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Identifying and weighting elongation factors promoting science and technology parks for development of the national innovation system

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A B S T R A C T

This paper presents an empirical investigation to identify and weight elongation factors promoting science and technology parks for development of the national innovation system. The study designs a questionnaire in Likert scale and determines the relative importance of seven groups of items including policy, financial resources of innovation, knowledge acquisition for innovation, upgrading innovation technology, knowledge distribution, human resources development and good and service production. Using some statistical observation, the study indicates that human resources development is the most important factor followed by financial resources and policy. In addition, the study has determined positive and meaningful relationships among all pairs of factors in development of national innovation system.

1. Introduction

During the past few years, there have been tremendous changes on technology development in the world and most of these changes come from innovative ideas (Higgins, 1995). Thanks to innovative I-Pad and IPhone products, Apple has become one of the world's biggest firm and customers look for new products and services (Johnson, 2010; Nicolaï & Nicolaï, 1998; Linden et al., 2009; Hawn, 2004; Chesbrough, 2006). There are many other knowledge based firms, which rely on their creativity and innovation to develop their product and services (Phillimore, 1999). Pontiskoski and Asakawa (2009) discussed on the application of open innovation in three case examples of Apple, Nintendo, and Nokia. They described how each firm overcame barriers to utilizing open innovation strategy in R&D and commercialization projects. They identified three levels of barriers including cognitive, behavioral, and institutional, and explained the companies balanced between internal and external resources to launch products that were instrumental in firms reinventing themselves in mature markets.

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Durão et al. (2005) explained that virtual science and technology parks (V-STPs) and real-estate-based science and technology parks (RE-STPs) should not be alternative or opposed institutions but rather complementary solutions, since these two concepts may include strong synergies. They stated that the 'On Line Innovation (ONLI) project', corresponding to an 'ONLI' initiative, was a virtual European network of STPs for innovative services, developed by six organizations from various European countries under a European Union founded program.

According to Shelton (2009), product innovation alone does not generate sufficient or sustained competitive advantage and growth. Increasingly, industry leaders—such as HP, Apple, Rolls-Royce, TomTom, and GE—are complementing their product offerings with service innovations to create solutions, which build bigger customer value, improve brand preference, and create bigger cross-selling opportunities. We should keep in our mind that there is a need to fuse technology and business model innovation by organizing and leveraging the appropriate resources.

Hinterhuber and Liozu (2014) presented a canvas laying out more than 20 possible methods for innovation in pricing, offering to any organization, regardless of size, industry, or nationality, a few key ideas on how to increase both profits and customer satisfaction.

2. The proposed study

This paper presents an empirical investigation to identify and weight elongation factors promoting science and technology parks for development of the national innovation system. The study designs a questionnaire in Likert scale and determines the relative importance of six groups of items including policy, financial resources of innovation, knowledge acquisition for innovation, upgrading innovation technology, knowledge distribution, human resources development and good and service production. The study first distributes the questionnaire among some experts to validate the overall questionnaire. Table 1 demonstrates Cronbach alphas for six items.

Table 1
The summary of Cronbach alphas calculated for six items

Item	Cronbach alpha
Policy	0.82
Financial resources of innovation	0.86
Knowledge acquisition for innovation	0.81
Upgrading innovation technology	0.76
Knowledge distribution	0.87
Human resources development	0.84
Good and service production	0.89
Total	0.89

As we can observe from the results of Table 1, all components of the survey maintain high level of values and this confirms the overall questionnaire.

3. The results

In this section, we present details of our findings on testing various factors.

3.1. Policy

The first item of the survey is associated with policy and Table 2 demonstrates the results of survey. As we can observe from the results of Table 2, all components associated with policy are statistically significant and we can conclude that they are effective on development of national innovation system.

Table 2
The summary of the effects of policy related issues on development of national innovation system

Item	Mean	Mean-diff	Sig.	df	t-value
Priority and the foundation of future activities	4.21	1.71	0.000	99	22.61
Professional management team	4.2	1.77	0.000	99	21.72
Future and national long-term plans	4.2	1.70	0.000	99	22.60
Promotion and development of strategic technologies at a competitive level	4.17	1.67	0.000	99	21.79
Effective management development center	4.05	1.55	0.000	99	19.16

3.2. Financial resources of innovation

The second factor is associated with financial resources of innovation with eight items described in Table 3 as follows,

Table 3
The summary of the effects of financial related issues on development of national innovation system

Item	Mean	Mean-diff	Sig.	df	t-value
Access to financial resources	4.2	1.70	0.000	99	21.14
Society acceptance	4.18	1.68	0.000	99	21.80
Financial support on behalf of industry	4.15	1.65	0.000	99	18.98
Financial support on project with high priorities	4.15	1.65	0.000	99	21.06
Capability of attracting financial support from international and NGOs	4.06	1.56	0.000	99	17.61
Capability of attracting financial support from provincial and federal governments	4.05	1.55	0.000	99	18.87
Financial support of non-financial organization involved with basic sciences	4.03	1.53	0.000	99	18.07
Tax relief promotion plans	4.01	1.51	0.000	99	16.75

According to the results of Table 3, all financial related components influence positively on development of national innovation system.

3.3. Knowledge acquisition for innovation

Knowledge acquisition for innovation is the third factors influencing on development of national innovation system and Table 4 demonstrates the summary of our survey.

Table 4
The summary of the effects of knowledge acquisition factors on development of national innovation system

Item	Mean	Mean-diff	Sig.	df	t-value
Access to financial resources	4.28	1.78	0.000	99	22.83
Society acceptance	4.15	1.65	0.000	99	18.98
Financial support on behalf of industry	4.14	1.64	0.000	99	17.19
Financial support on project with high priorities	4.12	1.62	0.000	99	20.37
Capability of attracting financial support from international and NGOs	4.05	1.55	0.000	99	18.08
Capability of attracting financial support from provincial and federal governments	4.04	1.54	0.000	99	16.34

Based on the survey results shown on Table 4, we can conclude that all six factors influence positively on development of national innovation system.

3.4. Upgrading innovation technology

Upgrading innovation technology is another important factor with four sub-component, summarized in Table 5.

Table 5
The summary of the effects of factors associated with upgrading innovation technology on development of national innovation system

Item	Mean	Mean-diff	Sig.	df	t-value
Rate of Spin-off firms extracted from science and technology parks	4.19	1.69	0.000	99	17.59
Support for newly established innovative firms	4.04	1.54	0.000	99	18.33
Availability of expert human resources	4.02	1.52	0.000	99	17.35
Improvement on innovation capacities for development of new ideas	4.02	1.52	0.000	99	19.86

The results of Table 5 specify that all four sub-components affect development of national innovation system.

3.5. Knowledge distribution

Knowledge distribution is another important factor, which is investigated in our survey. Table 6 shows the results of our survey.

Table 6
The summary of the effects of factors associated with knowledge distribution on development of national innovation system

Item	Mean	Mean-diff	Sig.	df	t-value
Generation and distribution of technological opportunities	4.07	1.57	0.000	99	18.09
Improved and timely distribution of knowledge and technology in firms	4.07	1.57	0.000	99	21.55
Recipients of capacity building and improved social context of science and Technology and innovation in community	4.05	1.55	0.000	99	19.78
Combining a cluster of units as well as creating synergies	4.03	1.53	0.000	99	16.71

The results of Table 6 clearly show that all components of the survey influence on development of national innovation system.

3.6. Human resources development

Human resources development (HRM) with six components is another component of the survey, which influences on development of national innovation system and Table 7 summarizes the results of our survey.

Table 7
The summary of the effects of HRM related factors on development of national innovation system

Item	Mean	Mean-diff	Sig.	df	t-value
Availability of workforce	4.17	1.67	0.000	99	21.79
Training, consultation and technical support	4.13	1.63	0.000	99	20.19
Existence of full time employees with, at least, bachelor degree of science	4.12	1.62	0.000	99	20.71
Regular replacement of university graduates	4.11	1.61	0.000	99	17.50
Commercial and Business Consulting Services	4.09	1.59	0.000	99	18.88
Workforce improvement program	4.09	1.59	0.000	99	21.10

The results of Table 7 demonstrate that all six factors associated with human resources development influence on development and advances of national innovation system.

3.7. Good and service production

In order to measure the effects of the mentioned factors on good and service production, the proposed study of this paper uses Pearson correlation ratio. Table 8 shows details of our findings. The results of

Table 8 indicate that there were positive and meaningful relationships between different components of the survey and development of national innovation system. The highest ratio belongs to knowledge distribution system followed by upgrading innovation technology and Knowledge acquisition for innovation.

Table 8
The summary of Pearson correlation between seven factors with development of national innovation system

Item	Pearson ratio	Sig.
Policy	0.31	0.00
Financial resources of innovation	0.475	0.00
Knowledge acquisition for innovation	0.452	0.01
Upgrading innovation technology	0.465	0.023
Knowledge distribution	0.549	0.033
Human resources development	0.313	0.041
Good and service production	0.442	0.048

4. Discussion and conclusion

There is no doubt that any economic development on society depends on creating new ideas. It is always important to learn more about the factors influencing the development of national innovation system. In this paper, we have presented an empirical investigation to determine important factors in this field in Iran. The study has determined that all seven groups of items including policy, financial resources of innovation, knowledge acquisition for innovation, upgrading innovation technology, knowledge distribution, human resources development and good and service production could contribute on innovation technology development. The results of our survey are consistent with findings earlier reported by Sun et al. (2007), Woodruff (1997) and Kandampully and Duddy (1999).

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