

3-6-2018

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### Recommended Citation

Trajkovski, J. (2018). Theoretical Framework for the Study of Intangible Investment into Innovative Capital in Resource Limited Environment: A Case for Synchronous Innovations?. *Economic and Business Review*, 20(1). <https://doi.org/10.15458/85451.60>

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# THEORETICAL FRAMEWORK FOR THE STUDY OF INTANGIBLE INVESTMENT INTO INNOVATIVE CAPITAL IN RESOURCE LIMITED ENVIRONMENT: A CASE FOR SYNCHRONOUS INNOVATIONS?

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Received: November 10, 2016

Accepted: March 29, 2017

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**ABSTRACT:** *Innovation intensity in firms depends on resource availability, primarily financial and human resource constraints. The paper proposes a theoretical framework for investment into innovative capital in the case of limited resources. By relying on the fragmented literature on innovation under resource constraints, the model proposes a comprehensive theoretical framework, which answers 3 questions: (1) Which innovation types are more relevant in resource limited environment and why, (2) which resources do they need and why at which stage of the innovation process, (3) what processes companies should embrace in order to kick-off the innovation activity (where should they start from), to successfully embark eventually all types of innovation, and how synchronous innovations explain the transition from one type of innovation to another.*

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**Key-words:** *intangible capital, innovation, developing countries, resource constraints, synchronous innovations*

**JEL classification:** O31, O32, O33

**DOI:** 10.15458/85451.60

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## 1. INTRODUCTION

Innovation has been long argued to be important for increasing value added, stimulating firms' progress along the value-chain, enhancing its productivity and profitability, stimulating knowledge spillover effects, and economic growth at large (Henderson & Cockburn, 1996). Innovation today also represents a major pillar of knowledge-based (OECD, 2012) intangible capital (Corrado et al., 2005; Corrado et al., 2009; van Ark et al., 2012), which can contribute up to one third of productivity growth (e.g. Corrado et al., 2009; van Ark et al., 2009; Fukao et al., 2009; Prašnikar, 2010). Empirical research shows that innovative capital and economic competencies usually represent around 80% or more of all knowledge capital (e.g. Corrado et al., 2009; van Ark et al., 2012), acknowledging their role in economic growth and in the development of the firms.

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Schumpeter (1942) defines innovation as introduction of new goods, new methods of production, the opening of new markets, the conquest of new sources of supply and carrying out of a new organization of industry. The Frascati Manual (2002) and Oslo Manual (2005) further define product innovations as significant improvements of the product with regards to technical specification, components, materials, incorporated software or other functional characteristic. Process innovations comprise significant improvements of the production process (e.g. production techniques, equipment or software, logistics, accounting, maintenance, etc.). Subtypes of market and marketing innovation include better addressing of customer's needs, opening new markets, newly positioning a firm's product on the market, product design, product placement, product promotion, product pricing. Organizational innovation represent the introduction of new or significantly improved management systems, implementation of new organizational methods such as implementing of new business practices, new methods for distributing responsibilities, decision-making, new division of work, new concepts for structuring of activities and establishing new external relations, like collaboration or outsourcing (Oslo Manual, 2005).

Innovation is a multi-stage process whereby organizations transform ideas into new or improved products, services or processes, in order to advance, compete and differentiate themselves successfully in their marketplace (Baregheh, Rowley & Sambrook, 2009). Investment into innovative capital can lower costs, strengthen firms' market position (Utterback & Abernathy, 1975) and even help firms establish themselves as market leaders (Porter, 1990). Especially radical innovations are a major source of competitive advantage and long-term survival (Chandy & Tellis, 1998), while any innovative capital investment, including those that lead to incremental changes, helps firms build competitive strength and increase value added (Katilia & Shane, 2005; Nohria & Gulati, 1996).

Innovation intensity in firms depends on resource availability (Klein & Knight, 2005), which includes financial resource availability, learning orientation, management support, and positive innovation climate or general attitude towards innovation. These resources are systematically divided into several categories: financial, physical, legal, human, relational, organizational and informational resources (Hunt, 2000).

The lack of any of these resources could be an important inhibitor to innovation (Savignac, 2006; Hewitt- Dundas, 2006; Hall & Lerner, 2009), which primarily laggard firms in the developed and often (in comparative manner) the majority of firms from the developing countries face. The lack of any of these resources can also intensify the lack availability of other resources and lead to a "vicious laggard spiral". But as Steve Jobs (1998) noticed also the literature suggests that firms can (partially) overcome a lack of specific resource. For example, the lack of financial resources forces the companies to think more creatively (Amabile et al. 1996; Katilia & Shane, 2005; Bicen & Johnson, 2014), and maximize the output by a recombination of the resources those firms already possess (Fleming, 2001). Alternatively, firms can shift from primarily research to also design and development (Forbes & Wield, 2000), improve its production processes, significantly depart from the current marketing practices and introduce a new ways of organization of work. Forbes

and Wield (2000) argue that due to a lack of specific resources, the latter (and not radical product innovation) often become one of the main factors for increased firm productivity in developing countries. Similar notion is also true for laggard firms in developed economies.

This paper proposes a theoretical model for the study and promotion of innovation under the resource constraints. The model answers 3 key questions: (1) Which innovation types are more relevant in resource limited environment and why, (2) which resources do they need and why at which stage of the innovation process, (3) what process companies should embrace in order to kick-off the innovation activity (where should they start from), and successfully embark eventually all types of innovation. In short, the paper studies, how different types of innovation activity are limited due to a limited access to different types of resources (most commonly financial), discusses the consequences of this limitation and proposes possible solutions.

Methodologically, the paper derives from an intense literature review, which links important theoretical concepts as well as providing an overview of the existing fragmented arguments in the literature by the recent bibliographic analysis study. The main strand of literature, supported by numerous views, lead into the development of a comprehensive model of innovation under the resource constraints with strong practical implications.

The paper aims at making several contributions to the literature. First, the paper aims to bridge the often existing gap between the economic and business literature. For example, the literature stressing the role of innovation for aggregate growth and development, and literature dealing with specific innovation types and the processes, are often neglecting the fact that they are in fact studying the same phenomenon. Comprehensive approach that acknowledges and incorporates both economic and business literature premises can provide a thorough and a more complete model. This model is such an attempt as it derives both from development as well as management literature. Second, the paper follows the premise that although innovations are important for firms at large, firms often face resource limitations which constrain innovative activity regardless whether they come from developing or developed countries (Forbes & Wiled, 2000). To contribute to the resolution of this problem, the paper proposes a model of innovation in resource limited environment. By doing so, the paper also attempts to contribute to the otherwise very limited spectrum of literature of resource-limited innovation (Katilia & Shane, 2005) and synchronous innovation (Damanpour, 2014) and to the best of our knowledge is the first comprehensive model for the study and explanation of innovation in such cases. The paper also links the literature about the role of intangible or knowledge capital with the literature about the impact of resource availability (Fukao et al., 2009; Corrado et al., 2009) and to the best of our knowledge is the first such attempt. Furthermore, due to the fact that resource limitation is more stringent in comparatively laggard firms or countries, the model attempts to on the one hand explain part of the causes for the lag and on the other hand suggests solutions and by doing so attempts to contribute both to theoretical as well as practical literature. Last, the paper attempts several other practical implications for business. By applying the conclusions in practice at the firm level, the paper provides

a practical basis on which managers can build structures and systems that stimulate innovation activities.

In continuing, first innovative capital is defined, with a particular focus on the resources needed in order to innovate. The core of the paper represents a discussion about the factors that determine each type of innovation and how these determinants gain or lose importance for total innovative activity, if the firm is facing financial constraints. Also by introducing the synchronous innovation the link between different types of innovation trajectory is explained, and the effects of the resources constraints are elaborated. The model comprehensively covers all of the possible innovation activities that can emerge on a firm level, and analyses how the innovation trajectory of the firms is developed based on the influence of the resource constraints. The paper concludes with a discussion and challenges for future research.

## 2. THEORETICAL BACKGROUND

Innovative activities are essential to future growth of the firm and productivity increase (e.g. van Ark et al., 2009), but there is a difference in the mechanisms and nature of innovation in leaders and followers (Forbes & Wield, 2000), regardless whether these are countries or firms. The developed firms and economies are those that define the technological frontier and move it forward. According to the data, the developed economies (where also the majority of leading firms are located) account for 94.7 % of global R&D expenditure (2014 Global R&D Funding Forecast, 2013). Their primary focus is on developing new products, but also they are creating organizational practices that are enhancing their capabilities to assimilate and exploit externally available information (Cohen & Levinthal, 1990). The intensity and the nature of the innovation activity depend on the resources availability of the firm, a notion, which is analyzed by the resource-based view of the firm. In order to build a comprehensive model that explains innovation activities in resource limited environment it is important to first deeply understand the nature of the innovation types and the resources required. In this theoretical background, the paper addressed the problem of resource availability and examines the existing literature in order to link innovation and its specific subtypes to the required types of resources and categorize the resources by importance. Methodologically, to ensure completeness, this literature review will on the one hand rely on classical approach and on the other an automated bibliographic analysis.<sup>2</sup> The following research questions will be addressed in this segment:

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<sup>2</sup> A comprehensive review process was used, based on the exact word matches and stemmed words. In total 90 papers were selected based on the number of citation and year of publication, all from each different subtype of innovation, and also for knowledge management, and financial constraints. The frequency of the word “innovation“, among this papers occur for more than 14 000 times, which suggest that the papers selected are in line with the nature of the problem that we are arguing. The second more frequent word with 5840 references is “managing“, which is what we are trying to advance in this paper, the managing of the innovation trajectory of the firm. In the annex tables the most frequent words are displayed. We can conclude that the sample of papers is innovation orientated, with the management of innovation on the focus. Also all types of innovation like product, process, marketing and organizational innovation are equally covered. (5648, 4786, 5620, 4331). Also the most important niche of all is the usage of the word knowledge, with its

- (1) Which resources are required for specific innovation types;
- (2) Which resources are comparatively more important for specific innovation types and
- (3) How can the lack of a specific resource relevant for a specific innovation type be overcome

## 2.1 Innovation resources

Innovation intensity in firms generally depends on resource availability (Katila & Shane 2005; Klein & Knight, 2005), which includes financial resource availability, learning orientation, management support, and positive innovation climate or general attitude towards innovation. These resources are systematically divided into several categories: financial, physical, legal, human, relational, organizational and informational resources (Hunt, 2000).

Most commonly, the financial resources are perceived as being the central problem. The internal funding, which often represents the major source of innovation funding (Hall & Lerner, 2009), since the financial systems are less developed (OECD, 2012). Due to the laggard nature and often low profit margins, caused by their positions within global value chains, the internal resources are limited. Access to external finance is especially problematic due to the underdeveloped financial systems, conservative approaches in the financial sector and lack of venture capital (EBRD Transition Report, 2015), which is particularly problematic for laggard firms.

But for the discussion in continuing, the resource-based view of the firm adds an important dimension that links these “categories” into a much more interdependent “whole”. According to the resource-based view, firms’ structure, nature, behavior and performance can be explained based on firms’ resources, which in fact comprise a bundle of idiosyncratic resources and capabilities. The primary task of management is to maximize the firms’ value through the optimal deployment of existing resources and capabilities while developing the firm’s resource base for the future (Barney, 1991; Grant 1996).

Upgraded by the knowledge-based theory, the resource based view of the firm adds an important category. It suggests that learning, closely related also to firms’ competencies, capabilities and genetic material (Nelson & Winter, 1982) and knowledge dissemination within the firms, is one of the key determinants of innovation. Innovation in the view of resource-based and knowledge-based is a result of a cumulative learning. But it is important to stress the close relationship between the knowledge and human capital: knowledge is created and exists within individuals and the organizations exist to integrate that knowledge and canalize it toward new products and process (Grant, 1996). The key

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synonym like learning etc., because this paper is an effort to establish the organizational innovation as the foundation for other innovation types to occur. (Annex 2 Most frequent words). Software NVivo9 was used to analyze selected documents during the methodological stage of data collection, coding, formulation of categories and content and interpretation.

role of the management team is to use the knowledge of the firm and market to define and shape expansion paths (Penrose, 1959) that transform firm's resources into profitable innovation trajectories (Table 3) and further growth.

Following the above discussion, to study the required resources for the innovation and discuss the nature of innovation in resource limited environment, the paper focus on financial and human resources, and in continuing relies on the Hunt's (2000) definitions and categorization of resources. According to Table 1, and the overall frequency of synonyms for human resources (Annex 2) it is reasonable to expect that the main types of resources necessary for innovation activity are human resources and the financial resources are just a positive moderator that (Mishina, Pollock & Porac, 2004) that support the innovation activity of the firm. Each innovation type requires a specific set of resources, but human and financial are the fundamental ones, without which innovation is impossible to occur. Nonetheless, we will argue that the comparative importance of the two sources differs for specific innovation types. In continuing the innovation resources are discussed in more detail, followed by a discussion of the role of limitations for each innovation type and possible solutions.

Table 1 presents an analysis of the comparative importance of human resources and human-capital related resources (knowledge, learning, also management) for different innovation types. NVivo11 software was used to analyze or extract key-terms that describe different aspects of human capital. After separation of the papers regard their type of innovation coverage, the synonyms for human resources and financial resources were taken into account, for estimating the importance of the given resource in different types of innovation (Annex 1). Based on theoretical background and frequency estimation of this sample, Table 1 is provided, which summaries the importance of human and financial resources in given innovation types.

Table 1: *Key-word search results: Relative frequency of different types of human resources<sup>3</sup> and financial resources<sup>4</sup> in % of total key-word count (4929 key-words in 90 papers)*

Total word count 4929	Word frequency of different types of human resource				Word frequency of different types of financial resource			
Number of papers: 90	Management	Knowledge	Learning	Human resources	Internal finance	External finance	Finance	
Subtype of innovation	Total				Total			
Product	Technical specifications							
	Components or materials used	5,2	3,1	2,8	11,1	1,5	0,2	1,7
Process	Technology of production							
		21,4	10,1	9,8	41,4	2,9	0,3	3,2
Marketing	Product design, placement, promotion and pricing							
	Better addressing of customer needs	13,7	8,6	8,0	30,3	4,3	4,5	8,8
Organizational	Opening new markets							
	Business practices							
	Workplace organizations							
	New methods for distributing responsibilities	24,8	39,5	11,0	53,4	3,0	0,6	3,6
<b>Total</b>		<b>40,3</b>	<b>21,9</b>	<b>20,5</b>	<b>82,7</b>	<b>11,6</b>	<b>5,7</b>	<b>17,3</b>

The results support the notions in the literature that knowledge and related components of human capital or activities that are directly dependent on human capital (such as management) do have a strong relationship with innovation. On average, management stands out most, among the search words, which were widely chosen, followed by knowledge and learning. Interestingly, the comparative importance of these terms differs among innovation types. Knowledge is most commonly linked to organizational innovation, followed by marketing innovation. Management is extremely important also for process innovation. Interestingly, learning, which could be interpreted as a summary word for continuous competence build-up is relatively equally important across categories, with much less variation than knowledge (accumulated situation).

The fact that human capital and related components as well as their combination are important, but in different extent, for different innovation types has been also stressed by a number of authors. Human resources are highly valuable, ambiguous therefore hard to imitate or replicate, and they are part of a more complex social phenomena which give them the advantage to be the main pillar of competitive advantage of the firm (Barney,

<sup>3</sup> Key words used for identification of human resources: management, knowledge, learning, studying, capabilities, people, creativity

<sup>4</sup> Key words used for identification of financial resources: for external financial resources: banks, loan, borrowing; and for internal financial resources: cash, profitability, liquidity

1991). Therefore human capital is seen as one of the types of resources that can help a firm to differentiate itself on the market. Improvements in human capital are the foundation of other types of innovation to occur (Table 3). Laggard firms are usually more orientated to non-technological innovations. That means that types like process, marketing and organizational innovation are more common, mostly because they required more human resources than financial resources (Table 1). Regard the importance of the human and financial resources we are suggesting the first proposition:

*Proposition 1: Human resources and financial resources are the fundamental ones, without which innovation is impossible to occur.*

Financial resources are acting like a moderator in the innovation activity especially when product innovation are pursued (Mishina, Pollock & Porac, 2004). Results in Table 1 speak in favor of that. Out of 90 analyzed papers, with in total identified replication of the selected key-words being almost 5000, the financial resources (external and internal) emerged only in 17.3 percent of cases. Interestingly, they are comparatively more important for marketing innovation. Financing of R&D provides a potentially higher product development, which is associated with higher accumulation of financial and also human resources requirements. The interaction between financial and human resources is well noticed by their implication on growth of the firm (Mishina, Pollock & Porac, 2004) and the overall innovation activity. Their interdependences and mutual advantageous conjunction are important for the overall innovation activity of the firm. This results of the comparatively lower importance of financial resources is also in line with Klein and Knight (2005), who claim that the successful implementation of innovation requires first financial resource availability, but above all also learning orientation, management support, and positive innovation climate or general attitude towards innovation. Better financial system improves the probability of successful innovation (King & Levine, 1993), firstly by evaluating of the entrepreneurs idea and second by funding the idea.

Table 2: *Categorization of innovation resources*

Innovation type	Subtype of innovation	Relevant resources		Selected papers from the sample
		Financial resources	Human resource	
Product Innovation				
	Technical specifications	High	High	Utterback & Abernathy (1975); Ashok et al., (1986); Doygherty (1992); Brown & Eisenhardt (1995); Tushman & O'Reilly (1996); deCastro (2015);
	Components or materials used	High	High	Handerson & (1990); Dorothy (1992);
Process Innovation				
	Technology of production	Medium - High	High	Cohen & Levinthal (1989); Schroeder (1990); Attwell (1992); Katilia & Shane (2005);
Marketing Innovation				
	Product design, placement, promotion and pricing	Medium - High	High	Danneels (2002); Forbes & Wield (2000);
Market Innovation				
	Better addressing of customer needs	Medium - High	Medium - High	Thomke & von Hippel (2002); Matthing, Sanden & Edvardsson 2004; Katilia & Shane (2005);
	Opening new markets	Medium - High	High	Levitt (1960); Storbacka & Nenonen (2015); Kjellberg et.al. (2015);
Organizational Innovation				
	Business practices	Low - Medium	High	Slater & Narver (1995); Nohria & Gulati (1996); Grant (1996); Alavi et.al. (2001); Benner & Tushman (2003); Bloom & van Reenen (2007); Armbruster et.al. (2008);
	Workplace organizations	Low - Medium	High	Ettlie 1988; Ettlie & Reza (1992); Nonaka (1994); Amiable et.al. (1996); Grant (1996); Alavi et.al. (2001); Benner & Tushman (2003); Mishina, Pollock & Porac, (2004); Overvest & Veldman (2008); Crossan & Apaydin (2010); Troilo, Luca & Atuahene-Gima (2013);
	New methods for distributing responsibilities	Medium	High	Damanpour (1991); Levinthal (1993); Baum & Locke (2004);

In sum, both human and financial resources are important. Table 2 provides an overview of selected references, linking different innovation subtypes with the resource requirements. Based on the results of the literature overview and supported by both theoretical as well as empirical estimates of resources availability and innovation types, it can be expected that human resources (with related categories of knowledge, learning, capabilities, management attitude, creativity) are comparatively (in relation to financial resources) especially important

for organizational innovation, slightly less, yet still a lot for marketing innovation. A number of authors stressed the linkages between these two innovation types and human capital, from Levitt (1960), Grant (1996), Bloom & van Reenen (2007), Troilo, Luca & Atuahene-Gima, (2013) and many others. On the other hand, when speaking about product and process innovation, financial resources are gaining comparative importance. This is not diminishing the role of human capital, which is still extremely important with high importance, but the development and implementation of process changes, product development requires significantly larger financial input, which is also acknowledged in the literature (Cohen & Levinthal, 1989; Katilia & Shane, 2005, and other). Based on the importance of the certain resources in the innovation process, we are suggesting the second proposition:

*Proposition 2: Human resources is highly important for organizational, marketing, process and product innovation to occur but financial resources are gaining importance as the firm progress in the value chain.*

## **2.2 Innovation under the resource constraints**

Although firms at large optimize and resources are limited in general, when speaking about the resource limited environment this must be understood primarily in comparative manner with regards to industry or competition. In resource limited environment innovation is different and as we will argue is even more dependent on human resources than in general.

First, innovation in resource limited environment is less commonly radical, and is more commonly incremental, which is true for all types of innovation (Forbes & Wiold, 2000), including product innovation. Namely, data shows that the firms that invest most into R&D and contribute most new technologies are strong (multinational) firms which come either from North America, Europe (Germany) and Japan (Global R&D funding forecast , 2014). These are the companies and countries that shape the technological frontier. Technology frontiers research centers are more exploratory oriented. Units that engage in exploratory innovation pursue new knowledge and develop new products and services for emerging customers or markets (Benner & Tushman, 2003). They possess financial resources and human capital to do so.

Laggard firms (those are also normally more resource constrained) are pursuing exploitative innovation, build on existing knowledge and extend existing products and services for existing customers. The latter approach is used, or is more often used in resource limited environment due to the fact that financial resources needed are relatively smaller, compared to the explorative innovation. In resource limited environment improvements are cumulative so that each invention incorporates and builds on features that came before, similar to the concept of frugal innovation (Radjou & Prabhu, 2015). Therefore, optimizing the usage of the current technology within the firm's constraints is an approach more often used. Edquist and Hommen (1999) also emphasized that firms never innovate in isolation but by interaction more or less closely with other organizations

through complex relations that are often characterized by reciprocity and feedback mechanism in several loops, which emphasizes the learning process.

The level of success of process innovation in resource limited environment depends on the adoption capacity of the firm (Karahanna, Straub & Chervany, 1999), adoptability of the technology (Levin, 1988) and diffusion of the new information about the production process (Davies, 1979). These determinants are firm specific and knowledge dependent. Knowledge resources are part of dynamic capabilities of the firm (Teece, Pisano & Shunen, 1997) which are crucial for the renewal of the firm competences in changing environments. Their intensity is moderated by the size of the firm, finance, the investing human capital of the firm (Mansfield, 1963). Primarily technology and marketing competences are seen as crucial for development of new products and processes (Rajkovic, 2009). While companies often focus on production processes, Dougherty (1992) stressed that improving the processes in the firm should also more profoundly link technology and customer's needs (Danneels, 2002), which is also considered as another (human capital related) resource – integrative capability (Henderson & Cockburn, 1996). Implementation of a process innovation can increase the likelihood of improving the performances of the firm. (Utterback & Abernathy, 1975).

Marketing innovation is very important for firms that are operating in resource limited environment. Promotion and design trends usually arise in developed countries, and represent benchmark for the laggard firms. Therefore if firms closely follow the strategy of their competitors they can significantly departure from their current promotion practices or improve the design of their product, which will affect their profitability. Financial resources do help also in marketing innovation, but are not essential. Knowledge, learning and attitudes are more important as well as their efficient combination (see Klein & Knight, 2005, Katila and Shane, 2005). Here, companies must rely on combining low-level learning on a long term with high-level learning that occur in sequences can produce new approaches and identification of customer needs, product strategies regard the design, pricing, promotion and placement. Continuously collecting information about target-customers' needs and competitor capabilities is part of adaptive learning that improve adaptive capacity of the firm on the current market and stimulate marketing innovation. Through interaction with customers and competitors, firms in resource limited environment are adapting to the new information that are gathered, and innovating new marketing practices that will provide competitive advantage for the firm.

Markets evolve in a perpetual reciprocal process as various actors introduce new ideas in the form of new or modified business model elements that influence the market practice actors engage in (Storbacka and Nenonen, 2015). In order to succeed, firms need to use their routinized capabilities or absorb those of the already established firms to help them acquire and assemble resource-capabilities that other new entrants may have not yet mastered (Bhide, 1992). Utilizing these human related resources at optimal level will produce competitive advantage in the short run. Even though in the short run non-financial resources could help to establish themselves as a market leaders (Mishina, Pollock & Porac, 2004), financial resources should be invested in market analyzing activities.

Companies can reduce the need for such resources by leveraging more on its human related resources – in this case primarily adaptive learning, relying on trends, practices and information easily observed either from other firms or customers.

Organizational innovations depends of the organizational structure and its flexibility, management skills, implementation of a new business practices, improving workplace organization and new methods for distributing responsibilities (Table 2). The adoption of organizational changes or organizational innovation depends on the dynamics of the environment and organizational climate. Laggard firms are, also in this case, exposed to the new practices from the leaders, and they can choose which practices to adopt. Depending on the entrepreneurship capabilities of the managers (again human capital related), different organizational innovations are implemented and depend on the organizational characteristics of the firm; different performance improvements are achieved.

Given the multilevel nature of organizational innovation, the same variables that initiate organizational innovation are the ones that hinder their implementation on another level. These ambidextrous organizations are composed of multiple tightly coupled subunits that are themselves loosely coupled with each other (Benner & Tushman, 2003). Centralization negatively affects exploratory innovation, whereas formalization positively influence exploitative innovation (Jansen, van Den Bosch & Volberda, 2006). To be effective, ambidextrous senior teams must develop processes for establishing new, forward looking cognitive models for exploration units, while allowing backward-looking experimental learning to rapidly unfold for exploitation units (Gavetti & Levinthal, 2000).

When speaking about the resources, the notion of learning requires special focus. Innovation is largely dependent on ideas that come from the outside knowledge that is absorbed, technology which is transferred and adapted, etc., concepts which are closely related to learning (Slater & Narver, 1995). Several models in the literature have dealt with this issue. Forbes and Wield (2000) stress that for the laggard firms, the future and the technology (could also be viewed as knowledge) frontier are given outside (and can be absorbed). Open innovation approach is in the literature highly popular and refers to both inward and outward flows of knowledge and ideas (see e.g. Chesbrough, 2003; Chesbrough, 2007) and is as such closely related to learning. Also empirical results show that laggard firms are more likely absorbing rather than sharing (inward rather than outward open innovation) and are focusing more on process than product innovation (Redek & Farčnik, 2015, Farčnik & Redek, 2015).

Following the discussion of the innovation resources at large and innovation under the resource limitation, the following proposition can be made:

*Proposition 3: Non-technological types of innovation are more common for resource limited environment.*

As was evident from the literature overview (Tables 1 and 2) and the preceding discussion of innovation under the resource constraints, it is clear that not all innovation types are

equally resource demanding. Also, it was shown that human resources are more important for some innovation types. Third, financial resources are usually a bigger problem for laggard firms, which embark more on incremental and exploitative innovation. Firms in resource-limited environment would consequently logically pursue first those that can be supported by the available resources. Following the preceding discussion, it is primarily clear that organizational innovation are least financial-resources intense, while on the other hand product innovation (more radical) are most.

Firms that do face constraints initially have to answer two questions: which innovation types are more important in such cases and where to start, or even further, which sub-type could be the starting point. A firm would rationally, when limited in terms of resources, start with activities which are not comparatively resource intense, but do have value added. Namely, according to Hunt & Morgan (2000) innovation activities can be determined by the relative costs of the resources with the produced value of the usage of those resources.

### 3. A MODEL OF INNOVATION UNDER THE RESOURCE CONSTRAINTS

Relying on classification of innovation (Table 2) and the discussion about the required resources (Table 1), we propose a model of innovation under resource limited environment. The model is presented by a matrix, which explores the trajectories of innovation activity in laggard firms.

The proposed model answers several questions that are relevant for firms under the resource constraints:

- 1) Which innovation types are more relevant/important?
- 2) What process or innovation type they should embrace first (where should they start from), and,
- 3) Which resources do they need and why at a specific stage of the innovation process.

By developing a 3x3 matrix, which links financial, human resource intensity and value added of different innovation types and an extended discussion of constraint, the proposed model shows the following answers to questions (1)-(3): (1) organizational innovation, followed by a progress from organizational towards marketing and progress from organizational towards process innovation are under resource constraints initially more important than product innovations, (2) organizational innovations consequently represent a starting point or a core innovation type that eventually facilitates and stimulates other innovation types, and (3) primarily knowledge and managerial aptitude towards innovation represent an important resource.

To build a model of innovation in resource limited environment, we rely on two theoretical constructs, crossing the relative costs of the fundamental resources with the relative produced value (Table 3). By merging them and applying them to innovation issue, we develop the model in two steps, (1) sequence and (2) explanation, which is visualized in Figure 1.

### 3.1 A discussion of resources requirements and innovation types' sequence

When companies have scarce resources, also scarce human and scarce knowledge resources (according to resource-based theory) they are likely to rely primarily on organizational innovation (Lam, 2004). With progress, marketing and process innovations gain importance (Slater & Narver, 1995), while product innovation, which require most human and other resources come to the forefront last. It must also be acknowledge that innovation (all types) also impact productivity and increase value added and thereby help loosen the resource constraint. As a consequence of both the resource limitations and the impact of different innovation types on value added, a specific sequencing of innovation could be anticipated.

Table 3: *Innovation stages in laggard firms*

		Relation between resource intensity and produced value		
		<i>Low</i>	<i>Medium</i>	<i>High</i>
Relative Resource Costs (financial and human resources)	<i>Low</i>	<b>Organizational Innovations</b>	<b>Organizational Innovations toward Marketing Innovations</b>	<b>Marketing Innovations</b>
	<i>Medium</i>	<b>Organizational Innovations toward Process Innovations</b>	<b>Organizational Innovations toward Product Innovations</b>	<b>Marketing Innovations toward Product Innovations</b>
	<i>High</i>	<b>Process Innovations</b>	<b>Process Innovations toward Product Innovations</b>	<b>Product Innovations</b>

The initial development and usage of the existing knowledge in the firm form the foundation for other types of innovation to occur. Organizational innovations also represent an introduction of new or significantly improved management systems, new types of collaborations with other business, research organizations or customers, outsourcing or subcontracting of business activities in production and changes to the management structure can stimulate increasing performances of the firm (Oslo Manual, 2005). Such improvements in organizational structure can also impact innovation at large.

According to Baldrige & Burnham (1975) structural characteristic of the organization such as size and complexity affect the organization's innovation activity. The more flexible the structure the more organization is open to new approaches to solve problems. Good practices from other firms are adopted (Prašnikar, 2010), by which new ways of work organization is taking place. Therefore organizational improvements are the center of the innovation activity in laggard firms (Lam, 2004). They are the starting point for increasing the performance of the firm. This is basically the first stage of the innovation activity. Here, as we can see in Table 3, resources with low and medium relative costs are used and the expected value that is produced (Jansen, van Den Bosch & Volberda, 2006) is also low to medium. Increasing knowledge in certain activity increase the likelihood of rewards for engaging in that activity, thereby further increasing the willingness for knowledge creation.

The organizational innovation stimulates on one hand learning on the other hand also increases resource availability. Firms that are pursuing marketing innovation will have to improve or would be expected to enhance their organizational capabilities toward marketing innovation, either by conceiving a separate department for marketing and accumulate external knowledge in that area or outsourcing their marketing department and accumulate expertise knowledge. By doing so, they are laying the foundations for other types of innovation to occur. At this point it is important to introduce the idea of synchronous or interdependent innovation (Damanpour, 2014). While some authors feel that the concept is especially relevant for technological innovation (Damanpur, 2014), others agree that this concept is equally important for non-technological innovations where innovations are much more interdependent (Armbruster et al.; Kargaonkar, 2011). In the context of the above discussion, the concept of synchronous corresponds well into the resource limited innovation.

*Proposition 4: Firms are leveraging towards human resources in resource limited environment whenever they are available, embarking first on using the human capital in organizational innovation, followed by other innovation types, where the path depends on the strategy of the firm the current resources availability and mindset of the manager.*

In continuing, a model of innovation activity under the resource constraint is proposed, following the discussion regarding the limitations of resources and possible interconnection of innovation types.

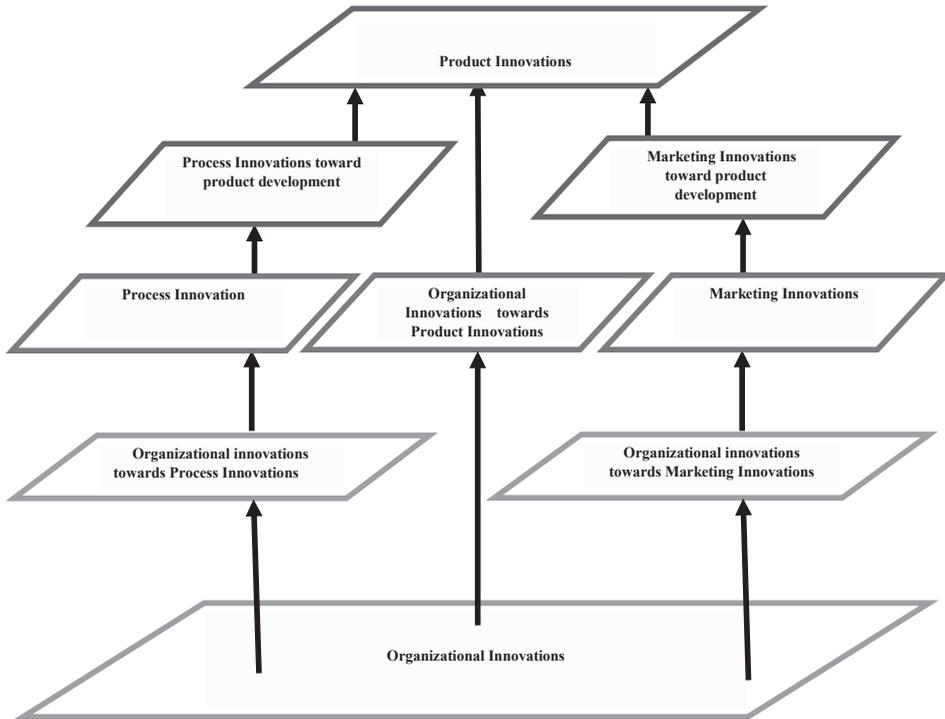
### **3.2. Model of innovation in resource limited environment**

Aforementioned types of innovation and synchronous types of innovation are structured into Figure 1, based on the preceding discussion a model of innovation in resource limited environment is proposed.

The model developed from here is derived from the matrix (Table 3), imply that the most relevant types of innovations for laggard firms are non-technological innovations like

organizational, marketing and also process innovation. Those are the types of innovations that are more dependent on human resources and consume less financial resources. Product innovation in laggard firms is characterized by incremental improvements, (Troilo, Luca & Atuahene-Gima, 2013), which are more resource demanding and therefore less reachable.

Figure 1: *Proposed model of innovation under resource constraints*



Human and financial resources are the main contributors for innovation activity of the firm (Table 1). Depending on the current resource limitations, mostly financial, the firm are leveraging toward their human resources (Mishina, Pollock & Porac, 2004) in order to improve the value crated and level up the innovation activity towards types of innovation that are producing higher value added. Therefore the foundation for overall innovation activity of the firm depends on the bundle of knowledge-based resources that are created, absorbed, adopt and implemented within the firm (Wiklund & Shepherd, 2005). These are in particular important for organizational innovation.

**Organizational innovation** are representing the core of the model for initiating improvement within the organization. Given the resources needed to initiate an innovation activity, it is expected, firms to start investing into this segment of innovative capital by

which they will enhance their organization creativity (Amabile, 1988; Woodman, Sawyer & Griffin., 1993) and therefore organizational capabilities. As they are progressing in the process, the value that is created by organizational innovation will provide more finance to support their further organizational improvements that eventually will lead toward introducing a new type of innovation activity, like marketing or process innovations. Depend on the innovation type pursued, and entrepreneur mindset for further development, there are few innovation trajectories that can emerge (Figure 1).

**From organizational innovation toward marketing innovation.** Let us embark on this discussion based on an example. Outsourcing is an example of organizational innovation. If the firm outsources some of the activities, like the market analytic department, they will acquire a significant amount of specialized external knowledge that can lead to increasing understanding of the market, significantly improved method of advertising, promotion or even improved pricing strategies. This synchronous type of innovation (Georgantzias & Shapiro, 1993; Damanpour, 2014) where the collaboration with other business, due to exposing to external expertise, can change the product placement on the market and open new sales channels (Slater & Narver, 1995). Laggard firms can also benefit from being exposed to the new findings, or new practices, created by other firms. They can choose which ones from a wide range of organizational improvements to adopt. Therefore, the complexity of the decision process is reduced to selection from limited number of new practices. The importance of organizational innovation for marketing innovation and their interdependence is confirmed also by the literature review. The frequency of the words that are synonyms for organizational innovation in the group of papers that are dealing with marketing innovation, are supporting this notion of this type of synchronous innovation<sup>5</sup>. (Annex 1) With regards to the resources required, the marketing innovation is of medium value to the firm with regards to value added, but is also of lower resource intensity in comparison to other types. Its relative value for the company is consequently high or marketing innovation are important for stimulating other types (Table 3).

**From organizational innovation towards process innovation.** Synchronous type of innovation (Georgantzias & Shapiro, 1993; Damanpour, 2014) where organizational improvements, which are part of the subtypes of organizational innovation, like introduction to new types of collaboration with other business, research organizations or consumers can lead to development of other types of innovation, like process innovation. Here, organizational innovation for example stimulates knowledge transfer and open innovation. The accumulation of external knowledge, adopted and adapted to local needs can lead to significantly improvements in the process of production that was initially encouraged by enabling collaboration with other business (Redek & Farčnik, 2015). The process of adopting new practices requires a certain amount of learning in order to implement the new practices (Senge, 1990). By increasing stimulating this higher order learnings, firms from developing countries are entering in a higher phase of the innovation activity. The frequently usage of synonyms that are typical for organizational

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<sup>5</sup> Synonyms for organizational innovation ( management (674), knowledge (425), learning (699)), are among the 20 most frequent words used in the papers related to marketing innovation

in the group of papers that are dealing with process innovation, are supporting this notion of synchronous innovation type. (Annex 1)<sup>6</sup> With regards to the contribution of process innovation to the firm – process innovation are more resource demanding, both with regards to human as well as financial, but also can bring on average more value added (not necessarily) (Table 3).

**From organizational innovation toward product innovation.** Organizational improvements can lead also to product innovation or are closely linked to product innovation in a synchronous manner, linking product innovation with organizational, marketing and process innovation. If the ultimate goal of the firm is to develop something new, then the increased abilities of the production process (Danneels, 2008), and increased awareness for the customer needs, eventually will lead to development of a new product. It all depends on the firm strategy, attitude toward innovation (Bicen & Johnson, 2014) and current resources availability. In resource limited environment the improvements are cumulative so that each invention incorporates and builds on features (or improvements) that came before. This is the transition from second to third stage in innovation process where the costs of the resources are relatively high but also the produced value is high (Figure 1). Frequently usage of the words synonyms for organizational innovation in the group of papers that are dealing with product innovation, are supporting this notion of synchronous innovation type<sup>7</sup>. (Annex 1) Product innovation are most demanding with respect to inputs, but potentially also generate most value added, depending on the new product/service performance (Table 3).

**Marketing innovations** are usually more financially demanding compared to organizational innovation but also the value that they produced is significantly higher. Firms that possessed marketing capabilities have superior financial performances compared to those focusing solely on operation capabilities (Kamboj, Goyal & Rahman 2015). If they want to keep the pace with the competition they have to adopt the marketing methods used in the more competitive firms or adopt practices of firms from developed countries. Innovation ideas and motivation arise through learning from and with customers (Thomke & Hippel, 2002), competition and from the influence of technology or the environment (Matthing, Sanden & Edvardsson 2004). Improving marketing skills of the employees and stimulating high-level learning in the organization will enhance the understanding of the market, which will eventually lead to increased performances of the firm (Kamboj, Goyal & Rahman 2015).

**Marketing innovation towards product improvements.** Understanding the customer needs by implementing new marketing methods can lead to the development of new products. This again is an example of synchronous or interdependent innovation (Georgantzis & Shapiro, 1993; Damanpour, 2014). Increased skills in product design can add value for the customers (Forbes & Wild). The development is generally perceived as

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6 Synonyms for organizational innovation ( management (1056), studying (483)), are among the 20 most frequent words used in the papers related to process innovation

7 Synonyms for organizational innovation ( management (255), knowledge (155)), are among the 20 most frequent words used in the papers related to product innovation

financially (very) demanding, but it is not necessarily so, because knowledge, learning, creativity and attitudes are often more important. This for example implies that the higher integration between the R&D and the marketing department (Gupta & Wilemon, 1986), should lead to improved product, which would increase firm revenues. It is also important to note that when fewer firms (lack of competition) operate in the market, more resources are. This is often the case in developing countries available (e.g. monopoly rents, examples of Albania, BIH, see Prašnikar & Knežević Cvelbar, 2012). Under this condition instead of flexibility, firms need the routinized capabilities of established firms to help them acquire and assemble resource-capabilities that new firms have not yet mastered (Bhide, 1992). Words that are synonyms for marketing innovation are frequently used in the group of papers that are dealing with product innovation, are supporting this type of synchronous innovation<sup>8</sup>. (Annex 1) From the perspective of resource requirements, the synchronous approach allows the firm to leverage the product development (with high potential value added) on existing human capital, which makes the innovation process less resource intense than independent efforts for new product development (Table 3).

**Process innovations.** As firm's competences and knowledge base increases, process innovations become more important and more viable. The costs for implementing process innovation are relatively higher and therefore higher produced value is expected. The costs are mostly related to the knowledge creation and technology adoption (Damanpour & Gopalakrishnan, 1998), diffusion (Attewell, 1992) because in order to improve the production process, higher level of learning and knowledge should be applied. Given their resources limitations, the combinations that are allowed are often finite and small relative to what the firm might desire or what competitors are doing. In addition, properties of the resources that the firms already own are well known therefore the output can be easily predicted. These two factors significantly impact the potential for process innovation. But again firms can leverage a lot on human capital (Table 1), primarily through learning by doing, inventors in a short amount of time will get to the optimal combination of components. Process innovation in performance maximizing strategy is expected to be more original, not necessarily more complex or sophisticated technologically (Utterback & Abernathy, 1975). Process innovation can also be understood as a process of increasing productivity by adopting new technical specifications, or change in the components and material of the product, which are based on acquired new knowledge. In resource limited environment technological improvements are cumulative so that each invention incorporates and builds on features that came before. Firms adopt complex technology knowledge at the moment they obtain sufficient technical know-how to implement and operate it successfully (Attewell, 1992). Awareness of the technology boundary and the limitation of currently available resources describe the natural trajectory for technology progression. By doing so, the firms are moving toward innovations types that are consider as more resource demanding but also they are providing higher value added (Table 3). In terms of process innovation, also the interdependence with other innovation types is relevant (as was mentioned).

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<sup>8</sup> Synonyms for marketing innovation (marketing (242)), are among the 20 most frequent words used in the papers related to product innovation

**From process innovations toward product innovation.** Synchronous type of innovation (Georgantzas & Shapiro, 1993; Damanpour, 2014) is also important in case of product innovation. Innovation effort is often (when already more advanced) concentrated on a limited number of distinct, identifiable problems with predominant orientation for extension of the range of application for technology that we already possessed. Experimentation with new components and new combinations leads also to new product specifications (Fleming, 2001; Pisano & Shih, 2009, 2012). Namely, as Pisano and Shih (2012) stress some product innovation are directly linked to the production process and in such cases especially, process changes (regardless of whether it is technology, material, etc.) can stimulate product change and lead to a significant increase in value added. Namely, Pisano and Shih (2012) show that examples of such products are often also high-value added high-end products (e.g. fashion, design). The frequency of the synonyms for process innovation in the group of papers that are dealing with product innovation, are one additional clue, that support this notion of synchronous innovation type<sup>9</sup>. (Annex 1). With regards to the value created, such innovations carry a lot of potential, although they are also more resource demanding (Table 3).

**Product Innovation.** This type of innovation, in resource constrained environment, is often represented by incremental improvements of the products that the firm already produced. That's caused mostly because of the resources needed (Table 2) and the level of uncertainty. Product innovation is characterized by high risk, and also, it requires significant investment of time and human and financial resources (Troilo, Luca & Atuahene-Gima, 2013). It is expected that firm's organizational capabilities, marketing skills and process competences are on a higher level, so the firms can engage in this kind of innovation activity. An effective design requires that technological possibilities for a product are linked with market possibilities (Dougherty, 1992). The relative costs of the resources needed for product innovation are high, but also the expected produced value is high. Introduction of a new product, will initiate the need for new organizational improvements by which a new iterative process of improvement will begin.

*Proposition 5: Synchronous types of innovation are derived one from another, evolving towards more value added types of innovation.*

#### 4. DISCUSSION

Based on the theoretical discussion of main concepts and the propositions, a model of innovation under the resource constraints was developed. The model shows that human and financial resources are fundamental ones, without which any type of innovation is impossible to occur. But the financial constraints (often externally-imposed) force firms impose a specific innovation trajectory. Organizational innovation is highly dependent on human resources, and it is the starting point that forms the foundation for other types of

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<sup>9</sup> Synonyms for process innovation ( technology (173)), are among the 20 most frequent words used in the papers related to product innovation

innovation to emerge. When firms face financial constraints, they are leveraging towards human resources whenever they are comparatively more available. Also, the notion of synchronous types of innovation is explaining the transition between different types of innovation. Regarding the types of innovation, process, marketing and organizational innovations are more important than product innovation, while incremental innovation dominate over radical.

For all types of innovation a certain mix from financial and human resources is needed. Product innovation required high level of both human and financial resources, while organization innovations are less dependent on financial resources. Therefore, organizational innovation like changing business practices, organization of work and distribution, investing into human resources at large as well as primarily changing managerial attitudes and organization turns out to be the starting element of promoting innovation. In this endogenous process of interaction, the learning enhances the innovation capabilities and allows the company to efficiently climb along the value chain.

**Contributions to the literature.** The article makes several contributions to the literature. The most important contribution is the development of the model that explains or suggests an innovation trajectory under resource constraints that helps the firm successfully overcome the constraint. Second, there are not many papers related to the role of limited resources in the literature yet, primarily this is one of the first, that specifically and methodologically overviews the link between innovation types, limited resources and the role of the intangible capital for mitigating those limitations. So far, papers have primarily investigated financial constraints regard the total innovation activity of the firm regardless of the subtype of innovation or focused on a specific innovation type. Therefore, the paper provides a comprehensive approach. Third, the article presents a literature review about the role of limited resources in the innovation process, regard different type of innovation and sub-innovation. The paper also deepens the discussion about the intangible capital in the laggard firms. So far, the literature has focused primarily on measuring the levels and impacts, but has done limited work on explaining the “whys” (e.g. Hao & Manole, 2008; Prašnikar, ed., 2010; Prašnikar and Knežević Cvelbar, 2012; Prašnikar et al., 2012,). This paper provides an extensive summary of the literature regarding the reasons behind the comparatively low levels of intangible investment, focusing on innovative capital, in developing countries. Third, the paper by summarizing the factors proposes a model of innovation in firms from developing countries, incorporating also the limited resources idea, and the introduction of the synchronous types of innovation, which extends the innovation literature for developing countries (Forbes and Wield, 2000).

**Practical implications.** The paper makes several practical implications for the firms. First, by the identification of the fundamental resources needed for innovation and a specific innovation type, the findings can contribute towards increasing the awareness of the innovation potential of the firms. Even in those firms where innovation was perhaps neglected due to a misperception that innovation primarily requires significant financial input. Second, by stressing the resources needed for a specific innovation type, firms can assess the feasibility of specific innovation. Third, and most importantly, the paper stresses

that all firms can be innovative and that resource constraints can be overcome successfully. By relying on a specific trajectory of innovation, which allows to creatively combine and recombine the resources that they possess firms can be successful innovators even in cases of resource constraints and climb gradually towards more resource demanding innovation types. Here, a major role also synchronous innovation plays. The importance of the financial resources is relatively reduced and firms leverage towards human resources when these are comparatively more important. Enhancing the importance of the human resources can impact manager's mind set towards more organizational innovation, which will increase the propensity for further innovation.

**Limitations and challenges for future research.** The paper faced several limitations, which at the same time present challenges for future research. First, empirically testing of the proposed model in order to confirm the relationships proposed in the model will provide a deeper understanding of the strength of the impact of resources constraints on a distinct type of innovation. Second, the paper summarized the scarce and fragmented literature on innovation in limited resources environment. Increasing the sample size will enlarge the generalizability of the proposition made in this paper. Third, developing measures for grasping the effects from the synchronous type of innovation which is a major limitation and also challenging task for future researchers. Fourth, introducing of other types of resources constraints, e.g. legal (patent protection) or broader institutional, that affect the innovation, in addition to the fundamental ones would further strengthen the model.

## 5. CONCLUSION

Innovation capital is an increasingly important intangible asset, which in many countries represents the largest share of intangible/knowledge capital investment (van Ark et al., 2009, OECD, 2012), which is one of the major drivers of productivity. Innovations, either product, process, marketing or organizational, increase firm productivity and value added and improve the efficiency and efficacy of the organizational structure.

This paper dealt with the resource limited innovation, which is primarily relevant for laggard firms from developed or developing countries. Innovation activity in laggard economies or firms is affected by their resources' constraints, where the constraint refers to both financial as well as human resources. Innovation in such firms is due to their following nature not simpler, but is primarily different than that in market leaders or comparatively more developed firms.

This paper proposed a model, which shows how resource constrained firms may overcome the resource problem and gradually progress from the resource less demanding organizational innovation to more demanding innovation types. Also the synchronicity of innovation is shown to be important.

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**Annex 1. Word frequency query results in different type of innovation**

<b>Word frequency query results</b>							
<i>Word frequency query results from papers related to product innovation</i>			<i>Word frequency query results from papers related to process innovation</i>				
Word	Length	Count	Weighted Percentage (%)	Word	Length	Count	Weighted Percentage (%)
products	8	658	2.13	innovators	10	1576	1.11
development	11	410	1.33	process	7	1373	0.97
innovators	10	278	0.90	technology	10	1359	0.96
project	7	266	0.86	managing	8	1056	0.74
managing	8	255	0.83	adopts	6	873	0.61
markets	7	242	0.78	organizationally	16	837	0.59
design	6	197	0.64	organizing	10	799	0.56
successful	10	196	0.63	changing	8	680	0.48
researchers	11	188	0.61	research	8	672	0.47
team	4	187	0.61	model	5	664	0.47
organizing	10	181	0.59	using	5	654	0.46
process	7	175	0.57	product	7	623	0.44
technology	10	173	0.56	firm	4	615	0.43
systems	7	158	0.51	informs	7	578	0.41
knowledge	9	155	0.50	development	11	567	0.40
firms'	6	138	0.45	terms	5	530	0.37
capability	10	136	0.44	systems	7	517	0.36
problems	8	136	0.44	behaviors	9	500	0.35
communications	14	134	0.43	studying	8	483	0.34
people	6	132	0.43	theory	6	473	0.33

<b>Word frequency query results</b>							
<i>Word frequency query results from papers related to marketing innovation</i>			<i>Word frequency query results from papers related to organizational innovation</i>				
Word	Length	Count	Weighted Percentage (%)	Word	Length	Count	Weighted Percentage (%)
markets	7	2215	1.91	innovators'	11	2893	2.26
innovators	10	1790	1.54	organizational	14	1608	1.25
firms'	6	705	0.61	managing	8	1223	0.95
learning'	9	699	0.60	organization	12	1159	0.90
managers	8	674	0.58	process'	8	968	0.75
customized	10	665	0.57	knowledge'	10	869	0.68
products	8	665	0.57	firms'	6	675	0.53
services	8	551	0.47	markets	7	668	0.52
organs	6	543	0.47	research'	9	635	0.49
developments	12	523	0.45	products	8	627	0.49
processing	10	508	0.44	develops	8	545	0.42
research	8	458	0.39	model'	6	544	0.42
journal	7	431	0.37	learning	8	542	0.42
knowledge	9	425	0.37	technology	10	520	0.41
performing	10	419	0.36	performs	8	519	0.40
studying	8	393	0.34	study	5	481	0.37
effect	6	384	0.33	effects	7	422	0.33
using	5	384	0.33	informs	7	408	0.32
organizationally	16	373	0.32	creativity'	11	406	0.32
businesses	10	324	0.28	units	5	405	0.32

**Annex 2.** Word frequency query results across all sample

Word	Length	Count	Weighted Percentage (%)	Similar Words
innovators'	11	14441	1.84	innov, innovate, innovated, innovates, innovating, innovation, innovation', 'innovation, innovation', innovation", innovation'7ouma, innovations, innovations', innovations', innovative, innovativeness, innovativeness', innovativity, innovator, innovators, innovators'
managing	8	5840	0.74	manag, manage, manageable, managed, management, management', management', management", managements, manager, 'manager', managers, managers', 'managers, 'managers', managers', manages, managing, managing'
products'	9	5648	0.72	product, 'product, production, production', 'production, production', production", productions, productive, productively, productivity, productivity", productized, products, products'
market'	7	5620	0.72	market, market', 'market, market', marketability, marketable, marketed, marketer, marketers, marketers', marketing, markets, markets', 'markets, markets'
firms'	6	5150	0.66	firm, firm', 'firm, firms, firms', firms'
process'	8	4786	0.61	process, process', process', processed, processes, processes', 'processes, processes', processing
organizational'	15	4331	0.55	organiz, organizational, 'organizational, organizational', organizationally
technology'	11	4138	0.53	technologi, technological, 'technological, technological', technological", technologically, technologies, technologies', technologies', technology, technology', 'technology, technology'
research'	9	4090	0.52	research, research', research', research", researched, researcher, researchers, researchers', researchers, researches, researching
develops	8	3986	0.51	develop, developed, developer, developers, developing, development, development', development', developments, developments', develops
knowledgeable	13	3894	0.50	knowledge, knowledge', 'knowledge, 'knowledge', knowledge', knowledgeable, knowledgeable, knowledgeable

organs	6	3802	0.48	organ, organic, organic', organicity, organism, organisms, organization, organization', organization', organization'', organizations, organizations', 'organizations, organizations', organizations'', organize, organized, organizers, organizes, organizing, 'organizing, organizing', organs
using	5	2600	0.33	use, use'', used, 'used, useful, usefully, usefulness, uses, using
informs	7	2566	0.33	inform, informal, informality, informally, informant, informants, informants', informed, information, 'information, information', informational, informative, informed, informing, informs
study'	6	2509	0.32	studied, studies, studies', study, study', studying
performs	8	2486	0.32	perform, performance, performance', performance', performances, performativity, performed, performer, performers, performers', performing, performs
activity	8	2457	0.31	activ, activate, activated, activates, activating, activation, active, actively, activism, activities, activities', activity, 'activity, activity'
model'	6	2359	0.30	model, model', modeled, modeling, modelled, modelling, models, 'models, models'
effects'	8	2317	0.29	effect, effect', effect', effected, effective, effectively, effectiveness, effectiveness', effects, effects'
changing	8	2294	0.29	chang, change, change', change', changed, changes, changes', changing