Firm - Environment Alignment of Entrepreneurial Opportunity Exploitation in Technology-based Ventures: A Configurational Approach

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Abstract. *This paper explores configurations for firm-environment alignment of entrepreneurial opportunity exploitation in technology-based ventures to explain firm performance using fuzzy-set Qualitative Comparative Analysis. Classifying entrepreneurial opportunities by their source and location as technology-driven and market-driven, we develop a framework to investigate a multitude of factors in the firm and in the environment that influence firm performance only when aligned with each other. Results highlight the presence of complete firm-environment alignment of technological and market opportunity exploitation in cases with very high organisational growth rates. High growth cases are driven by market opportunity exploitation. Firm-environment misalignment characterises low growth cases. Our results extend entrepreneurial opportunity exploitation literature to encompass a configurational setting from a quality perspective and provides entrepreneurs, managers and policy-makers with informed choices of alternative growth strategies when focusing on organisational and policy priorities.*

Introduction

In recent decades, research in the entrepreneurship field has shown that opportunities are fundamental to entrepreneurship (Venkataraman, 1997; Eckhardt & Shane, 2003; Choi & Shepherd, 2004; Alvarez & Barney 2010; Alvarez, Barney & Anderson, 2013; Davidsson, 2015). Their effective exploitation substantially increases organisational growth rates in entrepreneurially oriented ventures (Shane and Venkataraman, 2000; Wiklund & Shepherd, 2003b; Shepherd & DeTienne, 2005; Eckhardt & Shane, 2003,

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2011; Gielnik, Zacher & Schmitt, 2017). Entrepreneurial opportunities are embedded in technological, market and institutional domains (Gregorie & Shepherd, 2012) and the alignment among those domains is complex and difficult to examine within symmetric and linear settings. It is not apparent whether factors related to opportunity exploitation in technologies, markets and institutions are all present to achieve high organisational growth, or high growth can be sustained in the absence of some factors, but not others. If so, what is the level of substitution between these factors? Moreover, entrepreneurial opportunities are not only exploited inside the firm but also through the interaction with its environment. The moderating or mediating effects of the environment related conditions have been widely investigated in literature as in hostile versus friendly/dynamic environments (Covin & Slevin, 1989; Lumpkin & Dess, 2001), uncertainty in the domestic and foreign environment (Dimitratos, Lioukas & Carter, 2004), or market turbulence (Chaston & Sadler-Smith, 2012). However, their alignment has not been investigated in the entrepreneurship literature to date. An investigation of whether there may be an interdependency among the factors that relate to opportunity exploitation set in a configurational context has yet to be conducted.

Moreover, the configurational approach has been recently making inroads into business research literature (Fiss, 2011; Raymond & St-Pierre, 2011; Munoz & Cohen ,2017; McKnight & Zietsma, 2018; Gast et al., 2018; Haddoud, Jones & Newberry, 2020). There have been calls for such research to be conducted in the field of entrepreneurship to particularly explore successful entrepreneurial orchestration process to enhance venture performance (Short, Payne & Ketchen, 2008; Wright & Stigliani, 2012; Douglas, Shepherd & Prentice, 2020). We respond to these calls by drawing on Miller's (1996) configuration as quality approach and conceptualising and analysing the role of entrepreneurial opportunity exploitation on firm performance within a configurational setting.

Framed by the above, we seek to investigate the extent of alignment between the entrepreneurial opportunity exploitation in the firm and its environment in technology-based firms. The research aim considers what configurations for firm - environment alignment of technology-driven and market-driven entrepreneurial opportunity exploitation are possible in technology-based ventures and how do these configurations drive firm growth? To explore these questions, we develop a configurational alignment framework with two main dimensions of entrepreneurial opportunity exploitation comprising the firm and its environment. These dimensions are divided into four sub-dimensions encompassing technology-related and market-related aspects of entrepreneurial opportunity exploitation at both levels. This study does not

consider how much growth rates increase or decrease when each of the dimensions increase or decrease in value. This study focuses on the degree of overall alignment among the configurational dimensions which in turn delivers high growth rates. Here, a configurational alignment is articulated as the degree of fit or match among a set of heterogeneous elements, which here represents entrepreneurial opportunity exploitation of a firm in the technology and market domains embedded inside the firm and its environment, so as to generate high performance.

When configurational alignment of the firm and its environment is considered as the complex compatibility of many variables within configurations, empirical testing becomes challenging. To overcome this difficulty, we employ the set-theoretic approach fuzzy-set Qualitative Comparative Analysis (fsQCA) (Ragin, 1987, 2000, 2008a). fsQCA is a suitable analytical tool to test configurational quality to implement principles of comparison in cases when using small samples (Ragin, 2000; Misangyi et al., 2017). Originally developed as a case-based comparative method (Ragin 1987), QCA is praised for its strength in dealing with small sample sizes (Berg-Schlosser, De Meur, Rihoux & Ragin, 2009: 4), and its superiority to comparative case study method (Häge, 2007). There are not many studies which exploited this unique ability of QCA. We intend to contribute by purposefully selecting seven cases and implementing fsQCA.

The paper is structured as follows. It starts with a discussion of the concept of configuration as quality. Section 3 conceptualises the configurational alignment of entrepreneurial opportunity exploitation drawing from the earlier contributions in entrepreneurship literature. Section 4 describes research methodology, informs about cases and data collection, particular aspects and advantages of fsQCA technique in comparison to comparative case study and the transformational procedure for indicators used in analysis. Results are presented in section 5. Section 6 provides a discussion and section 7 concludes.

Configuration as Quality

Rooted in the argument that organisations are complex entities, configurational theory argues that the fit among the structure of the organisation, its strategy and its environment are influential on firm performance (Mintzberg, 1973; Miller, 1981, 1986, 1987b, 1990). Miller (1996) identifies three types of approaches to study configurations: configuration as typology, configuration as taxonomy and configuration as quality. Previous work on configurational perspective adopted the first two approaches, both of which allow for methodical classification of organisations based on identification of common elements (Hambrick,

1984). Typology configurations drive from empirical qualitative observations and are conceptually driven (see Miles & Snow (1978) and Porter (1980)). Taxonomy configurations rely on quantitative data and methods such as factor and cluster analyses as first implemented by Miller and Friesen (1977) in search of organisational archetypes.

Miller (1996) conceptually elaborates on the third approach, configuration as quality, and argues that it increases knowledge on how and why the attributes in typologies and taxonomies developed are interrelated. However, largely due to methodological constraints, this has been overlooked empirically. Attributes of the configuration are expected to be tightly interdependent and mutually supportive, the significance of which can be best understood by making reference to the whole, that is the configurational setting, which Miller (1996) refers to as 'complex systems'. Miller (1996: 509) defines configuration as quality as the degree to which an organisation's attributes are orchestrated by a single theme which can be found within or across categories. Unlike taxonomy and typology approaches, configuration as quality does not aim to group organisations with empirically or conceptually significant clustering of attributes. Instead, it aims to explain the degree of alignment or coherence among the attributes of the theme or concept being studied. The higher the degree of coherence among the attributes of a concept, the better their joint performance. Where there is discord, the overall quality of the performance is poor.

Configuration as quality approach encompasses characteristics such as causality, asymmetry,[2] equifinality[3] and substitution, which differentiate this approach from taxonomies and typologies (Miller, 1987b, 1990, 1996; Venkatraman, 1989). Causal, equifinal and asymmetric alignment configurations are important to uncover in the entrepreneurship field. They provide insights for entrepreneurs, managers and policy makers to make informed choices of available alternative strategies when focusing on organisational and policy priorities. Therefore, adopting a configurational approach framed by quality perspective will enhance our understanding of the alignment among the attributes of entrepreneurial opportunity exploitation at different levels and will allow us to contribute both conceptually and empirically to the entrepreneurship field.[4] The following section explains the framework.

[2] Asymmetry principle suggests attributes that are found to be causally related in one configuration may be unrelated in another configuration (Meyer, Tsui & Hinnings, 1993).
[3] Equfinality principle allows for more than one way of achieving the desired outcome and produces several configurations leading to the same desired outcome (Gresov & Drazin, 1997; Fiss, 2007).
[4] Two related exceptions, albeit within the concept of entrepreneurial orientation, have been Naman and Slevin (1993) examining the relationship of fit with performance employing first a factor analysis and then linear regressions and Wiklund and Shepherd (2005) investigating the three-way interaction of entrepreneurial orientation, environmental dynamism and access to capital on firm performance tested by hierarchical linear regression analyses.

Conceptualizing Firm - Environment Alignment of Entrepreneurial Opportunity Exploitation from a Configurational Quality Perspective

Entrepreneurship literature discusses resources, competences and opportunities for their effects on firm survival and growth (Dess, Lumpkin & Covin, 1997; Audretsch, Bönte & Keilbach, 2008; Foss & Klein, 2012). These are observed as technology-related (Shane, 1992, 1996; Wiklund & Shepherd, 2003a, 2003b; Gregoire & Shepherd, 2012), market-related (McKelvie & Wiklund, 2004; Shepherd & DeTienne, 2005; Zahra, Korri & Ji, 2005) and as institutional factors (Sine & David, 2003, 2010; Wright, Filatotchev, Hoskissopm & Peng, 2005). Manifested at the organisation and in the environment, opportunities can be observed as firms having the appropriate technological, market-related and financial resources, distinctive competences in place when the market opportunity emerges. A focus on opportunities particularly in entrepreneurially driven firms affects business growth positively (Gielnik et al., 2017).

Our framework is rooted in the theme of entrepreneurial opportunity exploitation which established that timely discovery, identification and effective exploitation of entrepreneurial opportunities lead to high level firm performance (Venkataraman, 1997; Shane & Venkataraman, 2000; Shepherd & DeTienne, 2005; Beynon, Jones & Pickernell, 2016). Here, we regard opportunity exploitation to occur at firm level. This resonates with Choi and Shepherd's (2004) view of opportunity exploitation which is realizing efficient and full-scale operations in a firm. Discovery, identification or exploration phases of entrepreneurial opportunities can be attributed to entrepreneur level whereby a conceptualisation, testing ideas and prototypes occurs, but exploitation necessitates efficient business systems for production activity (Choi, Levesque & Shepherd, 2008).

Following Covin and Miles (1999), we adopt the approach that entrepreneurial philosophy which penetrates into firm's intramural attitudes, operations and management styles that guide the firm towards achieving higher performance over time, may be realized in new young firms or at times in established old firms alike. It may be observed as: (i) entrepreneurial activity, the scaling up and forging ahead of a newly founded firm at the emergence stage of its life cycle, and (ii) intrapreneurial activity, the rejuvenating and forging ahead of an established old organisation at revival stage of its life cycle. Hence, entrepreneurial activity can take place in an established old enterprise if it were to break its routines and embark on producing a significantly new product, process or service, although developing such competence would reasonably build on its prior knowledge in the area (Zahra, Nielsen & Bogner, 1999).

Entrepreneurial opportunities[5] manifest themselves as conditions that create a favourable habitat for creation of the new or novel (McMullen, Plummer & Acs, 2007). Casson (1982) regards opportunities as situations in which new goods, services, raw materials and organizing methods can be introduced and sold at greater than their cost of production. The profit element is the driving force that calls for creation of the novel by use of either new resources or a recombination of existing resources into new forms. Whilst Shane (2012: 15) stresses the 'situations in which it is possible to recombine resources in a way that generates a profit", Sanders (2007) locates opportunities in the core of technological activity as tools that pave the way for generation of new knowledge and value creation activities. Recombination of resources in the entrepreneurial sense requires some level of creativity to generate the new and novel. It necessitates tapping into newly emerging opportunities. This is different from optimising existing resources to generate profits. Hence, exploitation of entrepreneurial opportunites requires creativity rather than optimisation (Eckhardt & Shane, 2003). We argue that there may be different combinations or configurations for entrepreneurial opportunity exploitation in a creative and regenerative manner. For this, we argue that the location and source of entrepreneurial opportunities are important to discuss. Entrepreneurial opportunites manifest themselves in parts of the value chain and emerge as a result of changes in the value chain (Echardt & Shane, 2003) triggered by asymmetries in the existing information held by various stakeholders in technology-and demand-driven aspects of markets (Kirzner, 1973, 1985, 1997) or exogenous shocks of new information particularly in creation of new knowledge (Schumpeter, 1934; Malerba & McKelvey, 2015). Firms' units where operations take place and its environment are the locus of entrepreneurial opportunities. Opportunities are driven by changes in technology and markets. Firms create and internalise opportunities within their own boundaries supported by their grasp of opportunities available in the environment (see Fig.1).

Insert Figure 1 near here

The 'environment', however, is a broad concept. It represents a range of external factors which potentially enhances or hinders entrepreneurial activity. Covin and Slevin (1989) and Zahra (1993) investigated the effect of hostile versus benign and dynamic versus stable environments from market-related

[5] For an elaborate investigation on the definitions of 'opportunity', 'opportunity related processes' and 'entrepreneurial opportunity'see Hansen, Shrader and Monllor (2011) and Davidsson (2015).

perspectives. Recent research examines the effects of institutional factors such as economic freedom, education, training, cultural and social norms, government policies and financial support on entrepreneurship (McMullen et al., 2008; Sine & David, 2010; Zahra & Wright, 2011; Welter & Smallbone, 2011; Estrin, Korosteleva & Mickiewicz, 2013; Valdez & Richardson, 2017). When entrepreneurial opportunities are manifested within institutions they create favourable habitats for new ventures to flourish (Radosevic et al., 2010; Radosevic and Yoruk 2013; Acs et al., 2014). Legislative norms and regulations and specifically institutional change are considered to be important in defining environments particularly in newly emerging sectors to create opportunities for entrepreneurial activity (Hekkert et al., 2007), as well as embracing intrapreneurial activity in slow-changing mature sectors (Sine & David, 2003). Given the complexity of environment, we will only focus on its technological and market-related aspects.

From a supply and demand perspective, change in technological and market conditions drives formation of new entrepreneurial opportunities (Shane ,1996; Audretsch et al., 2008; Eckhardt & Shane, 2011). Supply-side changes occur in technologies, the way products, processes and services are organised from a technological perspective (Schumpeter ,1934). In the firm, these changes involve generation of new knowledge facilitated by R&D and patenting (Coad & Rao, 2008; Stam & Wennberg, 2009) and successful management of human resources (Marlow, 2006). Attracting skilled labour into the firm and their continous training lead to exploitation of available skills-related opportunities. Firms need to establish dynamic relationships to acquire knowledge that they do not possess but require for innovation generation and for value chain activities. To continue with innovative activity, firms regularly monitor the changing opportunities in the environment and seize upon them (Teece, Pisano & Shuen, 1997). Awareness of changes in technology policy tools such as IPR protection (Autio & Acs, 2010), government's procurement of advanced products (Edquist & Zabala-Iturriagagoitia, 2012) and R&D tax incentives (Castellacci & Lie, 2015; Ng & Hamilton, 2016; Castano, Mendez & Galindo, 2016) facilitate firms' opportunity identification and exploitation for technology generation. Tapping into skills training programmes and involvement in specialized research and training services improves firms' comptences skills-related in technological issues (Patton, Marlow & Hannon, 2000). Quality of networks can be enhanced by availability of opportunities to connect to the best suppliers, the premium research institutes and benefit from industrial clusters. Arenius and De Clercq (2005) find that education level and cohesiveness of networks embedded in increases opportunity recognition. Heinze and Kuhlmann (2008) note quantity and quality of staff at research

institutions influence conducive environment for research collaboration in high-tech sectors. Wennberg and Lindqvist (2010) state that being located in industrial clusters have supported new ventures in high technology fields by creating jobs, paying higher taxes and increasing employee wages. Tornikoski, Rannikko and Heimonen (2017) highlight location advantages in technology-based entrepreneurial firms' technological distinctiveness. We argue that if firm and environment level opportunity exploitation activities in technology domain are aligned with each other firm performance will increase.

Demand-side changes are about changing preferences and tastes of consumers. Eckhardt and Shane (2003) state that changes in demand can generate entrepreneurial opportunities. They specifically note the role of increasingly more sophisticated buyers in creation of demand-driven entrepreneurial opportunities via radical changes in consumer preferences. In markets or sectors with a high degree of buyer sophistication, firms need to consider what buyers require, for instance high technology products with enhanced performance. Stimulation of demand articulation is an important function in macro management of innovation to generate higher degrees of buyer sophistication (Smits and Kuhlmann 2004) driven by users (Von Hippel, 1986). Ability to sense buyers' emerging needs is key in exploiting these opportunities. Choi and Shepherd (2004) found that if entrepreneurs identify increased customer demand for a new product, they are likely to exploit market-related opportunities. Competitive imperfections, imbalances, asymmetries, inefficiencies that exist in product markets imply market-related opportunities (Alvarez & Barney 2010; Alvarez et al., 2013). If firms demonstrate awareness and prompt action to grasp these opportunities they increase their existing market share or access new markets by increasing their export capability to tap into new markets (Kirzner, 1997; Hobday, 1994; McMullen, 2011). Internationalisation of young technology-based firms increases the likelihood of survival and growth in these firms (Coeurderoy, Cowling, Licht & Murray, 2010). Skarmeas, Lisboa and Saridakis (2016) show that in intrapreneurial firms export performance is a core factor in exploration and exploitation of market opportunities. Bruton, Su and Filatotchev (2018) state that entrepreneurial behaviour overpowers the negative effects of dysfunctional competition particularly in transition economies. We argue that if firms promptly sense and adequately respond to imperfections in consumers' preferences that are brought forward by market forces or policy tools, they can align their interior and exterior and their performance levels increase.

Similarly, exploiting finance market opportunities is crucial in funding entrepreneurial and intrapreneurial activity (Korosteleva & Mickieiwicz, 2011; Ayyagari, Demirguc-Kunt & Maksimovic,

2017; Cumming & Johan, 2017). Whilst availability of initial finance is crucial for starting new ventures, other opportunities that appear in the form of available grants and loans to fund innovative entrepreneurial activity are equally important to sustain growth (Castano et al., 2016). Especially when firms lack internal resources, external financing through public loans becomes a crucial substitute (Beck & Demirguc-Kunt, 2006). New ventures' growth is dependent on how well their capital structures are formed at the start of their life and the subsequent support by continuous funding of innovation activity throughout their life cycle (Ahlstrom & Bruton, 2006; Mazzucato, 2013). Typically, the issue is about whether firms are aware of these financial opportunities or not so that prompt reaction to the opportunity takes place. We regard finance market opportunities as a subset of market opportunities as complemantary to demand-driven opportunities. Figure 2 conceptualises our configurational setting for firm - environment alignment of technology-driven and market-driven entrepreneurial opportunity exploitation to generate high growth. We use fsQCA to obtain these configurations.

Insert Figure 2 near here

Methods

Case selection and data collection

Two key criteria of sufficient homogeneity to represent case characteristics and maximum heterogeneity pertaining to conditions and present/absent outcomes have been taken into consideration when selecting our cases (Rihoux & Ragin 2008, Jordan, Gross, Javernick-Will & Garvin, 2011, Kimmitt & Munoz, 2017). Data come from seven purposefully selected technology-based SMEs operating in advanced materials and electric vehicle sectors and located in Central and Eastern Europe (CEE). We focus on technology-based ventures, since their growth trajectories have always been of interest as the fastest growing enterprises and they actively seek entrepreneurial opportunities to exploit for survival, growth and scaling up (Yli-Renko, Autio & Sapienza, 2001; Autio, 2017). The CEE region is specifically chosen, since it has been going through a transformation period of convergence with western Europe. Advanced materials and electric vehicles technologies provide feasible high technology engineering applications for more efficient products and processes, play a crucial role in transition to knowledge-based, low-carbon and cost-competitive technologies which are prioritized in many countries' technology strategy plans.

As a characteristic of case study research, the sampling was based on theoretical and empirical reasoning (Makela & Maula 2006) and not on statistical representativeness. We aim to identify the broad and rich configurational characterisations formed by holistic analysis of many variables rather than justified generalisations (Miller, 1981). To ensure maximum heterogenity in cases we implemented purposeful sampling strategy with emphasis on variation illustrating important shared patterns that cut across cases and derived their significance from having emerged out of heterogeneity (Palinkas et al., 2015). We identified cases based on their behavior as entrepreneurial, intrapreneurial and conservative (Fig. 3). Entrepreneurial ventures are considered as young firms beyond the age of 5 but below 10. Thus, they are not brand new but on-track start-ups. Intrapreneurial and conservative firms are already established firms beyond the age of 20. Whilst intrapreneurial firms have taken the challenge of moving into a new and emerging technology area associated with their major technology field of production, conservative firms abide by the status quo and have been inert in taking radical decisions and not altering their routines (Covin 1991). By technology type, we further classified firms into science-based, niche and conventional technology. Science-based technologies represent high-tech and sophisticated technologies used in production of advanced materials, whereas conventional technologies symbolize traditional methods of materials production. Niche technologies represent electric vehicles and products related to electric vehicles.

Insert Figure 3 near here

Using the framework for case selection we identified suitable cases in the Amadeus database that may fit into our criteria. Then we explored their suitability further via their websites. Eventually, we selected the seven cases in Figure 3.[6] A structured questionnaire was e-mailed during the November 2013 to January 2014 period to managers in three waves (involving two reminders) followed up by telephone calls for further data collection about their products and processes. Given the focus on domestic SMEs, the manager/director was targeted as key informant as the most reliable source of information (Kumar, Stern & Anderson, 1993; Sousa, Martínez-López & Coelho, 2008). Reliability checks were conducted on key firm-level indicators (available at the Amadeus database and firm's website) such as firm age, employment size, turnover and

[6] Appendix A elaborates on how we used Amadeus database to select our cases.

turnover growth rate for a match/mismatch with the manager's answers. The correlations between the Amadeus database and data obtained from the manager was stronger than 0.8 in all cases, suggesting that the survey data obtained was reliable.[7]

The Cases

Table 1 informs about cases. ENTSB is a Polish young entrepreneurial technology-based firm founded in 2004. Its processes and products are high-tech, complex and science-based. ENTNICHE is a Hungarian young entrepreneurial technology-based firm founded in 2004 for designing and producing a diverse range of electric vehicles for use in niche markets of passenger transportation (with vehicle capacities of 2-14 persons) in golf courses, airports, national parks, tourist zones, castles, zoos, etc. INTSB is a Czech intrapreneurial technology-based firm. Established in 1958 as a state-owned firm, it started operations by producing conventional components for the motor vehicles industry such as fuses, ignition coils, etc. After privatization in 1996, it added high-tech ceramics to its product range and became an OEM supplier for major car brands. INTNICHE is a Hungarian intrapreneurial technology-based firm operating in niche electric motors market. It has been producing conventional auto parts and motors since 1992. In 2009, it started to produce electric motors for alternative vehicles. Niche technologies can be captured by both new ventures and established incumbents (Berggren, Magnusson & Sushandoyo,2015).

Insert Table 1 near here

The three conventional firms, CC1, CC2 and CC3, are established firms characterised by not being able to break routines and keep using conventional processes for production of technical ceramics and fibre-optic cables. CC1 and CC2 started during the mid-1990s as corporate spin-offs of large state-owned firms. This kind of firm formation has been a typical characteristic of the Czech industry during the transition period. These firms usually accede to the practice and characteristics of the firm that they parted from. CC3 is a Polish firm established in 1996 and produces conventional fibre-optics.

[7] Appendix B outlines what information we sought in the questionnaire and provides a table with survey questions.

A systematized approach to case comparison: Very small-N fsQCA

Causal complexity, equifinality and causal asymmetry as characteristics of configurational approach can be methodologically explored by fsQCA (Misangyi et al., 2017) and suits the purposes of our research. We exploit fsQCA's origins as a case-based comparative method (Ragin, 1987) and implement it as a systematized approach to comparative case analysis (Cooper, Glaesser, Gomm & Hammerley, 2012) using small-N. Not many studies use small-N, that is 6 to 20 cases, which is difficult-to-deal with the number of cases in comparative case analysis. The vast majority of studies use sample sizes either less than 5 or more than 20.[8] Berg-Schlosser et al. (2009: 4) highlight the applicability of QCA in very small sample sizes as small as 2-3 to 10-15. Häge (2007) implemented QCA for only three cases and affirmed its superiority to comparative case study methods. Krogslund and Michel (2014) demonstrate that results from QCA prove to be relatively stable based on a lower n/k ratio (number of cases/number of conditions) which implies the method is safely applicable to small sample sizes. fsQCA is particularly attractive when the number of cases available is greater than what the researcher can reliably manage by narrative comparison yet too low to support statistical procedures (Stokke, 2007; Greckhamer, Misangyi & Fiss, 2013), since it provides the advantage of inferential power of statistical validity (Jordan et al., 2011).

Several aspects of QCA allows it to substitute comparative case analysis in a systematic way. First, sample representativeness is less of an issue in QCA. As a 'case-oriented' technique, QCA conceptualizes cases as configurations of attributes (Ragin, 2000; Fiss, 2011). Attributes are calibrated and that reduces sample dependence as it defines set membership as relative to substantive knowledge rather than the sample mean.[9] Second, unlike conventional regression methods, the nonparametric method QCA does not assume data are drawn from a given probability distribution (Fiss, 2011; Kimmitt & Munoz, 2017). This unprobabilistic nature of QCA, whether it is few or many cases with certain conditions, allows for deliberate and purposeful selection of cases with maximum variety making the method comparable to case study (Mahoney & Goertz, 2006, Berg-Schlosser & De Meur, 2009). The 'logical remainders' logic in QCA, that is the inclusion of unobserved cases, ensures QCA algorithm produces robust results even with large amounts

[8] Bollen, Entwistle and Alderson (1993: 328) observe that in the field of comparative sociology only 13percent of scholarly articles analysed 6-20 cases, whilst 45percent analysed 1 to 5 cases (that is very small-N) and 42percent analysed more than 20 cases. Ragin (2000: 25) stresses that this strongly U-shaped association between number of publications and number of observations is replicated in many research areas.

[9] We benchmark each manifest indicator against national values and then calibrate for set membership (see values in Table 2). These processes inherent to QCA, systematically positions the cases against external benchmark ensuring better objectivity, which is not possible in comparative case analysis.

of empty data space (Jordan et al., 2011). Third, intimate case knowledge, a strength of the small-N QCA, demands investigation of well-known cases rather than anonymous (Berg-Schlosser et al., 2009, Misangyi et al., 2017) which is crucial in the original design of the research (Krogslund & Michel, 2014). Cooper and Glaesser (2016) point to the challenges arising when fsQCA is used in large-N samples without sufficient case knowledge. Second and third aspects combined, case selection issue bears utmost importance in QCA, since the inclusion of each case should be justified within sound theoretical and methodological framework (Jordan et al., 2011).

Measures, benchmarking, coding and calibration of set memberships

Descriptions of measures are presented in Table 2. Rather than using a statement method to operationalize the concepts, we use the outcome measure approach. The World Economic Forum – Global Competitiveness Report (WEF GCR) questions were specifically adopted in the questionnnaire, since it would be possible to source benchmark values for indicators at national level. We follow Ragin (2008a, 2008b) and Fiss (2011) when benchmarking, coding and calibrating measures against the national average values for Czech Republic, Hungary and Poland. Using a benchmark value drawn from the population, rather than the sample, increases the credibility of analysis. To implement fsQCA we developed a three-value fuzzy-set – that is full membership, full non-membership and the crossover point or the point of maximum ambiguity for neither fully in nor fully out. Our data are not of one type. Some measures are numeric, some Likert scale survey data and some are qualitative data. Both quantitative and qualitative data can be calibrated into sets in QCA (Misangyi et al., 2017).

Outcome measures. We test solutions for four outcome measures: (i) Very high growth sales, (ii) High growth sales, (iii) Not-high growth sales and (iv) not-very high growth sales.

(i) High growth sales and very high growth sales. The outcome of interest is the degree of membership in a set of firms that show high and very high performance rates. We measure performance by firm's sales growth (SALESGROWTH). Sales growth have been used to assess performance in high-growth firms (Garnsey, Stam & Heffernan, 2006; Eckhardt & Shane, 2010). Miller and Friesen (1984) use a 15 percent cut-off rate for sales growth to differentiate between high growth, maturity and revival phases in the life cycle of an entrepreneurial firm. For very high growth Fiss (2011) uses growth rates over 25 percent. We

follow their thresholds to set high and very high sales growth rates. Firms were directly asked about their sales growth rates over the period of 2007 to 2012. Preceding the calibration process, we calculated the average growth rate of SMEs in Czech Republic, Hungary and Poland. An average growth rate of 2.53 percent was realised per annum during 2007-2012 period. For high growth set membership, being fully out was set at 0 if a firm grew equal to or less than 2.53 percent; being fully in was set at 1 if a firm grew equal to or more than 15 percent and the midpoint was chosen as halfway between 2.53 and 15 percent. For very high growth set membership, we repeated this procedure setting 25 percent sales growth rate as the upper threshold for full membership.

(ii) Not high growth sales and not very high growth sales. Company sales growth indicator is negated in forming the truth tables – that is ~SALESGROWTH.

Insert Table 2 near here

Independent measures. We developed four causal conditions by using the manifest indicators in Table 2. A total of 32 manifest indicators are collapsed into four conditions, namely FIRMTECH, FIRMMARKET, ENVIROTECH and ENVIROMARKET, to represent opportunity exploitation at technological and market-related contexts in the firm and environment, respectively.

Manifest indicators are guided by the existing literature as discussed in the literature review sections. Technological opportunity exploitation at firm (FIRMTECH) is operationalized by use of indicators such as innovations, patents, trademarks, design capability representing technology generation; employees with postgraduate degrees, R&D staff, extent of training provided to employees, brain drain and gain capturing different grades of human capital; type, extent and form of knowledge and value chain networks. Representing real demand, the demand that the firm generates for its products in the domestic and foreign markets was used. The availability of own funds to self-support innovative activities was used to assess firm-level financial conditions (FIRMMARKET). To operationalize technological opportunity exploitation in the environment (ENVIROTECH), we used government procurement of advanced technology products, IPR protection, R&D tax incentives to represent technology generation, the quality of the educational system and local availability of specialised research and training services to stand for human skills, the quality of scientific research institutions and the quantity and quality of local suppliers as well as state of cluster

development to stand for networks. Buyer sophistication and market competition are used as the indicators influencing real market demand. Venture capital availability and funds available from local, national and supranational bodies are used to assess the finance market opportunities and their efficiency (ENVIROMARKET).

To construct conditions using manifest indicators, we used the summation technique (Boyd, Gove & Hitt, 2005; Gilbert & Campbell, 2015). The benchmark values of each manifest indicator at national level, sourced from WEF GCR, were used prior to the summation method. We calculated the benchmark values using data sources given in Table 2 and by averaging national values for the three countries. External benchmarking of indicators using the national averages is superior to using sample-dependent anchor such as the mean for firms in the sample (Fiss, 2011: 404). The construction of the conditions process is as follows. For instance, FIRMTECH incorporates 13 manifest indicators. Using the national benchmark values, we determined whether each firm in the sample scored below or above the benchmark value for each manifest indicator. If it scored below we coded it as 'no'. If it scored above, we coded it as 'yes'. We then summed up the 'yes' for each manifest indicator to code FIRMTECH as a condition. It will be in the form of a Likert scale indicator ranging from 0 to 13. That is a code of 0 if the firm scored below the benchmark value in all 13 manifest indicators, to a code of 13 if the firm scored above the benchmark value in all indicators. This summation logic was applied to all causal conditions. The range of the condition scoring would depend on the number of manifest indicators involved in its construction. Subsequently, following Fiss (2011) we calibrated the conditions that are in the form of Likert scale indicators. Full membership threshold was selected as the maximum value for a condition, full non-membership threshold was selected as the minimum value of 0 and the midpoint as the crossover point.

Analysis and Findings

We used fsQCA software 3.0 (Ragin & Davey 2016). All of the seven cases appear on the truth table. To operationalize the truth table for small-N, we set the frequency threshold at 1 and consistency cut-off value at 0.75 (Ragin, 2008b).[10] We report findings (Tables 3 and 5) and elaborate on causes for 'present' and 'absent' outcomes (Tables 4 and 6) using our knowledge of cases.

[10] The consistency threshold distinguishes configurations that are subsets of the outcome from those that are not.

Firm – environment alignment configurations

Table 3 presents solutions for high sales growth and very high sales growth present outcomes. Solution for attaining very high growth generated configuration 1. Solution for attaining high growth generated two configurations, 2a and 2b, which are natural permutations indicating within-type equifinality, since they both demand the same core conditions but differ on their peripheral conditions.[11, 12]

Insert Table 3 near here

Configuration 1 suggests very high sales growth rates are possible if a firm generates complete firm - environment alignment exploiting both market and technological opportunities. This path requires technology opportunity exploitation as core condition. Only ENTSB fulfils these conditions. Regarding high sales growth, configurations 2a and 2b suggest market opportunities exploitation drive firm - environment alignment as complemented by technological opportunity exploitation. These configurations are represented by entrepreneurial and intrapreneurial technology-based ventures ENTNICHE, INTNICHE and ENTSB.

Insert Table 4 near here

Table 4 shows that ENTSB can grow at very high rate and high rate based on its technological competences by aligning the firm - environment opportunity exploitation. Moreover, it has two options if it were to pursue high sales growth: focusing on either firm level or environment level technological opportunity exploitation. ENTSB achieved remarkable sales growth rate of 50 percent per year along with 16 percent employee growth rate and introduced 4 new-to-world innovations, 12 patents and 7 trademarks from 2007 to 2012 by investing 30 percent of its total sales revenues in R&D activities and own design activity. Enforced levels of IPR protection have been influential on technology generation as well as effective

[11] Both solutions have acceptable overall solution consistency values of ≥ 0.75. Consistency measures the degree to which configurations and the solution as a whole (overall solution consistency) are subsets of the outcome (Ragin, 2008b: 85). Overall solution consistency denotes the extent that cases correspond to the set-theoretic relationship expressed in a solution (Fiss, 2011: 402). For all configurations, raw consistency values are set as equal to or above 0.75 acceptable threshold value.

[12] Overall solution coverage informs that configurations 2a and 2b jointly explain 60 percent of membership in the present outcome. Coverage measures how much of the outcome is explained by each configuration (represented by raw coverage and unique coverage) and by the solution as a whole (overall solution coverage) (Ragin, 2008b: 85). Raw coverage measures the proportion of memberships by each condition in the outcome, whereas unique coverage measures the proportion of cases that follow the specific configuration leading to the outcome (Ragin 2008b: 86). Unique coverage statistics suggest that configuration 2a is more significant than configuration 2b in terms of frequency of occurrence of the outcome, 0.17 against 0.06 respectively. According to raw coverage statistics, conditions explain the configurations at 54percent and 43percent for 2a and 2b, respectively.

exploitation of opportunities in government procurement of advanced products and R&D tax incentives. Overall, 51 percent of its employees are either graduates or postgraduates whilst 10 percent of its employees work in the R&D department. It invests heavily in employee training to attract and retain skills. ENTSB is proactive in local and foreign connections with universities, research institutes, suppliers, customers and consultants in joint product innovation which necessitate deeper knowledge flow in the form of complex and formal contract-based agreements. ENTSB also shows firm - environment alignment in market opportunity exploitation. With significant presence in the domestic market, it can provide the high performance products demanded by high level of buyer sophistication and not threathened by competition from large foreign companies due to high technology-based nature of its products.[13]

High growth configurations 2a and 2b are driven by firm - environment alignment of market opportunity exploitation and exemplified by niche entrepreneurial firms. ENTNICHE enjoys both domestic and foreign markets. It first established itself successfully in the local niche market and was able to move onto foreign markets. INTNICHE operates in domestic markets. Their market success stems from their timely response to sophisticated and performance-conscious buyers and good management of high level market competition. They show aggressive approach to bank loans, public loans and EU funds. Seizing external funding complements their internal funding capacity. They are constrained in technological opportunity exploitation. ENTNICHE grew 10 percent and doubled its workforce, shows strong commitment in innovation activities introducing 5 new-to-country innovations, one patent and one trademark. Its endogenous technology generation efforts outperform locally available opportunities, but miss out on government's procurement of advanced products and R&D tax incentives offered to SMEs. Overall, 17 percent of employees hold university degrees and they continuously take part in R&D projects, however ENTNICHE failure to exploit skills related opportunities in the environment, particularly local training services, might play role in not being able to provide effective on-the-job training and ensuring that the employees stay in the firm. It is connected with its suppliers and customers but only focusing on arm's length and unidirectional relationships in technical support and licensing agreement. INTNICHE grows at high rates, 17 percent in sales and 27 percent in employment. A radical break off from the routine technological

[13] As complexity of processes and products increase market competition with advanced western counterparts operating at the technology frontier may become fierce. Although currently, ENTSB can deliver what domestic market wants, its high technology products' performances – that are structural and functional properties of ceramic products - may not yet have achieved the technology frontier level, hampering ENTSB's current access to foreign markets.

activity in an established firm is difficult. Therefore, INTNICHE exploits technological opportunities in the environment based on its prior knowledge by focusing ongovernment procurement of advanced technology products and R&D tax incentives. It has no patents, but one trademark and 8 new-to-firm innovations. Absence of endogenous technological skills is compensated by opportunites exploited in the environment, that are value chain networking, the education system in recruiting skills and availability of specialized research and employee training services. Supported by the already existing networks, INTNICHE can engage in research contract-out relationships with domestic partners. Its networking capabilities are strengthened by its location, an industrial cluster, which makes it easier to connect to relevant partners.

Firm – environment misalignment configurations

fsQCA, in an asymmetric manner, can explore 'what if the outcome does not exist?' question. Table 5 reports results from negated solutions. Configurations 3 and 4 explain not-high sales growth, configurations 5 and 6, not-very high sales growth.[14]

Insert Table 5 near here

Configurations 3 and 4 suggest a complete firm - environment misalignment of market and technological opportunities exploitation is the cause for not achieving very high growth rates. Conservative firms CC1 and CC2 exemplify these paths that lead to low sales growth rates. Configurations 5 and 6 imply a lack of firm - environment alignment driven by technological opportunity exploitation causes low growth rates. Along with CC1 and CC2, CC3 and INTSB represent these paths. This path also informs us about why ENTNICHE and INTNICHE cannot grow beyond 25 percent.

Insert Table 6 near here

[14] Both solutions have acceptable overall solution consistency values of ≥0.75. In terms of overall solution coverage, configurations 3 and 4 jointly explain 65 percent of membership in the not-high growth sales outcome and configurations 5 and 6 jointly explain 81 percent of membership in the not-very high growth sales outcome. For all configurations, raw consistency values are set as equal to or above 0.75 acceptable threshold value. Unique coverage statistics suggest that configuration 3 is more significant than configuration 4 in terms of frequency of occurrence, 0.21 against 0.10 respectively. According to raw coverage statistics, conditions explain the configurations at 54 percent and 44 percent for configuration 3 and 4, respectively.

Table 6 demonstrates causes of firm - environment misalignment in CC1 and CC2 leading to low rate growth. CC1 and CC2 have very low R&D expenditures, trivial design activities, low rate of skilled labour and almost absent knowledge networking activity. They do not have any patents or trademarks, but new-to-firm products. Customer-oriented production is the norm where customers reveal design recipes for the tailored product.[15] Despite limitations in endogenous technologies, they exploit technological opportunities in the environment particularly provided by government procurement of advanced technology products. Their strong presence in foreign markets, in more or less mature segments of the advanced ceramics sector where buyers are price-conscious but not performance-driven, is an influential factor for sustaining their low sales growth. They are happy with the status quo and the extent of institutional support, which sustains slow but still positive sales growth rates.

Configurations 5 and 6 increase insight onto causes of not achieving very high sales growth in CC1, CC2, CC3, ENTNICHE, INTNICHE and INTSB. Conservative firms which produce technical ceramics and fibre-optic cables, CC2 and CC3, ENTNICHE which produces electric vehicles, and INTSB which moved onto production of electro-technical ceramics and ultra-thin film ceramic coating technologies, have developed some level of endogeneous technological capabilities. However, these firms face difficulties to exploit technological opportunities available in the environment. INTSB is worthy of discussion, since it is illustrative of several unique conditions pertaining to configuration 5. Despite being an established firm which put itself onto an intrapreneurial route, INTSB does not show potential growth beyond 25 percent as compared to ENTSB. Its commitment towards increasing expenses in R&D, recruitment of R&D staff and own design activities for newly launched technological activities do not pay off. It also puts effort into developing knowledge networks in the form of R&D agreements in line with its new activities, but is held back by inexperience in the new science field. It needs to tap into available technological opportunities at more advanced level and must build new networks. As an export-oriented firm, INTSB is highly embedded in value chains. This only encompasses its primary activities related to inbound and outbound logistics, marketing and sales as well as secondary value chain activities of human resource management and technology development. These suggest intrapreneurship in high technology areas may be riskier than

[15] As a lab porcelain producer, CC1 does not need sophisticated production techniques, but relies on customer-guided designs, recipes for powder mixtures and all the technical drawings for product shape and tolerances being supplied by client firms. This is due to the specialized supplier nature of CC1, which produce customized products. It regards each 'customer-oriented' product as an innovation, although the majority of the changes in these new products are nothing more than design alteration. CC2 produces electrical and technical ceramic parts. These are intricate products that rely on specific formulas of metal/ceramic powders. Hence, CC2 needs to generate these specific formulas together with clients to yield very good structural properties.

entrepreneurship in high technology areas, since the former necessitates breaking established routines in conventional activities at the expense of creating new routines.

Discussion

In spite of the wide recognition of the impact of entrepreneurial opportunity exploitation on firm performance, the effect of firm - environment alignment of entrepreneurial opportunity exploitation on firm performance has been overlooked in the literature. With a view to fill this gap, we developed and tested a conceptual framework using fsQCA methodology on domestically-owned technology-based ventures. We show that firm heterogeneity demands firm-specific strategizing in aligning of differently located and differently sourced entrepreneurial opportunity exploitation for high performance. To this aim, we identified three pathways and explored how these pathways drove or inhibited growth. Technological or market opportunity exploitation act as the driving force for high performance, however only when aligned in the firm and in the environment. When misaligned they cause low growth. Our results are consistent with firm level heterogeneity (Penrose, 1959) as well as heterogeneity in entrepreneurial behavior (Welter & Smallbone, 2011): firms behave differently from each other in generating pathways to success. They are not confined to one single path which suggests they have choice when strategizing their entrepreneurial activities framed by their core competences and opportunities available in the environment.

We found that the highest growth rate achieved by young entrepreneurial firm in advanced materials and producing complex high-technology products was due to its ability to ascertain firm - environment alignment in exploitation of entrepreneurial opportunities in technology and market domains. Complexity depends on the structure of the problem that can be explained by the nature and extent of interactions among technological opportunities (Macher & Boerner 2012). Technological complexity is managed by successful attraction of human capital as well as continuous cultivating and incubating of skills hosting knowledge (Patton et al., 2000; Cooper & Park, 2008). When technological complexity is very high costs of accessing to new markets may be higher, although when entered into new markets benefits will be increased (Singh, 1997). This is what we observe here, market opportunities exploitation being the peripheral conditions in the configuration but still aligned in the firm and in its environment.

Young entrepreneurial and established intrapreneurial firms operating in niche markets of electric vehicles that grew at relatively high rates were also able to generate firm - environment alignment, yet at a

different level which was largely driven by market opportunities exploitation and complemented by technological opportunities exploitation either in technological or market domain. In energy transitions literature, more risky and novel innovations are associated with 'niche' technologies – that is a product designed for small part of the market (Schot & Geels, 2008). The risks and uncertainties that the niche technology faces are not necessarily due to the technologically complex nature of the product, but it may be due to the fierce competition it faces from the already established products in the market. Recognition of new niche products by users generally requires their first appearance in a local niche market where a set of arrangements are required to protect novel technologies and to provide them with attention, legitimation and funding (Bakker, Van Lente & Engels 2012) to allow for the co-evolution of technology, user practices, and regulatory structures (Schot & Geels 2008). Electric, hybrid and hydrogen cars are products located within this context of taking advantage of niche market opportunities (Andrews & DeVault 2009; Bakker, Van Lente and Engels 2012; Bakker, Van Lente and Meeus 2012). We observe the alignment from markets perspective in these two firms that are involved in niche technology production and are able to match their internal market objectives with the available market-related opportunities in their environment.

Our results also increase knowledge on cases of failure. We demonstrate that even if some technology-based firms can hold competences separately in technologies or markets to exploit available opportunities, the absence of an alignment between firm and environment for technological or market related opportunities prevents achieving high sales growth. Conservative technology-based firms which are locked in their conventional operations and unable to break the routines fall into this situation. One has to note these firms are not low-technology firms. They are high-tech firms which fail to rejuvenate themselves in accordance with the recent technological advances.

Our findings suggest firm - environment alignment when exploiting technological and market opportunities is important for growth of technology-based entrepreneurial ventures. Indeed, it is the entrepreneurial ventures that can fulfil this condition. They can be the engines of growth for economies if they sustain compatibility of their interior and exterior. This suggests that new firm formation should be encouraged in technology-based firms along with intrapreneurial activity in established firms. However, we find that shift to high level technology-based intrapreneurial activity in established firms is difficult to engineer. Established routines may be playing a lock-in effect in old firms that decide to move onto cutting-edge science areas in a major shift. This means these firms require tailored institutional support to enhance

their technological capabilities so they can establish the alignment of firm and environment that serves for the aim. Careful policy-tailored approach for such intrapreneurial activity might prove useful to test how far such change can go.

Our research is not without limitations. Although our cases were purposefully selected to satisfy maximum heterogeneity condition in the outcome and fsQCA analysis aimed to provide a systematic approach to comparative case studies, we are unable to generalise our results. In future, larger sample size can be used to allow for generalisation. However, even with large sample size caution must be taken to ensure maximum heterogeneity in outcome for a diverse sample. If larger sample sizes are used, we expect more configurations to emerge capturing more heterogeneous settings and possibly a comparison between large and small firms. Additionally, our selection of manifest indicators is not exhaustive. In future, the model can involve more of manifest indicators allowing for investigation of as many causes as possible.

Conclusion

Configurational research's contention that structure and environmental factors explain outcomes (Doty, Glick & Huber, 1993; Ketchen et al., 1993; Short et al., 2008) has much to offer to the entrepreneurship field. Our contribution to the entrepreneurship literature, is threefold. First, we extend entrepreneurial opportunity exploitation literature to examine the environment and the organisation within a configurational setting from a quality perspective whereby firm-level entrepreneurial opportunity exploitation aligns with that of the environment. This is different from investigating the effect of environment on firm performance from a moderating or mediating perspective and typology or taxonomy approaches to configurational analysis. The congruence between the firm and its environment has been analysed in the strategic management literature. We show that the firm - environment alignment discussion set within a configurational framework is important for the entrepreneurship literature especially when entrepreneurial opportunity exploitation concept can bridge the two levels, the firm and its environment. Second, connected to that, we empirically illustrate the methodological suitability of the novel use of QCA method to study the concept of alignment within a configurational setting from a quality perspective. Third, we take the firm as the locus of entrepreneurial activity (Foss & Klein 2012), but show that not all firms possess this attribute even if they are technology-based ventures. Set within a comparative approach, we demonstrate stark differences in firm - environment alignment paths of entrepreneurial opportunity exploitation in young

entrepreneurial, old entrepreneurial (intrapreneurial) versus old conservative (locked-in-the-status-quo) firms. We take attention to demands for different environmental conditions in intrapreneurial technology-based firms when compared to entrepreneurial young firms (Bosma, Stam & Wennekers, 2014). We show that entrepreneurial and intrapreneurial firms have several paths to generate firm - environment alignment based on the rate of growth they target. In that sense, our results have implications providing entrepreneurs, managers, practitioners and policy-makers with informed choices of alternative growth strategies when focusing on organisational and policy priorities.

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Figure 1. Location vs source dimensions of entrepreneurial opportunity exploitation

Locus of entrepreneurial opportunity exploitation	Source of entrepreneurial opportunity exploitation: Technology-driven	Source of entrepreneurial opportunity exploitation: Market-driven
Firm	Creation/internalisation and exploitation of technology-driven opportunities in the firm for new knowledge and value generation using skilled labour and networks.	Creation/internalisation and exploitation of market-driven opportunities in the firm to access new markets and generation of internal funds to invest in new value creation.
Environment	Grasp and exploitation of technology-driven opportunities in the environment to enhance new value generation by tapping into available skills and networks.	Grasp and exploitation of market-driven opportunities in the environment by sensing and seizing changes in buyer preferences, market competition and seizing available external funding to invest in new value creation.

Figure 3. The setting for case selection by level of technology and type of entrepreneurial activity.

Type of technology \ Type of entrepreneurial activity	**Young Entrepreneurial** (Age: 5 to 10)	**Established Intrapreneurial** (Age: over 20)	**Established Conservative** (Age: over 20)
Science-based	**Case 1: ENTSB**	**Case 3: INTSB**	
Niche	**Case 2: ENTNICHE**	**Case 4: INTNICHE**	
Conventional			**Case 5: CC1** **Case 6: CC2** **Case 7: CC3**

Figure 2. Conceptual framework for firm – environment alignment of technological and market opportunity exploitation from a configurational perspective.

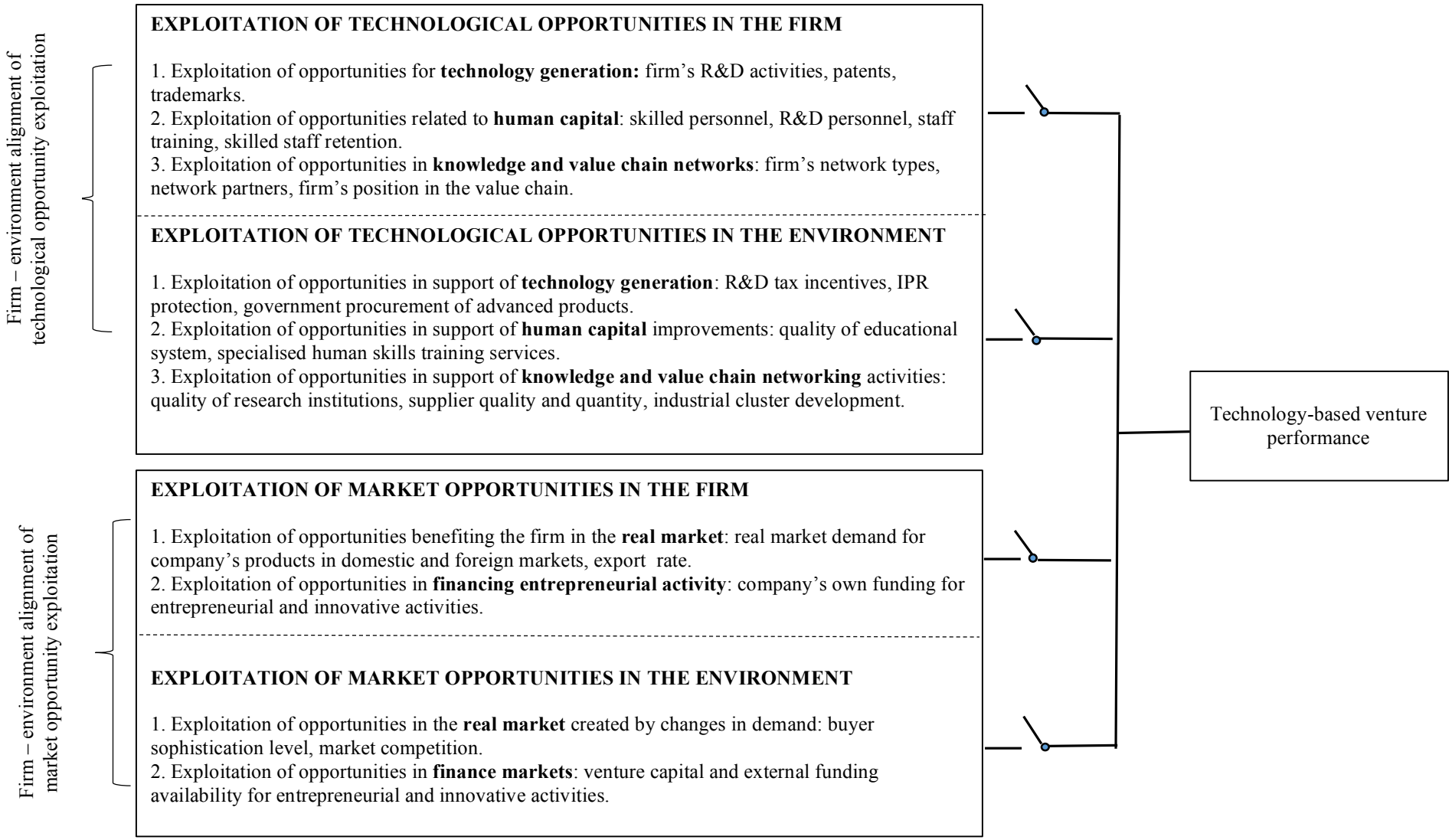

Table 1. Main characteristics of the cases by type of activity and technology.

Activity type	Technology type	Firm code	Country	Foundation year	Firm location	Number of employees (2013)	Sales growth rate (2007-2012) pa	Technology field	Technical specifications of products and processes in cases	
Entrepreneurial	Science-based	ENTSB	PL	2004	independent location	80	50	Advanced materials - Surface engineering	***Products.*** Ultra-thin ceramic coated products[1] with functional properties that are raw materials in textile, automotive, defence, aircraft, machinery and cutting tools industries and bio-medical applications of hip, knee prostheses and bone joints. ***Processes.*** Powder/vapour deposition techniques of ceramics onto metal, glass or ceramic substrates such as laser cladding, laser hardening, high velocity oxy-fuel spraying (HVOF) and plasma spraying.[2]	
	Niche	ENTNICHE	HU	2004	independent location	12	10	Electric vehicles	***Products.*** Battery electric vehicles for passenger transportation in tourism and sports sectors. ***Processes.*** Design and production.	
Intrapreneurial	Science-based	INTSB	CZ	1996	independent location	409	10	Auto parts incl. advanced materials - Electro-technical ceramic components and surface engineering	***Products.*** Optoelectronic devices, ceramic ferrites, thin film resistors, sensors, piezoelectrics and semiconductors produced mainly for the automotive and computer industry. ***Processes***. Thick and thin film vacuum deposition techniques (magnetron sputtering).[3]	
	Niche	INTNICHE	HU	1992	industrial cluster open to any kind of firm	14	17	Auto parts for electric vehicles - Electric motors for alternative vehicles	***Products.*** Electric motors for electric vehicles. ***Processes***. Electric motor production technologies.	
Conservative	Conventional	CC1	CZ	1995	independent location	65	1.5	Advanced materials - Lab porcelains/ceramics	***Products.*** Laboratory porcelains and ceramics.	***Processes.*** Use of medium technology processes such as wet/dry/hydraulic/hot/cold pressing of ceramic powder[4] for technical ceramics[5] and plastic fibre-optic cable processes rather than glass fibre-optics provide products with structural properties for automotive, iron and steel, standard electronics, textiles, machine tools, etc.
	Conventional	CC2	CZ	1994	industrial cluster specific to technical ceramics	114	4	Advanced materials - Technical, electrical ceramics	***Products***. High thermal resistance insulators.	
	Conventional	CC3	PL	1996	Technology park	72	12	Advanced materials - Conventional fibre optics	**Products**. Fibre-optic cables.	

1 A ceramic coating is a thin layer, of micrometer or nanometer scale, applied on a substrate of any material. The aim of coating is to endow the surface of the material with the desired structural and functional properties. Functional properties of an advanced material refer to physical, chemical, thermochemical and biological functions possessed by the material. These relate to anti-wear, frictionless surfaces, high thermal conductivity or insulation, high electrical conductivity or resistance, high chemical stability, piezoelectricity, corrosion resistance, biocompatibility, etc. Structural properties of a material refer to mechanical properties such as high-temperature strength, wear resistance and lightweight.

2 Deposition techniques such as thermal spraying, chemical vapour deposition (CVD), physical vapour deposition (PVD) and HVOF are novel techniques developed by the end of 1980s in surface engineering as compared to traditional techniques of electrodeposition, chemical conversion and coating methods. The resulting ceramic coatings from these processes have low porosity and high bond strength. They are typically used to deposit wear and corrosion resistant coatings on materials, such as ceramic and metallic layers. These processes provide conventional materials with superior structural and functional properties.

3 Magnetron sputtering is a form of chemical vapour deposition (CVD).

4 Powder metallurgy techniques of ceramic powder pressing are low/medium technology processes compared to sophisticated technologies of surface engineering. The former are used for production of intricate and small metal/ceramic parts formed from metal/ceramic powders. Products possess structural properties of thermal resistance in the case of ceramic components, but can suffer from brittleness; and ductility/high strength in the case of metal components.

5 Conventional technology advanced ceramics are different from traditional ceramics. The latter are ordinary products such as tiles, sanitary ceramics, earthenware, etc. and are not within the scope of this research.

Table 2. Operationalisation of conditions based on manifest indicators and survey questions, benchmark values for manifest indicators and calibration thresholds for conditions.

Conditions	Sub-conditions	Manifest Indicators (year) (if question is adopted from external source)	Benchmark value[1] (source)	fsQCA calibration criteria for 4 conditions (fully in, crossover point, fully out)
Firm Performance (SALESGROWTH)		Sales growth rate (2007-2012 pa)	2.53percent (EUROSTAT_Turnover in manufacturing industry, SMEs only)	High growth set membership: HIGHSALESGROWTH (15, 8.77, 2.53) Very high growth set membership: VERYHIGHSALESGROWTH (25, 13.77, 2.53)
Firm-level Technological Opportunity Exploitation (FIRMTECH)	**Technology generation**	R&D expenditures percent in turnover (2012)	0.19percent (EUROSTAT_BERD/ Turnover in manufacturing industry for SMEs)	FIRMTECH (13,6.5,0)
		Design capability	Conducting own design activity	
		Innovation quality (2007-2012)	Having introduced onto the market new-to-country and/or new-to-world innovations	
		Patents (2007-2012)	0.05 (WIPO_Patents filed 2007-12 sum/EUROSTAT_Number of enterprises - SME)	
		Trademarks (2007-2012)	1.75 ((WIPO_Trademarks filed 2007-12 sum/EUROSTAT_Number of enterprises -SME)	
		ISO9001, 14001 certificates (2007-2012)	0.11 (ISO_9001 and 14001 certificates in 2012/ EUROSTAT_Number of enterprises - SME)	
	Human skills and training	Employees with PhDs, Master's, Graduates (percent in total employees) (2012)	25.5percent (EUROSTAT_ percent of science, maths, computing, engineering, manufacturing and construction graduates in total population (15-74 years old) (in 2012)	
		R&D personnel _percent in total employment (2012)	0.46percent (EUROSTAT_ Total business enterprise R&D personnel as percent of total employment (2012)	
		Extent of staff training (2011-12) (WEF GCR Q.5.08)	3.9 (WEF GCR_ on a Likert scale of 1 to 7)	
		Brain drain (2011-12) (WEF GCR Q.7.07)	2.8 (WEF GCR_ on a Likert scale of 1 to 7)	
	Knowledge networks and value chain	Partners in innovation collaboration	Interaction with more than 3 partners	
		Modes of innovation collaboration	Know-how generation within bi-directional modes of collaboration	
		Value chain breadth (2011-12) (WEF GCR Q.11.05)	3.9 (WEF GCR_ on a Likert scale of 1 to 7)	
Firm-level Market Opportunity Exploitation (FIRMMARKET)	**Real market demand and Finance market**	Firm's foreign market size (2011) (WEF GCR Q.10.02)	5.4 (WEF GCR_ on a Likert scale of 1 to 7)	FIRMMARKET (3,1.5,0)
		Firm's domestic market size (2011) (WEF GCR Q.10.01)	4.4 (WEF GCR_ on a Likert scale of 1 to 7)	
		Source of funds: own financial sources	3.5 (midway value_ on a Likert scale of 1 to 7)	

Environment level Technological Opportunity Exploitation (ENVIROTECH)	**Technology generation**	Government procurement of advanced technology products (2011-12) (WEF GCR Q.12.05)	3 (WEF GCR_ on a Likert scale of 1 to 7)	ENVIROTECH (9,4.5,0)
		IPR protection (2011-12) (WEF GCR Q.1.02)	3.5 (WEF GCR_ on a Likert scale of 1 to 7)	
		R&D tax incentive availability	3.5 (midway value_ on a Likert scale of 1 to 7)	
	Human skills and training	Quality of the educational system (2011-12) (WEF GCR Q.5.03)	3.7 (WEF GCR_ on a Likert scale of 1 to 7)	
		Local availability of specialized research and training services (2011-12) (WEF GCR Q.5.07)	4.6 (WEF GCR_ on a Likert scale of 1 to 7)	
	Knowledge networks and value chain	Quality of scientific research institutions (2011-12) (WEF GCR Q.12.02)	4.7 (WEF GCR_ on a Likert scale of 1 to 7)	
		Local supplier quantity (2011-12) (WEF GCR Q.11.01)	5 (WEF GCR_ on a Likert scale of 1 to 7)	
		Local supplier quality (2011-12) (WEF GCR Q.11.02)	4.9 (WEF GCR_ on a Likert scale of 1 to 7)	
		State of cluster development (2011-12) (WEF GCR Q.11.03)	3.5 (WEF GCR_ on a Likert scale of 1 to 7)	
Environment level Market Opportunity Exploitation (ENVIROMARKET)	**Real market demand and Finance market**	Buyer sophistication (2011-12) (WEF GCR Q.6.16)	3.2 (WEF GCR_ on a Likert scale of 1 to 7)	ENVIROMARKET (7,3.5,0)
		Market competition (2011-12) (WEF GCR Q.6.02)	4 (WEF GCR_ on a Likert scale of 1 to 7)	
		Venture capital availability (2011-12) (WEF GCR Q.8.05)	2.3 (WEF GCR_ on a Likert scale of 1 to 7)	
		Source of funds: Public loan from national government or local authorities	3.5 (midway value_ on a Likert scale of 1 to 7)	
		Source of funds: Public grant from national government or local authorities	3.5 (midway value_ on a Likert scale of 1 to 7)	
		Source of funds: EU funds	3.5 (midway value_ on a Likert scale of 1 to 7)	
		Source of funds: funding from a bank (2011-12) (WEFGCR Q.8.04)	2.6 (WEF GCR_ on a Likert scale of 1 to 7)	

[1] Own calculations of average value for Czech Republic, Hungary and Poland using external publicly available data sources. Data sources and measurement scales are given in parentheses.

Table 3. Firm – environment alignment configurations for achieving high sales growth and very high sales growth, Outcome = Present

Solutions for	VERY HIGH SALESGROWTH	HIGH SALESGROWTH	
Configurations	1	2a	2b
FIRMTECH	●	•	
ENVIROTECH	●		•
FIRMMARKET	•	●	●
ENVIROMARKET	•	●	●
Raw coverage	0.56	0.54	0.43
Unique coverage	0.56	0.17	0.06
Raw consistency	0.78	0.81	0.81
Overall solution coverage	0.56	0.60	
Overall solution consistency	0.78	0.82	
Cases with greater than 0.5 membership in configuration	ENTSB	ENTSB ENTNICHE	ENTSB INTNICHE

● = core causal condition (present); ⊖ = core causal condition (absent); • = Peripheral or contributing causal condition (present); ⊖ = Peripheral or contributing causal condition (absent). Blank spaces denote 'don't care'.
For HIGHSALESGROWTH solution: Truth table frequency cut-off = 1, consistency cut-off = 0.75. Combination of intermediate and parsimonious solutions is presented.
For VERYHIGHSALESGROWTH solution: Truth table frequency cut-off = 1, consistency cut-off = 0.78. Combination of intermediate and parsimonious solutions is presented.

Table 5. Firm – environment alignment configurations for not achieving high growth sales and very high growth sales, Outcome = Absent.

Solutions for	~ HIGH SALESGROWTH		~ VERY HIGH SALESGROWTH	
Configurations	3	4	5	6
FIRMTECH	•	⊖	•	⊖
ENVIROTECH	⊖	●	⊖	•
FIRMMARKET	●	⊖		
ENVIROMARKET	⊖	•		•
Raw coverage	0.54	0.44	0.77	0.39
Unique coverage	0.21	0.10	0.42	0.03
Raw consistency	0.86	0.75	0.86	0.83
Overall solution coverage	0.65		0.81	
Overall solution consistency	0.80		0.82	
Cases with greater than 0.5 membership in configuration	CC2	CC1	CC2, CC3, ENTNICHE, INTSB	CC1, INTNICHE

Notes:

● = core causal condition (present); ⊖ = core causal condition (absent); • = Peripheral or contributing causal condition (present); ⊖ = Peripheral or contributing causal condition (absent). Blank spaces denote 'don't care'.
For HIGHSALESGROWTH solution: Truth table frequency cut-off = 1, consistency cut-off = 0.75. Combination of intermediate and parsimonious solutions is presented.
For VERYHIGHSALESGROWTH solution: Truth table frequency cut-off = 1, consistency cut-off = 0.80. Combination of intermediate and parsimonious solutions is presented.

Table 4. Elaborations on conditions that explain outcome present configurations for firm -environment alignment.

Conditions	Exemplar Cases	Strengths in manifest factors that explain firm - environment alignment conditions for present outcome
VERY HIGH GROWTH (>25percent): Configuration 1 - Complete firm - environment alignment of markets and technologies.		
Present: FIRMTECH (core) ENVIROTECH (core) FIRMMARKET (peripheral) ENVIROMARKET (peripheral)	ENTSB	*Technologies:* *Technology generation:* Very high level of R&D expenditures, design activities, new-to-world products, trademarks and patenting supported by high level of IPR protection. *Human skills:* Very high proportion of skilled staff with postgraduate diplomas and R&D personnel in total employees, proficient in-firm staff training and skills retention supported by medium level of specialised research and training services available in the environment. *Networks:* Extensive contract-based research collaborations with foreign and domestic knowledge suppliers supported by high level of quality in research institutes and local suppliers. *Markets:* Domestic market orientation supported by medium level of buyer sophistication and low barriers to market competition; sufficient internal finances complemented by high level of external funding in the form of loans and grants from national and regional sources as well as EU funds.
HIGH GROWTH (>15percent): Configuration 2a - Market-driven firm - environment alignment complemented by technologies in the firm.		
Present: FIRMMARKET (core) ENVIROMARKET (core) FIRMTECH (peripheral) Does not matter: ENVIROTECH	ENTNICHE	*Markets*: Export-orientation and existence in both foreign and domestic markets supported by very high level of buyer sophistication and medium level barriers to market competition; sufficient internal finances; some exploitation of external funding available from local sources in the form of grants. *Technologies:* *Technology generation:* High level of R&D expenditures, design activities, new products, trademarks and patenting supported by high level of IPR protection. *Human skills:* Very high rate of skilled staff with postgraduate diplomas and R&D personnel in total employees. *Networks:* Close interactions with local suppliers supported by high level local supplier quantity and quality factors.
	ENTSB	See above. This configuration, as a matter of equifinality principle, suggests that ENTSB fulfils the conditions for growth at rates of 15-25percent, since its effective exploitation of technological opportunities available in the environment does not matter for this configuration to yield a present outcome for high growth.
HIGH GROWTH (>15percent): Configuration 2b - Market-driven firm - environment alignment complemented by technologies in the environment.		
Present: FIRMMARKET (core) ENVIROMARKET (core) ENVIROTECH (peripheral) Does not matter: FIRMTECH	INTNICHE	*Markets:* Domestic market orientation supported by high level of buyer sophistication but high level barriers to market competition; sufficient internal finances complemented by high level of external funding in the form of loans and grants from national and regional sources as well as EU funds. *Technologies:* *Technology generation:* New products and trademarks supported by exploiting opportunities in government procurement of advanced products and R&D tax credits. *Human skills*: High rate of staff with graduate and postgraduate degrees, medium level in-firm staff training and skills retention. *Networks:* Embedded in domestic knowledge and supply networks supported with high level of local supplier quantity and quality as well as high level of research institute quality.
	ENTSB	See above. This configuration, as a matter of equifinality principle, suggests that ENTSB fulfils the conditions for growth at rates of 15-25percent, since its effective exploitation of technological opportunities in the firm does not matter for this configuration to yield a present outcome for high growth.

Table 6. Elaborations on conditions that explain outcome absent conditions for firm - environment misalignment.

Conditions	Exemplar Cases	Mismatch in strengths and weaknesses in manifest factors that explain firm - environment misalignment conditions for absent outcome
~ HIGH GROWTH (<15percent): Configuration 3 - Complete firm - environment misalignment driven by both markets and technologies.		
Present: FIRMMARKET (core) FIRMTECH (peripheral) Absent: ENVIROMARKET (peripheral) ENVIROTECH (core)	CC2	*Markets:* Strong export-orientation and existence in foreign markets, but very weak presence in domestic markets despite very low level of buyer sophistication for product and low barriers to market competition. Sufficient internal finances to fund innovative activities, but failure to exploit external funds available from local and national sources except for some exploitation of external funding available from EU in support of SMEs. *Technologies:* *Technology generation:* Low level of R&D expenditures, customer-driven design activities, new-to-firm products, no trademarks or patents, but medium level exploitation of opportunities provided by government procurement of advanced technology products. *Human skills:* Very low proportion of skilled staff with postgraduate diplomas and R&D personnel in total employees with medium level in-firm training activities and high rates of skill retention, despite medium level exploitation of education quality to recruit skills and medium level specialised research services exploitation. *Networks:* No embeddedness in knowledge networks apart from receiving technical support when necessary, despite opportunity available to cooperate with scientific research institutes. High level embeddedness in value chain with medium level support from local suppliers.
~ HIGH GROWTH (<15percent): Configuration 4 - Complete firm - environment misalignment driven by both technologies and markets.		
Present: ENVIROTECH (core) ENVIROMARKET (peripheral) Absent: FIRMTECH (core) FIRMMARKET (core)	CC1	*Markets:* Medium level of access to foreign and domestic markets with medium level of buyer sophistication for products and very high level barriers to market competition. Sufficient internal finances to fund innovative activities, but complete failure to exploit external funds available from local, national and supranational sources. *Technologies:* *Technology generation:* No expenditure on R&D, customer-driven design activities, some new-to-firm product generation, no patents or trademarks, despite ability to exploit opportunities in government procurement of advanced products. *Human skills*: Low rate of skilled staff with postgraduate diplomas and very low rate of R&D personnel in total employees with medium level in-firm training activities and high rates of skill retention, despite medium level exploitation of education quality to recruit skills and medium level specialised research services exploitation. *Networks:* No interactions in knowledge networks, despite opportunity available to cooperate with scientific research institutes. Embedded in value chain with medium level support from local suppliers.
~ VERY HIGH GROWTH (<25percent): Configuration 5 - Technology-driven firm - environment misalignment.		
Present: FIRMTECH (peripheral) Absent: ENVIROTECH (core) Does not matter: FIRMMARKET ENVIROMARKET	INTSB	*Technologies:* *Technology generation:* High level of R&D expenditures, own design activities, new products, but complete deficiency in exploiting opportunities provided by government procurement of advanced technology products and IPR protection except for tapping into opportunities for R&D tax credits. *Human skills:* Relatively high proportion of skilled staff with postgraduate diplomas and R&D personnel in total employees, in-firm staff training and high levels of skills retention, but exploiting specialised research and training services and education quality providing skills in the environment at medium level. *Networks:* Extensive contract-based research collaborations with foreign and domestic knowledge suppliers and deep embeddedness in value chains, but medium level opportunity exploitation in cooperating with research institutes and local suppliers.
	CC3	*Technologies:* *Technology generation:* No R&D expenditures, own design activities, new-to-firm products and trademarks, but failure to exploit opportunities provided by government procurement of advanced technology products and opportunities for R&D tax credits except for tapping into opportunities provided by IPR protection for trademarks. *Human skills:* Relatively high proportion of skilled staff with postgraduate diplomas R&D personnel, in-firm staff training and high levels of skills retention, but exploiting medium level specialised research and training services and education quality providing skills in the environment. *Networks:* Collaborations with domestic university to seek technical support only despite deep embeddedness in value chains where medium level opportunity exploitation exists in research institutes and local suppliers.
	ENTNICHE	*Technologies:* *Technology generation:* High level of R&D expenditures, own design activities, new products, trademark and patenting, but failure to exploit opportunities provided by government procurement of advanced technology products and R&D tax credits except for making some use of opportunities provided in IPR protection. *Human skills:* Very high proportion of skilled staff with postgraduate diplomas and R&D personnel in total employees, but incompetent in-firm staff training and low level skills retention with high rates of employee turnover, failing to exploit opportunities in specialised research and training services and education quality providing skills in the environment.

		Networks: Collaborations with domestic suppliers only with a focus on technical support and licensing, failing to join in value chains whereby opportunity exploitation in research institutes and local suppliers is at low to medium levels.
	CC2	See above. Analysis already identified causes for CC2 not growing at high rates.

~ VERY HIGH GROWTH (<25percent): Configuration 6 - Technology-driven firm - environment misalignment complemented by markets.

Present: ENVIROMARKET (peripheral) ENVIROTECH (peripheral) Absent: FIRMTECH (core) Does not matter: FIRMMARKET	INTNICHE	*Technologies:* *Technology generation:* Non-existent internal R&D activities, no design activities, new-to-firm product generation, trademarks, but ability to exploit well opportunities in government procurement of advanced products and tax credits with deficiency to exploit IPR protection rights. *Human skills*: A high rate of skilled staff with postgraduate diplomas in total employees, but no R&D staff, high rate of skill retention with medium level in-firm training activities, but failure to exploit opportunities in education quality to recruit skills in research and specialised research services. *Networks:* Embedded in domestic knowledge networks supported with high level of local supplier quantity and quality as well as high level of research institute quality. *Markets:* Export-orientation deficiency, despite high level of buyer sophistication for products.
	CC1	See above. Analysis already identified causes for CC1 not growing at high rates.

APPENDIX A. Case selection process guided by Amadeus database and web search.

Amadeus database holds information about firm activity and main products based on NACE Rev. 2 primary codes. This allowed us to reach firms that operate in the technologies studied in this research. 62 firms in advanced materials and automotive from Czech Republic, Poland and Hungary were identified.
In 2343 - Ceramic insulators and insulating fittings, there were 22 firms registered in 2012. Almost all of these firms are SMEs that produce small ceramic parts by traditional techniques of powder metallurgy.
In 3731 –Manufacture of fibre optic cables, there were 6 firms.
In 2344 - Manufacture of other technical ceramic products category there were 17 firms engaged in technical ceramics production using medium or high technology processes.
2561 - Treatment and coating of metals category involved 9 firms that use sophisticated technologies of surface technologies/treatment.
In 2910 – Manufacture of motor vehicles category majority of producers are MNEs. There is quite significant activity in electric bus production (particularly in Hungary) in large domestic firms, however their activities are largely based on assembly where they import electric engines from abroad. We identified 3 domestic SMEs engaged fully in electric vehicle production.
In 2931 - Manufacture of electrical and electronic equipment for motor vehicles for electric vehicle related components, 5 firms were suppliers of electric motors for electric vehicles.
After detailed firm website investigations (for the firms that had websites) we selected the seven cases as preresentative of each matrix category by technology type and entrepreneurial activity type in Figure 3. Sample representativeness of our cases in total population is 11.3percent.

APPENDIX B. The Questionnaire.

The questionnaire covered the following information:

1. General background information about the firm where questions related to product and process types, technology field that the firm is operating in, sales growth rates, employment figures, foundation date, firm location, etc. were posed.

2. Firm-level technological competence enquiring about the details of technology generation in terms of new products/processes, patents and trademarks, details about human skills structure, in-firm training and the nature and degree of networking to outsource external knowledge and to become part of value chains.

3. Firm-level market competence investigating about the domestic and foreign market size of the firm as well as firm-level financial strength.

4. Firm's assessment of environment in terms of technological opportunities elaborating on available macro level support in protecting intellectual property and mechanisms for enhancing its production, skills training, supplier quality and quantity, knowledge networks quality and quantity.

5. Firm's assessment of environment in terms of market opportunities elaborating on quality of demand for sophisticated products, market competition and financial support that is available through external funding systems to enhance entrepreneurial activity.

Appendix B Table. Survey questions that represent manifest indicators in this research and their WEF GCR correspondences.

Condition	Manifest Indicators (coverage year	Question/statement in this research's survey	Question in WEF GCR survey
	Sales growth rate (2007-2012 pa)	Rate of sales growth during 2007-12	
FIRMTECH	R&D expenditures, percent in turnover (2012)	Sh]are of R&D expenditures in total sales	
	Design capability	Main source of design activity as customer's design, other company's designs, own designs, other	
	Innovation quality (2007-2012)	Number of innovations introduced during 2007-12 as new-to-firm, new-to-country, new-to-world.	
	Patents (2007-2012)	Number of patents filed during 2007-12	
	Trademarks (2007-2012)	Number of trademarks filed during 2007-12	
	ISO9001, 14001 certificates (2007-2012)	Number of ISO 9001 and 14001 certificates acquired during 2007-12	
	Employees with PhDs, Master's, Graduates (percent in total employees) (2012)	Number of employees with PhDs, Master's and university diplomas as share of total employees	
	R&D personnel, percent in total employment (2012)	Number of R&D personnel as share of total employees	
	Extent of staff training (2011-12)	General approach of your firm to human resources is (1 = little in training and employee development, 7 = invest heavily to attract, train, retain employees)	**WEFGCR Q.5.08:** To what extent do companies in your country invest in training and employee development? [1 = hardly at all; 7 = to a great extent]
	Brain drain (2011-12)	Your firm's talented people (1 = normally leave to pursue opportunities in other firms, 7 = almost always remain in the firm)	**WEFGCR Q.7.07:** Does your country retain and attract talented people? [1 = no, the best and brightest normally leave to pursue opportunities in other countries; 7 = yes, there are many opportunities for talented people within the country]
	Partners in innovation collaboration	Types of partners collaborated specifically to introduce new products/ processes /services onto the market (university, research institute, customer, supplier, rival firm, government, consultant broken down as domestic and foreign)	
	Modes of innovation collaboration	Types of collaboration used specifically to introduce new products /processes /services onto the market (strategic alliance, R&D agreement, technical support, subcontracting, licensing agreement)	
	Value chain breadth (2011-12)	If your firm is exporting, you are [1 = primarily involved in individual steps of the value chain (e.g., resource extraction or production); 7 = present across the entire value chain (i.e., do not only produce but also perform product design, marketing sales, logistics, and after-sales services)]	**WEFGCR Q.11.05:** In your country, do exporting companies have a narrow or broad presence in the value chain? [1 = narrow, primarily involved in individual steps of the value chain (e.g., resource extraction or production); 7 = broad, present across the entire value chain (i.e., do not only produce but also perform product design, marketing sales, logistics, and after-sales services)]
FIRMMARKET	Firm's foreign market size (2011)	Your firm sells its high technology products in the foreign market (1=none, 7= almost all production)	**WEF GCR Q.10.02**: Value of exports of goods and services, normalized on a 1–7 (best)
	Firm's domestic market size (2011)	Your firm sells its high technology products in the domestic market (1=none, 7= almost all production)	**WEF GCR Q.10.01**: Sum of gross domestic product plus value of imports of goods and services, minus value of exports of goods and services, normalized on a 1–7 (best)
	Source of funds: own financial sources	Availability of own funding sources for innovation/networking/ease of access to other markets (1=not at all, 7=to a great extent)	

ENVIROTECH	Government procurement of advanced technology products (2011-12)	In your technology field, government procurement decisions result in technological innovation (1 = strongly disagree, 7 = strongly agree)	**WEFGCR Q.12.05:** Do government procurement decisions foster technological innovation in your country? [1 = no, not at all; 7 = yes, extremely effectively]
	IPR protection (2011-12)	Intellectual property protection and anti-counterfeiting measures in your country are (1 = weak and not enforced, 7 = strong and enforced)	**WEFGCR Q.1.02:** How would you rate intellectual property protection, including anti-counterfeiting measures, in your country? [1 = very weak; 7 = very strong]
	R&D tax incentive availability	Availability of R&D tax incentives (1=not at all, 7=to a great extent)	
	Quality of the educational system (2011-12)	Educational system /raising skills in your technology field (1 = does not meet the needs of a competitive economy, 7 = meets the needs)	**WEFGCR Q.5.03:** How well does the educational system in your country meet the needs of a competitive economy? [1 = not well at all; 7 = very well]
	Local availability of specialized research and training services (2011-12)	Specialized research/ employee training services in your technology field are (1 = not available, 7 = available from world-class local institutions)	**WEFGCR Q.5.07:** In your country, to what extent are high-quality, specialized training services available? [1 = not available; 7 = widely available]
	Quality of scientific research institutions (2011-12)	Scientific research institutions related to your technology field are (1 = non-existent, 7 = the best in their fields internationally)	**WEFGCR Q.12.02:** How would you assess the quality of scientific research institutions in your country? [1 = very poor; 7 = the best in their field internationally]
	Local supplier quantity (2011-12)	Quantity of local suppliers in your technology field in your country are (1 = non-existent, 7 = numerous and include the most important materials, components, equipment, and services)	**WEFGCR Q.11.01**: How numerous are local suppliers in your country? [1 = largely nonexistent; 7 = very numerous]
	Local supplier quality (2011-12)	Quality of local suppliers in your technology field in your country is (1 = very poor, 7 = very good)	**WEFGCR Q.11.02:** How would you assess the quality of local suppliers in your country? [1 = very poor; 7 = very good]
	State of cluster development (2011-12)	In your country, how widespread are well-developed and deep clusters with regard to your technology field? (1 = non-existent; 7 = widespread)	**WEFGCR Q.11.03:** In your country's economy, how prevalent are well-developed and deep clusters? [1 = nonexistent; 7 = widespread in many fields]
ENVIROMARKET	Buyer sophistication: buyer's purchasing decision (2011-12)	Customers of your firm make purchasing decisions (1 = based solely on the lowest price, 7 = based on a sophisticated analysis of performance attributes)	**WEFGCR Q.6.16:** In your country, how do buyers make purchasing decisions? [1 = based solely on the lowest price; 7 = based on a sophisticated analysis of performance attributes]
	Market competition (2011-12)	Competition and barriers of entry created by large companies, i.e. MNEs, create obstacles in the entrepreneurial activity of your firm1=not at all; 7=to a great extent)	**WEF GCR Q.6.02**: How would you characterize corporate activity in your country? [1 = dominated by a few business groups; 7 = spread among many firms]
	Venture capital availability (2011-12)	How easy is it in your country for a firm with innovative but risky projects to find venture capital? (1 = very difficult, 7 = very easy)	**WEFGCR Q.8.05:** In your country, how easy is it for entrepreneurs with innovative but risky projects to find venture capital? [1 = very difficult; 7 = very easy]
	Source of funds: Public loan from national government or local authorities	Availability of listed funding sources for innovation/networking/ease of access to other markets (1=not at all, 7=to a great extent)	
	Source of funds: Public grant from national government or local authorities		
	Source of funds: EU funds		
	Source of funds: funding from a bank (2011-12)	Availability of funding from a bank for innovation/networking/ease of access to other markets (1=not at all, 7=to a great extent)	**WEFGCR Q.8.04:** How easy is it to obtain a bank loan in your country with only a good business plan and no collateral? [1 = very difficult; 7 = very easy]