickul, Elin (2010), “The role of microfoundations in explicating dynamic capabilities: A case study of the Norwegian petroleum sector “, Oftedal & Anne Solheim chapter in M. van Geenhuizen, W. Nuttall, D. V. Gibson (eds), *Energy and innovation: structural change and policy implications*, Purdue University, Press, Business & Economics USA 3, ISBN 978-1-55753-578-8

Foss, N., Husted, K. & Michailova, S. (2010), 'Governing Knowledge Sharing in Organizations: Levels of Analysis, Governance Mechanisms, and Research Directions.' *Journal of Management Studies*, 47:3, 455-82.

Garnsey, E. (1998) ‘A Theory of the Early Growth of the Firm’, *Industrial and Corporate Change*, 7: 523-556.

Ge B., and B. Dong (2009) “Dynamic Capabilities and Firm Performance: An Empirical Study of Chinese New Ventures”, *Fourth International Conference on Cooperation and Promotion of Information Resources in Science and Technology*, Pub. IEEE, Pages: 113-117, ISBN: 9780769538983, DOI: 10.1109/COINFO.2009.13

Grande J., (2011), ‘New venture creation in the farm sector – Critical resources and capabilities’, *Journal of Rural Studies*, Vol. 27, 2, pp. 220-233.

Grimpe, C. and U. Kaiser (2010), “Balancing Internal and External Knowledge Acquisition: The Gains and Pains of R&D Outsourcing”, *Journal of Management Studies* 47(8), 1483-1509.

Helfat, C. E. (1997), ‘Know-how and asset complementarity and dynamic capability accumulation: the case of R&D,’ *Strategic Management Journal*, 18(5), 339–360.

Helfat, C. E., S. Finkelstein, W. Mitchell, M. A. Peteraf, H. Singh, D. J. Teece and S. G. Winter (2007), *Dynamic Capabilities: Understanding Strategic Change in Organization*. Blackwell Publishing: Malden MA.

Helfat C. E. and M. A. Peteraf (2009), ‘Understanding dynamic capabilities: Progress along a development path’, *Strategic Organization.* 7 (1).

Haeussler, C., L. Jiang, J. Thursby, and M. Thursby, (2010), “Strategic alliances and product development in high technology new firms: The moderating effect of technological capabilities”, *J. Bus. Venturing* doi:10.1016/j.jbusvent.2010.10.002

Henderson, R., & Clark, K. (1990), “Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms.”, *Administrative Science Quarterly*, 35, 9-30.

Iansiti M., Clark K., (1994), “Integration and dynamic capability: Evidence from product development in automobiles and mainframe computers”. I*ndustrial and Corporate Change*, 3 (3): 557-605

Jantunen A., K. Puumalainen, S. Saarenketo, K. Kylaheiko,(2005), “Entrepreneurial Orientation, Dynamic Capabilities and International Performance”, *Journal of International Entrepreneurship,* 3, 223–243

Kale, P., and Singh, H. (2007), “Building firm capabilities through learning: The role of the alliance learning process inalliance capability and firm-level alliance success”, *Strategic Management Journal*, 28: 981-1000.

Karagouni G., Kalesi M.,(2011), “Knowledge intensive entrepreneurship and dynamic capabilities in low tech SMEs: Evidence from the Greek food sector”, *MIBES Transaction On Line electronic version* available at http://mibes.teilar.gr, ISSN 1790-9899, Vol. 5/2, pp. 1-19

Karagouni G., (2011), “Autotelic Capabilities and Knowledge Intensive Entrepreneurship in Low Tech Sectors”, *4th Annual EuroMed Conference of the EuroMed Academy of Business,* ISBN: 978-9963-711-01-7, pp 946-949, October 20th-21st, 2011, Elounda, Crete, Greece

Kogut, B. (1991), ‘‘Joint ventures and the option to expand and acquire’’, *Management Science*, Vol. 37/1, pp. 19-34

Kuuluvainen A., (2011), “Dynamic capabilities in the international growth of SME: Case study from Finland’, *ICSB (International Council for Small Busines) -conference* , Stockholm, Sweden, 15-18 June, 2011

Lambe, C.J., Spekman, R.E. and Hunt, S.D. (2002), ‘‘Alliance competence, resources, and alliance success: conceptualization, measurement, and initial test’’, J*ournal of the Academy of Marketing Science,* Vol. 30 No. 2, pp. 141-58.

Lampel, J. and Shamsie, J. (2003), “Capabilities in motion: new organizational forms and the reshaping of the Hollywood movie industry”, *Journal of Management Studies*, 40, 2189–2210.

Lechner, C. and Dowling, M. (2003), “Firm networks: External relationships as sources for the growth and competitiveness of entrepreneurial firms”, *Entrepreneurship & Regional Development*, 15, 1–26.

Littunen, H. (2000), “Networks and Local Environmental Characteristics in the Survival of New Firms”, *Small Business Economics*, 15, pp. 59-71

McKelvie A, Davidsson P. (2009) “From resource base to dynamic capabilities: an investigation of new firms”, *British Journal of Management* **20**: S63–S80.

Marcus, A. A. and M. H.Anderson, (2006), “A general dynamic capability: Does it propagate business and social competencies in the retail food industry?”, *Journal of Management Studies*, 43: 19-46.

Nakamura, M., (2003) “Research alliances and collaborations: introduction to the special issue”, *Managerial and Decision Economics* 24, 47–49

Newbert, S.L. (2005), “New firm formation: a dynamic capability perspective. “, *Journal of Small Business Management*, 43(1), 55–77.

O'Gorman C., N. Evers, (2011) "Network intermediaries in the internationalisation of new firms in peripheral regions", *International Marketing Review*, Vol. 28 Iss: 4, pp.340 - 364

Pablo, A., Reay, T., Dewald, J.R. and Casebeer, A.L. (2007), “Identifying, enabling and managing dynamic capabilities in the public sector”, *Journal of Management Studies*, 44, 687–708

Park, S. H., Chen, R., & Gallagher, S. (2002). “Firm resources as moderators of the relationship between market growth and strategic alliances in semiconductor start-ups.”, *Academy of Management Journal*, 45: 527–545.

Paun F., N. von Tunzelmann and P. Richard, (2010), "Transferring new dynamic capabilities to SMEs: the role of ONERA – the French Aerospace Lab in promoting asymmetries management”, *Innovation Forum : environment, Innovation and Sustainable development”,* Marseilles : France

Paul S. M., D. S. Mytelka, C. T. Dunwiddie, C. C. Persinger, B. H. Munos, S. R. Lindborg & A. L. Schacht, (2010), „How to improve R&D productivity: the pharmaceutical industry's grand challenge", *Nature Reviews Drug Discovery* **9**, 203-214

Pavlou P. and El Sawy, O. (2011), "Understanding the Elusive Black Box of Dynamic Capabilities", *Decision Sciences*, Vol. 42/ 1, pp. 239–273

Penrose, E.T. (1959), *The Theory of the Growth of the Firm.* New York: John Wiley.

Pitelis C. N. and D. J. Teece, (2010), "Cross-border market co-creation, dynamic capabilities and the entrepreneurial theory of the multinational enterprise", *Industrial and Corporate Change*, vol. 19/ 4, pp. 1247-1270

Poulis J. (2009), **"**Dynamic capabilities in complex environments. Assessing the dynamic capabilities view: spare change, everyone?" *Strategic Organization* 2009 7: 75

Protogerou A., Y. Caloghirou and S. Lioukas, (2011), "Dynamic capabilities and their indirect impact on firm performance ",*Industrial and Corporate Change*, pp. 1–33, doi:10.1093/icc/dtr049

Quentier, J-M., (2011), "International New Ventures in the Commodity Sector: A Dynamic Capabilities Perspective", *IABD 23rd Annual Conference*, New Orleans, Louisiana, USA, April 7-9

Rafailidis A. and G. Tselekidis (2009), "Dynamic capabilities, change and innovation in Greek SMEs: a preliminary study", *International Journal of Entrepreneurship and Small Business V*ol. 7/.4, pp. 404 - 419

Rindova, V., and S. Kotha, (2001), "Continuous "morphing": Competing through dynamic capabilities, form, and function" , *Academy of Management Journal*, 44(6): 1263-1280.

Rothaermel, F. and Boeker, W. (2008), ''Old technology meets new technology: complementarities, similarities and alliance formation'', *Strategic Management Journal*, Vol. 29 No. 1, pp. 47-77

Salunke S., J. Weerawardena, J. R. McColl-Kennedy (2011), "Towards a model of dynamic capabilities in innovation-based competitive strategy: Insights from project-oriented service firms", downloaded from: http://eprints.qut.edu.au/47017/ [in press, (2011)] DOI:

http://www.sciencedirect.com/science/journal/00198501

Salvato, C. (2003), "The role of micro-strategies in the engineering of firm evolution", *Journal of Management Studies*, 40(1), 83–108.

Salvato, C., and Melin, L. (2003), "Competitive Advantage of Family Business. A Dynamic Capabilities Perspective.", *Research Forum Proceedings, FBN, 14th world conference*

Sapienza, H. J., Autio, E., George, G., & Zahra, S. A. (2006), "A capability perspective on the effects of early internationalization on firm survival and growth", *Academy of Management Review*, 31: 914–933.

Sciascia, S., Alberti, G.F., Salvato, C., (2009), "Firm-level entrepreneurial contents for strategic renewal: A knowledge-based perspective. in G.T. Lumpkin, Jerome A. Katz (ed.) Entrepreneurial Strategic Content (Advances in Entrepreneurship, Firm Emergence and Growth, Volume 11), Emerald Group Publishing Limited, pp.41-75.

Simon, A., (2010), "Resources, dynamic capabilities and Australian business success.", Management Science / Operations Research , Miscellaneous Papers, Journal of Global Business Technology, Vol. 6/ 2, Pp: 12-31, ISSN: 15535495

Schutjens, V. and Stam, E. (2003), "The evolution and nature of young firm networks: a longitudinal perspective", *Small Business Economics*, 21, 115-134

Spanos, Y. E. and S. Lioukas (2001), 'An examination into the causal logic of rent generation: contrasting Porter's competitive strategy framework and the resource-based perspective,'*Strategic Management Journal*, 22(10), 907–934.

Srinivasan R, G. L. Lilien, A. Rangaswamy, (2002) "The Role of Technological Opportunism in Radical Technology Adoption: An Application to e-Business," *Journal of Marketing*, Vol. 66, No. 3 (July), p. 47-60.

Stam, E., P. Gibcus, J. Telussa, and E. Garnsey (2007), "Employment Growth of New Firms," *Scales Research Reports H200716*, EIM Business and Policy Research

Stam, E. (2008), 'Entrepreneurship and Innovation Policy', *Jena Economic Research Paper*, 006-2008

Stam E. and K. Wennberg,(2009), "The roles of R&D in new firm growth", *Small Business Economy*, 33:77–89

Teece, D. J. (2007), 'Explicating dynamic capabilities: the nature and microfoundations of

(sustainable) enterprise performance,' *Strategic Management Journal*, 28(13), 1319–1350.

Teece, D. J., G. Pisano and A. Shuen (1997), 'Dynamic capabilities and strategic management,' *Strategic Management Journal*, 18(7), 509–533

Telussa, J., Stam, E. y Gibcus, P. (2006) "Entrepreneurship, Dynamic Capabilities and New Firm Growth", *Working Paper H200623*, Netherlands: Scientific Analysis of Entrepreneurship and SMEs

Tikkanen U. (2010) "Capability evolution in the Finnish forest cluster: a qualitative approach", in J. Lamberg and M.Peltoniemi, *Capabilities and competitive advantage in the forest industry*, *eprints.herce.fi/201/.../RAMI_Capabilities_Final_Report_12052010.p.*

Tsekouras G., E. Poulis, K. Poulis, (2011) "Innovation and dynamic capabilities in a traditional service sector: Evidence from shipping companies", *Baltic Journal of Management*, Vol. 6 / 3, pp.320 – 341

Wall, S., C. Zimmermann, R. Kliengebiel and D. Lange (2010), *Strategic Reconfigurations: Building Dynamic Capabilities in Rapid Innovation-Based Industries,* Edward Elgar: Cheltenham: UK.

Wang Y., X. Shi, (2011) "Thrive, not just survive: enhance dynamic capabilities of SMEs through IS competence", J*ournal of Systems and Information Technolog*y, Vol. 13 / 2, pp.200 - 222

West, III, P.G. & DeCastro, J. (2001), The Achilles heal of firm strategy: resource weaknesses and distinctive inadequacies, *Journal of Management Studies*, 38(3): 417-442.

Weerawardena, J., Sullivan Mort, G., Liesch, P. W., & Knight, G. (2007), "Conceptualizing accelerated internationalization in the born global firm: A dynamic capabilities perspective.", *Journal of World Business,* 42: 294–306.

Winter, S. G. (2003), 'Understanding dynamic capabilities,' *Strategic Management Journal*, 24(10), 991–995.

Wu L-Y, (2006), "Resources, dynamic capabilities and performance in a dynamic environment: Perceptions in Taiwanese IT enterprises", *Information & Management* 43, 447–454

Wu L-Y, (2007), "Entrepreneurial resources, dynamic capabilities and start-up performance of Taiwan's high-tech firms", *Journal of Business Research* 60, 549–555

Zahra, S. A. and I. Filatotchev (2004), 'Governance of the entrepreneurial threshold firm: a knowledge-based perspective', *Journal of Management Studies*, 41, pp. 885–897.

Zahra, S. A., H. J. Sapienza and P. Davidsson (2006), 'Entrepreneurship and dynamic capabilities: a review, model and research agenda,' *Journal of Management Studies,* 43(4),918–955.

Zollo M, Winter SG. (2002), "Deliberate learning and the evolution of dynamic capabilities.", Organization *Science* 13(3): 339-351

Zúñiga- -Vicente, J. A., & Vicente-Lorente, J. D. (2006), "Strategic moves and organizational survival in turbulent environments: The Case of Spanish Banks (1983-97).", *Journal of Management Studies*, 43: 485-519

Yli-Renko H, Autio E & Sapienza HJ. (2001), "Social Capital, Knowledge Acquisition, and Knowledge Exploitation in Young Technology-Based Firms", *Strategic Management Journal* 22: 587-613

Annex 1

CFA analysis results

Table A11: CFA analysis results for sensing capability

Sensing capability	Construct indicators	Standardized first-order loadings
Market adaptation	Our firm actively observes and adopts the best practices in our sector	0.650[a]
	Our firm responds rapidly to competitive moves	0.707*
	We change our practices based on customer feedback	0.676*
	Our firm regularly considers the consequences of changing market demand in terms of new products and services	0.750*
	Our firm is quick to recognize shifts in our market (e.g. competition, regulation, demography)	0.779*
	We quickly understand new opportunities to better serve our customers	0.770*
Technological adaptation	Employees share practical experiences on a frequent basis	0.524[a]
	There is a formal R&D department in our firm	0.640*
	There is a formal engineering and technical studies department in our firm	0.719*
	Design activity is important in introducing new products/services to the market	0.455*
	Goodness-of-fit statistics	
	χ^2(d.f.)	920.378(35) p=0.00
	CFI	0.911
	RMSEA	0.79

[a] Loadings are fixed to 1 for identification purposes. All factor loadings are significant at $p < 0.05$ level.

Table A12: CFA analysis results

Firm capability	Construct indicators	Standardized first-order loadings
New product development capability	Capability to offer novel products/services	0.712[a]
	Capacity to adapt the products/services to the specific needs of different customers/market niches	0.484*
	Marketing and promotion activities	0.407*
R&D and alliance related capabilities	R&D activities	0.761[a]
	Establishment of alliances/partnerships with other firms	0.406*

	Networking with scientific research organizations (universities, institutes, etc.)	0.621*
	Goodness-of-fit statistics	
	χ^2(d.f.)	178.30(8) p=0.00
	CFI	0.942
	RMSEA	0.73

[a] Loadings are fixed to 1 for identification purposes. All factor loadings are significant at $p < 0.05$ level.

Table A13: CFA analysis results: Networking capability

Construct indicators	**Standardized first-order loadings**
Selecting suppliers	0.592[a]
Recruiting skilled labor	0.565*
Collecting information about competitors	0.580*
Accessing distribution channels	0.612*
Assistance in obtaining business loans/attracting funds	0.596*
Advertising and promotion	0.588*
Developing new products/services	0.621*
Managing production and operations	0.677*
Assistance in arranging taxation or other legal issues	0.559*
Exploring export opportunities	0.559*
Goodness-of-fit statistics	
χ^2(d.f.)	920.378(38)
CFI	0.919
RMSEA	0.79

[a] Loadings are fixed to 1 for identification purposes. All factor loadings are significant at $p < 0.05$ level.

Table A14: CFA analysis results: Participation in collaborations

Construct indicators	**Standardized first-order loadings**
Strategic alliance	0.548[a]
R&D agreement	0.743*
Technical cooperation agreement	0.702*
Licensing agreement	0.523*
Research contract-out	0.549*

Goodness-of-fit statistics	
χ^2(d.f.)	160.688(5) p=0.00
CFI	0.963
RMSEA	0.88

[a] Loadings are fixed to 1 for identification purposes. All factor loadings are significant at p <0.05 level.

CFI and RMSEA measures (CFI >0.9 and RMSEA <0.9) indicate an acceptable fit of the data to the constructs tested.

Table A15: Reliability analysis for CFA constructs

Constructs	**Cronbach's Alpha**
Market adaptation	0.857
Technical adaptation	0.617
New product development capability	0.611
Networking capability	0.845
Participation in technological collaborations	0.742

All capabilities constructs can be considered as reliable based on Cronbach's Alpha indicator (>0.6).

Annex 2

Two-way analysis of variance results

1. **Dependent variable: Product development capability**

Table A21: Descriptive statistics (mean scores)

Technology class	Followers	All-around innovators	World-class innovators	Total sample	Total N
Low-tech	3.6	4.2	3.9	3.8	1066
Medium-low (LT=ref)	3.3	3.9	4.3	3.5	212
Medium-high	3.6	4.2	4.0	3.8	262
High-tech	3.7	4.2	3.8	3.9	103
KIHTS*	3.7	4.0	4.0	3.9	506
KI Market services	3.5	4.1	3.8	3.6	1077
Total	3.5	4.1	3.9	3.7	3226

*KIHTS: Knowledge-intensive high-tech business services

Table A22: Tests of Between-Subjects Effects (Dependent Variable: Capability/Product related)

Source	Type III	df	Mean Square	F	Sig.	Partial Eta

	Sum of Squares					Squared
Corrected Model	216.956(a)	17	12.762	22.105	**.000**	.105
Intercept	15168.576	1	15168.576	26272.699	.000	.891
KIE grouping	84.482	2	42.241	73.164	.000	.044
tech_class	6.144	5	1.229	2.128	.059	.003
KIE grouping * tech_class	8.493	10	.849	1.471	.144	.005
Error	1852.143	3208	.577			
Total	46910.000	3226				
Corrected Total	2069.099	3225				

a R^2= .105 (Adjusted R^2= .100)

2. Dependent variable: sensing capability (market adaptation)

Table A23. Descriptive statistics (mean scores)

Technology class	Followers	All-around innovators	World-class innovators	Total sample	Total N
Low-tech	3.6	4.0	3.8	3.7	1066
Medium-low (LT=ref)	3.6	4.2	4.2	3.8	212
Medium-high	3.7	4.2	4.1	3.9	262
High-tech	3.6	4.3	3.8	3.8	103
KIHTS	3.8	4.0	3.8	3.9	506
KI Market services	3.8	4.0	4.0	3.8	1077
Total	3.7	4.0	3.9	3.8	3226

Table A24: Tests of Between-Subjects Effects (Sensing capability: market adaptation)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	103.235(a)	17	6.073	8.427	.000	.043
Intercept	15462.918	1	15462.918	21457.243	.000	.870
KIE grouping	54.158	2	27.079	37.576	.000	.023
tech_class	9.563	5	1.913	2.654	.021	.004
KIE grouping * tech_class	14.201	10	1.420	1.971	.033	.006
Error	2311.809	3208	.721			
Total	49173.702	3226				
Corrected Total	2415.044	3225				

a R^2= .043 (Adjusted R^2= .038)

3. Dependent variable: Sensing capability: technology adaptation

Table A25: Descriptive statistics (mean scores)

Technology class	Followers	All-around innovators	World-class innovators	Total sample	Total N
Low-tech	2.2	2.8	2.7	2.4	1066
Medium-low (LT=ref)	2.3	3.0	3.1	2.5	212
Medium-high	2.4	3.5	3.7	2.9	262
High-tech	2.2	3.7	3.8	3.0	103
KIHTS	2.2	3.2	3.1	2.7	506
KI Market services	2.0	2.9	2.8	2.3	1077
Total	2.2	3.0	3.0	2.5	3226

Table A26: Tests of Between-Subjects Effects (Dependent variable: sensing capability: Technical adaptation)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	676.791(a)	17	39.811	36.448	.000	.162
Intercept	8324.505	1	8324.505	7621.240	.000	.704
KIE grouping	334.534	2	167.267	153.136	.000	.087
tech_class	92.573	5	18.515	16.950	.000	.026
KIE grouping * tech_class	42.101	10	4.210	3.854	.000	.012
Error	3504.025	3208	1.092			
Total	24282.528	3226				
Corrected Total	4180.815	3225				

a R^2= .162 (Adjusted R^2= .157)

4. Dependent variable: Networking capability

Table A27: Descriptive statistics (mean scores)

Technology class	Followers	All-around innovators	World-class innovators	Total sample	Total N
Low-tech	3.0	3.6	3.0	3.2	1066
Medium-low (LT=ref)	2.9	3.5	3.2	3.1	212
Medium-high	3.1	3.6	3.0	3.2	262

High-tech	3.1	3.6	2.8	3.1	103
KIHTS	2.6	3.2	3.0	2.9	506
KI Market services	2.6	3.4	2.9	2.8	1077
Total	2.8	3.5	3.0	3.0	3226

Table A28: Tests of Between-Subjects Effects (Dependent variable networking capability)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	323.029(a)	17	19.002	28.813	.000	.132
Intercept	9867.011	1	9867.011	14961.558	.000	.823
KIE grouping	95.821	2	47.910	72.648	.000	.043
tech_class	33.439	5	6.688	10.141	.000	.016
KIE grouping * tech_clas	17.622	10	1.762	2.672	.003	.008
Error	2115.647	3208	.659			
Total	31419.900	3226				
Corrected Total	2438.676	3225				

a R^2= .132 (Adjusted R^2= .128)

5. Dependent variable: Participation in alliances

Table A29: Descriptive statistics (mean scores)

Technology class	Followers	All-around innovators	World-class innovators	Total	Total N
Low-tech	1.5	2.1	1.9	1.7	1066
Medium-low (LT=ref)	1.6	2.0	2.1	1.7	212
Medium-high	1.7	2.4	2.4	2.0	262
High-tech	1.7	2.6	2.2	2.0	103
KIHTS	1.9	2.5	2.5	2.2	506
KI Market services	1.7	2.5	2.1	1.9	1077
Total	1.6	2.3	2.2	1.9	3226

Table A210: Tests of Between-Subjects Effects (Dependent variable: Participation in collaborations)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared

Corrected Model	377.727(a)	17	22.219	37.477	.000	.166
Intercept	4337.598	1	4337.598	7316.168	.000	.695
KIE group	143.291	2	71.646	120.844	.000	.070
tech_class	56.503	5	11.301	19.060	.000	.029
KIE group * tech_class	14.227	10	1.423	2.400	.008	.007
Error	1901.954	3208	.593			
Total	13731.040	3226				
Corrected Total	2279.681	3225				

a R^2= .166 (Adjusted R^2= .161)