Learning from Benchmarking: A Comparison of Iranian and Korean Foresight Exercises†

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Abstract

What are some of the explanations for cross-national diversity of foresight performance among technological followers? Why are some countries more successful than others in learning how to develop national innovation system foresight? This paper argues that the answers are linked to organizational capacities at three different levels: governmental, policy network and social learning. To corroborate this argument, the paper chose Iran and Korea as benchmarking partners, and attempts to find out what makes Iran a slow learner in building innovation system foresight. The conceptual model is an improved model of Saritas's, by integrating Borras' and Andersen's conceptions and classifications. The data are collected from comprehensive interviews in both countries and second-hand data of international indexes. The paper, finally, concludes that it is the weakness of analytical-systemic capacity that impedes and delays the emergence of systemic foresight in Iran, and that this weakness stems from the adverse impacts of the dominant institutions, surrounding the innovation system. The final point is that it is not sufficient for Iran to learn the methods and techniques of foresight from Korea. It should learn how to open its macro-policy towards the global market and design appropriate industrial strategy in a coherent policy-strategy portfolio.

Keywords
Iran, Korea, foresight, intelligent benchmarking, learning capacity, STEEPV

† The author would like to thank the anonymous reviewers for their very constructive comments.

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1. INTRODUCTION

Although Iran's first and second Pre-Foresight Exercises at the national level, launched in 2005 and 2007 respectively, did not accomplish the goals for which they were designed, they have rendered the Future Studies an excitement ever since (Paya & Shoraka, 2010). Promising foresight that would be open-ended, participatory, and action oriented, Iran seemed to be at the beginning of a radical change against 60 years' worth of central planning backdrop on which Iran future looking activities has been shaped. The government has created offices and/or institutes whose principal objective is to adopt methods of Future Studies. In academia, 9 universities, including the prestigious Tehran University, have started to offer Ph.D. programs in Future Studies. As a result of knowledge spillover from public organizations, private think tanks have emerged, including Assef Think tank, a spin-off from the Ministry of Defense, which has conducted various future oriented analyses (such as road mapping, visioning, etc.) for different organizations.

Surprisingly, such scattered efforts have not, thus far, led to the creation of a systematic integration of foresight into Iran's overall S&T policy formulation. This seems to be a learning failure. The purpose of this paper is to address this failure on the part of Iran innovation system governance, and to examine their causes and roots, using benchmarking.

This paper chooses the Korean foresight experience to study against Iran's case. It is a rather complicated task, involving opportunities and challenges. Iran has made strides towards technology development in recent years (UNCTAD, 2016); however, it is still a resource-based economy, and is heavily dependent upon its crude oil export revenues, and with more than 60 years of top-down central planning tradition, it shows reluctance to leave the old culture of closed hierarchical governance and use foresight to face future challenges and opportunities. On the other hand, systemic foresight is one of Korea's prime movers of its decision making process and governance (Ahn, 2017). Korea has a knowledge-intensive economy, and is a leader in numerous fields with a technological edge. That makes Korea a good benchmarking partner against which Iran can be compared, with a view to finding ways to improve its practices.

Moreover, Korea's foresight cycles have been the subject of a number of case studies and comparative studies: (Ahn, 2017; Choi & Choi, 2016; Cuhls, 2015; Da Costa, Warnke, Cagnin & Scapolo, 2008; Hwang, Kim, Son, & Han, 2011; Schlossstein & Park, 2006; Son, 2013b) which have made benchmarking a lot easier.

However, data is not the only requirement for cross-national benchmarking. Institutional context matters even more, which is challenging. There seems to be a large institutional distance between Iran and Korea. Korean and Iranian innovation systems have two very different backdrops in terms of cultural, political, economic and social conditions. Besides, Korean foresight exercise is far from a perfect picture (although there is no such thing as an optimal case in foresight anyway). For example, their foresight exercises have been target of criticism, especially regarding inclusiveness

and private sector participation. (Andersen & Andersen, 2012).

To deal with the aforementioned points and avoid imperfect benchmarking, the paper builds a conceptual model to compare Iran's experience of foresight exercises against Korean foresight experience, based on two pillars: Comparing Korea's strengths and weaknesses against the Iranian case with a view to improve exercises in both countries, and addressing the need for a third way in which both Iranian and Korean systems can pave the way for a more inclusive foresight exercise.

The conceptual model is based on the conviction that foresight itself encompasses a host of different levels of organizational learning processes, involving a variety of technical, institutional, policy, socio-political, and cultural issues. The hypothesis is that cross-national benchmarking is justifiable if one is mindful of the difference between the levels of organizational learning, and takes into account the conditions of each level.

In the following part, the paper presents literature review. Part III is devoted to research question and methodologies. The findings from qualitative and quantitative analysis of Korean and Iranian learning capacities are presented in Part IV and V, and the paper brings forth its discussion in Part VI, and finally, concludes in part VII.

2. LITERATURE REVIEW ON COMPARING NATIONAL FORESIGHT EXERCISES

Despite the fact that comparison is commonly used in more general settings than benchmarking, the two words are sometimes used interchangeably. In order to not miss any substantial work on foresight benchmarking, the paper looked into all literature materials providing national foresight comparison, especially those in which Korean foresight exercise is examined.

The general comparative literature dates back to the mid-1990s, starting with OECD in 1996 (OECD, 1996), continued with (Gavigan & Scapolo, 1999), and later, expands and accelerates in different forms (Weber, Amanatidou, Erdmann, & Nieminen, 2016). The vast amount of literature shows that there is no single methodology to underpin all the studies. As to the method of research, a mix of qualitative and quantitative methods is normally applied. Moreover, every study presents a special system of criteria upon which it classifies its foresight cases. In other words, there is generally a special set of assumptions around which the study pivots to explain the varieties or taxonomies of national foresights. Based on these assumptions, the literature can be divided into several categories. Among them, three stand out: The first category compares foresights with their internal organizations with parameters and qualitative and quantitative factors such as themes, rationales, duration (Havas, 2005). The second is a set of studies that look at the evolutionary process of national foresight, defining different generations for each foresight exercise (Georghiou, 2001; Havas, 2005). The general assumption is that there is a correlation between generations of foresight and the evolution of innovation systems and innovation models (Andersen & Andersen, 2012; Andersen & Rasmussen, 2014). And finally, the third category takes institutions involved in innovation gover-

nance (Havas & Weber, 2016) or the style of national governance (Keenan, 2002) and, more generally, political, economic and social institutions to classify foresight exercises accordingly (Andersen & Rasmussen, 2014).

In summary, there are three distinctive types of foresight classification. Each classification addresses one dimension, or "space," of national S&T foresights: the first focuses on organization and process of national foresight, or internal space. The second concentrates on the innovation system as the space linking the internal and external space, and the third one draws attention to the external space, including cultural, political, and social institutions and systems. The paper summarizes the abovementioned literature in Table 1. below as a rudimentary effort to build a conceptual model with three spaces.

TABLE 1. Three Interrelated Spaces of Foresight Exercise

	Category	Source	Assumptions to Explain the Variation of Foresight Exercises	Indicators
1	Content or Process of Foresight (The Internal Space)	(Havas, 2005)	Benchmarking exercises should be designed and conducted carefully, taking into account a host of actors and factors: themes, duration, aims, rationale, participants, etc.	Quantitative parameters: Size, duration, financial sponsorship, and repetition of foresight exercise, and well as some qualitative parameters
2	Generations of Foresight The Integration of Foresight with the Decision Making Process	(Andersen & Andersen, 2012; Georghiou, 2001; Havas, 2005)	The correlation between generation of innovation models, generation of innovation policies, and the generation of foresights (Andersen & Andersen, 2012)	1. Aims, domain, and participation (Havas, 2007) 2. Generation of innovation policy 3. Innovation model (Andersen & Rasmussen, 2014)
3	External Context of Foresight External Space	(Havas & Weber, 2016)	Exploring whether future-looking activities are compatible with innovation policy governance	1. Power structures: 2. Administrative culture: 3. Reliance on strategic policy intelligence: Relying on PPT or willingness (or lack thereof) to use them
		(Andersen & Rasmussen, 2014)	There is correlation between foresight integration to NIS and cultural institutions	The two spaces are power distance and uncertainty avoidance, which play a significant role in determining integration
		Michael Keenan and Rafael Popper in 2008 (Keenan & Popper, 2008)	The style of foresight is affected by geographical and historical factors	The distinct different regions are Northwest Europe, North America, Asia, Eastern Europe, South America, Southern Europe, and style is defined among eight spaces in terms of territorial scale, sponsors, number of participants, target groups, domain coverage, time horizon, use of foresight methods, and codified outputs of foresight

The literature review concludes with three points:

1. Content (the organization and process of foresight) and its surrounding context (political, cultural, geographical, and historical systems) are both vital when comparing two national foresight exercises.
2. Content (internal space) and context (external space) are interrelated: external space influences the content of foresight, in many ways. The most cited example in the literature is the impact of cultural settings when selecting the method of foresight, e.g., the choice of Delphi as the favorite method for collecting data in Asia versus workshops in North America (Keenan & Popper, 2008; Paya & Shoraka, 2010; Rusmussen, 2014). The content and process of foresight also impact innovation policy which might have, in return, enormous politico-economic and cultural repercussions on the surrounding systems (Weber, Amanatidou, Erdmann, & Nieminen, 2016).
3. The inter-space that links these two together plays a very crucial role to gate-keeping these interactions. It determines the dynamics of the whole foresight exercise.

Ozcan Saritas (Saritas, 2013) has already presented a conceptual model illustrating three separate, yet interlinking, spaces: the surrounding space encompasses social, technological, economic, and political and values (STEEPV) systems, while the inner space consists of content and process. His model, however, is relatively ambiguous and vague, as his description of the middle space (or "internal context," as he called it) conveys an amalgam of incoherent elements (skills, power, politics, and management) (Saritas, 2013).

Addressing this ambiguity as a research gap, the paper returns to the basics of policy learning and organizational capacity literature. Keeping in mind the different activities of foresight content and context, i.e., selecting and adapting, substantial part of the innovation policy is actually developed in the inter-space alternating between this two activities. It is the main place in which social needs and expectations guide science and technology endeavors carried out by managers and policy makers, using tools, such as translation, interpretation, and communication of information from external and internal spaces into each other's jargon and designing different co-creation and learning platforms.

3. RESEARCH QUESTIONS AND METHODOLOGY

Our main research question is what caused Iranian sluggishness in learning how to use foresight for designing national S&T policy. This is a typical question for innovation studies: Why do some countries learn less or slower than others? Another question would be what lessons one can draw from Korea as a fast learner in foresight exercise, and provided that there is no optimized case, next would be whether there is a third way for both countries to overcome the weaknesses of their styles of foresight and embrace the strengths of both experiences.
Table 1. already exhibits the contents of three distinct spaces of national foresight, extracted from

literature review. The relationships among these three spaces should then be codified, which is actually what one needs to compare two very different countries with different institutional settings, such as Iran and Korea, and find answers to the research questions.

Addressing this research gap, inspired by Borras' concept of organizational learning (2011) and Andersen and Andersen's co-evolution of innovation policy, model, and foresight (2014), the paper assumes foresight as a package of interactive learning processes using different mechanisms: scanning, scooping, visioning, interpreting, gaming, negotiating, and building consensus on social imagination about futures. The process requires various capacities. If one assumes foresight design and implementation to be a loop, first, it needs technical-methodological and managerial capacity for data gathering and implementing, and second, it necessitates analytical and systemic capacity to process the integrated nature of data, and third, it requires reflective-critical capacity to first include different visions and build consensus to provide legitimacy for the eventual result and then, to evaluate the impact of foresight on innovation policy. All three layers of technical, systemic, and reflective capacity share one important trait: They are inherently both the producer and the product of several processes of interactive learning at different levels.

In foresight, some issues are of informative nature within the reach of experts and researchers, such as managerial methods for organizing panels and groups or using tools to collect and analyze data. These processes can be learned by researching, copying other experiences, or learning by trial and error. Other processes need communicative capacity building through dialogue, negotiations, interactions, networking, translation of various policy fields into others, and fusion of the horizons among different networks, such as interactions between government policy planners and other policy networks, e.g., health industry or universities. At this level, analytical expertise and systemic thinking are most needed, in order to communicate through different policy spaces. Borras has called this organizational capacity "policy network learning (Borras, 2011)."

The third type of learning and capability building is related to the legitimacy of future visioning. It has transformative-reflective nature, and is concerned with the legitimacy of future vision and whether or not it includes public policy leaders, market players and civil society.

Since these learning processes have different natures, the paper draws on Borras (2011) and Howlett (2009)'s policy learning model to classify them by their actors, themes, and domain of learning. This is the way the paper develops a framework of codes to explain how different cross-national patterns are built, evaluation of foresights can be conducted, and learning occurs among nations.

As shown, the first layer is the level at which governments or firms learn how to design foresight process and content: How foresight exercises are organized, and precision and accuracy are improved. Learning at this level is technical and methodological (Table 1), and is transferable to other nations by monitoring, copying, searching, and training. The second layer of foresight is related to the relationship between foresight exercise and innovation policy in the national decision making

process. Based on the relationship between foresight and innovation system, the learning builds analytical-systemic capacity and reinforces the inter-space of foresight. The actors are professional networks, technology managers, policy analysts, and foresight organizers working with stakeholders. Obviously, the more developed the analytical-systemic capacity, the more integrated the foresight exercise and innovation system.

One of the conceptual instruments that can help to clarify the evolutionary nature of this level of learning is the concept of generations of foresight (Andersen et al., 2014; Georghiou & Cassingena, 2008). The concept of generations of foresight tends to illustrate the gradual progression of relationship between foresight and innovation policy. The proponents of this concept maintain that there is a process of co-evolution among models of innovation, innovation policies, and instruments, including foresight (Andersen & Andersen, 2012). The first and second generation foresight relied on supply push and market pull model of innovation. It is with the third generation of foresight that the insufficiency of 'bridging organizations' in the socio-economic system is recognized, and foresight starts to be seen as an arena for making the necessary network connections (Miles, Harper, Georghiou, Keenan, & Popper, 2008). This implies the broadening of a host of actors, including social stakeholders such as voluntary organizations, consumer groups, pressure groups, etc., into foresight projects. It also increasingly emphasizes socio-economic problem solving as an organizing principle rather than scientific opportunities (Georghiou, 2001). These changes imply that policy orientation moves towards a systemic ideal and closer to what we have described as 'innovation policy.' The analytical-systemic capacity can be measured by the determination of the innovation model and innovation policy type, as foresight exercise is co-evolved with them.

The third layer of foresight deals with transformative-reflective learning capacity. It transcends the innovation system, and relates to the harmony among the society (state-market and civil society) (Borras, 2011). When the national future vision of Future is for some reasons de-legitimized, the society needs critical and reflective capacity to build another and shift the dominant paradigm. It often entails a policy paradigm shift, from economic development to environment sustainability and social justice. This requires social learning and the change of deep cognitive-cultural institutions of the society – which are normally resistant to any alternations.

TABLE 2. Three Layers of Foresight Learning Capacity, Based on Borras (2011)

	Levels of Policy Learning	Actors	Lessons Learned	Organization Capacity	Qualitative Indicators	Proxies
Internal Space	Government learning	Government and Organizations	The technicality of the methods and managerial details	The managerial and technical capacity	Foresight is action oriented, participatory, and open ended	1. The number of cycles as the proxy of action orientation, 2. The size of participants as the proxy of participation 3. The number of technical methods used. as the proxy of openness 4. Targeted technologies

Inter Space	Policy Network Learning	Networks of stakeholders in the innovation policy	Relationship between foresight and innovation policy (IPF), to have a participatory, open ended and action oriented foresight	Analytical / systemic capacity for policy design and transition management	1. Model of innovation 2. Generation of innovation policy 3. Generation of foresight	1. Rothwell 's innovation model 2. Anderssen's innovation policy 3. Havas'three generations of foresight (Havas, 2007)
Political System	Social Learning	Socio-economic actors in the political system, visioning the futures regarding transition	Future means radical change and transition to a more inclusive and diverse society in which a balanced relationship among civil society, state and market exists	Integrative, reflective, and cognitive institutional capacity, harmony among social classes, inclusiveness of the political system, and willingness towards radical change	1. Political environment	Indicators in Global Innovation Index
Economic System					2. Business and economic environment	Indicators of Global Innovation Index
Cultural System					3. Cultural environment	Hofested's classification of cultural institutions (Hofested, n.d.)
Environmental Protection System	–	–	–	–	Environmental protection system	Environmental Performance Index (2016)
Social System	–	–	–	–	Social and welfare policy	Human Innovation Index (2016)
Technological Innovation System	–	–	–	–	Innovation policy	Global Innovation Index (2017)

Note: Author's own elaboration from Borras (2011) and Howlett (2009)

4. KOREA AND IRAN'S ORGANIZATIONAL LEARNING CAPACITY: FINDINGS OF THE QUALITATIVE ANALYSIS

4.1. The Content and Process of Foresight in Korea

Since implementing the first technology foresight (TF) in 1993-1994, TF in Korea has continuously advanced in response to the society's increasing demands. The Framework Act on Science and Technology (S&T) in 2001, which specified TFs to be carried out regularly, national TFs have been conducted every 5 years. In 2007, the third TF was revised to increase complementarities with the S&T Basic Plan, the nation's top-level plan in the field of S&T. The results of the revised TF were directly reflected in the second S&T Basic Plan. Furthermore, the results of the fourth TF (conduct-

ed during 2010-2011) were incorporated into the third S&T Basic Plan. All four TFs performed, to date, have primarily used the Delphi method. Since the third TF, future social trends were identified, then future technologies predicted based on these trends; moreover, the developed scenarios were founded on the results of the TF. Currently, the Ministry of Science, Information and Communication Technologies (ICT) and Future Planning (MSIP) is responsible for the TFs, while the Korea Institute of S&T Evaluation and Planning (KISTEP) conducts the TFs. (Ahn, 2017; Choi & Choi, 2016; Hwang, et al., 2011). The data analysis of Korea's Fourth Technology Foresight (2010-2011) is as below:

TABLE 3. Data Analysis of the Internal Space of Korea's Foresight Compiled, by the Author

1	Territorial Scale	National level
2	Sponsor	Ministry of Science, Information and Communication Technologies (ICT) and Future Planning (MSIP) is responsible for TFs, while Korea Institute of S&T Evaluation and Planning (KISTEP) conducts the TFs.
3	Participants	Experts in public sector and private sectors (based on their own merits)
4	Coverage	Social problems, Mega trends, Capability assessments, Emerging technology, Technological demand pull and supply push.
5	Time Horizons	2035 (20 years)
6	Methodology	a. Paper analysis; b. Trend analysis; c. SWOT analysis; d. Delphi; e. Scenario building; f. Technology roadmap…Big data for emerging issues, Themes: Codified outputs of foresight: Scenarios

As the result of fourth foresight exercise, 652 technologies were determined to be key future technology for Korea; 7.8 percent of these are supply push, and the rest (92.2) percent is extracted from scanning the social needs. (Ahn, 2017; Choi & Choi, 2016; Yim, 2017).

4.2. The Content and Process of Foresight in Iran

Iran is a country with over 60 years of central planning in economic development. The Plan and Budge Organization (PBO), established in 1948, had designed and monitored 6 consecutive development plans before 1979. After a short hiatus due to the turmoil of the Revolution of 1979, Iran resumed the five-year planning tradition. The goal, this time, was building "knowledge intensive society," especially after the third development plan (2005). This plan coincided with the key policy paper of "Iran Vision" at 2025. The document, for the first time, envisioned Iran in a time frame of next 20 years. It outlined the roadmap for the country's technological, economic, political, social, and cultural developments. The committee for preparation of the Vision was elected from top-level government officials and a circle of elites-experts. After Vision 2025, there was a flurry of technology-driven policy papers and master plans which were all elaborated by a limited circle of experts, selecting a list of scientific and technology priorities. The five-year development plans complemented these efforts by setting priority for nuclear energy, ICT, aerospace, and bio and nano-technologies as the future technologies of Iran, and mandated the government to invest on.

During 2005, Iran also witnessed another, and very significant, event regarding Future oriented activities: the first Pre-Pilot of Foresight for Most Appropriate Technologies for Iran (PAMFA I) was kicked off during this year. The goal was to gain experience through a genuine trial-and-error practice, and to prepare the foundation for the first national science and technology foresight. There were two phases; for each phase, three rounds of Delphi questionnaires were drawn up. It was decided that, for the first round of the Delphi, the report from Japan's 8th foresight be used as the guiding model for the exercise. The PAMFA I was sponsored by the Ministry of Science, Research and Technology, and the Center for Modern Technologies (CMT) and the Center of Defense Sciences and Technology Future Studies (CDSTFS) also pledged their financial support. The technologies chosen were not different from the technology priorities in the third five-year development plan. The 62 experts from Tehran and 60 from Esfahan participated in the PAMFA I in 2006. However, PAMFA I was soon halted due to financial difficulties, managerial problems, and shortage of skilled manpower.

PAMFA II was started in 2007. The panels of experts in the fields of energy, IT, biotechnology, aerospace, marine technology, manufacturing, new materials, and communication and electronics were established. It was decided that Japan's foresight formats would still be used as the main guiding model. The original questionnaire combined a set of questions adopted from the Japanese questionnaires, and some questions were devised to address local problems. The first round of the Delphi was in the fields of aerospace, marine technology, electronics and communication, and was distributed during winter of 2008. In total, 999 experts were identified in these fields, and the questionnaires sent. 637 experts completed and returned their questionnaires. For the second round of Delphi, the same team also translated a number of scenarios, given from the exercises carried out in various countries, for the main fields considered in PAMFA. Unfortunately, the fate of PAMFA II was not very different from its successor: this experience was also aborted, and never delivered what had been promised (Paya & Shoraka, 2010).

TABLE 4. The Internal Space of Foresight in Iran, by the Author

Indicators		
1	Territorial Scale	National level
2	Sponsor	The Ministry of Science, Research and Technology, Co-sponsored with the Ministry of Defense and Ministry of industry
3	Number of Participants	PAMFA I: 102 persons, PAMFA II: 637 persons
4	Targeted group	Selected experts
5	Coverage	Targeted technologies
6	Time Horizons	20 years
7	Methodology	a. Delphi, Brain storming,
8	Themes	Policy advice, (Shorka, Futures studies in Iran: Learning through trial and error, 2014)
9	–	As a result of pre-foresight I and II, A total of 7 technologies were selected for a supply push model

In measuring the distance between Korean and Iranian technical and managerial capacities, one should keep in mind that there is a difference between capacity in use and capacity in general. The data related to the national foresights shows that the gap between the two countries in relation to organization size, number of participants and repetition, and methods used in these exercises, etc., is quite large. Yet, numerous but scattered future activities in different forms of need scanning, road mapping, etc. shows that there are many potentials that are not actualized, due to some kind of systemic failure rooted at a much deeper level than managerial and technical level.

4.3. The Inter-Space: Systemic Innovation Foresight in Korea

Korean systemic foresight has co-evolved with its innovation system and innovation model. From the Global Innovation Index Report of 2017, the Korean innovation system received a score of 57.7, and was ranked 11 at the global level. According to the Global Competitiveness Report (2016-2017), its score is 5.03 out of 0.7, and is ranked 26 in the world. Korea is number one in total R&D, number 2 in GERD and tertiary enrolment, and number 3 in the number of researchers per million populations.

The literature on its foresight, however, demonstrates that there are some weaknesses along with strengths. A study published in 2006 by (Park, 2006) explained that Korea's Foresight Exercise was more systemic and organized than China's; a result of accumulating the experiences during past cycles and learning lessons from them, to harmonize the S&T policy design and foresight exercise (Paya & Shoraka, 2010). In more recent literature, the systemic nature of national technology foresight in the making was described in detail. Since the third technology foresight, Korea has considered, from the first stage, the relationship between technology and society, by identifying the needs of society and future technologies, to address those needs at different levels (Choi & Choi, 2016). At the second stage, it evaluated the impact of the implementation time of future technologies, and at the third stage, scenarios were created (Park & Son, 2010 as cited in Choi & Choi, 2016). During the fourth Korean technology foresight, the first stage forecasted the future of Korean society and examined future needs. The second stage identified future technologies and conducted the Delphi survey to examine factors, such as the technological implementation time and the time for socially penetrating future technologies, Korea's level of technology, main actors for technological development, and governmental policies required for implementing technologies. The third and final stage created scenarios and illustrations, depicting the shape of the future world that would be changed by implementing and distributing future technologies, divided into 13 different areas (Choi & Choi, 2016; Hwang, et al., 2011).

FIGURE 1. The Systematic Integration between Future Issues, Technologies, and Needs in the Fourth Cycle of Foresight

Global Trends	Future Issues
New International Economic Order	• Unlimited competition with globalization • Enlargement of common market • Global multi polar system (BRICs, TVT, …) • Rich-poor gap, etc
Problems of Energy, Resources, Environment Environment	• Competition for energy and resources • Demand for renewable energy and new materials • Change of life style • Industry change owing to resource depletion, etc.
Development and Acceleration of Fusion	• Multidisciplinary research and fusion technology • Not follow up but leading • Nurturing and supply of human resources • New manufacturing and producing systems, etc.
Change of Population Structure	• Low birth and old population society • Financial problems (medical insurance, farewell, …) • Silver industry and new style of medical service • Women's role, etc.
New Security Issue	• North eastern Asia politic complexity • Unification of south and north Korea • Use of weapon of mass destruction • Counter-terrorism strategies, etc.

Needs Related with S&T	
Information/ Communication	• IT based new industries • Development of fusion technologies with IT • Enlargement of cognitive ability and new communication service, etc.
Machinery/ Manufacturing	• New value creation in the processes of production and manufacturing • Demand on intelligent producing system • New industries including intelligent robot, etc
Space/ Aerospace Marine	• ST for military use and life convenience • Next generation aerospace (ex, S-UAV) • Surveillance and management of the sea, etc.
Life/Health	• Dem and on health promotion and life extension • Prevention and cure of new disease • Demand on high tech medical facilities and service • Maintenance of bio diversity with environmental change of Korea, etc.

Global Trends	Future Issues
New International Economic Order	• Unlimited competition with globalization • Enlargement of common market • Global multi polar system (BRICs, TVT, …) • Rich-poor gap, etc.
Problems of Energy, Resources, Environment Environment	• Competition for energy and resources • Demand for renewable energy and new materials • Change of life style • Industry change owing to resource depletion, etc.
Development and Acceleration of Fusion	• Multidisciplinary research and fusion technology • Not follow up but leading • Nurturing and supply of human resources • New manufacturing and producing systems, etc.
Change of Population Structure	• Low birth and old population society • Financial problems (medical insurance, farewell, …) • Silver industry and new style of medical service • Women's role, etc.
New Security Issue	• North eastern Asia politic complexity • Unification of south and north Korea • Use of weapon of mass destruction • Counter-terrorism strategies, etc.

Needs Related with S&T	
Environment/ Disaster	• Global climate change technology • Accuracy of weather forecast and monitoring • Response ability on natural and artificial disaster, etc.
Energy/ Resources	• Demand on renewable energy • High efficiency in using resources and energy • Exploration of new energy and resources, etc.
Parts/ Material	• Acquisition of generic technology • Acquisition of emerging industries • Fusion and combined technology development, etc.
Construction/ Transportation	• Demand on new space and green technology • Improvement of old city infrastructure • Speedy and convenient transportation, etc

Source: Hwang et al., (2011)

Korea's innovation system shows some structural weaknesses as well, such as the lack of bridging organizations between the private and public sectors, to encourage the private sector to participate in the Foresight exercise (Andersen & Andersen, 2012). This results in a weak participatory nature of foresight process, as well as the lack of inclusiveness of the needs of marginal social strata. The root of these shortcomings could be tracked down to the impact of the dominant institutions of the external space on the analytical-systemic capacity.

4.4. The Inter-Space: Integration of Foresight to the Innovation Policy in Iran

As mentioned before, despite the failure in implementation, PAMFA projects set the stage for growing interests on future-looking activities in Iran. The first governmental department to take Foresight seriously was the Ministry of Defense, which created Center for Defense Science and Technology Future Study (CDSTFS). The Institute for Management and Planning Studies (IMPS), the National Research Institute for Science Policy (NRISP), and High-Tech Industries Center (HTIC) of the Ministry of Industry and the Ministry of Oil, Communication and Power have also been pioneers in road mapping, publishing white papers, and policy documents.

As a result, various empirical and statistical methods of foresight has been assimilated and applied; software for data mining and phishing have since become prevalent. Yet, every initiative to galvanize the manpower and financial resources to organize a national foresight exercise has thus far failed. This failure has some roots in S&T policy routines, the linear model of innovation, and the structural-functional failures in the innovation system in Iran.

As for innovation policy, Iran's S&T policies have been designed and implemented for nearly 20 years. The process is still confined in the straitjacket of hierarchical central planning set out in S&T chapters of 5-year-development plans since 1995, drafted by the Plan and Budget Organization's experts and officials. It is action-oriented, of course. Yet, it is not participatory and open-ended. The various studies on the development of new technologies shows that the innovation model is basically supply push (Miremadi, 2014), and has yet to develop its structural elements and dynamic functions. Overall, Iran is ranked 75 in the Global Innovation System (2017).

4.5. The Comparative Study on Iranian and Korean External Space of Foresight Exercise: The Legitimacy of Foresight

A systematic foresight, integrated well into public policy and providing for societal needs, could not be simply created just by choices and calculated decisions of individuals. It is well rooted in the lack of analytical capacity originating from social, political, economic, and cultural institutions. In this part, to probe the deeper roots of foresight failure to integrate Iran's innovation policy from comparing with Korea's cases, the paper studies political, business, and cultural systems surrounding the innovation system. This sheds light on the origin of the weakness of analytical capacity and policy networking.

It is established that Korea's development of systemic S&T foresight is due to first the upgrading of innovation policy vertically to overarch the other parts of public policy, and second, the consistency among all parts of the policy portfolios that affect innovation rate. Both need strong institutional learning, including government effectiveness, regulatory quality and rule of law, and political and policy stability. The policy harmony and consistency are embedded in the analytical capacity of experts to communicate through different channels with different jargons. The meritocracy and technocracy at the government level help facilitate the coordination among different councils and committees (Erdoğdu, 2015).

Another factor is a clear and consistent industrial strategy for the global market. Korea does not have many natural resources, and has had to export to sustain its economy. Pietrobelli and Puppato (2015) drew attention to the existing strong ties between foresight and industrial strategies of successful path of catching up in South Korea. In fact, foresight cycles and industrial policies have become deeply intertwined via complex and, at times, overlapping measures. During the interviews, every Korean scholar emphasizes this factor. The catching up process, which Korea has followed since the end of Korean War, gave Korean strategists from both public and private sectors a clear vision of the path they should pursue.

Contrary to Korea Iran ranks fourth in terms of oil reserve and first in terms of natural gas in the world. By these natural endowments, this country is expected to have a straightforward path to economic development and prosperity. Instead, it has been a bumpy road due to the several dramatic events in its recent history, including the Revolution in 1979, the eight-year war against Iraq, 35 years of economic sanctions, the constant fluctuation of the oil market, and political instabilities in the turbulent region of the Persian Gulf.

All of these events have made the decision-making environment enveloped with a fog of uncertainties. Because of constant uncertainties and instabilities, the role of the government was enlarged at the cost of the private sector. The policy guidelines have recommended self-sufficiency, economic and industrial (hyper) independency, and social justice, for all Iranians. The government embarked on different developmental programs in the health, education, and science and technology sectors, as statistics show that Iran's rank in the Human Development Index is consistently improving. However, these developments were all dependent on the oil revenue and the way it is invested. A quasi-welfare government making huge investments in planning, executing, and monitoring development projects does not let the private sector play its historical role (Mahdavi, 1970; Manoocheri, 2017; Momeni, 2017). Besides, the constant policy instability hinders any long-sightedness and strategic planning.

Despite the extreme dissimilarities between these two countries, they have many things in common. Based on several interviews and Park (2009)'s paper, both countries' main concern is "national survival" in the turbulent international order. The difference is the strategies they develop to deter threats. Park shows how the Americanization of South Korea and the country's collective perception of its survival are interlinked. From interviews with Iran's political and political economic

scholars, a link between "national survival" and "Americanization" is recognized, but in a quite different way. While the popular sentiment towards America is cautiously positive, and it connotes economic growth and prosperity in Korea, the situation in Iran is much more complicated in the sense that "national survival" and "economic prosperity" often seem to require cultural independence against "Americanization" (Park, 2009).

The (over-) emphasis on security and independence in Iran does not leave any space for a national industrial strategy for global market, which is, in Korea's case, one of the foundations of foresight exercise (Pietrobelli & Puppato, 2015). The industrial strategy to conquer the global market, consolidated by national longing for economic progress and the developmental nature of the government, has paved the way to devise anticipatory innovation policies and demand foresight exercise as a vital tool. The symbiosis of these politico-economic and cultural factors is instigated by the social learning capacity beyond the innovation system, and brings forth the legitimacy of foresight and anticipatory actions.

5. KOREA'S AND IRAN'S ORGANIZATIONAL LEARNING CAPACITY: FINDINGS FROM QUANTITATIVE ANALYSIS

The data analysis of the previous part draws attention to the gap between the internal, overlapping, and external spaces of foresight in Iran and Korea. The goal of illustrations is to visually support the qualitative examination from Part IV with international indexes, and is not intended to represent mathematical accuracy and precision.

5.1. First Level: The Informative-managerial Capacity

To visualize Korea's and Iran's gap of informative and managerial learning capacities in use, the paper selects four quantitative indicators: number of repetitive cycles, size of participants, number of methods, and number of targeted technologies. The presumptions underpinning this selection are:

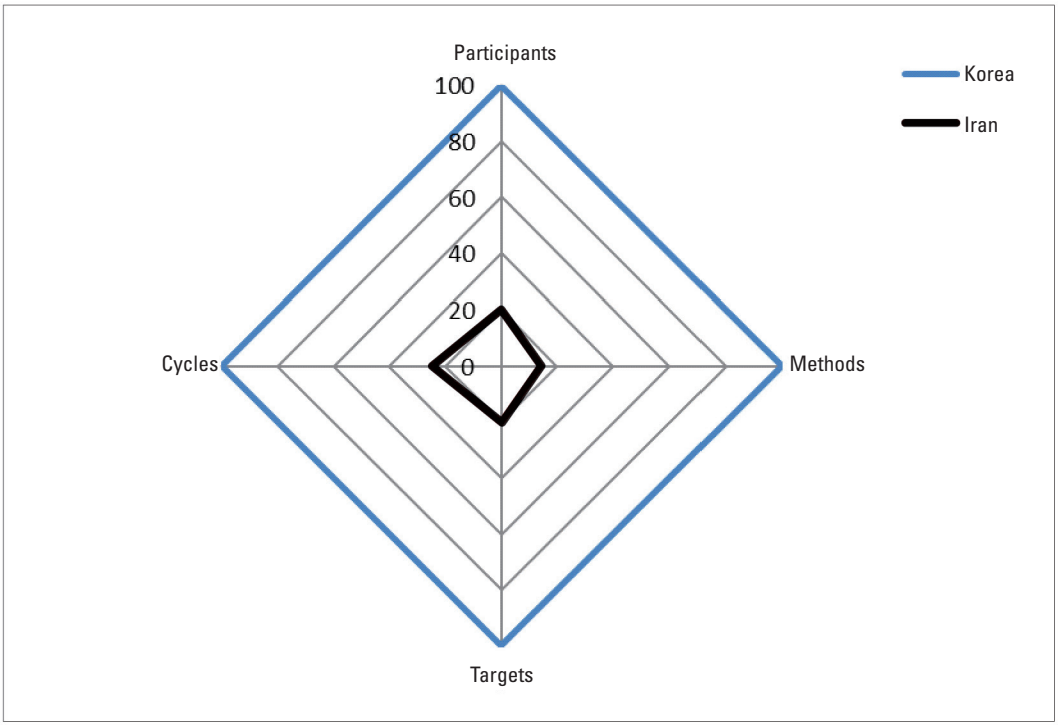
(1) Repetition of foresight exercise implies that the foresight is a routine tool for policy formulation, and is action-oriented.
(2) Size of participation is a proxy for the participatory nature of the process.
(3) Number of methods surrogates for "open-ended" foresight. It suffices to note that many countries have started foresight by utilizing Delphi, and after a while they mastered more complicated methods, e.g., software-designed scenarios. This is why it was presumed that foresight is more open-ended when methods in use outstretch from the basic ones, and a diverse range of techniques and approaches are used to deliver different futures.
(4) Number of technological domains is taken as a proxy for precision and development of foresight. Most foresights target a range of five to seven technology fields. Yet, some of them have gone further and pinpointed several tens to hundreds of technologies within this general technological field. This is why it was assumed that the foresight with precision

and detailed exactness is more developed than others with a more general approach. In our estimation, foresights are classified into three categories: those with less than 10 technologies, those with less than 99 technologies, and those with more than one hundred technologies.

Returning to the case in point: 739 participated in Iran's two mini foresights, using 2 methodologies (Delphi and brainstorming), and targeting 7 technology fields.

In contrast, in Korea, there have been 4 cycles of foresight exercises backed by 3 S&T basic plans, and the number of participants was 3322 (Schlossstein & Park, 2006). 7 methods were used: Delphi, Paper analysis, trend analysis, SWOT analysis, d. Delphi, scenario building, and Technology roadmap using complicated technical methods. Although Korea, like Iran, defined seven technological fields, it specifically selected 652 technologies among all others in these fields, showing the precision in detail. The accuracy of previous cycles was around 70 percent (Yim, 2017).

FIGURE 2. Gap Analysis of Korean and Iranian Informative-managerial Capacity in Use



As established, Figure 2. does not exhibit the overall technical capacity of foresight in Iran. It is just the capacity in use at the national level, since there are now many initiations without the chance of realization at the national level.

5.2. Second Level: The Analytical-Systemic Capacity and Policy Network Learning

The variables used in this estimation were extracted from two sources associated with the concept of generations of foresight (Andersen & Andersen, 2012; Havas, 2007). Overall, there are two types of factors: one represents 3 sets of foresight programs, consisting of three variables of aim, rationale, and affiliation of participants (Havas, 2007). The second consists of two factors of innovation model and innovation policy. (After reviewing literature on the status of Korea's foresight exercise, findings were asked and confirmed by experts during interviews).

FIGURE 3. Gap Analysis between Korea and Iran Foresight Policy Networking

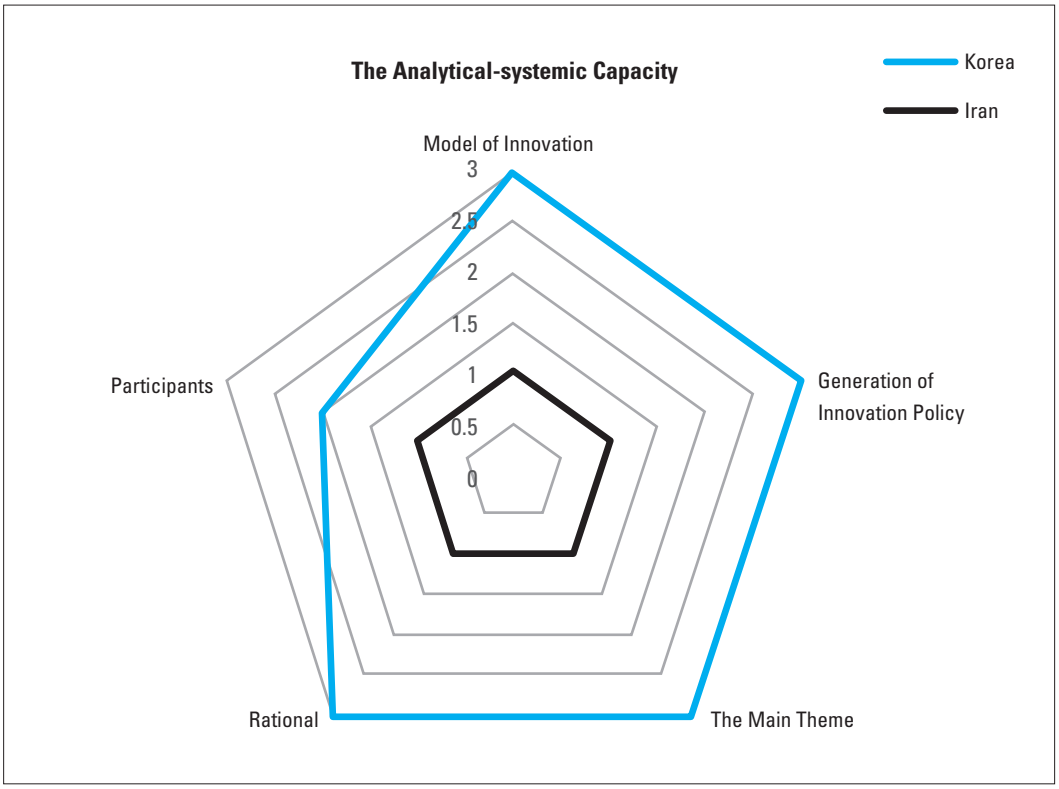


Figure 3. exhibiting Korean foresight, is co-evolved with the country's innovation model and policies. Emergence of systemic S&T foresight is due to two aspects of its public policy settings: one is upgrading innovation policy vertically to overarch the other parts of public policy, and second, Korea having acquired the policy network learning to achieve consistency among all parts of the policy portfolios that affect the innovation rate.

According to the studies, Korea's foresight is effective and systematic, action-oriented, and open to different uncertainties (Hwang, et al., 2011). Yet, Korea's institutional make-up, while encouraging harmonious innovation policy, shows some weakness in engaging the private sector in the process and being inclusive and innovative in its content.

Iran's situation is less developed, as the model of innovation is still supply push; innovation policy formulation is still about defining priorities for science and engineering (Andersen, et al., 2014). The dominant aim is S&T priorities, and the rationale is achieving S&T excellence, and the participants are governmental experts.

An important conclusion that can be drawn from Figure 3. is that the existing gap between Iran's and Korea's innovation systems is partially responsible for Iran's slow learning in the move toward systemic foresight. However, according to our conceptual model, the second level of learning is also under the impact of the third and deeper learning level, and for thoroughly explaining the roots of learning failure, one should pay attention to this layer, too.

5.3. Third Level: Social (Governance) Learning

In this part, the paper presents a comparative picture of Korea's and Iran's social, technological, economic, political, and cultural (STEEPV) systems surrounding the two NISs.

Regarding the proxies, it is worth noting that Korea's and Iran's scores from the Human Index Report (UNDP, 2016b) is presumed to represent the status of their social systems. The paper has used both countries' scores from the Global Innovation Index (Index, 2017) regarding technological system, and the scores of political environment and business environment, plus the market sophistication and easy credit, to exhibit the status of political and economic systems, respectively. The report from environment performance index (Dutta, Lanvin, & Wunsch-Vincent, 2017) was also employed to compare Korea's and Iran's environment protection performances. And finally, Hofstede's five cultural dimensions were utilized to compare Iran's and Korea's cultural institutions (Hofested, n.d.). The red numbers represent considerable gaps between two countries' capacity building, while the blue ones convey that the gap between the two countries is not too dramatic.

TABLE 5. Scores and Ranking of South Korea's Key Indicators of Innovation Systems Output

	Tertiary Enrolment	Graduate in STEM	Tertiary Inbound	R&D Expenditure	Researchers /m.popu	Gross Expenditure on R&D %GDP	Global R&D Companies' Average Expenditure (Top 3)	Average Score on University Ranking
Korea's Score	95.3	31.9	1.7	88.2	7/087.4	4.2	92.8	75.7
Korea's Ranking	2	8	75	1	3	2	5	9
Iran's Score	71.9	46.6	03	10.4	691.4	0.3	0	25.9
Iran's Ranking	23	2	97	58	56	78	43	45

Iran and Korea are in similar positions in STEM in graduate but they are separated by R&D Expenditure, researchers per million populations, and gross expenditure on R&D %GDP.

TABLE 6: Knowledge and Technology Outputs and High Tech Manufacturing

	Knowledge and Technology Outputs	Knowledge Creation	Patents by Origin/ bnppp GDP	Pct Patent Application/bn ppp$ GDP	Scientific Technical pap2r	Citable Documents H Index	High & Medium High Tech Manufactures
Korea's Score	54.7	80.4	90.3	8.1	29	41.8	0.5
Korea's Ranking	6	2	1	1	25	19	8
Iran's Score	25	10.1	0	-	21.5	15.9	0.3
Iran's Ranking	36	12	85	n/a	35	41	36

Source: Dutta et al., (2017)

From Table 6, one can see that the gap between Iran and Korea in the column of patents by origin ppp GDP is significant.

TABLE 7. Gap Analysis between Korean and Iranian Political Environment

	Political Environment	Political Stability	Government Effectiveness	Regulatory Environment	Regulatory Quality	Role of Law
Korea's Score	67	66.2	68.5	65.5	71.7	67.3
Korea's Global Rank	42	55	34	61	26	30
Iran's Score	39.4	41.9	37.3	40.3	9.4	115
Iran's Global Rank	99	105	82	115	126	116

Source: Dutta et al., (2017)

Table 7. shows that the gap between the two countries' rankings for political instability is 100.

This is the case for business and economic environment. The two most important columns, Business Environment and Market Sophistication, represent a wide gap between the status of Korean and Iranian economic environment.

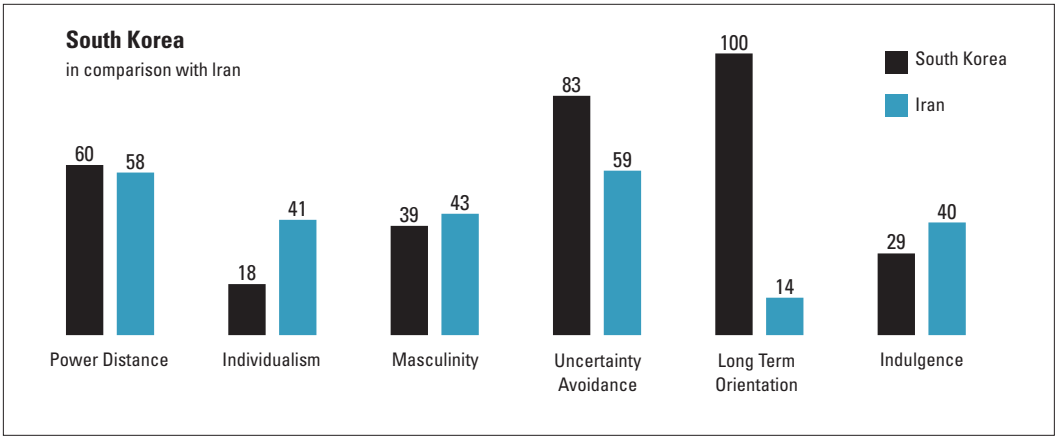
TABLE 8: Gap Analysis between Korea's and Iran's Business and Economic Institutions

	Business Environment	Ease of Starting a Business	Ease of Resolving Insolvency	Ease of Paying Taxes	Market Sophistication
Korea's Score	90.5	95.8	89.2	86.6	61.6
Korea's Global Rank	3	11	4	21	14
Iran's Score	50	35.1	25.3	59.8	35.5
Iran's Global Rank	98	77	123	75	112

Source: Dutta et al., (2017)

For cultural institutions, the variables of power distance, indulgence, and masculinity are almost similar, while individualism and uncertainty avoidance are relatively different; and finally, the variable of long term orientation is dramatically different between the two countries.

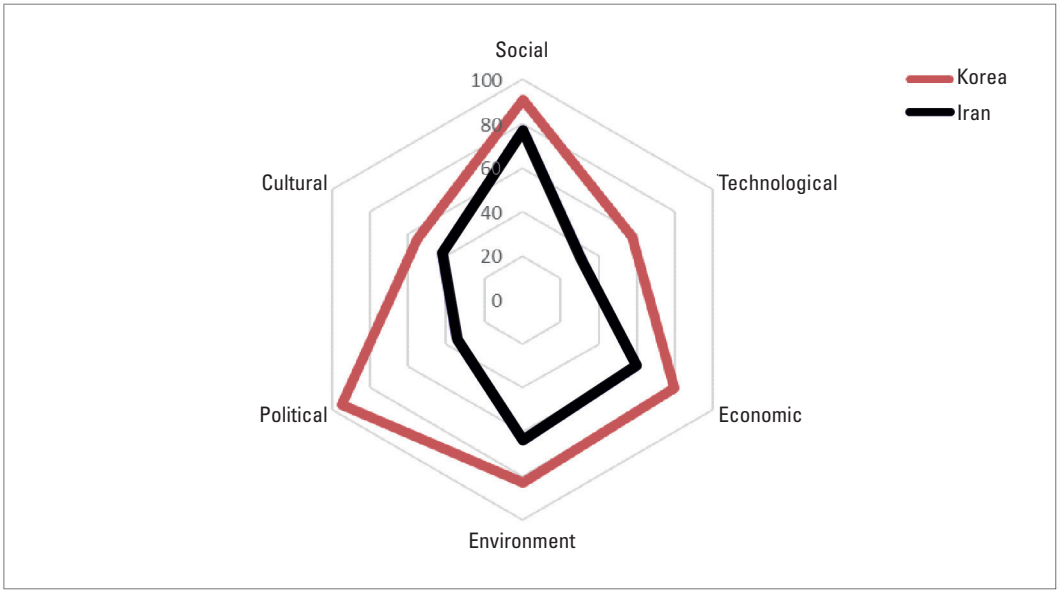
FIGURE 4. Cultural Institutional Distance between Korea and Iran



Source: Hofsted, (n.d.)

The final figure reflects the overall STEEPV systems in a graph, which is built by adding environment protection ranking (the Environmental Protection Index) and social system (the Human Development Index) to the quantitative analysis which we have already went through in detail.

FIGURE 5. Comparison between Iran's and Korea's STEEPV Systems, by the Author



Facts and figures show that innovation systems of the two countries are being impacted by very different external systems. The most significance is the cultural distance between short-sightedness in the Iranian context and long-sightedness in the Korean society. The next important difference is in the political environment (the Rule of law, regulatory quality, and political stability). The two societies are far less different in the environmental, social, and economic aspects of external space of foresight. Another important figure is the two countries' global innovation ranking distance, which is 64 points apart, as Korea is ranked 11 and Iran 75. The other important gaps existing between Iran's and Korea's institutions (as shown in red) are related to political stability, regulatory quality, and the rule of law in the overall political environment, business environment, and market sophistication categories.

In summary, these figures support the qualitative examinations already presented, of the gap between three levels of organizational leaning of the two countries in point, in detail.

6. DISCUSSION: BENCHING PARTNERS AND LEARNING PARTNERS

The paper contributes to the theoretical endeavors on systemic foresight by standing on the giants' shoulders, and in many ways integrates different approaches: First of all, most comparative studies focus just on one set of parameters, and even if some have multi-sets of parameters, the relationship among different sets of parameters are not elaborated, (e.g., Keenan & Popper, 2008). This paper presents three sets of parameters: content, context, and inter-space parameters of foresight in a multi-scalar pattern. This layering is similar to the work of Saritas (2013). However, his model falls short of delivering a comprehensive explanation of the middle layer or the inter-space area, which is the most important space for innovation policy. In order to theorize the inter-space, the paper uses the concept of generations of foresight and co-evolution of innovation model, policy, and foresight, with a delay (Andersen & Andersen, 2012; Andersen et al., 2014). This concept helps to compare different packages of innovation models, policy, and foresight, based on different generations. But, contrary to Saritas, whose stronghold is in explaining the mechanisms of the inter-spaces, this paper does not deal with the content and context of foresight exercise. To fill this research gap, the paper uses Howlett's theory of three layered organizations, applied by Borras (2011), in the context of innovation system, and categorizes all foresight activities into three learning layers.

Our presumption was that coding and layering every activity of foresight design, implement, and evaluation into three layered models of organizational learning would make intelligent benchmarking possible, despite large institutional distance that exist between two countries like Iran and Korea. The research confirms this presumption, based on qualitative and quantitative analyses.

According to the paper's findings, the root of effective and integrative style of Korean foresight can be traced back well into political institutions (developmental state) (Evans, 1995), economic institutions (lack of natural resource) (Erdoğdu, 2015), and cultural institutions of collectivism, long-sightedness, and power distance (House, et al., 2004).

The Iranian society doesn't share the same institutional settings: the legitimacy of the government does not stem from its leadership towards economic progress, as the economic decision making is influenced by oil revenues. The cultural setting promotes short termism (Katouzian, 2004; Manoocheri, 2017).

The paper also confirms the hypothesis of Anderssen et al. (2014) on the process of a delayed co-evolution of foresight with innovation model and policy, and explains why the innovation system foresight in Iran has yet to emerge. Considering the paper's conceptual model, the explanation goes even further and attributes this co-evolution (rather than lack thereof) to the weak analytical-systemic learning capacity and policy networking, caused by the failure of social learning on the unifying role of industrial strategy on the public policy and its significance in materializing anticipatory policy formulation.

On the other hand, Korea shows assiduousness to follow a path of economic growth oriented to the external market. For Koreans, "independence" and "national pride" are as important as for Iranians, but they have different associations than for Iranians. An Iranian strategist understands "survival" equal to "independent culture," while a Korean may translate it into economic growth and successful industrial strategy. Following the paths of leaders, the Korean society these days is undergoing a reflective-transformative turn. Korea's decades-old vision of future, coined "the Han River Miracle," seems no longer legitimate. To pass through this turbulent phase, it needs to reinforce reflective and transformative skills for a paradigm shift to let go of the "future" they had wished for in the past, and create new images of the future. Therefore, in a sense, both countries need to revisit their vision for the future and learn from each other.

7. CONCLUSION

The paper was designed to find answers for the two main questions: why Iran is a slower learner in systematizing its foresight, and what it can learn from Korea as a fast follower.

Cognizant of the various institutional distances between the two countries and to avoid naïve benchmarking, the paper built a conceptual model inspired by Andersen (Andersen & Andersen, 2012; Andersen, et al., 2014) and Borras (2011) to fill the research gap that was singled out in the three spaced work of Saritas (2013). It looked at internal space, which required managerial and technical level of learning, but did not stop there. It furthered its own research deep down to the inter space with analytical-systemic and external space with reflective-critical levels to find the underlying cause of this learning failure. The qualitative examinations backed by quantitative analysis showed that the adverse impacts of some dominant institutions from political, economic, and cultural environments are the main barriers to developing a national innovation foresight in Iran.

The crust of this paper's argument is that for Iran, it is not sufficient to learn the foresight organization, process, and methodologies (technical capacity) from its Korean counterpart. The first and

foremost lesson that Iran can draw from the Korean experience is how it has built consensus on economic growth as the target of its public policy and how it has translated said consensus into action plans and master programs (analytical capacity). On the other hand, Korea is already showing signs of reflection on the limits of its own pattern of growth, and tries to design policies that are more internal oriented (social learning capacity).

Finally, Foresight is a tool for innovation policy. Iran's and Korea's experiences show the potential and limits of this tool for follower countries. Korea's experience shows that for a follower country targeting the external market and catching up process, the chances of having systematic and rigorous foresight exercise are high. But it has its own limits. Conversely, Iran's foresight experience shows that if the industrial strategy does not target the external market, foresight can hardly be anything more than scattered and ineffective exercise. Because, for the former, the future has already been determined by the leaders of the global market, while for the latter, the consensus can hardly be built on what is the preferable future.

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