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Exploring the Impact of the Level of Absorptive Capacity in Technology Development Firms

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Abstract

Absorptive capacity (ACAP) is widely recognized as an effective means of obtaining and sustaining a competitive advantage. Although ACAP was globally introduced decades ago, researchers from Central and Eastern Europe have since underestimated its importance. The research objective of this paper is to answer the following questions: how does the level of ACAP influence the performances of technology-driven firms, and how does it catalyse their innovation outputs? Furthermore, we argue that exporting technology-driven firms possess even higher levels of ACAP than those who are weak or not-at-all exporters. ACAP measured value is examined alongside the innovation outputs of firms and their business performance, with an extended focus on exporters. A selected population of more than 600 Croatian firms were asked to fill in the questionnaire. Out of the 103 firms that completed the survey, 45 were recognized as intensive technology development performers, and 34 were identified as large exporters. Both populations were tested against formulated hypotheses, ultimately proving that higher levels of ACAP can be seen to positively drive innovation performance which, notably, can be seen most clearly with exporters.

1. INTRODUCTION

Technology acquisition has been studied widely, evidencing its impact on organizations. For example, Gupta et al (2018) and El Kassar and Singh (2018) studied the impact of various technologies on the performance of organizations, showing that several internal and external factors can influence impact. One of these factors is ACAP. Originally proposed bv Rostow (1956 and 1963), ACAP was later revived by Cohen and Levinthal (1989), who formulated the idiom 'absorption capacity'. *They put forward a definition which stated that absorptive capacity (ACAP) is the potential of a firm to "identify the value of new, external information, assimilate it, and apply it to commercial ends" (Cohen and Levinthal 1990:128*). ACAP often accompanies the search for innovation in firms which frequently focus on technological development. Initial

models of ACAP have been tested and, as a result, multiple new models have emerged. These new models show an evolution in response to accurate ACAP, and demonstrate the need to enhance or alter previous models in the light of new knowledge. Taking this into consideration, the approach of this paper implements the definition of ACAP in firms through a modified model, which is based on existing ones (Zahra and George, 2002).

Over the past two decades, numerous scholars across the world have been looking to determine favourable factors for ACAP (Stulova and Rungi, 2017; Cohen and Levinthal, 1990; Jansen, Van Den Bosch, and Volberda, 2005; Heimonen, Kohtamäki, and Heikkilä, web source). Prior research published in *Technological Forecasting and Social Change* has explored various aspects of ACAP: Ranguc and Slevec (2017) examined the impact of ACAP on manufacturing and service firms; Scaringella and Burtschell (2017) studied ACAP in the context of radical innovation challenges in Iran; Kokshagina and Masson (2017) focused on the role of open innovation in accelerating ACAP; Scaringella et al (2017) identified customers involvement and firm ACAP in radical innovation in the case of technological spin-offs; Luiza et al (2015) studied organizational antecedents of ACAP; Lau and Lo (2015) explored the relationships among regional innovation systems, ACAP, and innovation performance; and Denicolai et al (2016) studied ACAP within the context of internal R&D and external knowledge acquisition.

The research objective of this paper seeks to question the intensity and scope of the interaction of firms' ACAP function, and their innovativeness and business performance outputs (does the level of absorptive capacity influence the performances of technology-driven firms, and how does it catalyse their innovation outputs within a transitional economy environment?). In our research, we aim to examine all four constitutive components of ACAP (acquisition, assimilation, transformation, and exploitation). Historically, the operationalisation of ACAP in transition countries was a limited topic (authors of the paper, 2018), as demonstrated by the case of the Republic of Croatia. Primarily, firms with proven innovating activities were identified and researched in this paper. Despite operationalizing ACAP on the base population of technology-focused firms, this paper additionally focuses on R&D performers and exporters. The former are those that perform innovation and R&D activities within their firms, and the latter are these who are innovative but, at the same time, export goods or services. The rationale behind the inclusion of exporters stems from the fact that, in transition economies, exporters are considered to be more successful organizations than others, particularly when the internal market is of limited volume.

A literature review is discussed after the introduction, followed by a theoretical discussion, a hypothesis proposition, and an outline of the methodology, including the definition of the sample and scope. Finally, the

results are analysed and explained and the paper ends with a conclusion which explains practical implications, limitations, and opportunities for further research.

2. THEORETICAL BACKGROUND AND HYPOTHESIS DEVELOPMENT

Cohen and Levinthal's 1990 work was recognized and continued by Van Den Bosch, Van Wijk, and Volberda, 2003; Lane, Koka, and Pathak, 2006; Lichtenthaler and Lichtenthaler, 2009; Hart, Gilstrap, and Bolino, 2016. These researchers highlighted the importance of researching ACAP as a factor of R&D outsourcing (Un, 2017), while García-Sánchez, García-Morales, and Martín-Rojas (2017) note the importance of the environment and stakeholders. This influenced some researchers to focus their work on the implementation of ACAP for organizations of various types, particularly firms. Zahra and George (2002) pointed out that ACAP is an essential dynamic capability that can strongly influence the nature and sustainability of a competitive advantage. Nowadays, however, the concept of ACAP is studied through various organizational phenomena. The findings of Limaj and Bernroider (2017) demonstrate that firms with a well-balanced composition of hierarchy, adhocracy, clan, and market cultures seem to be more effective in generating exploratory and exploitative innovation when examined alongside firms that are less well-balanced. Zahra and George (2002) researched this in terms of strategic management (Nahapiet and Ghoshal, 1998) and technological management (Schilling, 1998; Rodriguez, Wise, and Ruy Martinez, 2013; Rush, Bessant, and Hobday, 2007) tendencies in governmental and nongovernmental policies from a political networking point of view (Kotabe, Jiang, and Murray, 2017).

Figure 1.

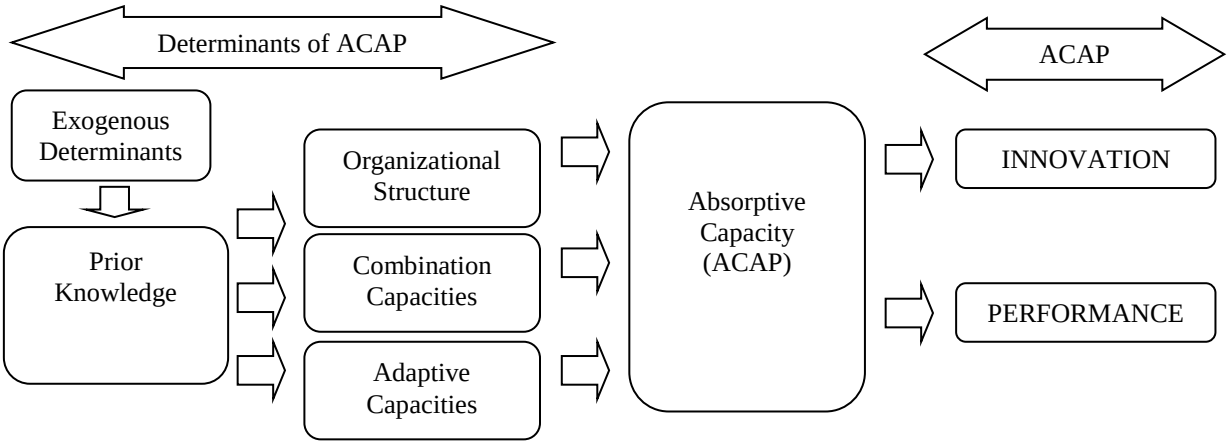


Fig. 1. Expanded ACAP: a model, adapted from Lane, Koka, and Pathak (2006), Lichtenthaler and Lichtenthaler (2009), and Van Den Bosch, Volberda, and De Boer (1999,) presented in de Araújo (2010).

Insert figure 1. about here

An extended model adapted from Lane, Koka, and Pathak (2006), Lichtenthaler and Lichtenthaler (2009) and Van Den Bosch, Volberda, and De Boer (1999), presented in de Araújo (2010), was selected, and this is shown in Figure 1. This model is particularly relevant to the context of this paper because its outputs are the innovation indicators and the firms' performance, which are the two components that we strive to focus on in our research.

A disclosed ACAP, along with the capacity to innovate, are essential in obtaining a competitive advantage (Cohen and Levinthal, 1989; Zahra and George, 2002). Various studies (Rakthin, 2013; Forés and Camisón, 2016) propose that this connection is necessary for a firm's sustainable competitive advantage (SCA). Chauvet and Guiot (2003) unveiled that this function is critical for achieving and maintaining a firm's SCA. This is the level of ACAP that is developed within a firm and it is bound by knowledge transfer capabilities. Daim et al (2008) and Daim and Kocaoglu (2008 and 2009) showed that different technological evaluation and acquisition strategies could lead to different results in terms of companies' performance in the US electronics manufacturing industry. Dabic et al (2012), on the other hand, explored the choice of R&D and acquisition approaches in Croatia and found significant relationships.

Tzokas, Kim, Akbar, and Al-Dajani (2015) pointed out that a positive correlation exists between ACAP and a firm's performance, this is achieved by a firm's understanding of the technological capabilities and loyalty of its customers. Tu, Vonderembse, Ragu-Nathan, and Sharkey (2006) researched 303 firms from a small and medium enterprises (SMEs) U.S. membership database, and confirmed active and direct relationships between ACAP and time-based production procedures.

ACAP is closely intertwined with the innovation process, as well as with the systematic management of knowledge. González-Loureiro, Dabic, and Puig (2014) demonstrated that, as the understanding of the co-evolutionary theory of multinational firms' competitive advantage develops, the ACAP of knowledge becomes a critical input for the achievement of a global, sustainable competitive advantage. It can therefore be assumed that ACAP is inevitably and inextricably tied to the success of SCA in firms. Saad, Kumar, and Bradford (2017) suggest that owners and managers ought to be capable of, and dedicated to, transforming their management style and introducing appropriate changes conducive to commitment, engagement, and motivation to learn and to share learning. Finally, Saad, Kumar, and Bradford (2017) conclude that the successful use of external knowledge is associated with the need for SMEs to develop more formal systems, procedures, rules, and

routines that can help them mitigate their weaknesses, foster their motivation qne interest in collaboration, and subsequently value learning and innovation.

Based on the contribution of ACAP to firms' performance, the first hypothesis is established:

H1. A higher level of ACAP positively influences performance in firms that perform research and technology development firms.

The intent of this hypothesis is to explain whether or not the level of ACAP positively correlates with a firm's performance or, when higher levels of ACAP are included, achieve better business performance. The empirical links and interactions between the level of ACAP, organizational innovation, and performance have been systematically evaluated over the years - Lin, Su, and Higgins (2016) explored the interaction of ACAP and the intensity of innovation processes initiation, with particular emphasis on externally available knowledge. Direct links to ACAP levels and the innovative firm's capacity in its workload has also been explored by Liao, Wu, Hu, and Tsuei (2009). Forés and Camisón (2016) observed a correlation between ACAP and the successfulness of innovation processes that utilize and initiate radical and incremental types of innovations. Resource-Based View (RBV) is used to establish which abilities of a firm (ACAP related) are indicative of its performance. Specifically, the measure of a firm's performance in work by Forés and Camisón is ROA (return on assets). Motivated by traditional industries and SMEs, the research of Spithoven et al. (2010) centres around utilizing ACAP at an inter-organizational level and featuring ACAP as a driver for open innovation.

In his two studies (Bahli, 2012; Bahli, Borgman, and Heier, 2013) Bahli and his co-authors investigated the ties between ACAP levels in firms and the amount of resultant innovative processes. In his second paper, Bahli, Borgman, and Heier (2013) referred to the ways in which uncertainty regarding starting innovative processes can be associated with the level of ACAP. Furthermore, in Bahli (2012), the type of generated innovation is examined (radical or incremental), which can depend on the current level of ACAP's components (acquisition, assimilation, transformation, and exploitation).

Rakthin (2013) carried out extensive research in which he explored links between two of ACAP's building blocks (PACAP and rACAP) and the firm's performance. In his work, Rahatkin appraised an extended range of the firm's performance indicators, the balance in the relationship of price/product differentiation, sales growth, market orientation, and customer loyalty, etc. When considering innovative typology, it is important to note that the type innovative output can vary from firm to firm (Garcia and Calantone, 2002). It can range from the incremental to the radical and, furthermore, can be presented in a disruptive form (Christensen, 1997). Nevertheless, for the purpose of the production of this paper, due to the specific sample pattern, the authors do

not aim to differentiate innovation typology and, as such, considering the paper's objectives, the second corresponding hypothesis is formed:

H2: A higher level of ACAP positively influences the triggering of innovation processes in firms that perform research and technology development.

When assessing this hypothesis, it was assumed that the firms that were examined possessed a high level of ACAP. They also performed better at initiating innovation processes, because the innovation potential was better recognized and thus the firms could consequently combine it with action.

The higher the level of innovation activity conducted in a firm, the higher the odds are of the firm performing successfully. Kalay and Lynn (2015) modified this statement, and claimed that innovation strategy is positively associated with successful innovation in firms. One of the largest barriers to the commercialization of innovation is substantial competition. Therefore, due to the effect of cannibalization, Kalay and Lynn (2015) pointed out that not all innovation or launches of innovative outcomes should be automatically satisfied. As a measure of successful innovation, some performance indicators in several categories can be reflected upon. The first type is productivity which, amongst others, can be quantified through the commonly used model of CDM offered by Crépon, Duguet, and Mairessec (1998), followed by the employment category (Lachenmaier, 2011; Harrison, 2008), financial indicators (Kemp et al., 2003; Artz et al., 2010), and others.

Artz et al. (2010) confirmed that collaborative networks positively influence product innovation. Finally, Dabic et al. (2009, 2017) concluded that innovation, as a direct result of knowledge or its combination, is considered to be a primary part of entrepreneurship and a fundamental component of a firm's success and progress. Based on the review of the research that links the innovation processes and performance of an enterprise, the third hypothesis is formulated:

H3. A higher incidence of initiated innovation processes positively influences performance in firms that perform research and technology development.

The testing of this hypothesis is assumed to occur in an legitimate situation where the innovation processes may be halted or interrupted in their implementation and, ultimately, these processes will not result in the sustainable commercialization of products. Another undesirable scenario that influences the process negatively is when a previously launched or commercialized product/service has not been successful in the market.

The fourth hypothesis is set as a validating hypothesis, which is influenced by the previous three. In testing this hypothesis, we sought to establish whether or not there exists a direct relationship between observed

variables or, in other words, whether the number of initiated innovation processes acts as mediator in realized absorptive capacity (rACAP) and firm performance (PosUsp) relationship and the intensity of this relationship.

H4: There is an impact on the frequency of initiated innovation processes as a mediator in the relationship between ACAP and the performance in research and technology development performing firms.

Export firms may benefit from the economies of scale by using technology and thereby increasing employment and labour productivity. They diminish the current account pressures on foreign capital goods by increasing the country's external earnings and inviting foreign investment, and they increase the total factor productivity (TFP) and thus the well-being of the country (Medina-Smith, 2001). Dai and Yu (2013) confirmed that there is *"a positive and significant relationship between skills related to identifying and using export market knowledge and export performance*". The relationship between ACAP and the performances of exporters was studied by Harris and Li (2008). In their work, a simplified model of interactions between ACAP, SCA, and technological resources is displayed (Fig 2).

Figure 2.

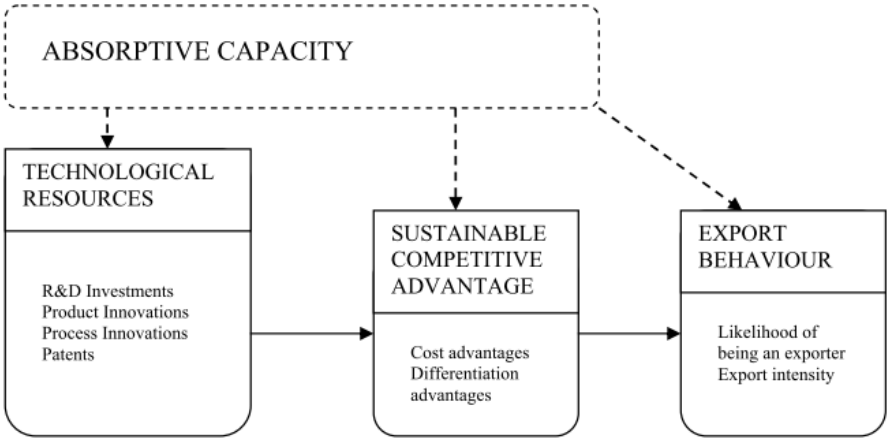


Fig. 2. Expanded version of Lopez Rodriguez and Garcia Rodriguez (2005) presented in Harris & Li (2008).

Insert figure 2. about here

To summarize, the research of this paper does not examine the barriers, or the intensity regarding firms export activities, as showed in Harris and Li (2008), but is instead orientated towards understanding the correlation intensity of the ACAP and performances with exporting orientation firms versus those deemed less or not at all export-oriented. The other link that we do not seek to examine is that of the genesis of interaction

or, more precisely, whether the development of ACAP causes exporter success or boosts the levels of ACAP, or both. To enhance firms' export performance, it has been suggested (Mogos, Descotes, and Walliser, 2013; Souchon and Diamantopoulos, 1997) that organizations need to assimilate their acquired knowledge (ACAP assimilation) throughout the entire structure of the firm. In our proposition, we consider ACAP to be critical to a firm's functionality in exporting performances and, in our consideration, we evaluate the aggregate ACAP value rather than evaluating each single component, as was done in Ahimbisibwe, Nkundabanyanga, Nkurunziza, and Nyamuyonjo (2016). Therefore, we hypothesize as follows:

H5: Higher levels of absorptive capacity positively influence the performance of exporting firms

The Model

Following this paper's hypotheses' formulation, and taking the selected model of ACAP (Figure 1. and Figure 2.) into consideration, an empirical model for research was created, as represented in Figure 3.

Figure 3.

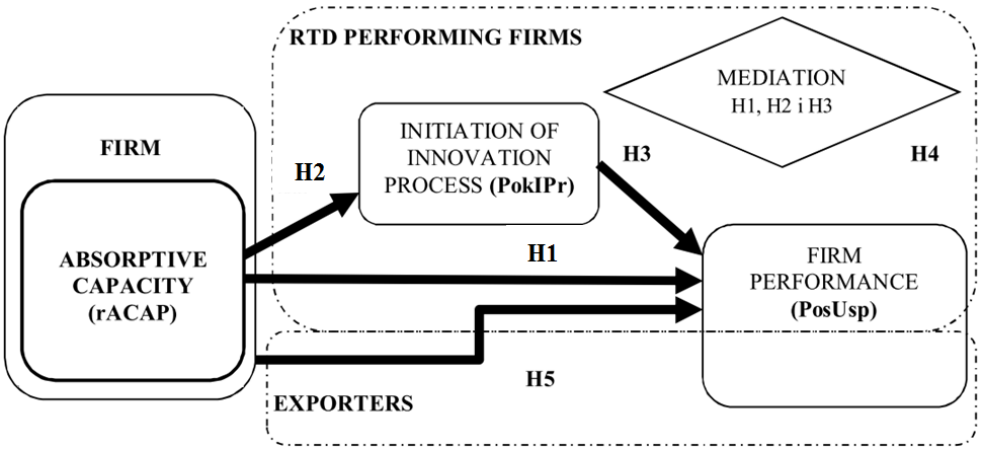


Fig. 3. Empirical research model with allocated hypotheses, authors' representation.

Insert figure 3. about here

3. METHODOLOGY

The information presented in this research was attained by surveying members of top management in active technology-intensive firms in Croatia. Prior research suggested that those occupying top management positions

tend to be more familiar with the core values of the firm in which they work, and would therefore be the most appropriate candidates to respond to our questionnaire (Hambrick and Mason, 1984). The target population for this research was technology-focused firms in Croatia, classified according to the National classification code (NKD, 2007), which corresponds to NACE (Eurostat, N.A.C.E., 2008) classification. Companies were selected using a database provided by the Croatian Chamber of Economy (CCE)[1] which is comprised of six hundred (n = 600) companies, registered in September 2018. Companies registered as technology-focused were first contacted via phone and, upon agreement to participate in the study, a questionnaire was sent via email. In order to iterate the paper's goals, the intention of a firm to conduct or continually conduct internal technology innovation processes was used as selection criteria to define firms as eligible candidates. When examined in terms of typology, this prevalently covers both types of innovation, both the incremental and the radical, independently as a product or service or a combination of the two (Garcia and Calantone, 2002).

At the end of the data collection, 103 responses were considered valid. Out of the 103 respondents of the online questionnaire (distributed to technology-focused firms), interviews with the respondents resulted in the classification of 40 companies as R&D performers. These were finally selected through a combination of multiple criteria, such as the number of initiated innovation projects, the acquaintance of authors and their teams with responding firms, and through direct telephone conversation and visits to the candidates. From this point, our research analysis went in two highly intervened directions. The first part focused only on R&D performers and the effect of absorptive capacity on firm performance in these companies (n=40; Hypothesis 1-4). Continuous conducting, or the intention of firms to conduct internal technology innovation processes, was used as selection criteria to determine whether or not a firm was an eligible candidate. Finally, it was assumed that firms that were selected had already carried out innovation activities or invested in R&D, and had subsequently already launched an innovation process. The second part focused on the effect of absorptive capacity on the performance of all technology-focused firms, deferring them according to different exportation levels (34 classified themselves as strong exporters, 52 as moderate exporters, and 17 as non-exporters) (n=103; Hypothesis 5). When forming a research sample, a great deal of attention was paid to avoiding selection and response bias. In the development of the questionnaire, well-trained professionals from both business and academic sectors were consulted. Authors developed personal relationships with respondents, assuring them of the anonymity and confidentiality of the study and giving them the confidence to answer as honestly as possible. Furthermore, cumulative reports were offered as a reward for respondents' participation. Authors dealt with the selection bias by contacting the entire population of technology-focused firms active in Croatia (according

[1] http://www1.biznet.hr/HgkWeb/do/extlogon

to Croatian Chamber of Economy). Non-response bias, unfortunately, could not be controlled. The structure of respondents who answered the survey questionnaire and the structure of the firms' market offerings are presented in Table 1.

Table 1.

Position/ownership	% return
Top management (MD, board member) as owner or co-owner	53,40
MD, board member (not in ownership)	19,42
Director/R&D manager or technical director	5,83
Director/M&S manager, operations manager, other	11,65
Unanswered	9,71
total	100

Market offering	% return
Product, exclusively	15,53
Product, mostly	18,45
Product and service	34,95
Service, mostly	16,50
Service, exclusively	14,56
Unanswered	0,97
total	100

Insert table 1. about here

Measures and Variables

The independent variable in this research is absorptive capacity (realized ACAP / rACAP). ACAP is comprised of four dimensions, and these were measured using the scale developed by Zahra and George (2002). The four dimensions are as follows: acquisition (9 items), assimilation (6 items), transformation (8 items), and exploitation (4 items). These variables were operationalized on 8-point Likert scale, thus avoiding neutral and undecided options. The study has one dependent variable: firm's business performance (PosUsp). Two items were used, measuring the firm's revenues and profits within the last five years. Variables were operationalized on a 7-item Likert scale, where 1 represented low-performing firms and 7 represented high-performing firms. The mediation variable in this research was the frequency of innovative products technology development processes (PoklPr). One direct question was used to determine the frequency of innovation process initiation within firms over the course of the last five years. Variables were operationalized on a 5-item Likert scale by authors' stratification, where 0 represented none and 4 represented a high level of frequency in innovation processes. According to guidelines established by Diamantopoulos, Sarstedt, Fuchs, Kaiser, and Wilczynski (2012), single-item measures were used due to small sample sizes (i.e., $N < 50$), as well as systematic redundancy of items explaining the phenomena.

Estimation Procedure

In order to test the hypotheses, this study used a combined approach: for the H1-H4 testing, a PLS variance-based structural equation modelling method, performed using SmartPLS v. 3.2.6. (Ringle, Wende, and Will, 2017) software was used; and to test the last H5, a simple linear regression approach using the SPSS software was applied. The first method was appropriate considering the research environment, the early stage of theoretical development, and the relatively small sample size (Hernández-Perlines, Moreno-García, and Yañez-Araque, 2016). PLS-SEM is a multivariate modelling technique, useful for testing multiple dependent and independent latent constructs at the same time (Mathwick, Wiertz, and De Ruyter, 2008), and does not require multivariate normality (Zhou, Zhang, Su, and Zhou, 2012), compared to Linear Structural Relationship Modelling or Multiple Regression Methods. The theoretical underpinnings of the research phenomena (absorptive capacity comprises of several sub-dimensions) demanded hierarchical-component modelling (HCM) (Lohmoller, 1989), building a higher order construct (HOC). Higher order construct ACAP was achieved using the repeated indicator approach (Hair et al., 2017) in a reflective-formative type of HCM. As a result of the nature of a repeated indicator approach, a two-stage approach had to be used (Hair et al., 2017). The research model was framed in such a way that, in the first stage, the latent variable scores (LVs) of each HOC were obtained. This way the number of relationships in the model was reduced, making the model more parsimonious and resistant to collinearity problems (Hair et al., 2017). The second stage consisted of loading LVs on HOC and, during further analysis, ACAP was treated as one construct. Analysis of the measurement model would provide this research with an estimation of how well the data would fit the proposed theory (Afthanorhan, 2013; Barclay, Higgins, and Thomson, 1995; Chin, 1998; Compeau and Huff, 1999; Yi and Davis, 2003). The analysis of the structural model would result in the statistical significance of path coefficients (using Bootstrapping procedure; 5,000 sub-samples; Hernández-Perlines et al., 2016).

In terms of H5, as a result of the sample size, applied linear regression analysis used the Pearson product moment correlation coefficient (ρ), while the practical relevance of the resultant models was proved via the correlation ratio according to the determination coefficient, by applying the Chaddock scale presented in Chaddock (1925). To determine whether any of the differences between the means were statistically significant, a one-way ANOVA with a reported ‘p’ value was used to determine the statistical significance of values <0.05.

4. RESULTS

Analysis of the Measurement Model

This model contains six reflective constructs and one second-order construct, which includes four dimensions of absorptive capacity (a similar methodological approach was also taken by Zaim, Tatoglu, and Zaim, 2007; and Bruhn, Georgi, and Hadwich, 2008). Tables 2 and 3 present the parameters used to evaluate internal consistency and reliability. The results indicate that all of the items (except items ACQ9, TRANSF5 and EXPL4) measured in this research possess satisfactory loading values (>0.7; Hair et al., 1998; de Pablo González, Pardo, and Perlines, 2014), and are statistically significant (t-values >2.58; Hair et al, 1998).

Table 2.

	Factor loadings	T Statistics (|O/STDEV|)
Firm business performance Cronbach's Alpha=0.84		
Percentage of total revenue (in the income statement, P&L) in the last five years generated from sales of innovative products and services:	0.923	42.676
Percentage of EBIT (in the income statement, P&L) in the last five years generated from sales of innovative products and services:	0.934	58.908
Acquisition - Absorptive Capacity Cronbach's Alpha=0.936		
We frequently scan the environment for new technologies.	0.857	29.515
We thoroughly observe technological trends.	0.861	22.03
We observe in detail external sources of new technologies.	0.853	11.555
We thoroughly collect information from our industry.	0.845	13.692
We have information on the state-of-the-art of external environment.	0.736	5.416
We frequently acquire technologies from external sources.	0.899	25.988
We periodically organize focused meetings with external partners to acquire new technologies.	0.809	11.045
Employees regularly approach external institutions to acquire technological knowledge.	0.773	9.749
In support of new technology acquisition we approach external networks and/or associations (clusters, chambers, associations, consortia, ...).	0.426	2.382
Assimilation - Absorptive Capacity Cronbach's Alpha=0.922		
1. We often transfer technological knowledge to our firm in response to technology acquisition opportunities.	0.815	9.267
2. We thoroughly maintain relevant knowledge over time.	0.871	10.346
3. Employees store technological knowledge for future reference.	0.893	15.637
4. We communicate relevant knowledge across the units of our firm.	0.905	24.941
5. We regularly match new technologies with ideas for new products.	0.762	6.421
6. We quickly recognize the usefulness of new technological knowledge for existing knowledge.	0.846	11.297
Transformation - Absorptive Capacity Cronbach's Alpha=0.927		
Knowledge management is functioning well in our company.	0.726	6.051
When recognizing a business opportunity, we can quickly rely on our existing knowledge.	0.903	23.653
We are proficient in reactivating existing knowledge for new uses.	0.892	30.975
We quickly analyse and interpret changing market demands for our technologies.	0.876	17.785
In support of new technology implementation and transformation into new products or services, we approach external networks and/or associations (clusters, chambers, associations, consortia, ...).	0.209	0.899
We are proficient in transforming technological knowledge into new products.	0.811	13.103
Our employees are capable of sharing their expertise to develop new products.	0.894	15.623
We regularly apply technologies in new products.	0.732	5.362
Exploitation Absorptive Capacity Cronbach's Alpha=0.846		
New opportunities to serve our customers with existing technologies are quickly understood.	0.86	16.388
We constantly consider how to better exploit technologies.	0.863	8.054
We easily implement technologies in new products.	0.895	21.361
It is well known who can best exploit new technologies inside our firm.	0.283	1.062

Frequency of initiation to innovate new product/service in the last 5 years, regardless of whether its commercialization was successful:		
Absorptive Capacity (*Second*-order, reflective-formative construct) Cronbach's Alpha=0.972		
Absorptive Capacity Acquisition	0.877	14.809
Absorptive Capacity Assimilation	0.96	20.866
Absorptive Capacity Transformation	0.946	16.687
Absorptive Capacity Exploitation	0.924	10.689

Table 2. Latent construct, constructs Cronbach's Alpha, measurement items, factor loadings, T-values.

Insert table 2. about here

Table 3

	rho_A	Composite Reliability	Average Variance Extracted	ACQ	ASSIM	TRAN	EXPL	PoklPr	PosUsp	HOC
Absorptive Capacity Acquisition (ACQ)	0.94	0.947	0.692	0.832						
Absorptive Capacity Assimilation (ASSIM)	0.925	0.94	0.723	0.825	0.85					
Absorptive Capacity Transformation (TRAN)	0.932	0.942	0.701	0.738	0.836	0.837				
Absorptive Capacity Exploitation (EXPL)	0.85	0.907	0.765	0.711	0.843	0.829	0.874			
Innovation process (PoklPr)	1	1	1	0.376	0.446	0.474	0.378	1		
Firm business performance (PosUsp)	0.843	0.926	0.862	0.66	0.719	0.73	0.716	0.612	0.928	
Absorptive Capacity (HOC)	0.974	0.944	0.611	0.902	0.961	0.941	0.896	0.459	0.76	0.782

Note. Diagonal elements present the square root of the AVE (in bold).

Table 3. Construct reliability and validity, discriminant validity

Insert table 3. about here

Items ACQ9, TRANSF5 and EXPL4 show loadings critically below 0.7 and they were excluded from further analysis. All of the indicators point towards the unidimensionalty and high internal consistency of the measurement scale. Cronbach's Alpha's levels for all latent constructs were above 0.7 (Kline, 2011). Composite reliability is achieved, setting values for each construct above 0.8 and below 0.95, which represents a satisfactory level according to Nunnally and Bernstein (1994). Finally, indicating the average variance extracted (AVE) above the recommended value of 0.5 for all constructs (Hair, Black, Babin, and Anderson, 2010), the convergence validity of each construct is confirmed. Correlations between each pair of latent constructs do not exceed the square root of each construct's AVE (Fornell and Larcker, 1981), confirming the model's discriminant validity. The only exception, while evaluating discriminant validity, can be seen between the second-order formative construct (HOC) and the latent constructs it comprises, however this was foreseen by Hair et al. (2017). This research does not present measures of model fit, since the PLS-SEM technique is focused more on prediction than on explanatory modelling; the overall fit measures are questionable, and

researchers are advised to avoid its use (Hair et al., 2017; Hair, Ringle, and Sarstedt, 2011; Henseler and Sarstedt, 2013).

Analysis of the structural model

Structural model analysis evaluates the statistical significance of structural coefficients presented in the PLS model. Structural coefficients correspond to β values in the Ordinary Least Squares regression (Henseler, Ringle, and Sinkovics, 2009), however the bootstrap method (5000 sub-samples; Hernández- Perlines et al., 2016) is used instead. To test Hypotheses 1 to 4, a sample of technology-focused R&D performing companies was used. The study confirms Hypothesis 1 in that there is a direct effect between ACAP and the firm's business performance. The direct effect is positive and is statistically significant (β=.761; t= 16.251; $p < .05$). Furthermore, this study confirms Hypothesis 2, indicating that ACAP has a direct effect on initiating innovation processes in research and technology development performing firms. This effect is positive and statistically significant (β=.459; t=3.16; $p < .05$). This study also confirms Hypothesis 3, demonstrating a direct effect between initiated innovation processes and business performances in research and technology development performing firms. The aforementioned effect is positive (β=.334) and statistically significant (t=3.205; $p < .05$). The results of the first three hypotheses present the basic criterion for the testing of Hypothesis 4, which investigated the mediating role of the initiation of innovation processes on the relationship between ACAP and firms' business performance. The results show that, with the inclusion of the variable regarding the initiation of an innovation process in the model, the strength of the direct relationship between ACAP and firms' business performance is still statistically significant (t=7.868) but has been reduced from β=.761 to β=.607. This result indicates that the variable of the initiation of an innovation process serves as mediator in the observed model. The indirect effect of ACAP on firms' business performance through the initiation of an innovation process is β=.153306 (t= 2.29954222; $p < .05$). The strength of the mediation effect (VAF) is 0.201637236 (20%), which corresponds to a partial mediation (Hair et al, 2017). The results of the testing of Hypotheses 1 to 4 can be found in Table 4.

Table 4

Effect of Absorptive Capacity on firms' business performance, direct and indirect effect

	Original Sample (O)	T Statistics (|O/STDEV|)	P Values
Direct effect			
Absorptive Capacity → Firm Business Performance	0.761	16.251	0
Indirect effect (after mediation)			
Absorptive Capacity → Firm Business Performance	0.607	7.868	0
Absorptive Capacity → Initiation of innovation process (a)	0.459	3.16	0.002
Innovation process → Firm Business Performance (b)	0.334	3.205	0.001
Absorptive Capacity → Innovation process → Firm Business Performance (axb)	0.153	2.299	0.01

Note. Results of Bootstrapping analysis; 5000 sub-samples

Table 4. Effect of Absorptive Capacity on Firm Business Performance, direct and indirect effect

Insert table 4. about here

Furthermore, analysis of the structural model also presents the R2 as a measure of model consistency. This measure indicates a relatively solid consistency according to Neter et al (1990) (Adjusted R2 Firm Business Performance=0.648; Adjusted R2 Initiation of innovation process=0.19).

In order to test Hypothesis 5, the effect of ACAP on firm business performance, in terms of the firm's level of export, tended to be focused on technology orientated firms (not only R&D performing) (n=103). The analysis distinguished three groups of exportation level (high, moderate, and low levels of exportation). Performance of this kind of analysis using a PLS modelling would require a PLS-MGA method. The PLS-MGA analysis examines the statistical significance of two comparable sub-samples' path coefficients (Hair et al., 2017). Thirty-four firms were high exporters. High exporters were those firms defined with net income in which export participation in income were > 65%; Fifty two firms were moderate exporters. Moderate exporters are those firms in which export participation in income was between 26 and 65%; Seventeen firms were defined as low exporters in which export participation in income were below 25% of net income).PLS-MGA is not recommended, even more it could result with invalid findings.

Table 5.

category (nr. samples)	*rACAP*	*pACAP*	*ACAPaq*	*ACAass*	*reACAP*	*ACAPtr*	*ACAPex*
all firms (103)	6,17	6,22	6,00	6,55	6,12	6,05	6,24
strong exporters (34)	6,34	6,38	6,23	6,62	6,28	6,21	6,43
moderate exporters (52)	6,32	6,45	6,18	6,85	6,16	6,15	6,17
weak exporters (17)	5,86	5,82	5,60	6,17	5,91	5,81	6,12

Table 2. ACAP values and results

Hypothesis 5 was tested using simple linear regression, and the results are presented in Table 6.

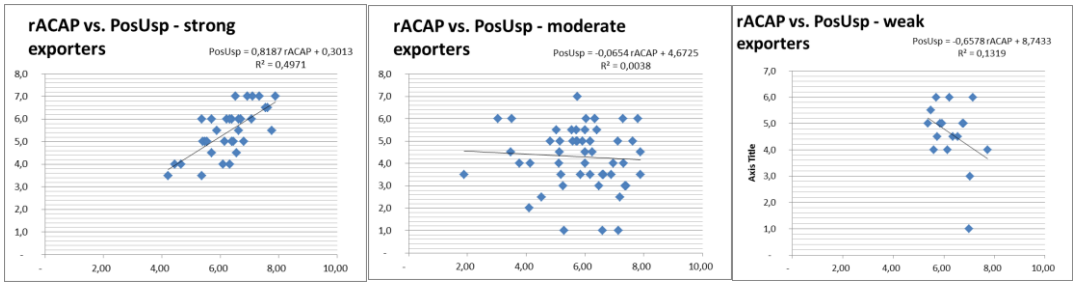
Table 6.

Table 6. H5 regression analysis results

Hypothesis 5	Regression formula	ρ	r2	p
Highly exporting firms	PosUsp = 0,8187 rACAP + 0,3013	0,705	0,4971	0,000
Moderate exporting firms	PosUsp = -0,0654 rACAP + 4,6725	-0,061	0,0038	0,6634
Non-exporting firms	PosUsp = -0,6578 rACAP + 8,7433	-0,363	0,1319	0,1518

Insert table 6. about here

Figure 4



Insert figure 4. about here

In the examination of the exporter population, one can observe a strong correlation between the ACAP level (rACAP) and business performance (PosUsp), ρ =0,705, with high significance expressed in the population sampling. The situation becomes complicated when the moderate exporters are considered, where there is no practical correlating bond (ρ = -0,061), also accompanied with a sudden drop of significance below the interpretation level. In the third stratum, the weak and non-exporters express the same significance issue but, when compared with moderate exporters, we observe a negative correlation (ρ = -0,363). Due to the lower significance level, the statistical results should not be interpreted; however one can observe that the scatter diagrams and the regression results indicate that the lower the amount of performed exporting activity, the lower the level of ACAP, or vice versa.

5. DISCUSSION

Croatian's are more capable of dealing with the identification and the internationalization of the idea, rather than transforming the idea into a viable innovative product or service. This reveals the chronic cultural lack of cooperative spirit amongst these firms, and their internal behaviour continues to operate in a closed-off manner. The results from Table 5 align themselves with the assertions of Limaj and Bernroider (2017) who postulated that balanced forms of organizational cultures had the propensity to moderate the impact of both potential and actual ACAP in simultaneously cultivating exploratory and exploitative innovations. Empirical survey data collected from 138 small to medium-sized enterprises was used to put forth an argument advocating a more nuanced understanding of the complementary roles of potential absorptive capacity (pACAP) and realized

absorptive capacity (rACAP). These roles facilitate both types of innovation and exemplify the extent to which cultural balance can be seen to impact these relationships. As previously discussed, the results of the testing of our hypotheses provide valuable insights into the ways in which innovations are affected and the conditions that enable these changes to be made. Potential ACAP has a positive effect on realized ACAP. This aligns itself with the key assumptions previously made regarding ACAP and its cumulativeness (Limaj and Bernroider (in press; Roper et al., 2008), particularly with regard to PACAP and rACAP (Zahra & George, 2002)

Croatian companies consider themselves to be organizations that have developed innovative potential, but are not able to employ it in an effective way in order to develop a new product or service. Furthermore, the results of the survey suggest that Croatian companies are aware of the fact that they must act innovatively. This is one of their most critical success factors for achieving a competitive advantage. However, they do not consider themselves to be exceptionally capable in terms of the practical application of existing or otherwise available knowledge/ideas that could be transformed into innovative products or services. They conduct a market and technological audit on a regular basis, observe development trends, and even, to some extent, possess necessary resources and knowledge for innovation. However, in the segment of transformation, a feeling or need to strengthen cooperation with organizations of institutional and non-institutional environments is not well developed.

R&D Performers

As a result of the testing of Hypothesis 1, it was determined that a higher level of ACAP could positively influence business performance in technology driven firms that regularly perform R&D activities, as suggested by Tzokas, Kim, Akbar, and Al-Dajani (2015), and Tu, Vonderembse, Ragu-Nathan, and Sharkey (2006). When testing Hypothesis 2, we determined that a higher level of ACAP had a positive impact on the number of initiated innovation processes in R&D performing Croatian firms. This corresponds to the findings of Lin, Su, and Higgins (2016), Liao, Wu, Hu, and Tsuei (2009), Forés and Camisón (2016), and also to Bahli, (2012) and Bahli, Borgman, and Heier (2013); although the latest of these examined a specific type of innovation, while this work does not differentiate between alternate forms. Finally, the testing of Hypothesis 3 demonstrated that the higher the frequency of the initiated innovation processes, the higher the business performance of R&D performing firms. This directly supports the contribution of Kalay and Lynn (2015) with regard to overall performance levels and, at the same time, confirms the findings of Kemp et al. (2013) and Artz et al. (2010), in which financial outputs were examined.

Lastly, the applied mediation analysis shows that there exists an effect of partial mediation of the number of innovative processes initiated as mediating variables in ACAP vs. business performance relationships. This

is understandable, and even welcomed, because a full mediation effect would indicate that the business success of the examined firm was based on the frequency of initiated innovation processes, which is unacceptable. On the other hand, a full exclusion of mediation would indicate that the frequency of initiated innovation processes is irrelevant to the business which, again, represents an unwanted and illogical outcome. To the authors' best knowledge, this relationship has not been tested in previous scholarly work, and it can thus be assumed that the findings deriving from the testing of Hypothesis 4 represent a specific and unique contribution of this paper.

Exporters vs. Non-Exporters

As previously mentioned, one of the primary motivations of this study is not to explore the principle of causality between the level of ACAP and the business performance, but rather to evaluate the level of ACAP in exporting firms. The results of the statistical analysis for the exporting categories have shown that the only relevant and usable data is those of strong (intense) exporters. This study has demonstrated that there is a strong relationship between the level of ACAP and the business performance of exporters. When examining Table 5, it is evident that the differentiation is particularly noted in the segment of potential ACAP (pACAP = 6,38), and even more precisely with the assimilation component (ACAPas = 6,62). However, in realized ACAP the differentiating value demonstrates the transformation component (ACAPtr = 6,43). This indicates the existence of developed skills that assist in assimilating external knowledge amongst exporters, and the possession of the exploitation skills required to compete in international markets. As a conclusion of this analysis, we might state that, for firms to become globally relevant and to compete in global export markets, they must possess developed knowledge and skills, particularly those pertaining to innovation and international business management. Such knowledge is related to the whole process of innovative performance in firms, from idea generation (caused by external or internal triggers), down-streaming the transformation of knowledge, and finally to the exploitation of the knowledge. This process is moderately developed with exporters in Croatia.

Unfortunately, the same conclusions cannot be drawn with moderate, weak, and not-at-all exporting firms. Our statistics have determined, although not fully interpretable, that the lower the export activity, the weaker the correlation between ACAP and a firm's business performances. This finding contributes to existing theory and complements the work of Harris and Li (2008).

Table 7.

Table: hypotheses testing results

Hypotheses	IV	DV	Type of relationships	Results
H1	(rACAP)	Firm Business Performance (PosUsp)	Positive: as ACAP factors increase, performance in research and technology development performing firms will increase	Supported
H2	(rACAP)	Initiation of innovation process (PoklPr)	Positive: as ACAP factors increase, the number of attempts to initiate innovation in research and technology development performing firms increases	Supported
H3	(Initiation of innovation process) (PoklPr)	Firm Business Performance (PosUsp)	Positive: as the number of attempts to initiate innovation increases, performance in research and technology development performing firms increases	Supported
H4	(rACAP) (PoklPr as mediation variable)	Firm Business Performance (PosUsp)	Positive: an increase in ACAP will initiate innovation processes which will increase performance in research and technology development firms	Supported
H5	rACAP	Firm Business Performance of highly exporting countries (PosUsp)	Positive: an increase in ACAP increases the performance of highly exporting technology focused firms, while the same effect is not supported in less or non-exporting firms.	Supported

6. CONCLUSION AND MANAGERIAL IMPLICATIONS

While the obtained results were within the expected boundaries of the measurement of ACAP and its components, they have produced a result with an absolute value. This is indicative of the fact that similar studies have not yet been performed in a transition country environment and, to our best knowledge, have not been conducted in Central and Eastern Europe (CEE). Nevertheless, the values produced through ACAP measurement are fundamental in facilitating an understanding of the relationship between various components of a firm's innovation performance, and may be used in future cross-comparisons or benchmarking research efforts.

The results produced in this paper have unveiled that the Croatian companies examined struggle with a number of problems in their innovation process performance.

One of the more obvious challenges is a lack of ability in identifying and implementing the new knowledge needed to trigger the activation of the innovation process. With this paper, we indicate that this major drawback is rooted in the cultural and social aspects of the Croatian business environment. On the other hand, through hypotheses testing, (although with different levels of correlation and significance), this research has determined and confirmed that the various interlinked relationships of ACAP and other processes exist in firms. From our results, it is reasonable to conclude that a Croatian firm's ACAP strongly correlates with their business performance or financial results, much more than with innovation returns. This finding is interesting because innovation does not necessarily produce positive performance results, especially since the innovation process is usually long-lasting, and the results come with a certain time delay. The strong link between ACAP and the business performance of exporting firms is demonstrated as well, however we were still unable to provide an answer as to whether or not is it the ACAP that drives the export or vice versa. A positive outcome of this study may be restricted by the fact that the examined population was a naturally knowledge and technology improvement oriented one.

Through examining innovation capacities, particularly from the ACAP perspective, a considerable scope opens up for its practical implementation in improving the current situation regarding both the firms and the institutional framework, which is obligated to foster national innovation policies.

Managerial Implications

There are several key managerial implications that can be derived from this research. Firstly, it is crucial for R&D organizations to increase internal managerial awareness of the importance of possessing elevated ACAP levels as a prerequisite for developing new products/services and, ultimately, to increase organizational performance. Management should also be aware of the ways in which different ACAP components are being developed and deployed within the organization. In accordance with the organization's profile and its offerings, it is important to identify which ACAP components are crucial for the success of the business and then strengthen them in order to elevate ACAP quality to a higher level. Equally, our results have demonstrated that ACAP is important to technology exporters. However, in this case it is necessary to investigate its genesis, and whether or not the results are only better for exporters because their managers have previously developed higher ACAP levels, or vice versa with a simultaneous process.

Lastly, managers need to be aware of the optimum frequency of initiating innovation processes. It has been demonstrated that a higher frequency of initiated processes moderates organizational performance, but the question for managers is: what is the optimal measure of initiated concurrent processes, in order to not produce the opposite effect and have output performance decline.

From an academic perspective, research on a topic of this volume represents a practical contribution and presents a gap for future ACAP research to investigate. This research should ideally be oriented towards the future operationalization of ACAP by using new or upgraded models, rather than purely theoretical research.

7. LIMITATIONS AND FUTURE STREAMS

As demonstrated in other pieces of research conducted in various parts of the world, the number of questionnaires distributed to firms in Croatia has grown steadily, limiting the availability of knowledgeable persons to fill them out. Although the final response of 103 fully completed questionnaires can be seen as a good result, the process was demanding as it took several rounds of reaching out and persuading the firms' representatives to fill them in and submit them in order to obtain this result.

Furthermore, one should be aware that no matter how much effort was spent on the process of making questions clear to a large population of subjects; it should be noted that respondents have different skills, different hierarchical positions in companies, and different cognitive abilities. Therefore, while we had to assume that they would understand and interpret the same questions in different ways, in the conducted empirical analysis their responses were treated and evaluated equally.

The empirical research results, derived from the operational part of this thesis, provide a solid methodological and knowledgeable ground for future research of ACAP in transition countries. Our results thus provide an opportunity for comparative research within a regional or broader international arena, particularly those in transition economies.

It is also possible to upgrade this empirical research for Croatian firms specifically by connecting ACAP to key economic-business interdisciplinary areas, such as strategic management, human resources management, management of finance, and others. The same is valid for trans-disciplinary fields, such as innovation management, systematic knowledge management in firms, and project management.

We would recommend that future researchers explore the resulting correlation between ACAP and exporters' performances or, better yet, attempt to answer the question of whether an exporter is successful because of a higher initial ACAP, or if ACAP is manifested throughout the risky and complicated process of exportation, or both.

In the end, a measured ACAP is demonstrative of the level of intensity and the structured efforts that organizations implement within firms, and this is subtly reflective of the influence on their business

performance. Nevertheless, it is increasingly evident that firms must innovate in order to maintain their competitive edge.

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Appendices

APPENDIX 1. – VARIABLE DEFINITIONS

Var.	Measured	Var. description
ACAPaq	Likert scale 1-8, 9 questions	ACAP -> PACAP -> determined level of **acquisition** component, arithmetic median in range from 1-8.
ACAPas	Likert scale 1-8, 6 questions	ACAP -> PACAP -> determined level of **assimilation** component, arithmetic median in range from 1-8.
ACAPtr	Likert scale 1-8, 8 questions	ACAP -> RACAP -> determined level of **transformation** component, arithmetic median in range from 1-8.
ACAPex	Likert scale 1-8, 4 questions	ACAP -> RACAP -> determined level of **exploitation** component, arithmetic median in range from 1-8.
pACAP	Likert scale 1-8, result from 15 questions	ACAP -> determined level of **potential ACAP** component, **ACAPaq** + **ACAPas**,
raACAP	Likert scale 1-8, result from 12 questions	ACAP -> determined level of **realized ACAP** component, **ACAPtr** + **ACAPex**.
rACAP	Likert scale 1-8, result from all 27 ACAP related questions	determined level of **ACAP** in firms, **pACAP + raACAP**.
PokIPr	Pondered: 0=0, 1=1, from 2 - 4 =2, from 5 to 10 =3 and >10=4	Number of initiated innovation processes; numeric variable from 0-4; determined through time span of 5 years.
Yprih	pondered: strongly decreasing=1, ... remain the same=4, ... strongly increasing=7	Total revenues trend in 5 years; Numerical value from 0-7.
Ydobit	pondered: strongly decreasing=1, ... remain the same=4, ... strongly increasing=7	Net profits trend in 5 years; Numerical value from 0-7.
PosUsp	composite of **Yprih** + **Ydobit**	Business performance; arithmetic median of as composite **Yprih** + **Ydobit**.

APPENDIX 2. – The Survey Questions and Variable Definitions

PACAP: AQUISITION, ASSIMILATION *RACAP: TRANSFORMATION, EXPLOITATION*

		1 = Strongly disagree; 8 = Strongly agree
1	*We frequently scan the environment for new technologies.*	1 – 2 – 3 – 4 – 5 – 6 – 7 – 8
2	*We thoroughly observe technological trends.*	1 – 2 – 3 – 4 – 5 – 6 – 7 – 8
3	*We observe in detail external sources of new technologies.*	1 – 2 – 3 – 4 – 5 – 6 – 7 – 8
4	*We thoroughly collect information from industry.*	1 – 2 – 3 – 4 – 5 – 6 – 7 – 8
5	*We have information on the state-of-the-art of external environment.*	1 – 2 – 3 – 4 – 5 – 6 – 7 – 8
6	*We frequently acquire technologies from external sources.*	1 – 2 – 3 – 4 – 5 – 6 – 7 – 8
7	*We periodically organize focused meetings with external partners to acquire new technologies.*	1 – 2 – 3 – 4 – 5 – 6 – 7 – 8
8	*Employees regularly approach external institutions to acquire technological knowledge*	1 – 2 – 3 – 4 – 5 – 6 – 7 – 8
9	*In support of new technology acquisition, we approach external networks and/or associations (clusters, chambers, associations, consortia, ...)*	1 – 2 – 3 – 4 – 5 – 6 – 7 – 8
10	*We often transfer technological knowledge to our firm in response to technology acquisition opportunities.*	1 – 2 – 3 – 4 – 5 – 6 – 7 – 8
11	*We thoroughly maintain relevant knowledge over time.*	1 – 2 – 3 – 4 – 5 – 6 – 7 – 8
12	*Employees store technological knowledge for future reference.*	1 – 2 – 3 – 4 – 5 – 6 – 7 – 8
13	*We communicate relevant knowledge across the units of our firm.*	1 – 2 – 3 – 4 – 5 – 6 – 7 – 8
14	*We regularly match new technologies with ideas for new products.*	1 – 2 – 3 – 4 – 5 – 6 – 7 – 8
15	*We quickly recognize the usefulness of new technological knowledge for existing knowledge.*	1 – 2 – 3 – 4 – 5 – 6 – 7 – 8
16	*Knowledge management is functioning well in our company.*	1 – 2 – 3 – 4 – 5 – 6 – 7 – 8
17	*When recognizing a business opportunity, we can quickly rely on our existing knowledge.*	1 – 2 – 3 – 4 – 5 – 6 – 7 – 8
18	*We are proficient in reactivating existing knowledge for new uses.*	1 – 2 – 3 – 4 – 5 – 6 – 7 – 8
19	*We quickly analyse and interpret changing market demands for our technologies.*	1 – 2 – 3 – 4 – 5 – 6 – 7 – 8
20	*In support of new technology implementation and transformation into new products or services, we approach external networks and/or associations (clusters, chambers, associations, consortia, ...).*	1 – 2 – 3 – 4 – 5 – 6 – 7 – 8
21	*We are proficient in transforming technological knowledge into new products.*	1 – 2 – 3 – 4 – 5 – 6 – 7 – 8
22	*Our employees are capable of sharing their expertise to develop new products.*	1 – 2 – 3 – 4 – 5 – 6 – 7 – 8
23	*We regularly apply technologies in new products.*	1 – 2 – 3 – 4 – 5 – 6 – 7 – 8
24	*New opportunities to serve our customers with existing technologies are quickly understood.*	1 – 2 – 3 – 4 – 5 – 6 – 7 – 8
25	*We constantly consider how to better exploit technologies.*	1 – 2 – 3 – 4 – 5 – 6 – 7 – 8
26	*We easily implement technologies in new products.*	1 – 2 – 3 – 4 – 5 – 6 – 7 – 8
27	*It is well known who can best exploit new technologies inside our firm.*	1 – 2 – 3 – 4 – 5 – 6 – 7 – 8