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FROM DEMAND-PULL AND TECHNOLOGY-PUSH INNOVATIONS, TOWARDS KNOWLEDGE-BASED INNOVATION SYSTEMS. EVIDENCE FROM ALBANIAN SMALL AND MEDIUM ENTERPRISES.

Abstract:

This paper focuses at small and medium enterprises (SMEs) which are facing growing competition. Technological innovation and the increasing role of knowledge exploitation in the enterprise, provide an important source of innovation and competitive advantage. Technological innovation is being perceived to a greater extent as a continuous, collaborative, multi-actor process requiring new collaboration-supporting technologies and focusing on knowledge and social dynamics perspectives. This paper tries to determine if any relationships do exist between measures for adapting technological innovation in SMEs and whether these are caused by a technology-push or demand-pull. It also aims at verifying if activities related to knowledge management in the enterprise lead to planned or incidental innovations. In doing so we get insights on how different activities could affect technological innovation and it contributes to the small business management literature by adding to the body of knowledge on technological innovation adaption and utilization in SMEs. The empirical investigation is carried out in an emerging market nation such as Albania

Keywords:

SMEs, technology innovation, knowledge management, emerging market economy

JEL Classification: O30, M20, O32

1 Introduction

Small and medium enterprises are crucial to the economy, providing essential employment opportunities, supporting entrepreneurship and innovation and thus fostering competitiveness. The growth of such enterprises requires the introduction of new products, processes, and management changes as well as acquiring new systems. These steps can all be viewed as innovative (Gibb, 2000).

In the context of intense and dynamic global competition driven by the continuously increasing pace of technological development, innovation is considered as mandatory for their survival. (Nonaka and Kenney, 1991, Forrester, 2000, Cardinal, 2001). Innovation is defined in many different ways in the literature. It refers often not only to a technology renewal, but also to renewal in terms of thought and action (Thong 1999, p.190).

According to Chen et al. (2004) innovation bring up the introduction of a new combination of essential factors of production into the production system. Innovation capital is the competence of organizing and implementing research and development, bringing forth the new technology and the new product to meet the demands of customers. It involves the new product, the new technology, the new market, the new material and the new combination. Cardinal et al. (2001) show that the innovation process embraces the technical, physical, and knowledge-based activities that are central in forming product development routines.

Comparing to large enterprises, small enterprises are often assumed to have a greater potential to innovate. Small enterprises in the US produce twice as many “innovations” as large enterprises and a significantly greater numbers of patents (Stringer 2000). These are often used as a measure of innovation. SMEs are generally more flexible, adapt themselves better, and are better placed to develop and implement new ideas. The flexibility of SMEs with simple organizational structure, low risk and receptivity are the essential features enabling them to be innovative (Harrison and Watson 1998). Technological innovation refers to the learning process through which a company generates the technological knowledge, competencies and capabilities based on knowledge-intensive inputs and it is unavoidable for firms which want to develop and maintain a competitive advantage and/or gain entry in new markets (Becheikh et al. 2006).

2 Literature review: from technology-push and demand-pull innovations to an increasing role of knowledge in the innovation process

Technological innovation has been subject of extensive theoretical and empirical studies and is now widely acknowledged as an important determinant of sustained superior performance. Research indicates that technologically innovative companies may outperform their competitors. According to (Nieto M. 2004, p.322) technological innovation is a dynamic process which shows the following characteristics:

- Continuous nature: most innovations originate from small incremental improvements
- Path dependency: decisions of past technology adaptions condition the actual and future evolution
- Irreversible innovation: due to strong resistance to the abandonment of a technological trajectory because of accumulated knowledge about that technology,

network effects, complementary technologies, economies of scale and dissemination of information about the new technology

- Different uncertainty types of technological innovation: such as technical, usage and performance.

It is often mentioned that there is a lack of a standard definition of technological innovation (Garcia and Calantone, 2002). The OECD definition of technology and technological innovation states that technology can be understood as a complex of knowledge, routines, skills, competence, equipment and engineering practice that are necessary for producing a product or service. Technological innovation occurs when new or changed products are introduced to the market, or when a new or changed process is used in commercial production (OECD, 1992).

Product innovations involve the development, production and dissemination of new consumer and capital goods and services, whereas process innovations improve the production process by introducing new methods, machines and production systems which apply not only to the traditional definition of production but also to distribution, data processing and services. New technology (e.g. Information Systems) adoption falls under the category of process innovation (Poutsma et. al., 1987). Innovation in itself may occur because of technology-push or market-pull. Technology-push implies developing and offering an innovation in a matured form in the capital-goods market. The market absorbs the innovation because of the superiority of the new innovation as well as from the pressure and the competing suppliers. In a market-pull the new technology is developed because of an acknowledged social need. Both, technology-push as well as market-pull are also influencers of IS adoption (King et. al., 1994).

Many innovative SMEs attribute the origin of their innovations to a combination of firm level technological capability owing to internal factors such as self-motivation, technical qualification, knowledge, experience, and innovative ideas of the entrepreneur as well as to market pressure caused by customer requirements and demand, information provided by suppliers of equipment's and materials, market opportunities and competition. As we can see, 'technology-push' and 'demand-pull' have both contributed to innovation (Subrahmanya, M. H. et. al., 2010, p.16).

Technology in itself, as the main input and output of the innovation process, is made up of codified knowledge (information) and tacit knowledge. The generated benefits of a technology depend on protection mechanisms and are not perfectly appropriable. Furthermore, certain knowledge characteristics, casual ambiguity and transaction costs make technology transition imperfect and the assimilation of new technology dependent on previously accumulated technological knowledge (it´s absorption capacity) (Nieto M. 2004, p.322).

3 The role of knowledge in the innovation process of SMEs.

A lot of the various definitions of innovation in the literature share common themes relating to knowledge, which may be turned into new products, processes and services to improve competitive advantage and meet customers' changing needs (Nystrom, 1990). While a growing body of literature has attempted to understand innovation, the literature shows definite gaps in the investigation of knowledge management processes and innovation (Gloet and Terziovski 2004, p. 404).

The growing importance of knowledge as a determinant of innovation and factor of production can be viewed as the result of the continuous accumulation of technical knowledge over time, and by the rapid worldwide availability of that knowledge, driven by the use of communications technologies and information systems (Hidalgo and Albors 2008, p.113pp). The concepts, tools and methods of knowledge management are recognized to be of importance to small and medium enterprises (SMEs) in the knowledge-driven economy (Gourova, E. 2010, p. 639). Constantly evolving theories on innovation management emphasize the increasing importance of social ingredients in explaining innovation. Ideas that innovation is determined by research (technology-push theory) and by unordered interaction between firms and other actors (technological-networks theory) are being more and more replaced by insight which state that knowledge plays a more crucial role in fostering innovation. Reliance on `technology-push' is one of the main reasons for not yet successfully exploiting the opportunities arising from knowledge management to achieve competitive advantage. A techno-centric approach to knowledge management is not sufficient to attain the necessary organizational culture and context which will promote organizational learning and the sharing of knowledge to support achievement of organizational goals. A socio-technical definition is considered to be more suitable, stating that knowledge management systems must be socio-technical systems which comprise the intellectual capital of the organization, organizational attributes (including intangibles such as culture), policies and procedures, as well as some form of electronic storage and retrieval system. Emphasizes on the knowledge-sharing culture is what enables the conditions for a successful exploitation and management of knowledge (Damodaran & Olphert 2000).

Hence innovation is being perceived to a greater extent as a continuous multi-actor process requiring high integration at inter- and intra-firm levels and collaboration-supporting information systems that can enhance systemic integration and networking from a knowledge and social dynamics perspectives. This happens by achieving flexible and customized response to internal and external signals, as well as playing a coordinating and integrating role (Adamides & Karacapilidis 2006).

While the available literature confirms that large enterprises already have some sort of knowledge management in place, it is found to be largely disregarded by SMEs, mainly due to a lack of a formal approach to the sharing, recording, transferring, auditing and exploiting of organizational knowledge. Another reason is also a lack of utilization of information technology. Nevertheless, this informality in SMEs can be considered as a motivator for adopting knowledge management, which would contribute to the transfer of experiences, retention and dissemination of relevant knowledge in future projects and organizational development (Egbu et al., 2004). Potential consequences for SMEs that do not pay attention to such processes consist of making them vulnerable to knowledge leakage and consequent losses in efficiency and productivity, this makes them less competitive (Baptista Nunes, M. Et. Al. 2006, p. 101pp).

A broad collection of information technologies supporting knowledge management can be applied and integrated into the technological platforms of organizations. Luan and Serban (2002) group these technologies into the following categories: business intelligence, knowledge base, collaboration, content and document management, portals, customer relationship management, data mining, workflow, search and e-learning. Furthermore, important factors that needed to be considered when developing knowledge management

systems include the simplicity of technology, ease of use, suitability to users' needs, relevancy of knowledge content

4 Methodology

Based on the above mentioned characteristics of knowledge management adaption and technological innovation a questionnaire was adapted and sent to SMEs by means of e-mail, google docs, personally, or asked for completing through phone calls. In this paper we include micro enterprises in the term SMEs. The appendix offers a clear definition and classification of SMEs as described in this paper. The questionnaire was developed for SMEs operating in the tertiary (service) sector such as tourism sector, ICT, bars and restaurants. As stated by Yin (2003) the communication between the researcher and the contacted person should not be necessarily face to face.
Depending on the situation, the context, limitations and the different objectives, it can take place by other means such as by post, e-mail, phone, audio and video chat (e.g. through Skype), social network platforms etc. We received 112 correctly filled questionnaires which we could statistically evaluate by using SPSS to perform the Chi-Square test of independence. In the questionnaire we included questions relying on the findings of the literature review, which aimed at identifying the determinants of technological innovation. These can be retrieved from the contingency tables for the Chi- Square test found in the appendix.

We perform the Chi-Square test in order to determine:

1. Whether there is evidence of a relationship between the demand-pull as well as technology-push innovations and innovation activities in small and medium enterprises (SMEs)

We determine the H_0 and H_1 hypothesis as follows:

- H_0: for the interviewed population of SMEs, there is no evidence of a relationship between the innovation activities and the technology-push or demand-pull type of innovations.
- H_1: for the interviewed population of SMEs, There is a strong evidence of a relationship between the innovation activities and the technology-push or demand-pull type of innovations.

After calculating the Chi Square test in SPSS we find a Chi-Square value of 0.737 and a probability of (0.864) for 3 degrees of freedom, which is larger than the p-value (0.05), as a result the null hypothesis cannot be rejected, thus the alternative hypothesis cannot be accepted. It can be stated that there is no strong evidence of a relationship between innovation activities and type (demand-pull or technology-push) of technological innovation

Table 1: Results of test on relationship between innovation activities and type of innovation (demand-pull and technology-push)

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)
Pearson Chi-Square	.737[a]	3	.864	.875
Likelihood Ratio	.735	3	.865	.875
Fisher's Exact Test	.741			.875
N of Valid Cases	151			

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 8.11.

Furthermore we perform another Chi-Square test in order to determine:

2. Whether there is evidence of a relationship between technological innovation activities and the planned or incidental type of innovations in small and medium enterprises (SMEs). The results of the Chi-Square test are illustrated below:

Table 2: Results of test on relationship between innovation activities and type of innovation (planned or incidental innovations)

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	23.809[a]	5	.000	.000		
Likelihood Ratio	24.631	5	.000	.000		
Fisher's Exact Test	23.909			.000		
Linear-by-Linear Association	.002[b]	1	.961	.980	.491	.020
N of Valid Cases	182					

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 10.04.

b. The standardized statistic is .048.

We determine the H_0 and H_1 hypothesis as follows:

- H_0: for the interviewed population of SMEs, there is no evidence of a relationship between innovation activities and timing (planned or incidental) of technological innovation
- H_1: for the interviewed population of SMEs, There is a strong evidence of a relationship between innovation activities and timing (planned or incidental) of technological innovation.

After calculating the Chi Square test in SPSS we find a Chi Square value of 23.809 and a probability of (0.000) 'insignificant number' for 5 degrees of freedom, which is smaller than

the p-value (0.05), as a result the null hypothesis can be rejected and the alternative hypothesis accepted. It can be stated that there is a strong evidence of a relationship between innovation activities and timing (planned or incidental) of technological innovation

Conclusions

The prior literature review emphasizes the understanding of innovation as a core business process where sequential linear models of 'technology-push' (from R&D to the market) and 'market-pull' (from market to R&D) evolve more and more towards coupling and matching process where interaction is considered to be a critical element (Rothwell, 1992).

Our finding with regard to the first preposition state that there is no strong evidence of a relationship between innovation activities and type (demand-pull or technology-push) of technological innovation. With regard to the second raised preposition we find that there is a strong evidence of a relationship between innovation activities and timing (planned or incidental) of technological innovation. However we consider that this study has certain limitations which lead to a somehow unexpected result, especially with the second preposition. This could be due to the poor understanding of SME managers on technological innovation and especially knowledge management. This was partially overcome by providing explanations to certain terms which were considered as being too specific and exceeding the level of expected common knowledge among SME managers.

Although we could verify that certain SMEs already perform some sort of knowledge management (through using certain technologies such as Google Drive or Dropbox) they do not relate it explicitly to the term knowledge management and do not have any routines in place or use best practices with regard to knowledge management and even have difficulties in understanding how it could lead to innovation. We also find that most Albanian SMEs do not have an organizational culture that favours the introduction of change, open collaboration or knowledge-sharing activities. Very often we encounter a strong resistance from staff and sometimes from management, also because of a lack of qualified and unexperienced personnel with poor IT skills and not supporting organizational culture.

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Appendix

SME definition in EU and Albania

According to the EU definition of 2003, an enterprise is "any entity engaged in an economic activity, irrespective of its legal norm". The focus being laid on the economic activity rather than the legal form (European Union, 2003). There are three criteria which determine whether an enterprise is classified as a micro, small or medium enterprise. These criteria are the staff headcount, annual turnover and balance sheet. An enterprise should meet the staff headcount threshold, but it can choose between meeting the balance sheet ceiling or the turnover without falling in a different category (European Union, 2003).

Table: Enterprise classification in the European Union

Enterprise category	*Headcount: Annual Work Unit (AWU)*	*Annual turnover*	*← or →*	*Annual balance sheet total*
Medium-sized	< 250	≤ € 50 million	*← or →*	≤ € 43 million
Small	< 50	≤ € 10 million	*← or →*	≤ € 10 million
Micro	< 10	≤ € 2 million	*← or →*	≤ € 2 million

Source: Adapted based on EU data from 2003 (European Union 2003, p.14)

According to the latest changes (2008) in the law no. 8957 of 2002 "on small and medium enterprises", in Albania, the category of micro, small and medium enterprises consists of enterprises which employ fewer than 250 persons and which have an annual turnover and/or an annual balance sheet total not exceeding 250 million ALL. Medium enterprises employ 50 to 249 persons. A small enterprise is defined as an enterprise which employs fewer than 50 persons (10 to 49 persons) and whose annual turnover and/or annual balance sheet total does not exceed 50 million ALL. A micro enterprise is defined as an enterprise which employs fewer than 10 persons (0 to 9 persons) and whose annual turnover and/or annual balance sheet total does not exceed 10 million ALL (European Union, 2012a).

Chi-Square Crosstabulation tables

Innovation activities * Planned and Incidental Crosstabulation

			Planned and Incidental		Total
			Planned	Incidental	
Innovation activities	Strategy and objective	Count	21	14	35
		Std. Residual	.6	-.7	
	Availability of technology and necessary infrastructure	Count	8	14	22
		Std. Residual	-1.0	1.1	
	Ressources	Count	16	5	21
		Std. Residual	1.5	-1.6	
	Top-management support	Count	13	9	22
		Std. Residual	.4	-.5	
	Motivational factors	Count	11	32	43
		Std. Residual	-2.4	2.5	
	Human ressource management	Count	26	13	39
		Std. Residual	1.3	-1.3	
Total		Count	95	87	182

Activities * Type of innovation Crosstabulation

			Type of innovation		Total
			Demand-pull	Technology-push	
Activities	Market research for innovative technology	Count	7	18	25
		Std. Residual	-.4	.3	
	Knowledge-sharing culture	Count	11	23	34
		Std. Residual	.0	.0	
	Usage of online collaboration technologies (Google Drive, Dropbox, Social Networks etc.)	Count	14	32	46
		Std. Residual	-.2	.2	
	Training on usage of new technology	Count	17	29	46
		Std. Residual	.5	-.4	
Total		Count	49	102	151