An Investigation of Innovation in Small Scale Industries Located in Science Parks of Iran

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Abstract

In recent decades with increasing of global economic competition, small scale industries have known as an economic growth engine and a tool for employment so they have important role in growth and development of countries. The importance small scale industries of is its need more investment for their survival and competition capability than big firms to new products and processes. Therefore, small scale industries are a potential resource for achieving new ideas and innovation. Previous studies on science and technology parks' performance in the most of countries demonstrate the effective and positive roles of these institutions in entrepreneurship, technology and economical development, increasing technological innovation and employment. This paper investigates the innovation in small scale industries which is settled in science parks of Iran. The primary data collected from questionnaire and has been analyzed through using SPSS version 16 software. The results of this study indicate that there are some factors that accelerate innovation within firms. Beside small scale industries has a positive and significant effect on innovation and the range of innovation in small scale industries is more than other firms.

Keywords: Innovation, Small scale industries, Science and Technology Parks

1. Introduction

Innovation is fast becoming a crucial factor in company performance and survival as a result of the evolution of the competitive environment (Wheelwright and Clark, 1992; Bueno and Ordon˜ ez, 2004). In this vein, Balachandra and Friar (1997) consider that the successful introduction of new products is the lifeblood of most organizations. The importance of product innovation for good long-term company results is now widely recognized and has been extensively reported in the literature (Capon et al., 1992; Lemon and Sahota, 2004; Montalvo, 2006). Innovation consists of successfully implementing creative ideas within an organization (Myers and Marquis, 1969; Amabile et al., 1996). Many researchers (Calvert et al., 1996; Hofstede, 1991; Janssens et al., 1995; Nejad, 1997; Porter, 1990; White, 1988) suggest that using the findings of innovation studies in advanced countries to explain the innovative behaviour in less developed countries is likely to be inappropriate. This line of thinking is supported by differences in national conditions that affect firm conduct and innovative performance.

Small firms have long engaged the interest of students of innovation. The innovative efforts of small firms embody a tension between serious barriers and distinct advantages relative to large firms. Establishing empirically the balance between these forces involved investigating whether small firms innovated more or less efficiently than large firms. From the policy viewpoint, new technology-based firms have been studied for their promise of growth and new jobs. Such studies have assumed that small firms were mini-large firms: Were mini-large firms more or less efficient innovators than large firms? Which mini-large firms would grow large?

Science and technology (S&T) parks have been viewed sceptically in much of the academic literature when judged in terms of technology development or urban renewal. Academic studies of science and technology parks have generally tended to be quite critical of their underlying assumptions and actual performance (for a summary

see Grayson, 1993). Perhaps the best known and most critical work in this respect is that of Massey et al. (1992), who regarded such parks as 'high tech fantasies (Quintas et al., 1992)

The role of innovation and its importance as a driver of competitiveness, profitability and productivity is well documented in the literature (Porter, 1998).

There are several factors that influence innovation in small firms. In this study, we are investigating some important factors that cause to increase innovation in SSIs.

The paper is structured as follows. First, we review the literature on innovation in SSIs and define the hypotheses. Second, we discuss the research methodology employed to carry out the empirical work. Third, the analysis is presented and discussed. Finally, the managerial implications of the results are discussed.

2. Literature review

The Austrian economist Schumpeter (1934) is the instigator of the idea of innovation and creative destruction. He defined innovation as "to create or use something new". This always goes together with the loss of old products and processes, Schumpeter calls this creative destruction. Schumpeter considered that the term innovation fits into five categories;

- Introduction of a new product or a qualitative change of an existing product;
- Process innovation which is new for a business sector;
- Opening of a new market;
- Development of new resources;
- Change in the organization and management.

Innovation is defined by Linder et al. (2003) as "implementing new ideas that create value". This generic description refers to the various forms that innovation can take such as product development, the deployment of new process technologies or innovative management practices (Zott, 2003; Glynn, 1996). From a practitioner perspective, this means the adoption of new products and/or processes to increase competitiveness and overall profitability, based on customer needs and requirements (Zahra et al., 1999; Mone et al., 1998). Effective innovation therefore means that SMEs need to maximize the creative resources that they possess (Nonaka and Takeuchi, 1995). The importance of innovation as a driver of performance and competitive advantage is well covered in the literature (McEvily et al., 2004; Shoham and Fieganbaum, 2002; Roberts, 1999; Hitt et al., 1996; Banbury and Mitchell, 1995). Kanter (1999) encapsulates the benefits of innovation by stating that "winning in business today demands innovation". However, existing studies on innovation focus largely on drivers of product development such as creativity (Amabile et al., 1996), resource availability (Dougherty and Hardy, 1996), mergers, acquisitions, divestitures, downsizing, and cost reduction (Hitt et al., 1996), as well as firm size (Acs and Audretsch, 1988). More recently, attention has focused on the need to meet customer demands in shorter product cycles using flexible manufacturing systems (Zenger and Hesterly, 1997).

However, despite the numerous articles and theoretical discussions, there is no conclusive theoretical perspective on innovation (Drazin and Schoomhoven, 1996; Tushman and O'Reilly, 1997). Following a review of previous research on innovation, Shoham and Fieganbaum (2002) suggest the need for additional theoretical integration to link organizational context with innovation – an issue addressed by this study.

Organizational innovation is in general a unidimensional phenomenon (Wilson et al.,1999). It expresses firms' proclivity towards the initiation or/and implementation of different types of innovations, such as technological, administrative, product and process. Along this line, its concept can be captured through different aspects within the organizational setting, such as technology-related, behaviour-related and product-related (Foxall, 1984; Hurley and Hult, 1998; Kimberly, 1981; Kitchell, 1995; Lumpkin and Dess, 1996; Rogers, 1983; Stalk et al., 1992).

Existing studies on the subject provide several leads about various factors that can be expected to contribute to the build-up of innovation capability. Factors internal to the firm include first of all, the knowledge and skills brought into the firm by the entrepreneur(s) and workforce, which they obtained through earlier experience. Firms require an adequate stock of technically qualified manpower to absorb new technologies, modify them, create and transfer new technological information, particularly scientists and engineers (Hoffman et al., 1998; Wignaraja, 1998). The inability to recruit high quality technical staff can be a serious constraint on subsequent growth (Hoffman et al., 1998). Firms can further enhance their human capital stock over time through (formal and informal) internal staff training (Bell, 1984). Yet another major internal activity is 'learning-by-doing' through involvement in R&D, both as a formally organised activity (Malerba,1992; Cohen and Levinthal, 1989;

Hitt et al., 2000) and as informal technological efforts closely allied to production, directed at incremental problem solving and experimentation on the shop-floor (Bell, 1984; UNCTAD, 1996; Kim and Nelson, 2000).

The determinants indicate that a number of important internal and external factors contributed, in varying degree, to the innovation capability of small firms. The analytical concepts and the relationships between these factors, developed by Romijn and Albaladejo (2004). The innovation capabilities of firms accumulate as a result of various internal and external inputs. From this model, potentially important internal sources that are generated inside firms include: i) The initial educational background and prior working experience of the founder(s)/manager(s); ii) The professional qualifications of the workforce. iii) Various kinds of technological effort which induce further accumulation of technological capabilities, such as formal and informal R & D, formal and informal (on-the-job) training, acquisition of technological licences, among others.

Those generated from external sources include: i) Frequency of networking with a variety of other private-sector agents and various institutions; ii) Any geographical proximity advantages associated with networking; and iii) The nature and extent of institutional support received.

In the literature, several definitions of SSI are given in. There is no universal definition of small scale industries. In some countries, there are certain objective standards, which classify the units as micro, small or medium enterprises depending on the number of employees. In some countries**,** the classification is based on the investment in fixed assets in plant and machinery.

A major topic in the innovation literature is the importance of SMEs for innovation. Studies have shown that SMEs contributed to the main innovations of the twentieth century (Oakey, et al., 1988; Rothwell and Zegveld, 1982; Rothwell, 1994).

Innovation is common across the entire small business sector, regardless of size, industry or geographic location. Driven by their passion for their business, concern for their customers and nonstop market pressures, many small business owners innovate on a continuous basis to survive and thrive.

Although science parks provide an important resource network for new technology-based enterprises. (Castells and Hall, 1994) listed three motivations for establishing science parks: reindustrialization, regional development, and synergy creation. The first two motivations are straightforward and could be described as science and technology (S&T) development and regional renewal. The third motivation involves the promotion of technology transfers from universities or research institutes to enterprises. At science park's geographic proximity, it could be viewed as "the generation of new and valuable information through human intervention" to the extent that an "innovative milieu", which generates constant innovation, is created and sustained (Castells and Hall, 1994; Phillimore, 1999). The underlying assumptions and performance involved in the issue of "science park" have been researched.

However, the results from these researches have not been unanimous (Castells and Hall, 1994; Massey et al., 1992; Westhead and Storey, 1995; Vedovello, 1997; Storey and Tether, 1998; Phillimore, 1999).

The science park concept was originated in the late 1950s. The idea was, and still is, to provide a technical, logistical, administrative, and financial infrastructure to help young enterprises gain a toehold for their products in an increasingly competitive market. Science parks are usually based around universities and interact continuously with them (Guy, 1996). Monck et al. (1988) argued that funding for science parks generally comes from five sources: universities (including bank borrowing); local authorities; government development agencies; private sector institutions, and the tenant enterprises themselves.

As a rule, innovation policies pursued by governments can be broadly divided into three categories:

- Provision of finance for innovation which can take the form of direct support through grants or loans for individual projects, and indirect support through fiscal concessions for R&D or other technology-based activities.
- Support for networking in order to improve the collaboration between firms and public sector laboratories and universities.
- Provision of advice, information and infrastructure through, for example, the creation of business centres specialising in the provision of technological services to small and medium enterprises.

Governments devote considerable resources to science parks as policy instruments aimed at promoting research-based industrial and innovative activity (Lo¨ fsten and Lindelo¨f, 2002). Lorenzoni and Ornati (1988) suggested that enterprises located in "constellations" are more willing to seek information from outside sources such as higher education institutes, consultants, and community entrepreneurs than off-park enterprises.

Comparing the differences between science park and off-park enterprises, the observed differences could reflect the motivations of the enterprises as well as the benefits of a science park location (Lo¨fsten and Lindelo¨f, 2002). Felsenstein (1994) suggests science parks are "enclaves" for innovation. A cluster is defined as groups of related enterprises located in one geographical region or centered at a nation's science-based park (Baptista and Swann, 1998). The clustering and interchange process among industries in the cluster also works best when the industries involved are geographically concentrated. Many of the determinants for innovation capacity are more similar within a nation than across nations. Government policy, legal rules, capital market conditions, factor costs, and many other attributes that are common to a country make these differences important (Porter, 1990).

Previous works have also investigated the importance of SMEs as drivers of economic growth and policy issues in national economies (Birch, 1989; Radosevic, 1990; Bowen and Ricketts, 1992; Sullivan and Kang, 1999; Henderson, 2002; Fisher and Reuber, 2003). Henderson (2002) contends that entrepreneurs create new jobs, increase local incomes and wealth, and connect the community to the larger, global economy. The recognition of the importance of innovation and SMEs has led to the development of the National Systems of Innovation in several countries. Birch has been at the forefront of the research in this body of work (Birch, 1989; Birch and Medoff, 1994). For instance, Birch (1989) coined the term "gazelle" to refer to SMEs that have a high growth rate. It has been suggested that SMEs (e.g. "gazelles") operating high growth businesses are the engines of the economies and provide the majority of new jobs. While much has been researched about high growth SMEs, their roles and importance in the economy, what has been lacking in many of the studies in this stream is the important role that innovation plays in fueling such growth in the SMEs. Further, there is a dearth of studies relating to the understanding of the types of innovation that SMEs pursue and their impact on performance. This is potentially a major contribution to the innovation.

SMEs have some advantages because of their size. Many are flexible and have strong relationships with customers, enabling rapid response to technical and market shifts. Small firms usually have good internal communications and many have a dynamic and entrepreneurial management style (Rothwell, 1994). As well, some studies suggest that the average capability of technical people is higher in small firms and that innovations in these firms can be less expensive (Cooper, 1964). SMEs usually explore new technical spaces. In summary, innovation in small firms can be (more) efficient and effective (Vossen, 1998).of iOn the other hand, many SMEs are not innovative at all. Researchers have stressed the differences between a limited number of very innovative small firms and a large number of non-innovative firms (Acs and Yeung, 1999; Hadjimanolis and Dickson, 2000) Many obstacles to innovation in SMEs are also stressed in the literature. The lack of financial resources, inadequacy of management and marketing, lack of skilled workers, weakness in external information and linkages, and difficulty in coping with government regulations are factors that limit their competitiveness (Buijs, 1987; Freel, 2000; Rothwell, 1994). SMEs may be unable to exploit new products because of the limited organizational and marketing capabilities. Other studies discuss cultural barriers to innovation, such as reluctance to change, tendency to ignore procedure, focus on short-term requirements, lack of strategic vision and the diffusion of a blame culture (Filson and Lewis, 2000; Freel, 2000). SMEs' main problems are due particularly to the scarce attention devoted to organizational and managerial problems especially in the field of innovation (Cobbenhagen, 1999). SMEs are generally considered to have behavioural advantages that may justify their significant share in innovation (Dutta and Evrard, 1999), despite the disadvantages most often attributed to resource constraints (Freel, 2000). Their role has been recognised by policy makers in all countries. Surprisingly however there is almost no literature addressing specifically the determinants of innovation in smaller countries (Souitaris, 2001), although their industrial structure is dominated by SMEs. Clearly there is a need for empirical research in such countries which will be directed to identifying factors affecting SSIs' innovation.

3. Hypothesis

According to literature review and empirical research studies, we propose following hypothesis:

H1: Increased life time of organization in the Science and Technology park, innovation of firm increases.

H2: With increasing number of experts working in enterprise, the innovation of firm increases.

H3: With more investment in research and development (R & D) business, the innovation of firm increases.

4. Methodology

Sample and Data collection

To examine the innovation on small business, we conducted a survey from January to April 2010 among firms that are located in Science and Technology of Iran (East Azarbaijan province). East Azarbaijan is industrialized province in Iran. There are many SSIs in this province.

We choose a written survey in form of a standardized questionnaire adapted from Calantone et al, (2003) as appropriate way to collect data. All of our respondents were in charge of firms with in Science and Technology Park. Questionnaires were distributed by ourselves and we follow and chase the result of them by phone. We received 40 questionnaires that were filled completely and accurately.

General specification of different firms are given in figure 1. It is Summary of results of general companies responsive sections that has been gathered by the questionnaire. As can be seen scattered examples of life time of the organizations in terms of number of experts working in the organization and its industry sector activities is considerable.

5. Measurement

We evaluate our construct measurement in this study by examining the reliability and validity of the measurement scale. To examine reliability, we consider cronbachs alpha, by using SPSS software that is presented in table (1). Since Cronbach's alpha (0.81) is larger than 0.6, the reliability is acceptable.

In this study, we investigate innovation in SSI that are located in science and technology park of East Azarbaijan in Iran. Each section of the questionnaire indicates a particular variable, thus for analyzing desired section and analyzing the amount of variables on innovation, regression analysis is suggested as analysis method. We apply SPSS software version16 for analyzing data. Thus we used following pattern for analyzing data:

$$Inno_t = \alpha + \beta\ ITM_t + \gamma\ NOE_t + \delta\ R\ \&\ D_t + U_t$$

Inno: Innovation in firm

ITM: Life time of organization

NOE: Number of experts that are working in firm

R&D: Investment in research and development sector

U: Disturbing part

α, β, γ and δ respectively indicate width of source, influence of life time of organization on innovation, influence of number of experts on innovation and influence of investment in research and technology in firms.
Table 2, presents respectively, the correlation coefficient, coefficient of determination, adjusted coefficient of determination and standard error. The model correlation coefficient equal to 0.735 indicates high correlation and strong correlation among variables. According to Durbin-Watson test, (2.027) we can apply regression because there is no autocorrelation between errors.

Table 3 contains regression analysis of variance to evaluate the existence of linear association between variables. In this model, Sig. is less than 5 percent, thus we assume that the model is linear.

According to Table 4, column B, respectively, the constant regression coefficients are presented and therefore this model as a regression equation is Y = 1.310 +0.169 X1 +0.097 X2 +0.363 X3. To compare the effects of three variables in the regression model on the dependent variable, the standard coefficients are used. Therefore, the results to be explained are as follows:

- Variable coefficient of life time of organization equals 0.257 and at 0.031 is statistically significant. This result represents a significant and positive effect on life time of organization on innovation.

- Coefficient of variable number of experts in the business equal 0.169 and at 0.181 that showed non-significant effect of human capital on innovation in firm.

- Variable of investment in research and development in firms equals 0.575 and at 0.000 is statistically significant indicating the positive impact on innovation and meaning of this variable on innovation. Thus, investment in research and development has the most influence on firms in order to increase innovation.

Briefly increased life time of organization in the science and technology park causes to increase in innovation of firms. Thus firms with higher life time of organization are more innovative. In addition increasing number of experts working in enterprise does not cause to increase in firm innovation. Thus, the rate of innovation among firms that the number of experts working in them is not increased, it depends on other factors. Development of R

& D in firms cause to increase in firms innovation. Therefore, rate of innovation among firms that invest more in R & D are far higher than other firms.

6. Finding, Discussion and Conclusion

This paper contributes to modeling and measuring a typical innovation process with consideration of the several internal factors which influence innovation in firms. The frame-work was applied to Iran's Small Scale Industries located in Science and technology Parks. This study has been investigated the influence of "Life time of Organization, Number Of experts, R&D" on innovation in firms. The results of analysis show that all the hypotheses, except H2, are supported. Briefly, the statistical results show that two factors in order of importance are: (1) Investment in R&D (2) Life time of Organization.

The implications of the findings: According to results, there is significant, positive and strong relationship between investment in R&D and firm innovation. Thus, they have to notice to research and development (R&D) part and invest more in this section because it is the main district for improvement innovation in organizations. Other factor is life time of organization which has significant and positive relationship with firm innovation too. According to the result of regression, life time of organization is significant in innovation. With increasing age of firms in Science Parks, they have more opportunities to having more innovation.

It is perhaps surprising that the variable of number of experts in firms showed no statistical significance in this study. While it may be intuitive that should logically result in greater dispersion of ideas, and hence enhance the potential for the generation of new ideas, but it does not seem to be the case in this study. One possible and significant explanation for this unusual result could be due to the segregation of knowledge into their activities. It means they can't use their knowledge or maybe experts' activities in firms not sufficient alone for innovation and dependents on other organization factors. This study has therefore shown that organizations have it within themselves to improve their level of innovation and small firms have good potential for innovation so special innovation funds are no doubt important in providing a suitable infrastructure for innovation to proceed smoothly.

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Table 1. Reliability Statistics

Cronbach's Alpha	N of Items
.811	15

Table 2. Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.735[a]	.541	.503	.48325	2.027
a. Predictors: (Constant), id8, years of firm activity, number of specialistis in firms					
b. Dependent Variable: id					

Table 3. ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9.903	3	3.301	14.135	.000[a]
	Residual	8.407	36	.234		
	Total	18.310	39			
a. Predictors: (Constant), id8, years of firm activity, number of specialistis in firms						
b. Dependent Variable: id						

Table 4. Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.310	.349		3.754	.001
	years of firm activity	.169	.075	.257	2.251	.031
	number of specialists in firms	.097	.071	.169	1.364	.181
	id8	.363	.078	.575	4.673	.000

a. Dependent Variable: id

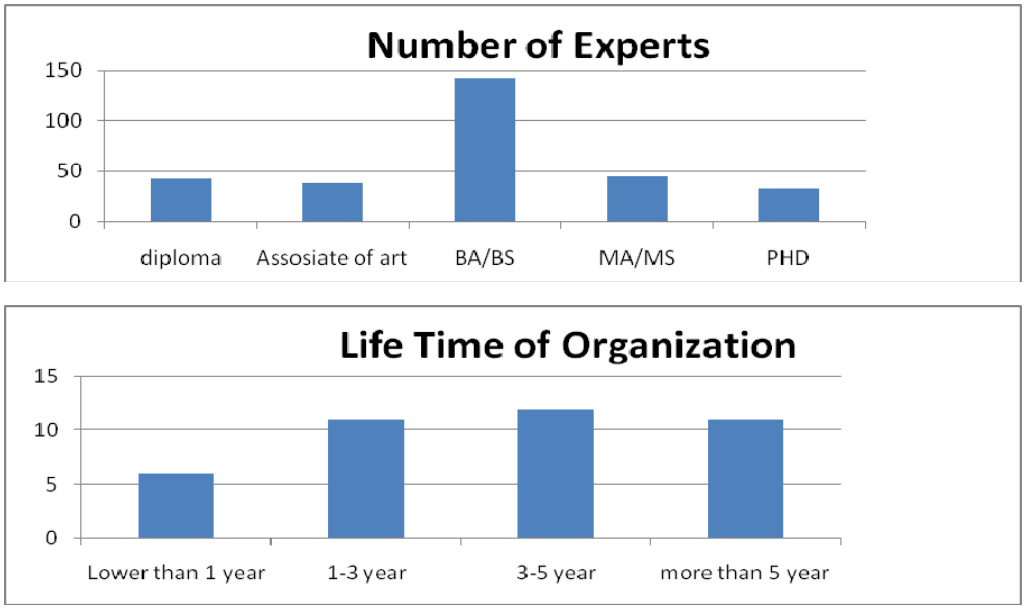

Figure 1. General specification of sample

ISSN 1833-3850 E-ISSN 1833-8119