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Emerging technologies—beyond the chasm: Assessing technological forecasting and its implication for innovation management in Korea

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ABSTRACT

Technology forecasting is inevitable in modern society; however, few studies have assessed it under an innovation management framework. By employing the Innovation Readiness Level, we have assessed the innovation performance of the 10 Emerging Future Technologies reported in 2009. The data-mining process, including a patent analysis and survey results, validates the following hypotheses. 1) Technological innovation activities involving the 10 Emerging Future Technologies have increased after their announcement. 2) A chasm exists in the commercialization process of the 10 Emerging Future Technologies. 3) Interaction between innovation practitioners is correlated with overcoming the chasm. 4) Government support is useful for groups having difficulties in overcoming the chasm. Those foundations stress the roles of technological forecasting when entrepreneur assumes the risk associated with uncertainty in commercializing emerging technologies.

1. Introduction

Any individual, organization, or nation that can be affected by technological change inevitably engages in Technology Forecasting (TF) with every decision that allocates resources to particular purposes. A technological change may invalidate a resource allocation decision. Therefore, every decision is based on the forecast that technology either will not change or will change favorably. If technological change is inevitable, TF can be justified based on its use in decision making, which implies that TF facilitates better decision making. In particular, forecasts play specific roles in improving the quality of decision making in each innovation management stage (Martino, 1993).

Hébert and Link (2009) have reported the entrepreneur exhibit no fewer than 12 identities of the entrepreneur in the historical economics literature. The entrepreneur can be the person who assumes the risk associated with uncertainty, the person who supplies financial capital, an innovator, a decision maker, an industrial leader, a manager, an organizer of economic resources, the owner of an enterprise, an employer of factors of production, a contractor, an arbitrageur, or an allocator of resources among alternative uses. Link and Scott (2010) have defined 'government as entrepreneur' as a unique lens through which to characterize a specific subset of government policy actions. If TF is indispensable to entrepreneur, its role should be determined from the 12 identities of entrepreneur.

Since innovation management frameworks have developed in the entrepreneurial perspectives, the entrepreneurial roles of TF can turn out from assessing it by innovation management framework. Among the diverse innovation management

Abbreviations: TF, Technology Forecasting; IRL, Innovation Readiness Level; EF Techs, Emerging Future Technologies; BMI, Brain Machine Interface; RNA, Ribo-Nucleic Acid; IoE, Internet of Everything; iPS, induced Pluripotent Stem Cell; IPC, International Patent Classification; CIS, Community Innovation Survey; O1, non-overcoming group; O2, overcoming group.

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techniques such as the Technology Readiness Level (Mankins, 1995) and Market Adoption Model (Moore, 1999), we adopt IRL (Tao et al., 2010) as evaluation framework. The IRL is a model integrating extant studies considering technology development and market evolution. Its innovation readiness concept involves dividing the whole innovation cycle into six phases and the readiness level into five key aspects to provide overall, explicit, and practical evaluation items for each element, so it has an advantage by discovering a chasm if it has a level less than 4. Adams et al. (2006) stressed that other techniques have not integrated sufficiently to conceptualize innovation as a process, differentiate its constituent phases. IRL can provide a comprehensive framework to measure them. Although IRL has a potential advantage in linking TF to entrepreneurship by assessing TF, very little research has focused on these advantages. In fact, TF have an important role in innovation management but its ex post evaluation has scarcely been reported on. The previous pioneering case studies, such as Japan (Kameoka et al., 2004) and Turkey (Öner and Beşer, 2011), have contributed marginally to progress linking TF to entrepreneurship, but the chasm-related researches, known as pertinent entrepreneurial issues, have not explored in assessing TF.

Based on the IRL, our study reveals the contributions to innovation, of the 10 EF Techs reported in 2009, such as TF effectiveness, its commercialization implications, and the effectiveness of public policies. For a brief introduction to the contents, we structure this report as follows. Section 2 describes the 10 EF Techs announced in 2009 and the methodological approaches have discussed in the Section 3. Section 4 deals with the assessment results. Section 5 presents discussions on the implications of assessing the TF. The final section closes with conclusions and suggestions.

2. Background

2.1. The 10 EF Techs in Korea

Several organizations have forecasted emerging technologies and reported on their forecasts. Some well-known forecasts are "Disruptive technologies" (Mckinsey Global Institute, 2013), "10 Breakthrough Technologies" (MIT, 2012), "Next 5 in 5" (IBM, 2012), and "Top 10 Strategic Technologies" (Gartner Group, 2012).

Similarly, in Korea, emerging technologies, which can be crucial to increasing the nation's prosperity, have reported regularly, because of their potential advantage in adding new value and reducing social opportunity cost. "The 10 EF Techs in Korea" (KISTEP, 2009) have been reported since 2009. The wiki-based approach have been applied to the first report of the 10 EF Techs since it can take its own advantage of the effective knowledge formation process in incorporating members' opinions, framing policies, and leading to the discovery of knowledge through a standardized consensual process. After identifying 25 candidates by the economic impacts expected over the following 10 years, the wiki-based expert review have selected the final 10 technologies depending on the purpose of forecasting. The final 10 technologies were BMI, RNA-based therapeutic agent, graphene nanostructure, clean coal technology, dye-sensitized solar cell, IoE, iPS, human body communication, cognitive robotics, and life-logging technology.

2.2. Conceptual framework

The year 2014 marks five years since the announcement of the 10 EF Techs in 2009. Therefore, an interim check is necessary because, normally, a 10-year period is considered when selecting such technologies, to evaluate their realization

Table 1
Commercialization tracing by patent disclosures.

Cause: disclosure	Lag (yr.)	Effect (sales/capital)		Effect (sales/employee)		Effect (capital/employee)		Effect (sales)		Effect (capital)	
		Forward	Reverse	Forward	Reverse	Forward	Reverse	Forward	Reverse	Forward	Reverse
BMI	1	8.718*	0.071	0.002	0.156	3.483	0.099	0.002	0.156	1.155	4.031
	2	5.213	3.244	23.76*	7.627	2.218	2.646	23.76*	7.627	14.89*	3.442
RNA-based therapeutic agent	1	28.42**	0.217	0.701	3.499	0.047	0.146	0.008	0.645	0.108	7.272
	2	8.961	0.673	3.498	0.222	0.285	2.094	0.049	5.723	16.52*	2.59
Graphene nanostructure	1	0.334	0.431	2.111	7.513*	0.204	2.824	–	–	–	–
	2	38.23**	6.452	16.02*	2.604	0.845	7.38	–	–	–	–
Clean coal technology	1	0.071	0.325	0.396	0.396	2.133	0.183	–	–	–	–
	2	1.034	2.698	0.667	3.026	0.675	22.91*	–	–	–	–
Dye-sensitized solar cell	1	1.012	2.847	3.015	2.682	0.733	2.749	–	–	–	–
	2	0.731	0.782	1.565	0.64	0.746	0.374	–	–	–	–
IoE	1	0.002	0.982	0.141	0.553	1.118	3.852	–	–	–	–
	2	0.416	0.297	1.228	2.411	0.796	1.141	–	–	–	–
iPS	1	0.959	2.283	22.71**	6.098	6.119*	0.03	–	–	–	–
	2	5.46	0.787	4.35	5.796	14.1*	1.591	–	–	–	–
Human body communication	1	0.267	0.136	0.222	0.467	0.007	1.413	–	–	–	–
	2	1.89	7.392	0.495	3.263	2.469	2.696	–	–	–	–
Cognitive robotics	1	0.942	0.006	1.327	0.019	9.965*	0.013	27.9**	0.002	1.891	0.002
	2	0.375	9.156	0.451	1.476	2.937	3.734	20.85*	1.104	0.823	1.714
Life-logging technology	1	27.54**	1.15	0.05	17.45**	1.63	0.102	–	–	–	–
	2	22.15*	0.823	2.707	5.739	0.04	6.653	–	–	–	–

* $p < 0.05$.
** $p < 0.01$.

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