A new approach to business innovation modes:
The “Research, Technology and Human Resource Management (RTH) model” in the ICT sector in Belarus

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Abstrct

Echoing previous contributions on ‘STI and DUI innovation modes’ (Science and technology-based Innovation, and Innovation based on learning-by-Doing, by-Using and by-Interacting), this study discusses their role in SME ability to develop novel products. In particular, the RTH model (based on Research, Technology and Human Resource Management) is proposed so as to describe the most effective approach taken by innovative SMEs. In this way, some structural limitations of those modes is overcome, mainly the ambiguous nature of technology that swings between the two primordial innovation modes (STI and DUI). On these bases, the STI and DUI modes are changed for a more empirical identification of business innovation modes centered on differentiating between three separate drivers of innovation: Research (R), non-R&D Technology (T), and Human Resource management (HRM). These are empirically rearranged in specific innovation profiles, which can be re-grouped into empirically-based innovation modes. This novelty can illustrate the more practical approaches to innovation taken by firms, particularly in contexts in which the development and exploitation of science and technology drivers diverge (e.g. firms focused on adopting new technologies without investing in R&D activities and infrastructure: the case of transition economies). The study focuses on analyzing how different drivers of innovation can be effectively aggregated within a firm to support its ability to produce innovation. With this objective in mind, we propose a new research instrument - RTH model - and test in on a sample of SMEs in the ICT sphere that operates in a technology-follower country in transition, Belarus. The results of the econometric analyses show insightful outcomes, i.e. the novelty of product innovation is more sensitive to the Technology and Human Resource Management (HRM) drivers than to the Research driver.

Keywords: innovation, drivers of innovation, modes of innovation, Belarus, transition economies.

1 Introduction

In recent years, the debate on business modes of innovation has attracted a noteworthy interest among international scholars. However, their country-based analyses on the modes of innovation (derived from the literature on innovation systems, i.e. Lundvall, 1992; Cooke et al., 2004) have been mainly tested in market economies (Jensen, et al., 2007; Amara et al., 2008; Aslesen et al., 2012; Parrilli & Elola, 2012; Isaksen and Nilsson, 2013; Fitjar and Rodriguez-Pose, 2013; Malaver and Vargas, 2013; Nunes &Lopes, 2015; Parrilli & Alcalde, 2016). These studies have shown that firms that combine STI and DUI modes of learning are more likely to innovate than those relying on the STI and DUI mode taken separately. This happens in Denmark (Jensen, et al., 2007), Norway and Sweden (Isaksen &Nilsson, 20132, Aslesen et al., 2012) and Canada (Amara et al., 2008). However, other studies developed in Spain (Parrilli & Elola, 2012; Gonzalez-Pernia, et al., 2012), China (Chen et al., 2011), Portugal (Nunes &Lopes, 2015) and Colombia (Malaver &Vargas, 2013) show more ambiguous results. This might lead to some context-specific interpretation of the importance of innovation modes that we aim at exploring in further depth. In the context of post-Soviet economies in transition (PSTE), the study of the effect of modes of innovation on firm performance has been developed to a limited extent (Apanasovich et al., 2016), thus motivating the present research endeavor. The peculiarities of these countries are, on the negative side, the lack of financial capital, innovation management experience and state-of-the-art technology, while, on the positive side, a rather high level of educated human capital (Aidis, et al., 2008; Rees & Miazhevich, 2009; Fink, et al., 2009). Together with former cultural and/or institutional interpretations of innovations system’s paradoxes (Edquist, 2005; Asheim &Gertler, 2005), this work promotes a novel hypothesis regarding the importance of human resources and technological context-specificities in transition economies.

Since our study was aimed to contribute to the ongoing debate on modes of innovation (Jensen et al.,2007, Aslesen et al.,2012, Parrilli & Elola, 2012), Isaksen & Karlsen, 2012a, Isaksen & Nilsson, 2013, Nunes & Lopes, 2015, Gonzalez-Pernia et al., 2015, Apanasovich et al., 2016) traditionally focused on small and medium-sized enterprises (SMEs), we decide to analyze this particular group of enterprises. Business research and empirical evidence shows that SMEs are a key competitive actor in most national and regional economies (Cooke, 2001; Becattini, et al., 2009; Rammer, et al., 2009). These firms are critical for a dynamic market economy as they are commonly recognized as nimbler than larger enterprises, thus can easily explore new types of activities (Rammer, et al., 2009).

Different studies focused on innovation in this type of firms as a means to increase their competitive capacity and that of their countries (Vossen, 1998; Acs &Audretsch, 1990). They concluded that the innovation capacity of SMEs is hindered by their scale limitations and the lack of financial and specialized human resources (see also Pavitt, 1998). Furthermore, in a context of uncertainty, new opportunities arise and innovation becomes determinant for survival. Within this new business milieu, our second contribution is to identify and weigh aspects of the innovation process, such as the key innovation drivers, profiles and modes adopted by SMEs in Post-Soviet Transition Economies (PSTE).

A third contribution of this study is the context-embedded selection of business innovation drivers that helps to explain why some firms are more innovative than others. The literature is relatively silent on how to connect the 'R', 'T' and 'H' drivers in one mode of innovation (Isaksen &Karlsen, 2012a). In this regard, the novelty of our study is that it goes beyond the analysis of modes of innovation and proposes a more fine-grained tool to identify 'real life' innovation profiles and modes of innovation, and their impact on the novelty of product innovation. In order to explain the logic behind this argument, we present the elements of the RTH model (see Appendix A). More specifically, each innovation profile implies a specific combination of the three drivers in different 'theoretical' proportions. Firms with similar innovation profiles are then grouped into 'practice-based’ clusters, which are defined as representative *modes of innovation*. The interrelation between innovation profiles and modes of innovation enables the identification of the most effective (and real) innovation mode, which involves particular levels of each driver.

We test the afore-mentioned research tool in the original context of transition economies (i.e. Belarus) on a sample of SMEs in the ICT sphere. In our exploratory work, we have selected the ICT sector because of its rapid growth and great potential to contribute to the Belarusian economy. In 2016 this sector demonstrated significant export growth. The average annual growth of IT-services is about 20-30%. There are successful examples of the Belarusian IT companies and start-ups that have received recognition of millions of users worldwide: Wargaming (World of Tanks, the world-famous "Tank Battle»), MAPS.ME (offline map of the world), "Masquerade» (MSQRD) and Viber messenger. The Belarusian Company EPAM Systems is the only listed on the New York Stock Exchange. As a consequence, the ICT industry is a good case for a preliminary study in which we explore the reasonableness of the proposed interpretive model (i.e. RTH).

This paper is structured as follows. In section two, we discuss the main streams of research focusing on the sources of innovation within the business innovation mode literature. The description of the RTH model of innovation and our research propositions are provided in section three. The empirical section four describes the sample, variables and econometric techniques employed. Section five presents the results of the statistical and econometric analysis, whereas the final section summarizes the findings and discusses the implications for research and policy-making.

2 The Debate on STI and DUI Innovation Modes

The model we propose with this work (see next section three) is based upon (and derived from) a sub-strand of the literature on innovation systems. In particular, the selected topic refers to the type of knowledge bases and innovation approaches developed by businesses in different countries and regions (Lundvall, 1992, 2007; Archibugi and Lundvall, 2001; Asheim and Coenen, 2005; Parrilli and Alcalde, 2016). Specifically, it frames the behavior of firms within country or regional perspectives – and their cultural idiosyncrasies – that should be considered when analyzing the business contribution to the innovation output of their regional and/or national economies (Parrilli, Fitjar and Rodriguez-Pose, 2016). On these bases, Jensen et al. (2007) explicitly identified the science and technology-based innovation mode (STI) through which firms can improve their innovation capabilities through a stronger connection to science that provides a platform for the firm's technological learning and innovation (Ibidem). The majority of innovation activities and research-based projects that characterize the STI mode of innovation take place in R&D departments, universities, and research institutes. Therefore, the key inputs for innovation are investments in R&D, scientific human capital and collaboration with scientific partners (Cohen & Levinthal, 1989; Romer, 1994; Griliches, 1979). However, this mode cannot explain the capacity of economies such as Denmark and Norway to demonstrate high innovation output despite their more limited R&D investments vis-à-vis other highly-R&D investing countries. In contrast, a second approach to business innovation stresses the importance of practice and interaction-based innovation that relies on learning-by-doing, by-using, and by-interacting -DUI- (Jensen et al., 2007; Chen et al., 2011; Fitjar and Rodriguez-Pose, 2013). Specifically, learning-by-doing is based upon the accumulation of experience (Arrow, 1962); learning-by-using machines and technological equipment allows to acquire competences by deploying relevant state-of-the-art technologies (Rosenberg, 1982); and learning-by-interacting involves collaborations between various organizations that provide access to different kinds of knowledge and market information, and impact positively on the development of novel innovation (Von Hippel, 1988; Lundvall, 1992; Fu, et al., 2013; Alcalde, 2014).

This debate has recently stressed that these "primordial" modes are not mutually exclusive. Scholars argue that these modes might complement each other in the production of higher outcomes in terms of both innovation and economic performance (Jensen et al., 2007; Isaksen and Karlsen, 2010; Chen et al., 2011; Aslesen et al., 2011; Parrilli and Alcalde, 2016). Specifically, positive evidence has been found in Norway and Sweden (Aslesen, et al., 2012; Isaksen & Karlsen, 2012a; Isaksen & Nilsson, 2013), Portugal (Nunes and Lopes, 2015), China (Chen et al., 2011), and Spain (Gonzalez et al., 2015; Parrilli and Alcalde, 2016).

Table 1provides information about the country comparison in terms of the most effective mode of innovation. In the majority of studies that analyze the STI and DUI modes of innovation, the STI+DUI mode is the most effective mode. At the same time, these countries differ a lot in the levels of development of such modes (Nielsen, 2011; UN, 2013). However, as posited by Isaksen and Karlsen (2012a), the afore-mentioned studies do not specify how firms mix the two modes of innovation to increase their own performance. In this regard, our research focuses on analyzing how different drivers of innovation can be effectively aggregated within a firm to support its capacity to produce innovation, as well as the novelty of such innovations.

Table 1. Literature review on innovation modes

Study	Country	Economy	The most effective mode
Jensen et al. (2007)	Denmark	Market, North Europe	STI+DUI
Aslesen et al. (2012), Isaksen & Karlsen (2012a), Isaksen & Nilsson (2013)	Norway, Sweden	Market, North Europe	STI+DUI
Nunes & Lopes (2015)	Portugal	Market, South Europe	STI+DUI
Parrilli & Elola (2012), Gonzalez-Pernia et al. (2015) Parrilli & Alcalde (2016)	Spain	Market, South Europe	STI (product innovation), STI+DUI
Amara et al. (2008)	Canada	Market, North America	STI+DUI
Chen et al. (2011)	China	Emerging country	STI+DUI in high-tech DUI in low-tech
Malaver & Vargas (2013)	Colombia	Emerging country	STI (product innovation)
Apanasovich et al. (2016)	Belarus	Transition, post-soviet	STI+DUI (product innovation), DUI (organizational innovation)

Adapted from Apanasovich (2016) & Parrilli, Fitjar and Rodriguez-Pose (2016).

3 The RTH model of innovation

Jensen et al. (2007) established an original classification of the STI, DUI and mixed STI+DUI modes of innovation. Regarding the characteristics of human resources, while the STI mode encourages the power of highly educated scientific employees to exploit codified knowledge and collaborate with other researchers, the DUI mode requires experienced and skilled managers, technicians and other employees who can adapt solutions that respond to the needs of lead customers (Isaksen & Karlsen, 2012a). The DUI mode can be perceived as a set of Human Resource Management (HRM) practices (Laursen & Foss, 2012, p. 13) because includes specific indicators like teamwork, integration of function, softened demarcations (decentralization), education/training systems, communication policy that involve the whole organization. These indicators should not be underestimated as there is growing evidence available to suggest that HRM practices are positively related to the generation of innovation (Shipton, et al., 2005; Beugelsdijk, 2008; Oke, et al., 2012). Beugelsdijk (2008) shows that HRM practices can foster both radical and incremental innovation: for example, training and performance-based pay promote incremental innovations, while radical innovations can be achieved by task autonomy and flexible working hours. Using longitudinal data from UK manufacturing firms, Shipton, et al. (2005) demonstrate that effective HRM systems (e.g. incorporating sophisticated approaches to recruitment, appraisal and training), have the potential to promote organizational innovation. As we show in this work, this is particularly relevant to characterize the context and opportunities of PSTE.

As pointed out before, previous studies did not focus on how SMEs mix effectively the STI and DUI modes of innovation or what the effective proportion of their drivers is. In our attempt to close this gap, and realizing the particular specificities derived from HRM, we propose the RTH model that allows revealing the actual proportions of innovation drivers in SME innovation profiles and, later, help to identify the most effective mode of innovation. This three-driver model fills the gap by connecting the set of classical economic drivers of innovation such as Research and

Technology (Cohen & Levinthal, 1989; Romer, 1994; Greunz, 2005) with HRM (Shipton et al. 2005; Beugelsdijk 2008; Oke et al. 2012). Our RTH model benefits from Research (level of scientific development), Technology (level of technological development) and HRM (HRM practices and interaction) innovation drivers (Table 2). The literature is relatively silent on how to separate research and technology; they are usually approximated by the same indicators within the STI mode (Jensen, et al., 2007; Parrilli & Elola, 2012). This separation is particularly important at the country level. In fact, the separation of the 'R' from the 'T' may be relevant not only in the context of countries in transition but also for catching up/emerging economies and developed countries. One of the main reasons why we decided to separate the 'R' from 'T' driver is that in practice firms can innovate in two quite distinct forms. Firstly, technological innovation can be connected to the purchase and installation of new machinery and the effective use of new equipment (Palacín & Radosevic, 2011). In our view, this is very likely to occur in emerging and transition economies. Secondly, other enterprises can benefit from R&D activities and outcomes, e.g. patents (R driver) conducted either by themselves or by public institutions and large enterprises. This second option is very likely to occur in the most advanced economies. For this expected divergence, in our work these two drivers are not bundled together in the innovation mode taken by individual firms. As said above, their intensity is very likely to be determined by the technological context-specificity (i.e. country level of development) and the firms' ability to absorb this knowledge.

Table 2. Description of RTH drivers

RTH drivers	Academic categorizations	Seminal contribution	Categories description
Research	Science	Romer, 1994	Basic Research Scientific collaboration
Technology	Learning-by-doing Learning-by-using Learning-by- technical interacting	Arrow, 1962 Rosenberg, 1982	Manufacturing Operations management Product development and customization Technical collaboration
HRM	Human resources practices Learning-by-internal interacting Learning-by-market interacting	Shipton et al., 2005 Lundvall, 1992	Human resource management practices Internal collaboration Market-based collaboration

Source: own elaboration

3.1 The 'R' driver

The Research driver targets innovation based on research and development (R&D), human capital (scientifically trained personnel with PhD and MSc degrees in S&T who work full time in innovation projects) and research collaborations. Business R&D teams increase the absorptive capacity of a company (Cohen & Levinthal, 1990). External R&D activities are considered as a main source of innovation in SMEs (Rammer et al. 2009; Alcalde, 2015). The firm expenditure in R&D can be considered as a long-term investment and if such investments do not have a direct commercial application, they can however generate a cash flow in the following years or even later on (Rosenberg, 1990). However, investing in R&D involves high costs and risks, thus firms carefully weigh up all the pros and cons and find a proper balance between the expected benefits from successful R&D activities and the costs and probability of failure and loss of invested capital (Rammer et al. 2009).

Nevertheless, SMEs benefit a lot in terms of innovation activities from a stronger connection to science (Fleming & Sorenson, 2004; Fabrizio, 2009; Parrilli & Elola, 2012). A large amount of such activities take place in collaboration with the centers that produce new knowledge; for example, R&D departments, research-intensive small firms and universities. Such interactions promote positive spillovers (Audretsch, 2003) and the generation of codified/scientific knowledge that a firm uses to produce radical technological innovation (Parrilli and Alcalde, 2016). Therefore, we can conclude that the Research driver, which emphasizes the importance of science and considers investments in R&D, scientific human capital, infrastructure and interaction with research partners, would impact positively on the development of novel products (Cohen & Levinthal, 1989; Romer, 1994; Fabrizio, 2009; Jong & Slavova, 2014).

However, when focusing on post-Soviet transition economies (PSTE) we must consider certain peculiarities which lead to reformulate previous arguments. They managed to preserve their scientific and engineering potential originated in the Soviet past (Yegorov, 2009); however, the lack of financial capital, innovation management experience and state-of-the-art technology (Rees & Miazhevich, 2009; Fink, et al., 2009; Apanasovich et al. 2016) does not facilitate the conversion of basic research into final product innovations. As posited in Apanasovich et al. (2016), PSTE do not fit into the global trend of rising expenditures on R&D, while such economies invest more in acquisition of basic machinery and equipment than in R&D. When comparing expenditure on innovation activities of PSTE, for example, Belarusian enterprises invest 81% of total expenditures on innovation activities in purchasing machinery, equipment and software (among Russian enterprises it is 90% of this type of expenditure). In contrast, Danish and Swedish enterprises spend respectively 81% and 83% of total business innovation expenditure in R&D (Belstat, 2011). The high share of expenditures in machinery and equipment can be explained by the fact that PSTEs are catching-up economies whose technological and innovation system operates behind the technology frontier (Varblane, et al., 2007; Alam, et al., 2008; Radosevic, 2011). Belarus has been chosen for our empirical analysis as a representative of PSTE because it shares most economic and political features with this group of countries. As it was argued by Apanasovich et al. (2016), Belarusian SMEs that rely on experience-based learning – DUI mode – are more likely to generate product innovation than those relying on the STI mode. This implies that the innovation capacity of such countries (PSTE) is more likely to be determined by the rate of absorption of new technologies and knowledge from abroad, and the effective use of machinery, i.e. DUI drivers (UNECE, 2011, Apanasovich et al., 2016).

For these set of reasons, in our first proposition, we argue that in PSTE, in contrast to market economies, the Research driver is not likely to have a significant impact on the novelty of product innovation.

3.2 The Technological 'T' driver

The relationship between science and technology was discussed in Rosenberg's book (1982). He questioned the statement that science precedes technological development and stated that technology is not only the application of scientific knowledge. Technology is "knowledge of techniques, methods and designs" and "if the human race had been confined to technologies that were understood in a scientific sense, it would have passed from the scene long ago" (Rosenberg, 1982, p. 143). Technologies are not compulsory and direct products of science because they have to satisfy customer needs. "One of the stylized facts coming out of research on the relation between science and technology is that in most areas, the results of scientific research are not directly useful for technological advance" (Jensen, et al., 2007, pp. 682-683). Hervas-Oliver et al (2011) analyze SMEs innovation in the context of a technology-follower country (Spain). They find that R&D activities are separated from non-R&D (including non-R&D technological) activities. Innovative SMEs do constantly scan markets for new technologies that might help to further develop and apply new ideas. The Technology driver includes important components such as the technological base (Adler & Shenhar, 1990) and the technological competences (Ritter and Gemünden, 2004; Rammer et al., 2009) that firms and their experts and technicians identify and value as a means to develop new products and processes. The *technological base* implies the technological know-how that enables a firm to develop and manufacture new products using the appropriate process technologies, and to benefit from opportunities that require prompt actions involving technology (Adler & Shenhar, 1990). The development of the technological base includes adopting more or less familiar technologies that hasten the technological process (Rosenberg 1982; Chen et al. 2011; Isaksen and Karlsen 2012a). *Technological competence* implies a firm’s ability to understand and use relevant state-of-the-art technology, build and deploy that know-how effectively, explore new ways of solving technical problems, produce and deliver goods and services that will help firms to generate innovations that outperform competitors and increase profitability (Ritter and Gemünden, 2004; Rammer et al. 2009). Such competences have a positive impact on innovation and product development (Patel & Pavitt, 1997; Ritter & Gemünden, 2003). Technologies have direct commercial applications and aim at responding to market demand. In a nutshell, it is an instrument for producing marketable goods and services. Crosby (2000) argues that international flows of capital and ideas are so intensive that there is no necessity to conduct large amounts of R&D in small countries. Such countries can purchase new technology and know-how.

Due to the fast rate of technological change, there is a need for constant monitoring of the-state-of-the-art-technologies. The ‘T’ driver in our model can be approximated with indicators such as monitoring and acquisition of up-to-date machinery, equipment and sophisticated technologies, engineering capabilities, and the interaction with technology organizations (Cooper & Kleinschmidt,1986; Adler & Shenhar, 1990; Patel & Pavitt, 1997; Ritter & Gemünden, 2004). The rapid growth in complexity and cost of new technologies has promoted the emergence of technical collaborations (Sen & Egelhoff, 2000). This type of interaction with technological agents (i.e. technical consortia, technology centers and engineering companies) leads to the development of technological capabilities which may impact on the creation of novel products (Sen & Egelhoff, 2000; Hagedoorn, 1993).

Our study goes beyond intramural R&D, considering the fact that in catching-up economies in transition SMEs do not perform high levels of investments in R&D; however they implement high expenditures in machinery and equipment (Belstat, 2011). This happens because these countries, which operate behind the technology frontier, try to reduce the technological gap they face vis-à-vis technological leading countries. Thus, they innovate through new technology acquisition and application, learning-by-doing and by-using- (Varblane, et al., 2007; Alam, et al., 2008; Radosevic, 2011; Apanasovich, 2016).

On these bases, in our second proposition we argue that Belarusian (PSTE) SMEs that rely on experience-based learning developed with usage of new technology (the 'T' driver), are likely to have a significant and positive impact on the novelty of product innovation.

3.3 The 'H' driver

The third HRM driver of innovation comprises *HRM practices* (Shipton, et al., 2005; Beugelsdijk, 2008; Laursen & Foss, 2012) and *interaction* (Ritter & Gemünden, 2004; Jensen, et al., 2007; Spithoven, et al., 2013). *HRM practices* involve methods of organizing work responsibilities and decision-making, employees' training, extensive lateral and vertical communication channels and the use of reward and recognition systems. According to Shipton et al. (2005, p. 119), such practices manage the "three stages of the organizational learning cycle – the creation, transfer and implementation of knowledge". It was shown by Rammer et al. (2009) that SMEs that do not apply in-house R&D can obtain a similar innovation performance by applying appropriate HRM practices to facilitate innovation processes. In this regard, the implementation of innovation-focused HRM practices influence positively the innovation performance in a firm and contribute to a sustained competitive advantage (Laursen and Foss 2003; Shipton et al. 2005;

Beugelsdijk 2008; Oke et al. 2012). Managerial skills can be more important for innovation than access to modern technology (Cooper, 1999; Varblane, et al., 2007).

Amabile (1998: 6) raised the question of motivation of scientists that can have outstanding education and a great facility for generating new knowledge, but if they lack “the motivation to do a particular job”, they “simply won't do it”; “their expertise and creative thinking will either go untapped or be applied to something else”. The capacity to generate innovations is largely dependent on the way employees are motivated to perform research activities and commercialize their results. In addition, HR policies that include rewards and recognition systems that promote innovation activities are likely to facilitate an innovative organizational culture. Such a culture tends to back up a firm's innovation strategy because it creates an environment that can be characterized as innovation encouraging, and provides the freedom to experiment and the openness to new ideas (Damanpour 1991; Oke et al. 2012). The notion that all employees are innovators enables one of the largest Chinese steel manufacturing companys to achieve an extraordinary innovation output (Chen, et al. 2011).

Beugelsdijk (2008) demonstrates that HRM practices can foster innovations with different degrees of novelty. Lorenz (2012) argues that if creativity and labor market mobility are mediated by an appropriate HRM they can generate a range of radical knowledge outputs. Creativity is expected to be supported and fostered by the creation and promotion of complex jobs within a firm (Beugelsdijk, 2008). Such jobs are associated with high levels of autonomy, variety of skills, significance and feedback (Beugelsdijk, 2008; Lorenz & Lundvall, 2011). The literature on HRM suggests that providing training facilities may create a positive employee attitude and commitment to promote sustainable development (Cooper, 1999; Benson et al. 2004). By the same token, education and complex jobs, creativity and innovation can be promoted by teamwork (Nonaka & Takeuchi, 1995), especially cross-functional teamwork (Cooper 1994; Lau & Ngo, 2004). Currently, innovation processes involve different areas and functions working together as a project team. Team meetings provide employees with a broad range of information and may be organized to search for and to discuss new ideas and perspectives. The involvement of employees in decision-making improves the business innovation propensity (Cosh et al. 2012). Several authors applied quantitative methodology to delve with the HRM contribution to innovation performance (Shipton et al., 2005; Beugelsdijk, 2008), however the link between HRM practices and innovation performance has not yet been clearly explained (Laursen & Foss, 2012).

The ‘H’ driver of our model includes both internal and external market *interactions* related to the manager´s ability to involve other market agents in the innovation process (Lundvall, 1988; Ritter & Gemünden, 2004). Internal interaction arises as part of the company logic and communication works in both directions: top-down and bottom-up (vertical communication) and between different company departments (horizontal communication) (Hinds & Kiesler, 1995; Cooper, 1999). Market interactions capture the firm´s capacity to interact with its business environment. Market partnerships involve a high degree of heterogeneity, which is represented by agents within the supply-chain and outside. Interactions within the supply-chain – mainly with suppliers and clients – are fundamentally formal (Fitjar, and Rodríguez-Pose, 2013) and aimed at improving the delivery of components and products in order to boost their competitiveness. These interactions are expected to be more directly related to problem-solving and will help firms to exploit better their current knowledge pool and search for new product solutions. Collaboration with clients is especially keen on getting market information and, in some cases, the direct involvement of clients and so as to create teams that lead to more successful innovations (Atuahene-Gima, 1995; Souder et al., 1997; Amara and Landry, 2005) and a stronger marker orientation to the final product (Cooper, 1994). In the same way, collaborations with suppliers are valuable sources of information to develop or improve products by reducing risks and lead times in product development, while enhancing flexibility, product quality and market adaptability (Chung and Kim, 2003).

However, it was found that competitors cooperation is oriented towards carrying out basic research and establishing standards (Gemunden et al., 1992; Tether, 2002; Bayona et al., 2003) to solve common problems that are outside the competitor’s area of influence—for instance, a regulatory change (Tether, 2002). Knowledge spillovers are more an unintended consequence of the relationship than its main purpose, as firms try to avoid direct transfer to rivals, but cannot control indirect transfer (von Hippel, 1987, p. 295).Therefore interaction with rivals seems to have a poor impact on innovation (Tomlinson & Fai, 2013) and a detrimental effect on the propensity of firms to innovate (Fitjar and Rodriguez-Pose, 2013). However, independently from the purpose of this collaboration, market interactions capture managers´ ability to connect with close business environments, which later impact on the firm's ability to exploit current capabilities and knowledge domains.

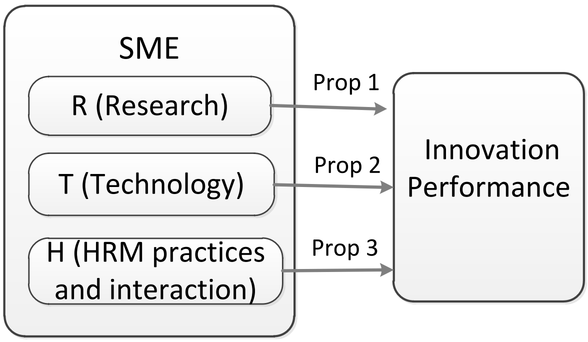
Thus, the ‘H’ driver can be approximated with indicators such as some HRM practices (e.g. training, communication, and reward systems), internal interaction (i.e. teamwork) and market collaboration (i.e. actors along the supply chain and with competitors).

When focusing on the context of transition economies, the introduction of the “H” driver becomes essential due to its high levels of human capital (Aidis, et al., 2008), particularly high in tertiary education. In these countries, managers focus on adopting effectively Western managerial approaches, experience and practices, which often arise from cooperation with supply chain partners located abroad (Miazhevich, 2007). As it is corroborated by Kuznetsov & Yakavenka (2005), these managers possess advanced skills and knowledge that allow them appreciating the value of imported concepts, knowledge and organizational practices. Therefore, high human capital, specific knowledge based on work experience, and market interactions would increase the business absorptive capacity (Vinding, 2006), and contribute to the development of novel products.

For these reasons, in our third proposition we argue that in the context of Belarus/PSTE, at least in the ICT sector, the ‘H’ driver is likely to have a positive and significant impact on the novelty of product innovation.

The three above mentioned propositions are summarized in Figure 1.

Figure 1. The theoretical RTH model in a Post-Soviet Transition Economy



Source: own elaboration. Note: → Expected result

4 Data and methods

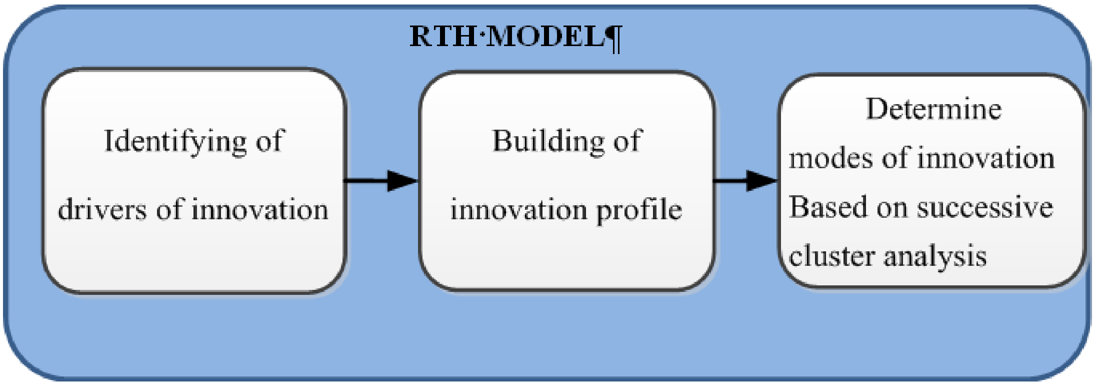
This study focuses on drivers and modes of innovation specific to SMEs in transition economies. However, due to the lack of available data related to HRM practices and Technology drivers, we conducted a specific survey of Belarusian ICT firms located in Minsk and its capital region. We select the ICT sector due to the great opportunities it involves for the economy. As recognized in the EU smart specialization strategy, the development of a competitive ICT sector represent an enabling technology as it tends to generate positive spillovers in the rest of economic sectors due to the development of ICT. The ability to disseminate ICT technologies increases the productivity of many sectors (e.g. traditional manufacturing, health, and automotive) and shifts upwards the territorial innovation frontier. Therefore, the ICT sector represents an opportunity to update the technological competences of PSTE. In Soviet times Minsk was one of the main ICT centers in USSR. In this city computer production facilities and design institutes were concentrated that enable Belarus to supply 60% of the USSR demand for computer production. With the independence, the country inherited one of the highest standards of scientific and technological potential of the former Soviet Union. Nowadays, highly skilled experts educated within local universities contribute to the success of the Belarusian ICT industry.

The ICT high potential for producing innovation is also recognized by Belarus policy-makers (SPID, 2011). In fact, during the last years the ICT sector (formed in early 2000s) has received strong governmental support in Belarus and it has become one of the top-priority economic sectors. As a result, Belarus today is one of ICT leaders in the Eastern European region (Maznyuk & Sergiychuk, 2010), and Minsk is one of the largest centers of offshore programming in the area of the former USSR. The main outputs of the companies are software services for clients, application development, solutions and ICT consulting services, and are successfully exporting their software products and services to North American and European high-tech markets (export share exceeds 80 per cent).

We sent the questionnaire to all 245 ICT companies that were registered in Minsk and its region at the time of the survey. Contact addresses were obtained from 'Regist Belarus' government database. The survey was conducted through a web-based questionnaire and personal e-mails sent to the all 245 IT firms based in the Minsk capital area. 82 firms completed the questionnaire. The response rate is 33%. In order to restrict the sample to SME firms, we followed the European Commission Recommendation (2003) criteria based on the number of employees. Therefore, we excluded companies with less than 10 employees and firms with more than 250 employees from the analysis. The final sample is composed of 51 IT firms. According to Hair et al. (2010) a multiple regression can be effective with a minimum sample of 50 and a minimum ratio of observations to variables is 5:1 (the preferred ratio is 15:1 or 20:1). In our analysis, the ratio of observations is 17:1. For this reason, our sample is valid. Moreover, the goal of this study is not to make strong generalizations, but to develop a new research instrument (RTH model) and demonstrate how it operates.

The sequential empirical validation of RTH model consists of three stages (Figure 2) that help to identify the most effective mode of innovation according to innovation output. In the first stage, we identify the key drivers of innovation, and propose indicators to identify each driver and analyze the relationship between drivers and innovation output. Secondly, we build various innovation profiles (possible combination of the drivers of innovation) that should help to describe the features of innovative firms, and visualize them using the mosaic plot. In the third stage, we perform a cluster analysis to determine the optimal number of innovation modes.

Figure 2. Stages of empirical validation



Source: own elaboration

4.1 Drivers of innovation

In the first stage we study drivers of innovation and analyze their impact on innovation output.

Dependent variables

The dependent variable in our study is the novelty of product innovation (IO). In this we follow the classification of product innovation used in the Community Innovation Surveys (CIS, 2008) and in the literature (Vega-Jurado, et al., 2008; Parrilli & Elola, 2012) that distinguish between: whether a firm introduced new or significantly improved goods and services that were (1) only new to this firm or (2) new to market (the product may have already been available in other markets). However in order to capture the novelty in a more detailed way, we rely on the Oslo Manual (OECD, 2005) and build an ordinal variable that

spans across: (1) new-to-firm, (2) new-to-national market and (3) new-to-international market innovation

Table 3. The rationale behind this classification is that in transition and in developing countries there is a substantial difference between national and international markets that needs to be taken into account.

Table 3. Description of the dependent variable

Variables	Description	Literature
Product innovation		
New-to-firm innovation	A firm report sales of innovative products that are new to firm (1)	(Jensen, et al., 2007; Chen et al., 2011; Parrilli & Elola, 2012; Fitjar and Rodriguez-Pose, 2013, Apanasovich et al., 2016)
New-to-market	A firm report sales of innovative products that are new to national market (2)	
New-to-international market	A firm report sales of innovative products that are new to international (3)	

Independent variables

The Research, Technology, and HRM drivers are independent variables in our study. We propose three groups of indicators to identify each driver (**Error! Reference source not found.**). The first driver, Research (R), contains 3 indicators that reflect the scientific approach and state that innovation is a result of R&D (Jensen et al. 2007). The 'T' driver represents a non-R&D technological driver, which emphasizes knowledge of techniques and methods (Rosenberg, 1982), technological competences (Ritter and Gemünden 2004; Rammer et al. 2009) and know-how that enable a firm to develop and manufacture new products using the appropriate process technologies (Sen and Egelhoff 2000; Hagedoorn 1993).

The HRM driver stresses that innovation is the result of HRM practices (Shipton et al. 2005; Beugelsdijk 2008; Laursen and Foss 2012) and interactions (Lundvall 1992; Ritter and Gemünden 2004; Jensen et al. 2007).

Table 4. Indicators of the R, T, H drivers and descriptive statistics

Indicators	Description	Mean	Std.Dev.	Min.	Max.
The Research driver					
Expenditures on R&D (R1)	Expenditures on R&D as share of total revenue, Likert scale	1,88	1,11	1,00	5,00
Scientifically trained personnel (R2)	A firm employs scientifically trained personnel (master and PhD degree), Likert scale	1,90	0,90	1,00	4,00
Interaction with research organizations (R3)	A firm cooperates with universities, scientific institutes, research centers, Likert scale	1,90	1,12	1,00	5,00
The Technology driver					
Monitoring of new technology in the market (T1)	A firm is constantly monitoring new technology appearance in the market, Likert scale	3,55	1,35	1,00	5,00
Purchase of technology, patents or external knowledge (T2)	The frequency of purchasing patents, external knowledge or licensing of patents and non-patented inventions, know-how, and other types of knowledge from other enterprises or organizations, Likert scale	2,61	1,36	1,00	5,00
Production facilities (T3)	A firm possesses state-of-the-art production facilities, Likert scale	2,63	1,40	1,00	5,00
Technological competence (T4)	The ability to develop and adapt current and new technologies, Likert scale	3,04	1,52	1,00	5,00
Interaction with technology organizations (T5)	Interaction and collaboration exist with technology centers, engineering companies and technical alliances, Likert scale	2,31	1,29	1,00	5,00
The HRM driver					
Reward systems (H1)	The reward and recognition systems encourage innovation and reinforce entrepreneurial behavior and teamwork, Likert scale	2,61	1,42	1,00	5,00
Training (H2)	A firm organizes training aimed to acquire and develop skills that are crucial to introduce new or significantly improved products and processes, Likert scale	2,71	1,36	1,00	5,00

Organizing work (H3) responsibilities and decision making	A firm has implemented new methods of organizing work responsibilities and delegation of decisions (decentralized form), Likert scale	2,53	1,29	1,00	5,00
Extensive lateral and vertical communication (H4)	Communication works in both directions: top-down and bottom-up (vertical communication) and between different company departments (horizontal communication), Likert scale	2,43	1,33	1,00	5,00
Internal collaboration (H5)	Teamwork and collaboration between employees arises spontaneously as part of the company logic, Likert scale	2,80	1,39	1,00	5,00
Market collaboration (H6)	A firm cooperates with customers and pilot-customers, suppliers, competitors, distributors, Likert scale	2,98	1,32	1,00	5,00

Our survey questionnaire was designed using a Likert type scale. Consistently with previous studies in the field (Parrilli & Elola, 2012, Apanasovich et al., 2016), we extracted key qualitative information, classified and treated it on a quantitative basis.

The value of indicators varies from 1 to 5 that can be seen in the descriptive Table 4. The highest value of mean is 3.55 (T1 driver, quite high) and smallest is 1.88 (R1 driver, quite low, something that is later confirmed with the inferential analysis). Each indicator was transformed into the ordinary scale and the final variable that characterizes the R driver was calculated. This variable was set to 1 ('low' level) when the sum of R indicators exceeded zero but was less or equal to 5. Medium' level (2) was assigned when the sum of R indicators exceeded 5 but was less or equal to 10. When the sum possessed a value greater than 10, the 'high' level (3) was assigned. The same procedure was performed to transform variables describing the T and H driver. The explanatory table of variable transformation is presented in Table 5.

Thus, the RTH model implies three innovation drivers (independent variables) and three levels for each driver (Figure 3). Variance inflation factors (VIFs) for R,T,H variables are 1.08, 1.45, 1.43 respectively. All variables are less than 10, meaning that there is no multicollinearity (Kutner et.al., 2004).

Table 5. The explanatory table of transformation of variables

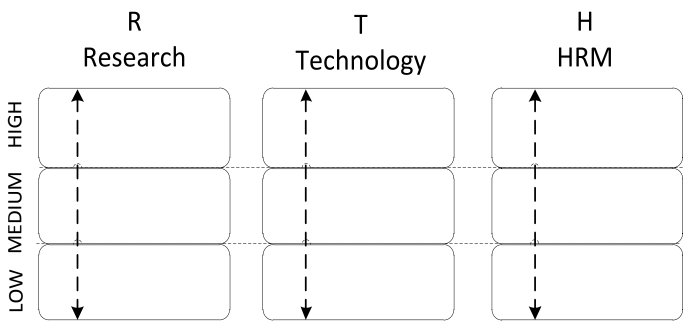
	Indicators	**Measure used in survey**	**Measure of indicators (transformational scale)**	**Measures of final variable in regression model**
R	Expenditures on R&D (R1)	Likert scale	1,2,3,4,5	If SI = 0 < SI <= 5 – low level (1); If 5< SI <= 10 – medium level (2); If SI > 10 – high level (3)
	Scientifically trained personnel (R2)			
	Interaction with research organizations (R3)			
T	Monitoring of new technology in the market (T1)			If SI = 0 < SI <= 8 – low level (1); If 5< SI <= 17 – medium level (2); If SI > 17 – high level (3)
	Purchase of technology, patents or external knowledge (T2)			
	Production facilities (T3)			
	Technological competence (T4)			

	Interaction with technology organizations (T5)			
H	Reward systems (H1)			If SI = 0 < SI <= 10 – low level (1); If 5< SI <= 20 – medium level (2); If SI > 20 – high level (3)
	Training (H2)			
	Organizing work (H3) responsibilities and decision making			
	Extensive lateral and vertical communication (H4)			
	Internal collaboration (H5)			
	Market collaboration (H6)			

* I – value of any indicator

* SI – sum of measures of indicators (I)

Figure 3. Categories of RTH drivers



Source: own elaboration

4.1.1 Regression analysis

In order to analyze the relationship between the ‘R’, ‘T’ and ‘H’ drivers of innovation output we perform a regression analysis. Since the outcome is measured as an ordinal scale (1, 2, 3), an ordinal regression model fits best. The ordinal regression allows the consolidation of the ordinal nature of both the dependent and independent variables.

Table 6 contains the parameters estimated for the model. The significance levels observed in this table indicate that the ‘T’ and ‘H’ drivers exert significant influence on the innovation output, but, the ‘R’ driver does not appear to be a significant in this relationship.

Table 6. Parameter estimates

	Estimate	Std. Error	Wald	Df	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
[ProdIO = 1]	-5,29	1,67	9,98	1	0,00	-8,57	-2,01
[ProdIO = 2]	-2,46	1,51	2,67	1	0,10	-5,41	0,49
[R=1]	-0,56	1,32	0,18	1	0,67	-3,16	2,03
[R=2]	0,00	1,42	0,00	1	1,00	-2,79	2,78
[R=3]	0[a]	.	.	0	.	.	.
[T=1]	-3,66***	1,04	12,33	1	0,00	-5,70	-1,62
[T=2]	-2,02**	0,82	6,08	1	0,01	-3,62	-0,41
[T=3]	0[a]	.	.	0	.	.	.
[H=1]	-2,64*	1,08	5,95	1	0,02	-4,76	-0,52
[H=2]	-1,60	0,94	2,92	1	0,09	-3,44	0,24
[H=3]	0[a]	.	.	0	.	.	.

Link function: Logit

Number of observation: 51

Chi-Square: 37,73

Pseudo R-Square:

- Cox and Snel: 0,523
- Nagelkerke's: 0,589
- McFadden's: 0,338

Level of significance: 0,001

0a – reference level

Table 7 contains new estimated coefficients for the model indicating that firms with greater levels of 'T' and 'H' obtain greater innovation outputs.

Table 7. Parameter estimates

	Estimate	Std. Error	Wald	Df	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
[ProdIO = 1]	-4,95	1,10	20,09	1	0,00	-7,11	-2,78
[ProdIO = 2]	-2,16	0,87	6,18	1	0,01	-3,86	-0,46
[T=1]	-3,77***	1,03	13,35	1	0,00	-5,79	-1,75
[T=2]	-1,97*	0,81	5,90	1	0,02	-3,56	-0,38
[T=3]	0[a]	.	.	0	.	.	.
[H=1]	-2,66**	1,07	6,23	1	0,01	-4,75	-0,57
[H=2]	-1,68	0,92	3,36	1	0,07	-3,49	0,12
[H=3]	0[a]	.	.	0	.	.	.
Link function: Logit Number of observation: 51 Chi-Square: 37,05 Pseudo R-Square: - Cox and Snel: 0,516 - Nagelkerke's: 0,582 - McFadden's: 0,332 Level of significance: 0,001							

0a – reference level

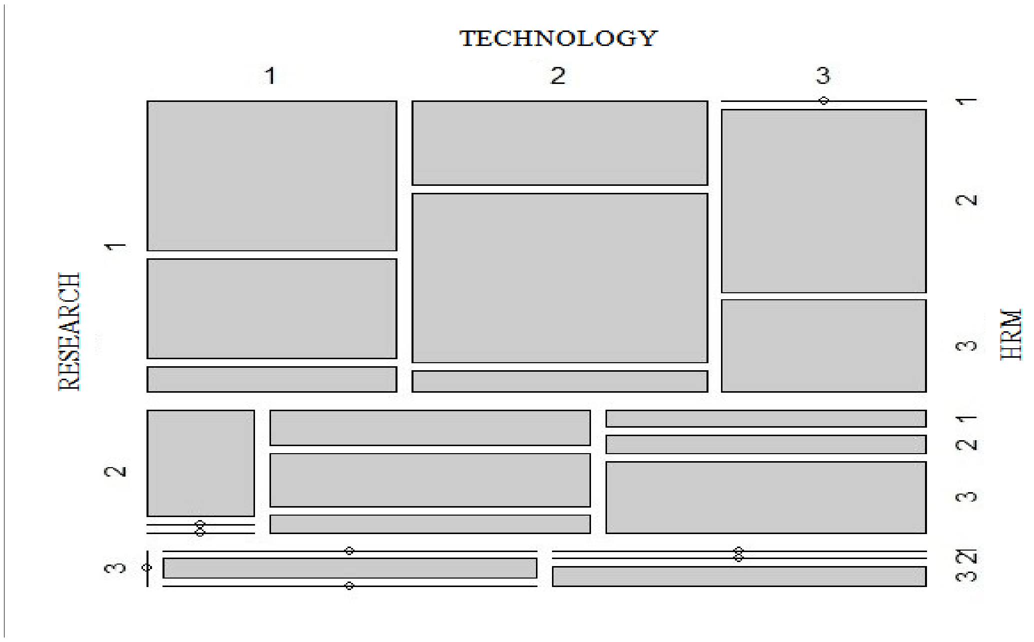
.

Concluding the results of the regression analysis we confirm the first proposition, that there is no statistically significant relationship between the 'R' driver and product innovation output in this particular case (ICT sector in Belarus). In contrast, the propositions related to the importance of the technological driver and the HR driver for innovation output are confirmed. ICT firms in Belarus (PSTE) are significantly influenced by these drivers as such firms manage effectively and creatively both the human/managerial capital and the (new) technological capital so as to be able to produce significant innovation output. Of course, it is an exploratory study centered on a very specific industry and a quite limited sample, thus will need further confirmation through wider and cross-sectoral studies.

4.2 Innovation Profiles

Once we categorized the 'R', 'T', 'H' drivers, we approach our second stage to reveal more precisely the innovation profile of the firms. Thus, a firm's innovation profile is a 'numerical combination' of the drivers of innovation. For example, the RTH profile (3, 2, 1) shows that the SME has a high level of the 'Research' driver, a medium level of 'Technology' and a low level of the 'HRM' driver within our framework. The RTH model implies 27 possible innovation profiles (numerical combination of 3 innovation drivers and 3 levels of each driver). The innovation profiles of the sampled firms are visualized in Figure 4 using the mosaic plot (Friendly, 1999), a graphical presentation of firm innovation profiles divided into rectangles, so that the area of each rectangle is proportional to the frequencies of the various possible RTH innovation profiles. The most frequent innovation profile (15.7% of firms) is RTH (1, 2, 2). We can see that there are 17 active firm profiles (i.e. populated by firms) out of 27 possible profiles in the Minsk region.

Figure 4. Mosaic plot of 'R', 'T' and 'H' drivers)



Source: own elaboration

4.3 Re-grouping the modes of innovation: empirical evidence

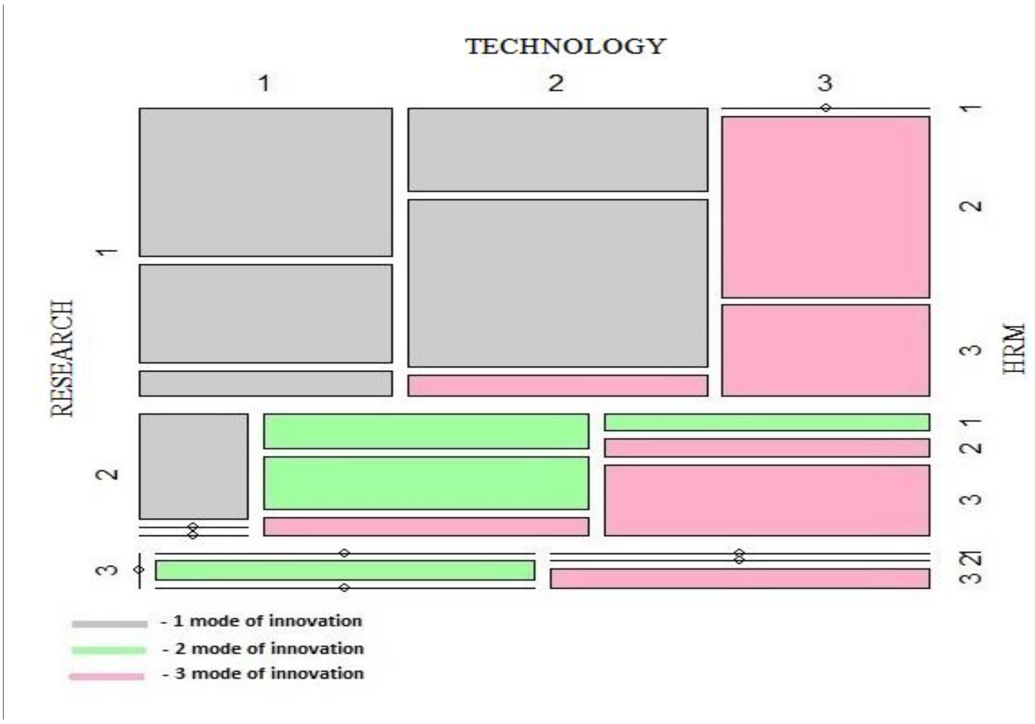
We identified the 'mode of innovation' as a group (cluster) of homogeneous innovation profiles extracted from 27 possible profiles[1]. To group innovation profiles in clusters (modes of innovation), we employ the hierarchical clustering algorithm (Kaufman & Rousseeuw, 1990). Cluster analysis is consistent with some influential works in this area (Jensen, et al., 2007; Fitjar & Rodriguez-Pose, 2013). The Manhattan distance method was used to measure the distance between ~to compute the distances between connected elements (Hastie et al. 2001), and the Tracew index to determine the optimal number of clusters. Tracew index has been one of the most popular indices suggested for use in clustering context (Edwards and Cavalli-Sforza 1965;Fukunaga and Koontz 1970).). Given that the criterion increasing monotonically with solutions containing fewer clusters, the maximum of the second differences scores are used to determine the number of clusters in the

[1] The explanation of the term 'innovation profile' is provided in a descriptive Table 1

data (Milligan and Cooper 1985). We performed scree plot (Appendix B). The location of the elbow in the resulting plot suggests a suitable number of clusters for the kmeans. The criterion increases monotonically with solutions containing fewer clusters. The maximum of the second differences scores allowed us to determine 3 optimal clusters (Friedman and Rubin, 1967). The dendrogram illustrated in Appendix C, provides a complete description of the hierarchical clustering in a graphical format (Hastie et al., 2001).

The three modes (groups of similar innovation profiles) of innovations are visualized in the Mosaic plot (Figure 5) in different colors.

Figure 5. Three modes of innovation, Mosaic plot



Source: own elaboration

With this empirics-based assignation of firms to the archetypal innovation modes, we find the effective way in which ICT businesses boost their innovation capacity in the context of Belarus and PSTE in general. Table 8 shows that the first mode of innovation is represented by the largest amount of firms (49% of total SMEs in our sample). As each driver has a low level, we designate this mode as 'low learning mode' or laggard organizations, and mainly report new-to-firm innovation. The R&T-based firms correspond to the second group of innovation profiles or mode of innovation (16 %), which rely on strong 'R' and 'T' drivers and low level of H driver, and develop new-to-national market and new-to-firm innovations. We can explain the increase in the degree of novelty of product innovation with the growth of the 'T' driver from low to medium. Finally, the creative organizations' refer to the third mode (35%) characterized by low level of 'R', high level of the 'T' and above medium level of the 'H' driver, and reports the highest innovation output i.e. new-to-international market products. Overall, this set of observations is in line with what the regression analysis has shown. Increasing the business effort on the one hand in the acquisition and usage of new technologies, and on the other in the adoption of an effective human resource management (including investment in upskilling the workforce) are the means that guarantee a more effective innovation capacity in the context of Belarus and other PSTE.

Table 8. Characteristics of business modes of innovation based on empirical clusters

Mode	Name	Characteristics	Product innovation novelty
1 mode	Laggard organizations	Low level of ‘R’, ‘T’ and ‘H’ drivers	New-to-firm
2 mode	S&T	Medium level of ‘R’ and ‘T’ drivers and low of ‘H’ driver	New-to-national market
3 mode	Creative organizations	Low level of ‘R’ and high level of ‘T’ and above medium level of ‘H’ driver	New-to-international market

Source: own elaboration

5 Conclusions and policy implications

In this study, we analyze the modes of innovation adopted by SMEs with a new framework that departing from the STI and DUI framework, propose a new approach based on empirically-based ‘innovation profiles’ and ‘business innovation modes’ – the RTH model of innovation. In our view, this better specifies the strategic behavior of SMEs as it recognizes that, especially in transition economies, firms may separate the ‘R’ driver from the ‘T’ driver, and obtain a differentiated impact on the novelty of product innovation. The degree, to which Research, Technology and HRM drivers are applied, however, depends on the contextual characteristics of the country and the industrial sector. The separation of the ‘R’ (R&D driver) from the ‘T’ (non-R&D technological driver) may be relevant not only in Belarus and other PSTE, but also in the broader context of technology-follower countries (e.g. transition and emerging), and developed countries where the technological catch-up process pushes firms to invest in the first stages of scientific knowledge generation. In our case study, we found that there is a statistically significant relationship between the 'T' and 'H' driver and the novelty of product innovation. In contrast, the 'R' driver does not relate to innovation output to a significant extent. This result leads us to make two relevant considerations. From an empirical perspective, this pattern may reflect context-specificities of a particular set of countries: the transition economies. In these countries, (IT) firms seem to have a special sensitivity for technology acquisition and the capacity to learn-by-doing and by-using. This is a more important driver than investments in R&D and highly skilled scientific human capital. From a conceptual perspective, we identify the importance of splitting the impact of R driver from T, thus breaking the former identification of a STI-type of innovation mode. This argument implies the importance to reconsider the theoretical framework that formed the debate on STI-DUI innovation modes, and to promote the search for more appropriate frameworks, e.g. the RTH model, which may explain better specific country contexts. An additional novelty of our study is instrumental to the former, although more general. We go beneath the analysis of 'modes of innovation' as contemplated by Jensen et al. (2007), Isaksen and Karlsen (2010), Chen, et al. (2011) among others, and propose the identification of 'innovation profiles' as a means to understand the various strategic combinations of drivers implemented by different sets of innovative firms. Firms with similar innovation profiles are then grouped into clusters which we identify as empirically-based 'modes of innovation', which are different from the more abstract and perhaps more dualistic modes identified by Jensen et al. (2007).

The relationship between innovation profiles and modes of innovation helps identifying the most effective innovation mode (and the most performing combination of drivers associated with this mode). Across Belarusian SMEs, we have identified 17 innovation profiles (whereas other ten potential profiles were not found in the sample) that we grouped through cluster analysis in 3 archetypical modes of innovation. The first mode of innovation can be characterized as a "low learning" mode or 'laggard organizations' due to the low levels of the 'R', 'T' and 'H' drivers. The “low learning” cluster gathers firms that neither invest in HRM, technology nor employ scientifically trained personnel. The firms belonging to this cluster do not have highly developed forms of organizations that support technology acquisition or HRM practices, and do not cooperate with researchers and value chain partners. In general, they can mostly develop no innovations or new-to-firm type of innovations. The second mode has a rather high level of ‘R’ and ‘T’, and a low level of ‘H’ driver. As the value of ‘T’ has grown in comparison with the first mode, the degree of novelty of product innovation has also increased. As a result, these SMEs are able to produce, in addition to new-to-firm, new-to-national-market innovations. We identified this mode as the ‘S&T-based mode’ of innovation. The third mode is characterized by low level of ‘R’ and high level of ‘T’ and above the average level of ‘H’. Firms in this cluster report the highest innovation output among the revealed modes i.e. manage to produce new-to-international market products and services. Firms belonging to this mode are characterized as ‘creative organizations’.

From a practical perspective, the new research instrument – the RTH model – for analyzing innovation processes across firms can be used not only by researchers, but also by policy-makers and managers. It enables the exploration of detailed innovation profiles across SMEs and the modes of innovation applied at the industry, region and country level. Policy-makers can use the concept of ‘modes of innovation’ to develop strategies and programs aimed at improving the innovation capacities of regions and sectors. The RTH model enables the exploration of the industry-based mode of innovation. Based on the RTH model, company managers can recognize the exact innovation profile that helps to develop and implement strategies, make strategic decisions and exploit their company’s limited resources in the most appropriate way. Thus, identifying the best combination of drivers that promote product innovation helps to create a more conducive environment for innovation-based development, thus enhancing the competitiveness of SMEs.

Our work is not exempt of limitations. In order to show how the RTH model operates we use data that represent one ICT sector (that requires specific knowledge base) in a technology-follower country in transition. On the grounds of the analysis of data collected by the National Statistical

Committee of the Republic of Belarus, that adopts a CIS-type of format, a wider set of Belarusian and other transition countries' SMEs might be studied in a set of representative manufacturing industries: metallic construction, furniture, apparel, footwear, bread and apparel. The lack of very meaningful indicators of HRM and T drivers in Belstat statistics might lead to conduct a specific survey that enables a wider access to relevant data, with the potential to extract results of interest for a larger universe of businesses and countries. It might be extremely adequate to collect data from several sectors both in technology-follower countries and in technology-leader countries as a means to test the consistence of the RTH model in different country contexts. In conclusion, our study aims at encouraging further research and policy analysis on business modes of innovation.

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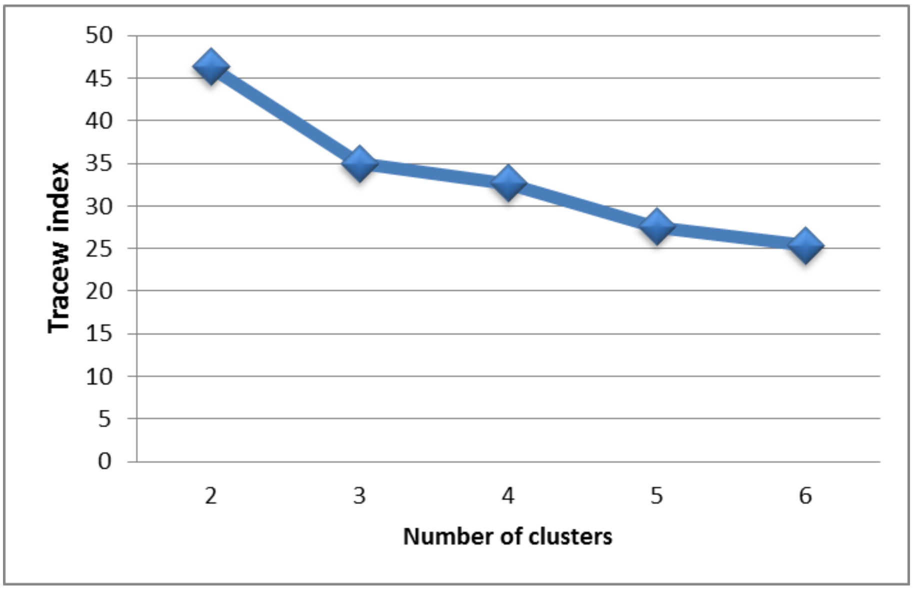
Appendix A

Concept	Definition	Details/explanation
Driver of innovation	The driving force that allows to create, implement and develop innovation	Research (R), Technology (T) and HRM (H)
Innovation profile	The combination of drivers of innovation, indicating the extent/weight to which SME relies on these drivers	E.g.: Profile RTH (3, 2, 1) shows, eg. SME that have a high level of 'R', medium 'T' and low level of H driver, and among others.
Mode of innovation	A firm's innovation strategy, a group/cluster of innovation profiles	E.g.: Laggard organizations, S&T organizations, and Creative organizations.
Model of innovation	Theoretical framework representing the relation between innovation performance and its critical drivers.	E.g.: RTH model (Figure 1)

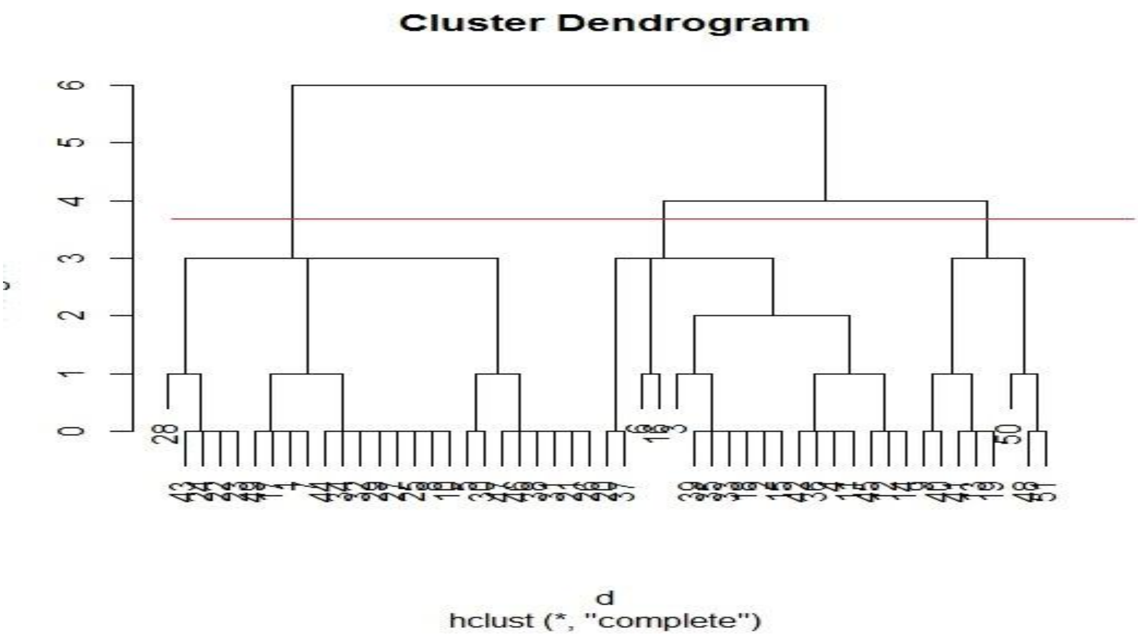
Source: own elaboration

Appendix B. Tracew index



Source: own elaboration

Appendix C. Cluster dendrogram



Source: own elaboration