

Reconsidering measurement of absorptive capacity in the case of knowledge transfer from Nordic to the Baltic countries

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Abstract

Knowledge transfer and benefits from spillover are one of the most desirable expectations from FDI and/or collaborations between domestic and foreign capital companies. However, the company may gain knowledge from collaboration if it has abilities properly to use knowledge or technologies that are accessible. The goal of the article is to provide a measurement tool for absorptive capacity. The study focuses on the collaboration between Nordic and Baltic countries. Thus, the targeting companies for research have been chosen as either Nordic capital companies operating in Lithuania and Estonia or domestic companies with an international relationship with Nordic capital companies. The article contributes to the theory of absorptive capacity and to the theory of internalization as well. The construct has been validated, and reliability has been estimated while testing 158 companies. The proposed measurement construct can be instrumental for further research of knowledge transfer from international collaborating companies of different capital origins for the mining industry sector since raw materials industries encounter new performance challenges in the context of the war in Ukraine, which caused a severe energy crisis.

Keywords

absorptive capacity, potential capacity, realized capacity, Nordic countries, Baltic countries, sectors of economy, manufacturing; raw materials industries; mining industry



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1. Introduction

Knowledge and knowledge assimilation are vital elements for developing innovations in a company. Even the scope of scientific research on innovation and knowledge transfer is constantly increasing, demonstrating the topic's significance. Knowledge or technology transfer is an interdisciplinary subject which is integrated into other fields of study, such as economics (Wu et al., 2016; Feriyanto et al., 2019; Vartanova et al., 2021), management (Wichitsathian, Nakruang, 2019; Martinez-Sanchez et al., 2020; Woniak & Wereda, 2020; Laužikas & Miliūtė, 2020; Hurmelinna-Laukkanen et al., 2021), psychology (Esau & Tengeh, 2022), engineering (Laužikas et al. 2021), environmental studies (Solnørdal, & Thyholdt, 2019; Antonioli et al., 2021; Maálej, 2022), innovation in agriculture (Moraless & Moreno, 2020), computer science (Duan et al., 2021) and artificial intelligence, and more others.

However, the vast volume of information, data and various sources of knowledge transfer do not guarantee successful knowledge assimilation resulting in innovation. Thus, the scientific studies raise questions (Limaj & Bernroider, 2019; Yuan & Li, 2021; Naqshbandi & Jasimmudin, 2022) and focus on the reasons why some companies are innovators, the others are imitators or even have no ability to recognize valuable external information, to adopt it and to assimilate. Modern companies operating in a changing environment face constant improvements in technologies and incompatible knowledge of firms. At the same time, companies with different abilities to learn to interfere with the problem of the "capability trap" and innovator dilemma (Duan et al. 2021). Knowledge very often transfers via foreign direct investment as a spillover of know-how (Sanchez-Sellero et al. 2014; Moraless & Moreno, 2020; Mehmood et al., 2021). However, even attracting FDI does not assure a great scale of assimilation of transferred knowledge or a high number of patents in the country. Burinskas et al. (2021) notice that although the Baltic States stimulate to attract FDI and even promote FDI in R&D, however, all three Baltic States are only modest innovators in the general context of the European Union. At the same time, approximately 20% of total FDI (2013-2019) in the Baltic States are from the Nordic countries that are among the innovation leaders in the EU. The Lithuanian companies have the lowest number of patents compared to the neighbouring countries. However, the most controversial fact is that the export of IT and high-tech sectors in the Baltic States is similar to the Nordic countries. Thus, the question arises of what factors determine the number of patents as the result of knowledge transfer and knowledge assimilation. The similarity of IT and high-tech sector exports show that the Baltic States are imitators rather than innovators. Once again, a low number of patents might be the result of attracting FDI in low-tech rather than high-tech. On the other hand, Duan et al. (2021) observe a phenomenon in China as it has a great number of patents every year and it has attracted a large volume of FDI; however, it still lacks core technologies in manufacturing such as semiconductors, pharmaceutical, electronics, frontier equipment and others (Yuan & Li, 2021). China imports high-tech products from the small EU country Lithuania whose number of patents is one of the lowest in the EU. Does it mean that Chinese firms are more focused on quantity rather than quality while pursuing innovations, or do Lithuanian firms lack the ability to pursue innovations? After all, the quality of innovations is based on innovations performance in processes, optimization, production, efficiency, output, on economic and even social benefits. Thus, low quality of innovations leads to low economic and social performance or even a lack of innovations. Companies may benefit and earn a competitive advantage in their field only from high-quality innovations. However, improvement of technology or development of innovation is highly linked to the ability of a company to recognize the opportunity for innovation, search for applicable knowledge and new technologies to innovate and increase competitive advantage. Thus, one of the critical factors for the successful development of innovation is the absorptive capacity. Companies gaining new knowledge from external sources might develop innovations through a series of internal processes, that absorptive capacity becomes a vital determinant. Scientific studies (Jimerez-Barrionuevo et al., 2011) imply that absorptive capacity serves for learning from technological advancements and innovation from outside an organization. In addition, entrepreneurial absorptive capacity is even more important than new knowledge spillovers for start-ups since it empowers entrepreneurs to recognize value knowledge, assimilate, absorb and commercialize it by creating a company (Qian & Acs, 2013). Therefore, absorptive capacity and commercialization impact the financial results of a company. Thus, absorptive capacity transforms into a resource as it might generate gain or loss in the case of unsuccessful commercialization or lack of innovation. Monteiro et al. (2019) refer to intangible resources as the capabilities of a company. Capabilities are linked to a company's ability to adapt to changes, perform various tasks, influence entrepreneurial orientation and technological intensity and application of newly acquired knowledge that might impact competitive advantage and implementation of strategic goals (Ferreira & Fernandes, 2017; Khan et al., 2019). Since absorptive capacity is based on staff skills, knowledge and experience, the company's abilities and reputation, additionally, it accelerates the assimilation of knowledge and learning and, as a result, stimulates innovation. Thus, according to the resource-based view, absorptive capacity is also recognized as a company's intangible resource. Meanwhile, most companies face difficulties in measuring intangible resources, especially when it comes to the absorptive capacity question. Such problems occur due to a variety of factors, multidimensionality and diverse understanding of intangible resources, leading to difficulties in conceptualizing. However, measuring absorptive capacity is highly significant for a company as it may identify its own weaknesses

in assimilating, absorbing, and transforming knowledge; which ability to exploit it would lead to an understanding of new needs of a company, adoption to change, developing ideas for new product and finally the increase in competitiveness in the market. Furthermore, recognition and a better understanding of weak points in a company may have an effect even on decision-making in developing or improving a company's strategy. On a tactical level, the results of measuring absorptive capacity may unveil the necessity to hire new staff or improve the skills of existing ones.

The article focuses on the problems that company faces while developing innovations. Especially emphasis is put on the measurement of the absorptive ability of a company and factors determining successful knowledge assimilation that results in the development of innovations. The goal of the study is to provide a measurement tool for absorptive capacity.

The article, for methodological purposes, is divided into three parts. The first part provides theoretical concepts on absorptive capacity and implies developing the construct for the research. The second part describes the methodology applied, data collection and sample composition. The third part discusses the empirical results of the research.

2. Theoretical conceptualization

Innovation literature suggests that a company's ability to innovate highly depends on knowledge absorption capabilities (Solnørđal & Thyholdt, 2019). Companies obtain knowledge and technologies from various external and internal channels. First of all, it is following analyzing external secondary data from the market. Such information collection and systemization, absorption and transformation require the highest level of competence of the human resources. In well-developed host countries, foreign subsidiaries can access, employ, or collaborate with high-qualified and experienced experts in the field, such as scientists, engineers, designers, etc. (Sánchez-Sellero et al., 2015), which stimulates company innovation performance. Thus, the most talented staff usually is employed by the largest international corporations and/or companies – innovators. Even more, knowledge acquired and assimilated from foreign locations improves the recipient's existing background of knowledge and reinforces its innovation performance (Agusti et al., 2022). However, the other category of companies, as imitators, usually follow innovators or try to acquire knowledge or technologies from them. Absorptive capacity driven by foreign direct investment causes technical progress. Various studies suggest that absorptive capacity is a multidimensional construct (Cohen & Levinthal, 1990; Lane & Lubatkin, 1998; Zahra & George, 2002; Lane et al., 2006; Arbussa & Coender, 2007; Todorova & Durisin, 2007; Martinez-Sanchez et al., 2020; Duan et al., 2021; Hurmelinna-Laukkanen et al., 2021; Agusti et al., 2022; Cuevas-Vargas et al., 2022; Naqshbandi & Jasimmudin, 2022) which contains a non-identical number of dimensions and content. However, there is no general point of view among the researchers in the context of absorptive capacity stages and the construct. The theory of absorptive capacity has been expanded by Cohen & Levinthal (1990). Since then, the concept of absorptive capacity has become the backbone of the theories of innovations. However, the first time the construct of absorptive capacity was developed in the early nineties. Kedia and Bhagat (1988) apply "absorptive capacity" on the macro level in the context of knowledge transfer from a more advanced economy to the emerging one. Absorptive capacity, as the classical understanding, is defined as the ability of the company to 'recognize the value of new, external information, assimilate it and apply it to the commercial ends' (Cohen & Levinthal, 1990). The ability to notice, recognize, and absorb new information is actually based on previously obtained knowledge and experience in how to absorb and assimilate knowledge and even commercialize it. In addition, the absorptive ability is understood as the joint abilities of all companies (Cohen and Levinthal, 1990). Thus, it might be referred to as a company's collective learning skills. Higher-educated employees absorb and assimilate knowledge better (Solnørđal & Thyholdt, 2019) compared to low-qualified staff members as they have gained the experience to acquire, assimilate and transform information during their studies and learning process. An experience of recognizing knowledge, absorbing and assimilating it even may stimulate and improve the internal learning process (Zahra & George, 2002). Cohen and Levinthal (1990) emphasize individual and firm levels while determining three capabilities: recognize the value, assimilate information and commercialize it. Thus, a company's absorptive capacity would depend on the absorptive capacity of all employees in a company. Later studies (Lane & Lubatkin, 1998) define absorptive ability similarly and uses the same construct to confirm it or has just slightly expanded the definition of absorptive capacity and limited the construct to two dimensions (Arbussa & Coender, 2007; Escribano et al. 2009; Hurmelinna-Laukkanen et al., 2021). The first one refers to the evaluation, acquisition and assimilation of information, while the second involves internal dissemination and application (Camison & Fores, 2010). The other study (Matusik & Heeley, 2005) creates a three-level model of absorptive capacity, which includes individual, intra-organizational and organizational levels focusing on two dimensions: access to the external knowledge and assimilation of external knowledge. However, these studies have not involved the possible fourth level as knowledge transfer from one country to another one. In general, absorptive capacity has become a part of organizational transfer theory (Šimelyte et al., 2021), which involves channels of technology and knowledge transfer such as networks, hubs, and FDI spill-overs. This concept is widely used in the fields of economics and

management. Absorptive capacity is an important factor for the innovativeness and competitiveness of a company as well. The most cited article analyzing the theory of absorptive capacity by Zahra and George (2002) reconceptualizes and expands the definition of absorptive capacity and combines construct to a set of organizational routines and strategic processes while creating dynamic organizational capability. This study reformulates the three-dimensional model (Cohen & Levintal, 1990) while introducing four capacities into the definition that characterizes four dimensions of absorptive capacity. At the same time, it integrates both natural and gained absorptive capacity while evolving dynamic organizational capability (Camison & Fores, 2010). Even more, these four dimensions are grouped into potential and realized absorptive capacity. According to Zahra and George (2002), potential and realized absorptive capacity perform different processes. Potential capacity facilitates the employment of necessary skills and knowledge while identifying environmental changes and contributes to renewing existing skills and knowledge. The other study proves that potential capacity stimulates the company's competitiveness while realized capacity drives the innovation development process and increases strategic flexibility (Miroshnychenko et al., 2021). Potential absorptive capacity is especially high in companies with strong intellectual capital or those continuously investing in intellectual capital. In addition, it has been proved that realized absorptive capacity fully mediates the direction of potential absorptive capacity to innovation (Limaj & Bernroider, 2019). A high level of potential absorptive capacity, existing experience and knowledge may even stimulate the desire to acquire new knowledge, assimilate it and transform. Further studies (Lane et al., 2006; Todorova and Durisin, 2007) argue that knowledge assimilation and knowledge transformation are divergent processes while developing innovation. Additionally, the question arises whether the transformation capacity is not part of the assimilation process but a relatively separate and independent alternative process. Researchers agree (Cuevas-Vargas et al., 2021) that in order to develop innovations or at least to improve existing processes, services or products, a company must obtain knowledge on how to notice valuable external information, scan and recognize applicable external knowledge that the company would expand knowledge assets (Hurmelinna-Laukkanen et al., 2021) and would either increase or develop the new competitive advantage of the company. Further, the acquired knowledge is supposed to be employed to the company's benefit. Otherwise, the knowledge would be wasted. Thus, according to Lane et al. (2006), the construct of absorptive capacity, a company's ability, is based on three processes. The first is recognition and understanding of new potentially valuable external knowledge through exploratory learning. Second is the assimilation of valuable external knowledge through transformative learning, and third is the use of assimilated knowledge in developing new knowledge and commercial outputs through exploitative learning. However, the growing company expands its organizational structure and bureaucracy increases. Thus, its flexibility declines, negatively affecting its absorptive capacity and ability to learn from new external knowledge (Wu & Voss, 2015). Additionally, the recognition of external knowledge and knowledge transformation capacities depend on the company's business sector. Furthermore, a company successfully recognizes, assimilates and transforms external knowledge to commercial ends if external knowledge fits the company's cognitive schemas (Camison & Fores, 2010), which are based on previous experience to innovate. Otherwise, if existing internal knowledge and previous experience do not fit, the external knowledge is transformed in a more appropriate way for further exploitation. For example, integrated ICT systems enhance absorptive capacity and open innovations (Cuevas-Vargas et al., 2022). Thus, to adapt knowledge and turn it into commercialized output, the individual cognitive structures should be modified (Todorova & Durisin, 2007; Camison & Fores, 2010; Agusti et al., 2022). Following Zahra and George (2002), the transformation of knowledge and assimilation is based on two separate capabilities of an organization: potential absorptive capacity and realized absorptive capacity. It has been noted (Cuevas-Vargas et al., 2022; Naqshbandi & Jasimmudin, 2022) that potential capacity is greater and more significant for creating innovation in companies with distinct organizational guidelines for developing intellectual capital: like job rotation and involvement in decision-making. Even more, organizational guidelines, including socialization, promote potential absorptive capacity that positively and directly affects the emergence of intellectual capital. Additionally, training and hiring external R&D might improve potential absorptive capacity. Martinez-Sanchez et al. (2020) prove that temporary employment does not mediate the relationship between absorptive capacity and the progress of R&D in a company. Thus, it might be stated that potential absorptive capacity is highly influenced, promoting flexibility (as job rotation), socialization and training in a company (Marinez-Sanchez et al., 2020; Cuevas-Vargas et al., 2022; Naqshbandi & Jasimmudin, 2022). Successful absorption, assimilation, exploration and commercialization of external knowledge that turns into innovations may develop or increase the company's competitive advantage. However, the company may fail to assimilate knowledge as it does not manage to exploit its potential absorptive capacity. Thus, the quality of exploitation of external knowledge shows realized absorptive capacity. Consequently, potential and realized absorptive capacity might differ. The study of Wang et al. (2020) modifies the construct proposed by Lane et al. (2006) and focuses on three dimensions as well, which are based on a company's ability to learn and include exploratory learning, transformative learning and exploitative learning. Exploratory learning helps to recognize valuable information from the external environment that might be transformed into novelty. Further, based on previous experience, obtained previous knowledge through transformative learning company assimilate information. Finally, the company commercializes assimilated knowledge through exploitative learning. In other

words, realized absorptive capacity empowers the company to innovate and create added value from acquired knowledge (see Tab. 1).

Tab. 1. Dimensions and Antecedents of Absorptive Capacity

Author	1st dimension	2nd dimension	3rd dimension	4th dimension
Cohen & Levinthal (1990)	Recognize value	Assimilate	Commercialize	
Lane & Lubatkin (1998)	Recognize value	Assimilate	Commercialize	
Lane et al. (2006), Wang et al (2020)	Recognize Exploratory learning	Assimilate Transformative learning	Commercialize Exploitative learning	
Zahra & George (2002), Santos et al. (2021), Miroshnychenko et al. (2021)	Potential		Realized	
	Acquire	Assimilate	Transform	Exploit
Matusik & Heeley (2005)	Access to external knowledge	Assimilate external knowledge		
Todorova & Durisin (2007)	Recognize	Acquire	Assimilate or transform	Exploit
Camison & Fores (2010)	Recognize	Assimilate	Transform	Commercialize
Naqshbandi & Jasimmudin (2022)	Absorb	Assimilate	Explore	Commercialize

Source: composed by the authors based on Jimenez-Barrionuevo et al., 2011

The other factors, such as the company's age, size, industry, management style or internalization, are considered moderating or mediating factors of absorptive capacity (Micheels & Nolan, 2016; Wu & Vos, 2015; Sánchez-Sellero et al., 2013). However, there is no general point of view regarding how a company's age, size or management style are related to the absorptive capacity (Miroshnychenko et al. 2021). Especially, strengthening absorptive capacity might be complicated for small companies (Micheels & Nolan, 2016) as these companies cannot hire a highly qualified labour force as it usually requires more financial funding. In addition, small companies have limited access to external knowledge or training from external R&D experts (Martinez-Sanchez et al., 2020). Hence, young companies are more flexible as they do not have bureaucratic organizational structure and documentation that enable faster to absorb and assimilate new knowledge and information. The flexibility empowers young companies to use their existing scarce resources more efficiently to gain their absorptive capacity (Zou et al., 2018). Thus, young and small companies may build up absorptive capacity in a shorter time. Although, small companies are characterized as more flexible. However, small or medium size companies run by family members have a lower ability to absorb spillovers from FDI (Sánchez-Sellero et al., 2014). Furthermore, potential and realized absorptive have a more significant effect on organizational outcomes if a company is involved in external large extensive branch networks. If a company enters the international market in the early stage of its development, then international performance might be much more affected by absorptive capacity (Tang and Zhang, 2016). Due to developed good reputations and clear organizational guidelines, organizational values, traditions and policies, mature companies are more likely to access external knowledge and participate in international networks (Zahra & George, 2002; Minbaeva et al., 2018). Thus, the question arises whether, joining external international networks, a company's absorptive capacity might be more influenced by social and cultural settings rather than organizational guidelines, processes or capabilities (Bouguerra et al., 2022). In addition, large and mature companies might be less willing to commercialize innovations due to the "innovators dilemma" (Wang et al., 2020), as the implementation of novel ideas might be unsuccessful and decrease revenues and profitability or even it would negative reflect on the image of the company and its stock value. However, large companies have already developed more complex processes and have experience in developing innovations. Thus, they would better absorb spillovers from FDI as companies implementing FDI have more complex and innovative production systems than smaller and younger ones, which assist them in absorbing knowledge better from similar complex and innovative foreign capital companies. In addition, reverse knowledge transfer from the host to the home country depends on the entry mode of the foreign capital company. Companies with high absorptive capacity can transform, apply acquired knowledge and produce innovations themselves. After engaging in international networks, companies learn about internalization and stimulate their absorptive capacity to acquire, assimilate, and utilize external knowledge provided by foreign partners. Thus, absorptive capacity positively impacts gaining knowledge even due to internalization.

From the available scientific literature, it was found that there are no research studies focused on the management of international trade in the mining industry, which represents a large research gap, and this was also the motivation for the realization of the study. For this reason, research was carried out with a focus on sector differentiation in the first phase. The study results will support the implementation of subsequent research with an emphasis on the mining industry, as the raw material policy is one of the priority areas of European countries. The study also appeals to the necessity of an examination of the structural changes in the economies related to the energy crisis and the war in Ukraine and exploring the effects of the structural changes associated with the use of alternative sources of raw materials and energy.

3. Material and Methods

3.1. Research construct and factors definition

In order to estimate the potential and realized absorptive capacity, the construct has been adopted following Zahra and George (2002), Lane et al. (2006), Jimenez-Barrionuevo et al. (2011), Flor et al. (2018). Lane et al. (2006) define absorptive capacity in three dimensions, emphasizing that the construct of the research depends on the magnitude of the understanding of original theoretical concepts. They define four categories of criteria to develop the construct. The first one defines the company's capability. The second one characterizes the company's knowledge background or existing previous experience in developing innovations. The third includes both of the previous ones. The fourth type of construction does not characterize the non-of-above mentioned. However, scientific literature provides a vast number of studies dedicated to absorptive capacity, which increased over the years. Still, there is ambiguity and a lack of general consensus regarding the construct and scale of the research. For example, Flor et al. (2018) notice that some earlier researchers (Cohen & Levintal, 1990; George et al., 2001; Tsai, 2001, Zahra & George, 2002) analyze absorptive capacity as unidimensional while the other more recent studies (Solnørdal & Thyholdt, 2019; Ritter-Hayashi et al. 2021; Miroshnychenko et al., 2021) focus on the multidimensional concept. Created internal knowledge is usually measured by R&D activities in a company or as a result of the number of patents developed by a company (Solnørdal & Thyholdt, 2019), which is considered the determinant of absorptive capability. Thus, unidimensional studies suggest the commercialization of R&D produced in a company or related to the investment into R&D (Sánchez-Sellero et al., 2013). This includes the growth of sales from R&D (Lau & Lo, 2015), expenses on R&D (Rothaermel & Alexandre, 2009; Fores & Camison, 2011; Sánchez-Sellero et al., 2013; Knockaert et al., 2014), ratio and number of employees with graduate degree (Hervas-Oliver et al., 2011), R&D intensity (Zahra & George, 2002; Sánchez-Sellero et al. 2013; Duan et al. 2021), R&D and non-R&D activities (Hervas-Oliver et al., 2011), the number of patents (George et al. 2001; Nooteboom et al., 2007), expenses on training for R&D personnel (Hervas-Oliver et al., 2011; Fores & Camison, 2011), innovation rate (Lau & Lo, 2015) (Tab. 2). However, it does not always represent the real situation in a company. Jimenez-Barrionuevo et al. (2011) claim that problems with conceptualization occur when it involves intangible assets and differences in defining dimensions of absorptive capacity. Thus, recent studies (Ritter-Hayashi et al., 2021; Santos et al., 2021) involve more multidimensional factors and use a second-order construct. Potential absorptive capacity includes the acquisition and assimilation of information, while realized absorptive capacity covers transformation and exploitation (see Tab. 2).

Tab. 2. Factors used to measure absorptive capacity

Author	Factors used
Cohen & Levintal (1990) George et al. (2001)	R&D effort (ratio between R&D expenditure and annual sales) Ability to acquire knowledge (expenditure on R&D); ability to apply knowledge (the number of patents)
Tsai (2001); Lane et al. (2001) Zahra & George (2002)	R&D effort (ratio between R&D expenditure and annual sales) Potential and realized absorptive capacity based on 4 (acquisition, assimilation, transformation, and exploitation) factor model
George et al. (2001); Nooteboom et al. (2007) Fores & Camison (2011) Jimenez-Barrionuevo et al. (2011)	The number of patents Expenses on R&D, expenses on training for R&D personnel, Scale of 18 items measuring potential (acquisition (5 items), assimilation (5 items), realized (transformation (6 items), exploitation (2 items))
Lau & Lo (2015) Flor et al. (2018).	Growth of sales from R&D 7 points scale agree or disagree. Scale of 10 items measuring potential (4 items) and realized (6 items) absorptive capacity.
Ritter-Hayashi et al. (2021)	Scale of 18 items measuring 4 absorptive capacity processes (knowledge acquisition (2 items), knowledge assimilation (3 items), knowledge transformation (2 items), knowledge exploitation (3 items))
Santos et al. (2021)	Scale of 17 items measuring potential (acquisition (3 items), assimilation (6 items)), and realized (transformation (5 items), exploitation (3 items)) absorptive capacity.
Miroshnychenko et al. (2021)	Scale of 13 items to measure potential (knowledge acquisition (2 items) and knowledge assimilation (4 items)) and realized absorptive capacity (knowledge exploitation 7 items)
Cuevas-Vargas et al. (2022)	Scale of 15 items to measure 4 processes of absorptive capacity which includes acquisition (3 items), assimilation (4 items), transformation (4 items), exploitation (3 items)

Source: composed by the authors

Knowledge acquisition denotes the company's ability to recognize and collect information that would be crucial for business and, as a result, generate novelty or innovation. Intensity, speed and direction are three main factors that influence a company's absorptive capacity in the knowledge acquisition process (Zahra & George, 2002). Intensity and speed unveil the company's effort to identify and gather information which, in addition, may determine the quality of absorptive capacity. The greater effort allows the company to develop obligatory skills

for a high level of absorptive capacity. The acquisition process of knowledge includes establishing networks with suppliers and customers (dos Santos et al., 2021; Lau & Lo, 2015), networking and collaborating with research centres and other scientific institutions (Ritter-Hayashi et al., 2021), searching for relevant information (Cuevas-Vargas et al. 2022; Miroshnychenko et al. 2021) management motivation to search for information, (Cuevas-Vargas et al. 2022; Miroshnychenko et al. 2021). Lau and Lo (2015) as the source for new knowledge, information and ideas include frequent visits to headquarters and even formal and informal (as lunch) visits with industry friends. However, based on their study, the last factor was insignificant while analyzing manufacturers from electronic, electrical appliance, toy, machinery and watch and clock industries. Jimenez-Barrionuevo et al. (2011) define knowledge acquisition as involving 5 (close personal interaction, trust, respect, friendship and reciprocity) factors representing collaboration with partnering companies which were significant in Spanish chemical and automotive industries. Thus, it might be summarized that knowledge acquisition depends on various types of external sources of collaboration among partners, clients, suppliers, network partners, and internal collaboration among employees and management that serves to intensify of recognizing information and gathering information in favour of the company's needs and activities.

Knowledge assimilation might be defined as a company's processes routines required to analyze, systemize, interpret, understand, and generalize gathered information. Generalizing external information might be difficult for the company if it falls beyond its search zone. Thus, this information has to be overlooked before comprehending it (Zahra & George, 2002). In order to successfully generalize obtained knowledge, the assimilation process usually covers sharing ideas and information cross-departments (Cuevas-Vargas et al., 2022; Miroshnychenko et al., 2021), the common language between two collaborating organizations or network members, complementarity and similarity in resources and capabilities between two collaborating companies, compatibility in organizational culture and management style (Jimenez-Barrionuevo et al., 2011), ability quickly analyze and interpret changes in demand and new opportunities serve to company's clients (Lau & Lo, 2015; Santos et al. 2021), quick information flow and clear responsibilities within departments and periodical meetings (Miroshnychenko et al. 2021; Ritter-Hayashi et al. 2021), recognizing shifts in the market and technologies and sufficient skills to plan with advisors about how changing demand in the market might be used in favour of business (Santos et al. 2021). Additionally, Ritter-Hayashi et al. (2021) introduce successfully acquired knowledge in order to understand trading partners' needs. Generalizing, knowledge assimilation refers to a company's ability successfully analyze and employ acquired knowledge to satisfy clients and partners and to adapt it to market changes while using the company's resources and processes and exploiting its capabilities and similarities with collaborating partners or partners in the network.

Knowledge transformation refers to a company's capabilities to create routines and processes within the organization that would successfully combine the newly acquired knowledge and existing knowledge, experience and skills. Thus, the company demonstrates the ability to identify two self-unique incompatible sets of information and then combine them into a new scheme, representing the transformation process (Zahra & George, 2002). Based on the definition of knowledge transformation, researchers in the construct include meetings in the departments (Jimenez-Barrionuevo et al., 2011; Santos et al., 2021) that involve department discussions on new market demands and products (Lau & Lo, 2015), documents published by a different department to share information, transmitting information regularly and on time the ability to assure the flow of information (Jimenez-Barrionuevo et al., 2011; Flow et al., 2018). Furthermore, knowledge transformation refers to the abilities of the employees (Micheels & Nolan, 2016) to structure collected information, prepare it for further purposes to use, provide new insights, and successfully adopt new information in their daily work (Santos et al., 2021; Cuevas-Vargas et al., 2022). Concluding, knowledge transformation describes the process of a successful combination of new knowledge that involves the number of required factors in a company, starting from a clear organizational structure and system to shared information and ensuring the flow of required information on time to improved capabilities of employees to improve their daily work.

Knowledge exploitation is related company's ability to integrate acquired and transformed knowledge in its operations. Even more, successfully exploiting acquired knowledge creates new knowledge (Zahra & George, 2002). Thus, scientists in the construct include the application of transformed knowledge on new business applications (Flor et al., 2018), creating prototypes (Miroshnychenko et al., 2021), commercialization of new products and services, increasing sales of new products in existing markets and new ones (Flor et al., 2018; Ritter-Hayashi et al., 2021; Santos et al. 2021). In addition, the company adopting new knowledge in their processes, recognize the need to consider and install new technologies (Miroshnychenko et al., 2021; Cuevas-Vargas et al., 2022), responsibility for using obtained information from external sources and the ability to exploit it (Jimenez-Barrionuevo et al., 2011). To summarize, knowledge exploitation by transforming information and obtaining knowledge improves the routines and systems of the company. The desired outcome of transformed knowledge is to apply it in creating new products or improving the existing ones, to improve management and organizational process or even new organizational systems.

Our research focuses on potential and realized absorptive capacity based on four dimensions; they have been included in the absorptive capacity construct: acquisition (3 items), assimilation (3 items), transformation (3 items)

and exploitation (2 items). The resulting scale has been composed of 11 items. Following Camison and Fores (2010) and Miroshnychenko et al. (2021), the study used 5-point Likert scale where 1 means "totally disagree" and 5 "totally agree".

3.2. Sample and data collection

The empirical research was conducted in Estonia and Lithuania, targeting companies that collaborate with Nordic companies or are the subsidiaries of Nordic capital companies. In the case of Lithuania, the information on the companies was provided by InvestLithuania. Meanwhile, in the case of Estonia, the Nordic Chambers of Commerce have provided the required information. The targeting list of companies contained main information, including the company's title, address, contact phone number, the origin of the capital, industry, number of employees, age and turnover. As there is no equal consensus how company's size and age influence absorptive capacity, small and medium size companies with more than 5 employees were included into the sample. In addition, Estonia and Lithuania, together, make 4 million people market. Moreover, the number of companies targeting business sectors is low as well. In general, the analysis of absorptive capacity is based on learning ability in relation to student-teacher (Jimenez-Barrionuevo et al., 2011). Thus, it was decided to include very small companies in the survey. Based on previous research (Zahra & Hayton, 2008; Camison & Fores, 2010; Jimenez-Barrionuevo et al., 2011; Gebauer et al., 2012; Flor et al., 2018), the key respondents' Chief Executive Officers (CEOs) have been chosen. The CEOs have been chosen due to their knowledge of the all collaboration and research process in the company. The list of companies for the survey has been composed after carefully filtering companies. Only operating and targeting companies with reliable contact telephone numbers have been included. In this way, all calls reached the targeted respondents. The survey was conducted by telephone, contacting the CEO or senior managers of 446 companies in Lithuania and 670 companies in Estonia. The data collection process lasted 8 weeks, from the beginning of November 2021 to the beginning of January 2022. 93 companies have responded to and fully answered the questionnaire in Lithuania, and 65 responses have been collected in Estonia. The targeting companies were more active in Lithuania, 20.8% of responsiveness rate. Meanwhile, in Estonia, it makes 9.7%. The final sample consisted of 158 companies which is a 13.9% of responsiveness rate. This rate is similar to the studies of Jimenez-Barrionuevo et al. (2011), Lau & Lo (2015), Agusti et al. (2022). As the research covers extremely narrow and specified business companies, the results are statistically significant in relation to how the population of the survey has been composed according to the origins of the capital, size and sectors. In both countries, the greatest part of companies originated from Finland, which made 457 (40%), the second largest investor or business partner in Estonia and Lithuania is Sweden – 308 (27%) companies, 219 (19%) were from Norway, the lowest number of companies or partners were from Iceland which made up 1% of all respondents. According to the number of employees, the greatest number of the population is composed of small and medium size companies (60%). Large companies make only 9% (Tab. 3). Most of the companies operate in manufacturing business sectors (48%), 9% are involved in trade, 24% of companies are in engineering design, services and consulting business, IT and telecommunication and logistics and transportation (Tab. 5). The average turnover of the companies included into the sample is 12.5 mil euros, while the median is 2.5 mil euros, mode of the turnover is 1.5 mil euros. The age of the companies that participated in the survey varied from 3 to 32 years. The average age of the companies in Lithuania is 15.6 years, and in Estonia – 20 years. 43% of the companies pointed out that they employ a significant number of skilled employees. From 61 to 100% of employees hold at least a bachelor's degree, which allows us to assume that companies may hold a high level of potential absorptive capacity. In 9% of companies, from 41% to 60% of all employees hold at least a bachelor's degree. However, 32% of respondents provided information, with 20% or even less of their staff members holding at least a bachelor's degree (Tab. 4).

Tab. 3. Sample composition

Country of Capital Origins		
Denmark	21	13%
Finland	35	22%
Iceland	1	1%
Norway	36	23%
Sweden	29	18%
Estonian	8	5%
Lithuanian	4	3%
Joint Venture (Estonian – Nordic)	11	7%
Joint venture (Lithuanian – Nordic)	13	8%
Total	158	100%
Size		
Very small company	41	26%
Small company	61	38%
Medium size company	41	26%
Large company	16	10%
Total	158	100%

Tab. 4. Qualification of the staff

Staff holding at least a bachelor's degree	Number of companies	% of sample
0-20%	51	32
21-40%	25	16
41-60%	14	9
61-80%	23	15
80-100%	45	28

Table 5. Distribution among Business sectors

Business sector	Number of companies	% of sample
Agriculture	3	2%
Business consulting	10	6%
Commercial activities	14	9%
Construction and real estate	5	3%
Engineering design, services and consultation	13	8%
Pharmaceuticals	4	3%
Financial sector	5	3%
IT and telecommunication	12	8%
Logistics and transportation	13	8%
Manufacturing	76	48%
Mining	1	1%
Other services	2	1%
Total	158	100

Source: composed by the authors

4. Results

The validity and reliability of constructed measurement scale are analyzed. The validity of the concept is based on factor analysis of items included in the construct. Factor analysis determines factors loadings and the relation between items. Further reliability confirms its internal consistency in evaluating the accuracy of the items of the construct. This analysis must confirm that that scale fulfils requirements for scarce parametrization containing a small number of items that provide relevant information and avoids surplus information.

4.1 Validity of the concept

The suitability of data for structure detection has been checked by applying the Kaiser-Meyer-Olkin Measure of Sampling Adequacy test (KMO) and Bartlett's Test of Sphericity. The KMO indicates the proportion of variance in variables that underlying factors might cause. High values closer to 1 indicates that factor analysis might be used for this data. A value lower than 0.5 shows that factor analysis is not an appropriate tool for analysis (Kaiser, 1970).

In our case, KMO is 0.891, which reveals that collected data is suitable for factor analysis. An alternative test, Bartlett's Test of Sphericity, shows the homoscedasticity of the data. Bartlett's Test of Sphericity confirms the KMO test ($p=0.000$, $\chi^2 = 528,03$; at 136 degrees of freedom. Further, confirmatory factor analysis (CFA) has been applied to determine the underlying dimensions of absorptive capacity. As it might be seen from Tab. 6, all items have significant loadings, as loadings higher than 0.5 are defined as significant (Hair et al. 1999). Confirmatory factor analysis has been performed while using SPSS Amos 26. Factor analysis has been based on the second-order construct of potential absorptive capacity, which has been composed of knowledge acquisition and knowledge assimilation, and realized absorptive capacity had been formed of Knowledge transformation and Knowledge Exploitation. Statistical analysis shows that model fits well (NFI=8.15; IFI=0.934; TLI=0.890, CFI=0.928; TLI=0.89 and RMSEA=0.054). $\chi^2 = 62,517$, $df=43$; $\frac{\chi^2}{df} = 1,43$; Relative chi-squared is less than 5, and $p < 0.01$; Incremental fit index (IFI) is > 0.9 , comparative fit index (CFI) > 0.9 , and root-mean-square error of approximation (RMSEA) < 0.1 (Byrne, 2002).

Table 6. Confirmatory factor analysis results

Constructs/ items	Standardized loading
Potential absorptive capacity	
AVE= 0.531; CR= 0.869	
Knowledge acquisition	
Acquisition 1 (<i>company successfully collects information while communicating with international business partners</i>).	0.645
Acquisition 2 (<i>company regularly sends employees to business fairs and other international business events</i>).	0.861

Acquisition 3 (company successfully collects information and/or recognizes new ideas for innovation)	0.537
Knowledge assimilation	
Assimilation 1 (<i>employees have the good individual ability to find, select and quickly absorb new information</i>).	0.774
Assimilation 2 (<i>the organizational culture and historical similarities exist between two companies</i>).	0.841
Assimilation 3 (<i>employees successfully assimilate knowledge to understand customer needs</i>).	0.659
Realized absorptive capacity (AVE=0.481; CR=0.729)	
Knowledge transformation	
Transformation 1 (<i>employees successfully utilize information and improve learning skills over transforming information</i>).	0.535
Transformation 2 (<i>employees successfully use existing knowledge and information-gathering technologies</i>).	0.599
Transformation 3 (<i>organizational structure allows successfully exploiting diverse competencies of employees</i>).	0.751
Knowledge Exploitation	
Exploitation1 (<i>employees successfully exploit collective competencies to adopt novelties or innovation</i>).	0.625
Exploitation 2 (<i>Installed new technologies in a company to drive further innovations</i>).	0.710

These results suggest the suitability of the construct for further studies.

4.2. Reliability analysis

Further, the reliability is supposed to be analyzed. Reliability denotes the internal consistency of scale and shows that the concept has been measured precisely without any incurring errors. Larger reliability means a lower error and a more accurate measurement instrument (Hair et al., 1999). In order to measure global reliability, Cronbach's Alpha has been estimated. Cronbach's Alpha evaluates strictness with the confirmation of what might occur if one of the items is eliminated. In this way, Cronbach's Alpha confirms or denies the existence of the property of parsimonious parametrization, which shows if the scale contains a small number of items that provides suitable information. The internal consistency of items is greater if Cronbach's Alpha is closer to 1. The minimum required value of Cronbach's Alpha is 0.6-0.7 (Kline, 1998). The Cronbach's Alpha of all items is above 0.7; it means that results confirm the property of parsimonious parametrization. Thus, results support the construct. Even re-estimated Cronbach's Alpha in the case when the item is removed does not change the situation and still confirms the condition.

Tab. 7. Internal consistency

ACQUISITION	Cronbach's Alpha 0.789	
	Average Variance Extracted 0.481	
	Composite reliability 0.729	
	Correlation Between Item	Cronbach's Alpha If Item Is Removed
Acquisition 1	0.610	0.801
Acquisition 2	0.762	0.733
Acquisition 3	0.778	0.723
ASSIMILATION	Cronbach's Alpha 0.742	
	Average Variance Extracted 0.582	
	Composite reliability: 0.804	
	Cronbach's Alpha If Item Is Removed	
Assimilation 1	0.545	0.764
Assimilation 2	0.788	0.752
Assimilation 3	0.645	0.729
TRANSFORMATION	Cronbach Alpha 0.821	
	Average Variance Extracted 0.401	
	Composite reliability 0.665	
	Cronbach's Alpha If Item Is Removed	
Transformation 1	0.663	0.800
Transformation 2	0.796	0.734
Transformation 3	0.764	0.758
EXPLOITATION	Cronbach Alpha 0.833	
	Average Variance Extracted 0.455	
	Composite reliability 0.617	
	Cronbach's Alpha If Item Is Removed	
Exploitation 1	0.714	0.917

Exploitation 2	0.887	0.719
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Further, following Fornell and Larcker (1981), composite reliability has been estimated to analyze the scale's internal consistency. Our study sets the minimum acceptable value of composite reliability at 0.6. In all cases, the results are acceptable, proving the results' reliability and the appropriability of chosen instrument and scale. The average variance extracted in the cases of acquisition, transformation and exploitation are slightly below 0.5. However, additionally estimated composite reliability in all the cases varies from 0.66 to 0.801, which average composite reliability makes 0.7, as proposed by Hair et al. (1999). In general, based on various different estimations, the model is at a good level of reliability. The correlation between items is from moderate (0.545) to a strong relationship (0.887) while $p < 0.000$.

5. Discussion and conclusions

The article proposes an alternative measurement of absorptive capacity. Following scientific literature, the new measurement of the construct has been validated in line with the most frequent recommendations. After validation and evaluation of reliability, the proposed instrument and scale confirmed its application to measure the company's ability to acquire, assimilate, transform and exploit information and knowledge. The analysis shows that all factors fulfil the requirement for parsimonious parametrization, which means that the instrument does not contain non-relevant or redundant information and knowledge. Thus, it might be used by other researchers in further studies. The results are in line with similar studies of Jimenez-Barrionuevo et al. (2011) and Camison and Fores (2010), who confirmed that the process of absorptive capacity typically is composed of four phases (acquire, assimilate, transform and exploit) in Spanish industrial companies. Similarly, Cuevas-Vargas et al. (2021) prove the existence of 4 phases of absorptive capacity in the Columbian ICT sector and their interlinkages with innovations. Specifically, the study has been focused on the Nordic capital companies in Estonia and Lithuania. These companies have been chosen due to the fact that Nordic countries produce the greatest number of patents in Europe. Based on the statistical results, it has been noticed that either Nordic capital subsidiaries or Lithuanian and Estonian companies that closely collaborate with Nordic companies are confident in acquiring information and knowledge for innovation collaborating with international business partners. (mean=4.297). However, the mean for a company successfully collecting information and/or recognizing new innovation ideas is only 2.95. This means that even if companies have all possibilities to access external knowledge through collaborating with partners or participating in business fairs, they still face difficulties in collecting appropriate information or recognizing ideas for innovations. On the other hand, companies are sure that their employees have good individual abilities to find, select and absorb new information (mean=4.7089) and clearly understand customers' needs (mean=4.7089). Companies are more satisfied and confident about their realized capacity as means of all items varies from 4.0043 (employees successfully use existing knowledge and information gathering technologies) to 4.5823 (employees successfully exploit collective competencies to adopt novelties or innovation).

The article has several theoretical implications. First of all, the article focuses on developing and adopting measurement of absorptive capacity that fulfil some gaps in the scientific literature. Thus, we contribute and expand the theory of absorptive capacity. Applying this instrument, researchers may focus on four dimensions (acquisition, assimilation, transformation and exploitation) of absorptive capacity in a company. Second, the article concentrates on the case of analyzing subsidiaries of foreign capital companies in the host economy and domestic companies closely collaborating with foreign companies. Thus, our research additionally creates added value to the internationalization theory as well which means that instruments for measurement might be used in interdisciplinary studies. The study's results might be useful for researchers focusing on the impact of foreign capital companies benefitting from spillover.

In addition, the results of the research have managerial implications. The results and insights of our research might be useful for foreign capital companies in Lithuania and Estonia, as the proposed measurement of absorptive capacity might be useful for a company. Focusing on specific factors, companies may analyze potential and realized capacity and find problematic points in building up absorptive capacity. This instrument is supposed to be a reliable tool to measure absorptive capacity for companies involved in various collaborative international networks to develop innovations or foreign capital companies or their affiliates in other countries. Especially for the companies which feel that they do not benefit from that collaboration or knowledge spillover due to FDI as expected. This instrument is needed especially for companies that absorb knowledge from external sources. Companies may be able to evaluate their capabilities to acquire, assimilate, transform and exploit knowledge. Each company may focus on the most problematic dimension and improve imperfections based on the results. The decision for the improvement might be even quite simple as training for staff or more effective software or require organizational changes in clarification of tasks, job description, or reorganization of the workplace. Identification of weaknesses may unveil the need for closer collaboration with partners. Learning from a partner or parenting company with higher absorptive capacity would increase the ability of staff members to transfer and exploit acquired knowledge. And in this way, the company might increase realized absorptive capacity. Hence, if the

company improves only realized absorptive capacity, it will benefit only in the short-term, while in the long-term, it will fail to recognize new ideas and adapt to changes. Consequently, the employment of such measurement tools may lead to a complex understanding of own strengths and weaknesses in absorptive capacity. Thus, it may result in further strategic or tactical decisions to improve both potential and realized absorptive capacity.

It has to be noted that the obtained results obtain special value for raw material industries, including the mining industry, since they can facilitate further research and its application for enhancing of absorptive capacity of companies moving towards more efficient performance in the context of structural changes in the economies encountering energy crisis triggered by the war in Ukraine.

Limitations and future research. Certainly, as with each study, the current study has some limitations guiding further research and exploration. First, the current study has been conducted in Estonia and Lithuania, targeting Nordic capital companies or domestic companies that had developed strong business relationships with Nordic capital companies without focusing on a specific sector. This is the main limitation: due to the low number of a very narrow and targeted number of companies, there has not been possible to measure absorptive capacity focusing only on manufacturing or high-tech sectors. Thus, for further research, the study might be extended to more countries focusing on the Nordic capital companies or specifically targeting specific business sectors. The sample would be greater, and the results would be more accurate if more countries were involved in the research. Additionally, several more items might be included in the measurement that may exhibit different results. For further research, the study may use the proposed construct and focus on the relationship between innovative performance and absorptive capacity and/or factors mediating or moderating innovative performance. Control variables such as the company's size, age, capital origins, and turnover might be included in the modelling. Further research could be focused exclusively on raw material industries, emphasizing the mining industry.

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