Sustainability Special issue of SOItmC 2017 – (2017.06.05)

Special Issue "Sustainability of Economy Growth – New Combination of Technology, Market and Society"

Special Issue Editors

Guest Editor (Managing)
Dr. JinHyo Joseph Yun

Soosung-gu GiSan-dong, Nokwon Apartment 102-1202, Daegu, Korea
www.openinnovationtmc.org / jhyun@dgist.ac.kr
Phone: +821066978355

**Interests:** open innovation; business model; open innovation economy; social open innovation; Schumpeterian dynamics; dynamics; game of life; knowledge; complexity

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Guest Editor
Dr. Tan Yigitcanlar

School of Civil Engineering and Built Environment, Queensland University of Technology, 2 George Street, Brisbane, Queensland 4001, Australia
Website / tan.yigitcanlar@qut.edu.au
Phone: +61450018734

**Interests:** sustainable cities; sustainable urban development; sustainable and resilient infrastructure; sustainable transport system; sustainability assessment; sustainability indicators and frameworks; climate change; water sensitive urban design

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Guest Editor
Dr. KwangHo Jung

Graduate School of Public Administration, Seoul national University, Seoul,
Website / kwjung77@snu.ac.kr
Phone: +821062294479

**Interests:** Public Administration, Social Innovation, Market Failure, System Failure

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Special Issue Information

Dear Colleagues,

This Special Issue includes selected studies that contribute to our understanding on how sustainability of economy growth by new combination between technology, and market or society. This Special Issue attempts to answer to the requirement “Let us conquer the growth limits of capitalism by new combination between technology, and market or society, the theme of SOItmC 2017 conference”. This Special Issue seeks to collect theoretical and empirical studies on open innovation strategy, open innovation economy, open business models, and several concrete new combinations. In addition to these 29 papers which were selected from SOItmC 2017 special sessions, nearly more than 40 papers will be published at this special issue.
Dr. JinHyo Joseph Yun
Dr. Tan Yigitcanlar
Dr. KwangHo Jung
Guest Editors

Submission
Manuscripts should be submitted online at www.mdpi.com by registering and logging in to this website. Once you are registered, click here to go to the submission form. Manuscripts can be submitted until the deadline. Papers will be published continuously (as soon as accepted) and will be listed together on the special issue website. Research articles, review articles as well as communications are invited. For planned papers, a title and short abstract (about 100 words) can be sent to the Editorial Office for announcement on this website. Submitted manuscripts should not have been published previously, nor be under consideration for publication elsewhere (except conference proceedings papers). All manuscripts are refereed through a peer-review process. A guide for authors and other relevant information for submission of manuscripts is available on the Instructions for Authors page. Sustainability is an international peer-reviewed Open Access monthly journal published by MDPI. Please visit the Instructions for Authors page before submitting a manuscript. The Article Processing Charge (APC) for publication in this open access journal is 1200 CHF (Swiss Francs).

Keywords
- open innovation;
- open business model
- new combination
- sustainability;
- autonomous;
- conditions;
- firms;
- clusters

Time schedule
- Special issue platform open: 2017, January
- Open the publishing system: 2017, June 19th.
- Closing this special issue platform: 2017, December 30th.

Shooting Method

Manuscripts should be submitted online at www.mdpi.com by registering and logging in to this website.

Publishing Plan of This Special issue

We want to publish until (30+α) papers which are presented at SOItmC 2017, and passed at the review process with high quality. We expect your great papers.
<table>
<thead>
<tr>
<th>No.</th>
<th>Paper Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Developing a classification framework for assessing ports’ environmental effectiveness</td>
</tr>
<tr>
<td>2</td>
<td>Human Resource Development through Re-manufacturing Business in Myanmar</td>
</tr>
<tr>
<td>3</td>
<td>Innovation ecosystem of CNG vehicle: a case from Sichuan Province in China</td>
</tr>
<tr>
<td>4</td>
<td>Sustainable predictive-analytics driven knowledge management in university teaching to improve students’ learning experience and performance</td>
</tr>
<tr>
<td>5</td>
<td>Entrepreneurial Behaviors, Technology Transfer, and Innovative Performance: Focused on Networks among Industries–Higher education &amp; Research Institutions, and Technoparks</td>
</tr>
<tr>
<td>6</td>
<td>Creative Attitude, Cultural Literacy, and Cultural Receptivity in an Era of Sustainable Development</td>
</tr>
<tr>
<td>7</td>
<td>The rise and fall of RFID-using food waste meter rate system: A case of Gangnam district in South Korea</td>
</tr>
<tr>
<td>8</td>
<td>A new time series analytic method using fast-fourier-transformation</td>
</tr>
<tr>
<td>9</td>
<td>Dismantling of the Inverted U Curve</td>
</tr>
<tr>
<td>10</td>
<td>Roadmapping for export of space segment based on portfolio analysis: A case of Korea</td>
</tr>
<tr>
<td>11</td>
<td>The role of business model in market growth: The difference between the converted industry and the emerging industry</td>
</tr>
<tr>
<td>12</td>
<td>Innovative Production Scheduling with Customer Satisfaction Based Measurement</td>
</tr>
<tr>
<td>13</td>
<td>The influence of institutional voids on the appropriability regime of servitization of manufacturing -- comparative study on the role of intermediaries between Taiwan and Korea’s ICT industries</td>
</tr>
<tr>
<td>14</td>
<td>Linking Firm Openness and Innovation: The Moderating Role of External Knowledge Search strategy</td>
</tr>
<tr>
<td>15</td>
<td>Efficiency Analysis of Retail Chain Stores in Korea</td>
</tr>
<tr>
<td>16</td>
<td>Effect of Art Enjoyment on the Perception of Inequality</td>
</tr>
<tr>
<td>17</td>
<td>Effect of Distance on Open Innovation: Differences among Institutions according to Patent Citation and Reference</td>
</tr>
<tr>
<td>18</td>
<td>Trends of phenological responses to climate change and urbanization in South Korea</td>
</tr>
<tr>
<td>19</td>
<td>Government support and SMEs innovations in the regional industries: Export perspective in South Korea</td>
</tr>
<tr>
<td>20</td>
<td>Do social networks foster innovation? An empirical study of social networks on innovation from knowledge quality perspective</td>
</tr>
<tr>
<td>21</td>
<td>The Effect of Sustainable Entrepreneurship on Entrepreneurial Intention: Focus on the Moderate Effect of Market Orientation</td>
</tr>
<tr>
<td>22</td>
<td>Research on China’s Technology Industrialization based on the Measure of Patent Propensity and Project Cooperation</td>
</tr>
<tr>
<td>23</td>
<td>Nation-wide Eco-System of Academia-Industry Collaborations for Technological Innovations and Industrial Economics: A Case Study of Science Parks</td>
</tr>
<tr>
<td>25</td>
<td>Transforming Government: A Platform Approach</td>
</tr>
<tr>
<td>26</td>
<td>Entrepreneurial Cycling Dynamics of Open Innovation - The Road to Entrepreneurial State in the 4th industrial revolution</td>
</tr>
<tr>
<td>27</td>
<td>The Influence of Perceive Quality on Word of Mouth as Mediated by Perceived Value (Social, Emotional and Functional) Study of Zara’s Customers in Surabaya, Indonesia</td>
</tr>
</tbody>
</table>
Developing a classification framework for assessing ports’ environmental effectiveness

Abstract

Purpose and Research Question:

The regulation landscape of the Baltic Sea is changing all the time towards a greener society. One of the biggest recent changes has been the Sulphur Directive (2012/33/EU) and IMO’s SECA recommendation. NOx emissions will be the next issue for regulation. While the EU-level legislation is uniform for member countries, previous studies have showed that there is a lot variation between countries in the actual implementation of the legislation and in how ports manage emissions (eg. Kunnaala-Hyrkki et al. 2015). A stable economical environment requires a predictable regulation landscape and thus it can be said that the continuing changes in the Baltic Sea Region might negatively influence the region’s potential for growth. Previous study by Kunnaala-Hyrkki et al. (2015) showed that there are also differences in national approaches to environmental regulation and the permits related to the environment.

The research questions are:

1. What kind of key environmental issue should be incorporated into the port environmental effectiveness assessment framework?

2. What should be the performance criteria that address the key environmental issues and allow for comparison between different ports?

Some examples for the potential criteria or measured categories are:

- Energy Efficiency
- Waste Management
- Eco-driving
- Water Conservation
- Staff Awareness and Training
- Environmental Management System
- Stakeholder Dialogue

Key Literature Review
Pollution (from ships, port operations and logistics) has a direct connection with handled cargo volumes in the ports. Dense ship traffic, port operations and port related land transportation cause a lot of different kinds of emissions to air and water. Especially ships produce waste, black and grey waters, ballast waters etc. Emissions to air are the most important factors that increase the greenhouse effect and climate change. The main source is exhaust gas from combustion engines that are used in marine and road traffic and partially in train traffic, as well as, working machines in the port area.

In addition to emissions to air and water, ports are facing many other challenges also, such as the changes in the economy, increasing competition, as well as various environmental and other legislative changes. Globalization and an increasing demand for goods have led to a growing requirement for freight transport in Europe. Transport is responsible for around a quarter of EU greenhouse gas emissions making it the second biggest greenhouse gas-emitting sector after energy. (European commission, 2012). Maritime transport emits around 1.000 million tonnes of CO2 annually and is responsible for about 2,5 % of global greenhouse gas emissions (IMO 2015).

Ports’ competitiveness is comprised of several other factors: geographical location, logistical connections, ship connections to other ports, port infrastructure and port operations. According Kunnaala-Hyrkki et al. (2015), ports also have a lot to gain from implementing environmental measures. For example, obtaining a greener image will come more and more important factor to the ports and its customers in the future.

Because of the changing regulatory environment and the growing competition between ports, it is vital to study how environmental performance measuring and monitoring practices and standards, as well as, best practices are executed in the Baltic Sea Region and how they should be performed in the future. In order to facilitate competition, the ports’ environmental performance measurements and practices should be comparable. Yet, nowadays it is not so. Ports have adopted different kinds of standards and best practices and measure their environmental performance with different metrics and criteria. In addition, ports are different, which is why all the standards, best practices and measurement metrics do not necessarily apply to all ports.

Ports that have adopted standards usually use ISO 14000, EMAS or CSR standards. In addition, many ports have developed best practices in their operations. Yet it should be noted that not all standards are applicable in every port; there are differences in the ports’ sizes and types of operations, which in some cases affect the implementation and accreditation of standards. Implementation and accreditation might also be expensive and small ports do not have enough recourse to do that.

In addition to standards, there are different kinds of benchmarking systems and performance measurement instruments that have been developed so that organizations can assess their
operations, find the issues that should be developed and compare their performance with other organizations. Yet, it is rare that a benchmarking or performance measurement instrument is completely applicable to all organizations of the same field, regardless of their sizes or types of operation. In this study we aim to develop a framework for assessing the ports’ level of environmental performance and efficiency that would be applicable to all ports.

**Design/ Methodology/ Approach:**

This study consists of a literature review and interview study. During the literature review, different kinds of standards, measurement systems and benchmarking that are used in different industry field are studied. After that, the features of the standards, benchmarking and measurement systems that are applicable also in assessing ports’ environmental performance are further developed to suit for the purpose of the developed classification framework.

In addition, an interview study will be conducted. In the interviews, relevant personnel from ports and port related operators will be interviewed in semi-structured interviews that have features from both, structured and unstructured interviews. The interviews will be constructed around the interview themes based on the research questions and do not concentrate strictly on a defined list of questions. Instead, the interviews will be based on discussion, which will allow the concentration on issues that were considered significant by the interviewee, which is not necessarily possible in a structured interview. Furthermore, the semi-structural manner of interviewing allows the interviewer to produce additional questions outside the original plan or list of questions. The interviews will audio-taped and additional notes will be written during the interviews.

An adaptation of qualitative content analysis will be used as the analysis method for the interview study. The interviews will be transcribed and thematically organized. After that, the interview data will be transferred into an Excel worksheet, in which the data will be organized into a matrix. The columns will be comprised of interview themes and related questions. The rows consisted of the answers of each interviewed person. The purpose of the matrix is to facilitate the examination of the data.

*(Expected) Findings/Results*

‘The expected result of the study is the development of a draft of the classification framework for assessing ports’ environmental effectiveness. The framework will indicate the environmental status of the ports and can be used practically in all ports regardless of their sizes and types of operations. In future studies, the draft framework may be tested in ports.

**Research limitations**
There is a risk that the authors do not get enough interviews in order to form a generalizable view of the situation. Thus, the interview data sample might be too subjective for creating the framework. In addition, it is important to remember that an interview always provides the interviewee's subjective perspective on issues. For instance, the prevailing situational conditions, the interviewees' mood and their experiences can impact the interviews’ outcome. In addition, the interviewer’s manner of asking questions or participating in the discussion with the interviewee can impact the outcome. The thematic interview method also has some weaknesses which are related to the analysis of the gathered data and the interview situations. When the interviewees are using their own words, it can be difficult to interpret the answers. The researcher’s preunderstanding, which can be biased, can affect the interviewer’s views on what he considers important enough to make notes of.

**Keywords:** Ports, Environmental impacts, Measurement system, Benchmarking
Human Resource Development through Re-manufacturing Business in Myanmar

Abstract:
Aim of Study
This paper focuses on the re-manufacturing of construction machineries industry from the perspectives of innovation study and human resource development process. Those cases will shed light to effective way to develop key engineers and technical workers with high skills and technologies in emerging economies.

The Japanese construction equipment industry is playing an important role as technological development and innovative perspectives. However, few studies have done about the construction equipment industries and roles in innovation and human resource development. In emerging countries, high demands for construction equipment and, especially, re-manufacturing in construction industry increased the demands for emerging economies. Therefore, this paper focus about re-manufacturing from the viewpoint of innovative roles and human resource perspectives.

As an emerging country, this paper analyses the case of Myanmar, one of the last frontier which opened its economy in 2011. In Myanmar, the attention of foreign direct investment has been accelerated since the start of new government on April 2016. However, as one of the latest country who has just started to industrialization, human resource development to support manufacturing and supporting industry lag behind. The demand for skilled workers and engineers are increasing, but the human resource development is far behind in numbers and quality.

Research Question
In emerging countries, the high demand on construction has been required the development of industrial equipment production in the country. In the process of production localization, re-manufacturing process was started in Myanmar by a Japanese construction equipment company.

Q1. What is the innovative contribution of construction equipment manufacture in emerging countries?
Q2. How does the re-manufacturing process in construction equipment contribute local human resource development?

Innovation Study in Industrial Equipment Industry
In order to study innovation in industrial equipment industry, the progress of mechanical excavator is a good example to explain the technological development and innovation as Christensen (2004) picked up the mechanical excavator industry for explaining disruptive innovation.

In recent years, the Japanese excavator industry has been continuing disruptive innovation in excavators by using IoT, internet of things. With utilizing internet to each excavator, mechanical excavators drastically improved their operational productivities by improving maintenance and production information through internet. ICT (Information and Communication Technology) progressed to innovate the operation system which improves the efficiency of operation, management, and product support of construction machinery and the construction computerization system.

From the view of human resource development, mechanical excavators have been contributing technology transfer and skill formation to emerging economies. That is “re-manufacturing” strategy in skill formation to emerging economies. Japanese construction equipment companies have been conducted the “Re-manufacturing” business which aims to recycle used main components of the construction and mining machinery and sell them as the units with the quality comparable to those of the new components. The reuse of the parts to be discarded
as an important issue from the aspects of machine operating cost, environment preservation and skill formation.

Re-Manufacturing Studies

Although not many, but there are several studies on re-manufacturing. Re-manufacturing is not well known or regarded important in general compared to other certain specific industries. What is re-manufacturing? According to the study of European Re-manufacturing Network, re-manufacturing is “returning a product to at least its original performance with a warranty that is equivalent or better than that of the newly manufactured product.” It is an important component of a resource-efficient manufacturing industry and a key strategy within the circular economy: by keeping components and their embodied material in use for longer, significant energy use and emission to air and water (e.g. CO2 and SO2) can be avoided. More importantly, the study pointed out re-manufacturing is beneficial for human resource development as cited “In addition to its environmental benefits, re-manufacturing provides opportunities for the creation of highly skilled jobs and economic growth.”

However, it is also true that despite many positives, re-manufacturing is an undervalued part of the industrial panorama and generally under recognized the importance. Therefore, re-manufacturing activities are undertaken on a sector-by-sector basis and the activities to facilitate knowledge transfer and promote the industry do not well exist. Re-manufacturing is differ from reuse or recycle. Re use and recycle are highly regarded and publicly recognized as important issues from an environmental perspectives. Attention from environmental economics tend to focus these issues from CO2 emissions and lower energy point of view. Re-manufacturing is differ from them, but not well understood.

In the studies, eight requirements and obstacles faced by companies in developing a new re-manufacturing business were summarized by Lund and Skeels (1983) as product selection, marketing strategy, re-manufacturing technology, financial aspects, organization factors, and legal consideration. Steinhilper (2001) pointed out eight criteria to be evaluated in establishing the suitability of products for re-manufacturing as follows: 1. Technical criteria, 2. Quantitative criteria, 3. Value criteria, 4. Time criteria, 5. Innovation criteria, 6. Disposal criteria, 7. Criteria regarding interference with new manufacturing.

Matsumoto and Umeda (2011) showed the motives for re-manufacturing and the measures to overcome the obstacles of re-manufacturing from the three requirements for re-manufacturing: (1) collection of used products, (2) efficient re-manufacturing processes, and (3) demand for re-manufactured products. The motives are long-term economic and environmental incentives. The importance are (1) establishing a new collection channel; (2) developing reverse logistics to collect used products; (3) designing products for re-manufacturing; (4) accumulating knowhow to establish re-manufacturing processes; and (5) controlling product quality to stimulate demand for re-manufactured products. Matsumoto and Umeda (2011) also pointed out that Japan’s Home Appliances Recycling Law and End-of-Life Vehicle Law have promoted material recycling but have been insufficient to stimulate re-manufacturing within the country.

Although the importance, re-manufacturing is unvalued as pointed out. Moreover, few studied or discussed from the view point of human resource development or skill formation. Therefore, this paper will show how re-manufacturing contributes to skill formation and technology transfer using the case of Japanese industrial machinery re-manufacturing operations in Myanmar, the late industrializing country in ASEAN.

Required Technological Processes for Re-manufacturing

Re-manufacturing is, as stated before, to return a product with original performance with “equal or better” quality. The practice and terminology in re-manufacturing differ slightly according to produce or sector. APRA Europe (2012) shows the levels of re-manufacturing practices listed at the top from the view point of quality level, as equivalent or better quality than new parts. Followed by rebuild, lower or equivalent, recondition, lower or equivalent, reconstruct, lower or equivalent, refurbish, lower, and so on. As shown here, re-manufacturing
is the equivalent or better product than the new product using used parts.

Re-manufacturing includes major technologies of manufacturing. Re-manufacturing process start first collecting used products. The used products were disassembled totally. Each sub parts were cleaned in special knowhow and surface treatment are applied. The cleaning and surface treatment process are the most important and needs special knowhow and techniques. Then, each parts are reconditioned to recover high quality and performance. Then, all the subparts are reassembled to finished product. After reassembly, all the products are tested to assure the quality and performance. Re-manufacturing is a manufacturing process that involves dismantling a product, restoring and replacing components, and testing the individual parts and the whole product to its original design specifications. The performance after re-manufacture is expected to be at least the same as the original performance specification (like new) or better, and the re-manufactured product generally comes with a warranty.

Industrial tooling, machine and cutting tools is an essential component of almost all manufacturing industries. The manufacturing technologies association, which represents them, defines machine tools as power drive machines and not portable by hand. This equipment is used to work and shape metal or other materials into the correct form before product assembly occurs. The size and operation of machines in these sub-sector varies greatly, due to the wide range of functions carried out. Due to the advances in technology in this sub-sector in recent years, more complex systems have been introduced in this equipment, notably computer numeral control system.

All of these processes involves human skills and techniques which cannot replaced by automated machineries. Sadoi (2014) pointed out there are two opposite strategies of technology transfer of Japanese MNCs to host countries. One is human skill oriented strategy and the other is high-tech machine oriented strategy as shown in Figure 4. The former case shows that there were a quite a few highly skilled workers performing the finishing and profiling processes, which required a minimum of a year of specific skill training. These workers use multiple-purpose machines to shape a variety of parts. The latter case shows that firms install state of arts mother machines to eliminate human skill or quality instability. Those mother machines are the same or even higher specification and prices than those of in Japan. In the case of re-manufacturing process it is based on human skill oriented strategies. In return, all the process is highly dependent to human skill or manual process. Therefore, HRD is the key issue for re-manufacturing.

Automobile parts are the most prevalent target of re-manufacturing in the world. In the world, about two thirds of re-manufacturing business is estimated to involve auto parts. Japan has a relatively well established re-manufacturing sector. Re-manufacturing is estimated at up to 500 billion yen, with the automotive sector 109 billion, as the highest among other sectors such as retread tires and photocopiers. Heavy duty and construction equipment for re-manufacturing is started to active in Japan. Hitachi construction machinery and Komatsu are the active players.

Research Methodology
For the empirical study, a major Japanese construction equipment manufacture, Komatsu, is surveyed by author in Japan and Myanmar from 2014 to 2016. Detailed interviews were conducted by author to Japanese managers and engineers in Japan and Myanmar, and Myanmar engineers and staffs during the period. For the comparative purpose, other metal and parts manufacturing factories in Myanmar was surveyed and evaluated.

Summary of Findings
1. High demands on construction in Myanmar as well as emerging countries lead local re-manufacturing business prior to manufacturing base.
2. Re-manufacturing requires higher level of local engineers or technicians than manufacturing.
3. Careful examination of skill formation process of local engineers showed the positive
effects on skill formation and quality and productivity achievement.

4. Global training system in Komatsu

5. The Japanese construction equipment manufacturer case shows the effective way of HRD in emerging countries.

**Implication**

The role of construction equipment industry was not much studied yet. Especially in emerging countries, the role is essential in the initial phase of industrialization. This study will shed light to the HRD and re-manufacturing business and can be applicable for other emerging countries.

**Key Words:** Re-manufacturing, Construction Equipment Industry, Human Resources Development, Myanmar

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**Note.**

i Re-manufacturing Market study 2015 by European Re-manufacturing Network

ii This definition was drawn by several process explained in Re-manufacturing market study by European Community European re-manufacturing network. Reference EC-09 404 ERN WP2.2


Innovation ecosystem of CNG vehicle: a case from Sichuan Province in China

Abstract

Purpose/Research Question: The dynamic innovation ecosystem provides the enterprise with the most competitive advantage of innovation environment. Sichuan Province in China, as one region of the earliest technology development of Compressed Natural Gas (CNG) station and CNG vehicle, had sustainably developed the innovation ecosystem of CNG vehicle over the past more than and 20 years. It relied on the advantages of the local conditions richly endowed by its resources. From the perspectives of energy security and emission reduction, the development of CNG vehicle has received extensive attention in academic circles. Many countries in the world are in the development of natural gas vehicle. In recent years, Chinese also began to accelerate the development of natural gas vehicle. This study takes the CNG vehicle innovation ecosystem in Sichuan Province, China as the research object. It studies the cultivation path and the characteristics of CNG vehicle innovation ecosystem in Sichuan, and predicts the future development scenarios of innovation ecosystem of Sichuan CNG vehicle. The scenarios are the baseline, energy-saving, emission reduction and comprehensive ones. This study used elastic coefficient method to predict the market demand, and modified the elastic coefficients according to the different scenarios.

Key Literature Reviews (About 3~5 papers): The scholars understood the concept of innovation ecosystem (IE) step by step. Adner (2006) regarded IE as a multiple enterprises’ cooperation on various products, with the purpose to better cope with customer’s requests. In 2010, Adner and Kapoor further reveals that IE not only includes the innovation activities of the core firm, but also the innovation activities of its upstream suppliers, its downstream customers and complementors. Therefore, IE is an intra-complementary network of all the aforementioned players, with a shared objective to provide valuable products and services for their customers. Zahra and Nambisan (2011) framed IE as a loose network, in which every enterprise coordinates on innovation and/or innovation platform, yet being dependable on each other for the ultimate benefits and survivals.

From academic research perspective, scholars have carried out series of research on innovation ecosystem. For example, according to Rohrbeck et al. (2009), IE is composed of three subsystems, namely research subsystem, development subsystem, and application subsystem. The enterprises span the boundary of traditional research and development between organizations, to obtain the external knowledge resources to improve the innovation competence (Rohrbeck et al., 2009). Scholars also examined what are the influential factors in building and maintaining the health of IE. Arimoto and Levien (2004) argued that along with the investment on manpower and finance, the knowledge creation and the long-term basic research were acting as the investment on innovation
in a healthy IE. The regional cluster will create new product or service, and increase enterprise profit and social welfare, through collaboration between university and industry. In an industry with frequent and rapid changes, enterprises need to be highly cooperative to cope with the continuously changing market expectations.

**Design/ Methodology/ Approach**: First of all, through literature research and expert interview, this paper reviewed the historical context of the development of Sichuan CNG innovation ecosystem, in order to reveal the cultivation path of innovation ecosystem. Secondly, according to the cultivation path, this research summarized the characteristics of Sichuan CNG vehicle innovation ecosystem. As to innovation ecosystem from the ecology metaphor, the characteristics includes the ability to integrate environment, ability to add value, health, life cycle (Wu 2015). Thirdly, it focused on the market demand of Sichuan CNG vehicle for scenario prediction. The market demand potential of CNG vehicle is the driving force of its innovative ecosystem.

Consumers have a wide selection of alternative technology trajectories of vehicle products. This research comparatively analyzed the development potentials of the alternative technology trajectories of vehicle products based on the expert interviews and data calculations for Sichuan province. The analysis showed that to continue to develop the innovation ecosystem of CNG vehicles has a great potential in the future of Sichuan province, China.

In order to predict the future market demand of Sichuan CNG vehicle, this research defined four scenarios of the future development based on the foregoing innovation ecosystem characteristics of Sichuan CNG vehicle. They were the baseline, energy-saving, emission reduction and comprehensive scenarios. Based on the elastic coefficient method of Guan and Kang (1996), this study revised the market demand prediction method, and gave the prediction formulas of Sichuan CNG vehicle.

(Expected) **Findings/Results**: This paper has important reference to the innovation ecosystem development of CNG vehicle for the regions with the resource advantages. It makes the regions maintain energy security and emission reduction. The theoretical contributions are as follows:

Firstly, through the review of the historical context of the development of Sichuan CNG innovation ecosystem, this paper revealed the cultivation path of innovation ecosystem. The path may be divided into three stages, i.e. innovation of product and complementary product, industrial innovation, ecosystem. In the three stage, the enterprise and the government performed their respective duties, to achieve innovation and consistent pace. There are big gaps of technology, talent, institution and culture between Chinese company and the government. Companies and the government need to achieve collaborative innovation mechanism according to the stage of development of innovation ecosystem.

Secondly, the study found that the characteristics of innovation ecosystem in essence is to create the "ecological environment" to connect enterprise technology improvement, complementary goods resources supply, market demand, and government strategy and policy in the process of
industrialization and technological achievements. This ecological environment will help to promote the continuous improvement of product innovation system and the network system of complementary products. If there is the lack of this dynamic environment, the innovation of the train will fall to the "death valley".

Thirdly, the study predicted the scenario developments of innovation ecosystem of Sichuan CNG vehicle. The development potentials of Sichuan different technical trajectories of the vehicle were compared based on the current characteristics and technology of innovation ecosystem of Sichuan CNG vehicle. It modified the elastic coefficients according to the trend of slowing down of the regional economic growth rate. On these grounds, it predicted the vehicle ownership, and production and sales of Sichuan CNG vehicle according to the formulas and the baseline, energy-saving, emission reduction and comprehensive scenarios.

**Research limitations/ Implications**: Any innovation policy needs to suit local conditions. In the resource and environmental constraints, China is imminent to build a new industrial system with the ecological characteristics (Feng, 2008). With the rich natural gas, low price, transportation layout of gas pipeline, Sichuan is dense in the natural resources advantage for the development of CNG vehicle. It is hopeful for Sichuan CNG vehicle to realize corner overtaking in the development of innovation ecosystem. Any innovation ecosystem is rooted in the local situation, there is no innovation ecosystem vacuum. Policy recommendations are mainly included in two aspects:

(1) It requires strict implementation of fuel consumption policy, so as to force the fuel vehicle companies to develop CNG vehicle in the local market. As the previous analysis on different technical trajectories, the development potential of fuel vehicles is minimal. In the future under the extrusion of saving oil policies, the enterprises of traditional fuel vehicles has no way to go. According to Chinese government' requirements, all of passenger cars averagely consumes fuel from the 6.9L/100km of 2015 to 5.0L/100km by 2020. Therefore, the development of CNG vehicle is a feasible path for the enterprises to rely on the resource advantage of Sichuan.

(2) It needs large scale promotion of CNG vehicle engine, and reduction of the content of sulfur in CNG. As previously defined the scenarios, there are a large potential in energy saving and emission reduction for Sichuan CNG vehicle. At present, Sichuan is promoting the technology of CNG tank for CNG vehicle. There is no large-scale promotion of special engine of CNG vehicle. The special engine will enhance the full combustion and dynamic performance for CNG vehicle. Moreover, the sulfides from CNG have a corrosive effect on CNG vehicle engine at present. They will improve the maintenance cost and reduce the service life of the vehicle.

**Keywords**: innovation ecosystem; CNG vehicle; cultivation path; scenario prediction
Sustainable predictive-analytics driven knowledge management in university teaching to improve students’ learning experience and performance

EXTENDED ABSTRACT

Purpose & Research Question:
The bulk of the responsibility of students’ performance falls on to the students themselves, for they ultimately have to effectively manage their time and motivate themselves to develop their competency in the subject. However, knowing that students’ personality factors can play important role in achieving their goals, if the instructing professor can predict students’ performance early on in the semester based on the students’ personality related to the class learning environment and sustain such knowledge over time, there is a significant opportunity for the professors to control the environment to obtain optimal effort and performance out of the students, resulting in students earning higher class grade than they would normally earn.

With the emergence of predictive analytics in the last decade, there exists a strong demand of its applications in wide areas to provide stakeholders at various organizational levels with valuable information to enhance their decision-making. One of the areas of tremendous opportunities for predictive analytics lies in higher education and how universities can leverage student and educational data to extract insights to benefit students, faculty, and administrators alike. These techniques also provide ability to predict the future outcomes based on set of assumptions as long as robust training data set is available to develop a predictive model. Furthermore, these techniques can map input (independent) variables to target (dependent) variable to understand which input variables are significant to the target variable, compare the several predictive models to determine the best model for the given data, and find value-adding associations between the inputs and target to manage the knowledge to sustain optimal student performance over the entire college curriculum.

In this research, we aim to answer if it is possible to use the predictive analytics to predict students’ semester grade in the first week of the semester using their non-cognitive factors. Once determine the feasibility, the result is to utilize to enhance students’ class experience and performance throughout the semester, and measure how much of an improvement this predictive application can make.
Key Literature Review:

Methodology:
Experiment versus control group are selected to conduct this research based on non-cognitive factors collected via survey from the students in the experiment group. These students’ data are collected and analyzed, to provide insights in enhancing learning environment and improve students’ class performance.

SAS Enterprise Miner will be used for the data mining and predictive analytics analysis. After identifying variables significant non-cognitive factors for students, and test for skewness of greater than +1 or less than -1. Upon identification of skewness, the log transformation will be applied to offset the skewness in the transform variable step. Then, the 70% of the data set will be partitioned to be used to train the predictive models with other 30% held out for the purpose of validating the model; this step takes place in the data partition step.

Predictive analytics techniques in decision tree, neutral network and various regressions will be developed for the data. This step will followed by comparing the models based on the average squared error (ASE) of the validation data’s known target values to the predicted values, which is a measure of the model’s predictive accuracy and performance. Finally, the model with the lowest ASE will be selected and its results analyzed. Once the reliable model is found, then the model will be used to predict the final semester grade for new students’ taking the class and the associations between the inputs and target are analyzed. The insights from these models will be managed to provide sustainable insights to optimize the learning environment and resources for the students.

Expected Result:
Based on preliminary research result, the performance of our methodology is very impressive with about 10% improvement in students’ performance from experiment versus the control group. There are more specific factors more significant than others in enhancing students’ performance, but will need further time to analyze the work and validate the finding for this research paper. Overall, the result is powerful approach to utilize predictive-analytics to managing student-performance knowledge in university teaching to improve students’ learning experience and their performance.

Limitations & Implications:
One of the limitations of this study is that the total sample of students’ performances are all from a business quantitative class offered from a single university and taught by a single faculty. Therefore, results may not be generalized to other courses and other universities with
different student makeup; however, this study provides framework for other researchers interested in developing similar predictive models for their courses in their universities.

For the future direction of the research, the increasing use of predictive model and improve accuracy can lead to increase in knowledge management activities. Over time, the research framework can transform the way universities teach and develop our students.

**Keywords:**
Knowledge Management, Sustainability in Education, Analytical Modeling

**Paper type:**
Academic Research Paper
No. 5

Entrepreneurial Behaviors, Technology Transfer, and Innovative Performance: Focused on Networks among Industries—Higher education & Research Institutions, and Technoparks

Abstract

Purpose/Research Question: In general, networks have played roles in improving innovation, as well as early-stage companies carry out entrepreneurial behaviors for securing technological competitiveness. In other words, the companies would like to get technology transfer by carrying out the entrepreneurial behaviors, and hence can increase innovative performance. In addition, by utilizing the networks, the companies would like to improve their innovative performance. Nevertheless, relatively few studies have been devoted to investigating empirical relationships among entrepreneurial behaviors, technology transfer, networks, and innovative performance. Especially, technology-based firms in technoparks are one of the best samples. Therefore, this study aims to explore characteristics of the firms and then investigate comprehensive and empirical relationships among entrepreneurial behaviors, technology transfer, networks, and innovative performance, based on technology-based firms that are occupied in South Korean Technoparks.

Key Literature Reviews (About 3–5 papers)


**Design/ Methodology/ Approach:** The study analyzes data from technology-based small and medium-sized enterprises (SMEs) in South Korean technoparks, by using structural equation modeling (SEM). It assumes that networks will play moderating roles in the relationships between entrepreneurial behaviors and innovation performance. That is to say, we would like to carry out the survey after making interviews with CEOs in the enterprises.

**(Expected) Findings/Results:** Technology-based SMEs will transfer useful technologies by carrying out entrepreneurial behaviors. Moreover, the stronger networks with other stakeholders such as universities, industries, and technoparks SMEs have, the higher innovative performance they have. With the stronger networks, tech-based SMEs will have useful technologies more easily and hence better innovative performance.

**Research limitations/ Implications:** There are some limitations in this study. First of all, this study relied heavily on just quantitative methods such as surveys. This approach is inadequate for considering individuals' in-depth opinions. Therefore, future research utilizing both qualitative and quantitative measures needs to be carried out. Second, this study has some academic limitations. Actually, this study considered restricted factors on innovation and networks, so it is necessary to evaluate other variables such as environmental factors (e.g., regulations or support policies) that might be significantly associated with networks and innovation hereafter. Finally, due to the fact that this study was focused on SMEs that are occupied in South Korean technoparks, it is difficult to generalize the above results. However, this study implies that a greater stronger network ties improve innovative performance, so SMEs must establish and reinforce networks to improve the performance.

**Keywords:** entrepreneurial behaviors, technology transfer, networks, innovative performance, technology-based small and medium-sized enterprises
Creative Attitude, Cultural Literacy, and Cultural Receptivity in an Era of Sustainable Development

<Abstract>

Research Question: Fostering creativity comes from various dimensions in terms of incentives, knowledge, and culture. Despite many diverse arguments on how to promote creative attitude and mind, there are two competing arguments about what factors promote creativity: economic and non-economic factors. Economic approach emphasizes that various extrinsic incentives including performance payment, bonus, and promotion facilitate creativity. On the contrary, non-economic approach suggests that creativity is a function of various non-pecuniary factors including cultural activities (Leung et al., 2008) like cultural literacy and receptivity as well as community trust, reciprocal respect, and life satisfaction (Carr, 2011; Chae, 2016; Davis, 2009; Niu, 2014; Pannells & Claxton, 2008). While most research focusing on how tangible products based on economic incentives (e.g., patent, article) are related to creativity, less empirical research has discussed how intangible activities such as cultural knowledge and orientation influence creativity. Sustainable development involves not only economic prosperity but also cultural activities and diversities. It is necessary to identify how cultural elements are related to creative mind and attitude in order to deepen an understanding how to foster creativity.

Research Background: Creativity has increasingly become a core agenda to solve global issues including sustainable economic growth, business competitiveness and entrepreneurship, inequality, and human development (Bass et al., 2008; Barron & Harrington, 1981; Boden, 2004; Neumann, 2007; Nickerson, 1999; Šarotar Žižek et al., 2014). The creative mind and attitude is crucial to not only promoting digital economy in an era of globalization but also to reaching an appropriate level of social and human development. Previous research has mainly focused on how creative elements embedded in people, organizations, regions, and culture are associated with innovation (Carmeli & Spreitzer, 2009; Rasulzada & Dackert, 2009; Sawyer, 2011) or economic prosperity. For instance, such conceptual instruments as creative class, creative city, and creative economy have been used as proxies to reflect the nature of creativity to uphold job, income, productivity, and innovation. However, most previous research has neglected how these non-economic factors such as cultural activities and knowledge can promote creativity.

Research Method: We, relying on a national representative sample in South Korea, empirically test whether or not there may be the significant relationships between creativity and cultural literacy, and between creativity and cultural receptivity. Creativity is measured as a proxy of creative attitude. In this study, creative attitude consist of four items: orientation for
newness, imaginativeness, receptivity to new ideas, and sensitivity. Cultural literacy is measured by an amount of cultural knowledge. This study uses 9 items with a dichotomy measure (Yes or No) to test cultural knowledge whether or not respondents know culturally related questions. Cultural receptivity consists of four items: the degree to treat foreigners as neighbor, the degree to trust foreigners regardless their nationalities and ethnicities, the willingness to participate in diverse events or festivals for foreigners, and the degree to agree on the point that foreign culture can prosper our culture. We will conduct multiple regression analyses of creative attitude, cultural literacy, and cultural receptivity, after controlling for age, gender, income, and education.

**Expected Findings:** It is expected that there are significant relationships between cultural literacy and creative attitude, and between cultural receptivity and creative attitude. We suggest that public policy to promote creativity should concern about various non-economic factors, especially culturally related intangible elements including cultural literacy and cultural receptivity.

**Keywords:** Creativity, Economic Incentives, Non-economic Factors, Cultural Literacy, Cultural Receptivity

**References**


The rise and fall of RFID-using food waste meter rate system: A case of
Gangnam district in South Korea

<Abstract>
This paper examines how the application of RFID technology for food waste disposal adopted, implemented, and terminated in Korean municipal governments. This case story of policy termination illustrates that even public policy based an attractive new technology can be terminated due to various organizational and human barriers. Since 2012, South Korea has adopted food waste meter rate system among the autonomous local districts. Some local governments have still used a conventional food disposal bag with a volume based fee system but others adopted the RFID technology for food waste disposal. The adoption of the RFID system has increased following an early diffusion model of new technology. However, few local governments have adopted at an early policy period of a volume based food waste disposal but terminated it after implementing due to various problems. For instance, Gangnam district, one of the wealthiest districts in South Korea, adopted RFID technology in food waste meter rate system in the early 2012 but returned to its traditional way of waste disposal, a garbage bag about a year later. We investigate, relying on interviews, Schilling’s Technology Lockout Model, and Q-Methodology, the whole process of RFID adoption which is composed of 5 sectors of Gangnam districts and identified several key factors to contributed to locking out of the RFID system. We have interviewed public officials, apartment complex residents and head of security office of apartment for in-depth case study. More specifically, we found key barriers to implementing the RFID system, including lack of core managerial capabilities, absorptive capacity, insufficient installed base, timing of entry, and policy network. Q- statements from Q-Methodology allows us to display various aspects of the locking out case and factor analysis provides key factors to look at this policy termination case. This policy case suggests that an innovative policy idea based new technology like RFID may face various organizational and human obstacles in the process of implementation and be terminated.
A new time series analytic method using fast-fourier-transformation

Abstract

A time series is defined as a series of data points indexed in time order. In the most cases, a time series is expressed as discrete time data which is a sequence sampled at equally spaced time. For examples, stock information, precipitation information, heights of ocean tides, counts of sunspots, etc.

The main purpose of time series analysis is to extract the meaningful and statistical information. Generally, time series is used to predict the future trends based on the previous estimated values. It is called as "time series forecasting". While regression analysis is often employed in such a way as to test theories that the current values of one or more independent time series affect the current value of another time series, this type of analysis of time series is not called "time series analysis", which focuses on comparing values of a single time series or multiple dependent time series at different points in time.

In this paper, in time series analysis, the new time series analytic method is proposed to answer the following question.

1) In correlated time-varying data, although there are some missing data, how can we reconstruct the missing data?
2) In correlated time-varying data, although there are some errored data, how can we reconstruct the errored data?
3) In correlated time-varying data, how can we expect the future data trend based on the previous data?

The proposed algorithm is as follows:

1) By applying FFT (Fast Fourier Transformation) to the correlated time-varying data, we can change the time domain to the frequency domain.
2) In frequency domain, the uncorrelated parts have the high frequency values.
3) If we cut high frequency values above the certain threshold and use zero-padding, we can erase the uncorrelated parts.
4) By applying IFFT (Inverse Fast Fourier Transformation), we can reconstruct the missing or errored data or expect the future data trend.

As a result, we expect the following results:

1) In correlated time-varying data, although there are some missing data, we can reconstruct the missing data.
2) In correlated time-varying data, although there are some errored data, we can reconstruct the errored data.
3) In correlated time-varying data, we can expect the future data trend based on the previous
data.

**Purpose/ Research Question:**
1. In correlated time-varying data, although there are some missing data, how can we reconstruct the missing data?
2. In correlated time-varying data, although there are some errored data, how can we reconstruct the errored data?
3. In correlated time-varying data, how can we expect the future data trend based on the previous data?

**Key Literature Reviews (About 3–5 papers):**

**Design/ Methodology/ Approach:**
1) By applying FFT (Fast Fourier Transformation) to the correlated time-varying data, we can change the time domain to the frequency domain.
2) In frequency domain, the uncorrelated parts have the high frequency values.
3) If we cut high frequency values above the certain threshold and use zero-padding, we can erase the uncorrelated parts.
4) By applying IFFT (Inverse Fast Fourier Transformation), we can reconstruct the missing or errored data or expect the future data trend.
5) In this process, the proper threshold and points of FFT and IFFT should be decided.

**(Expected) Findings/Results:**
1. In correlated time-varying data, although there are some missing data, we can reconstruct the missing data.
2. In correlated time-varying data, although there are some errored data, we can reconstruct the errored data.
3. In correlated time-varying data, we can expect the future data trend based on the previous data.

**Research limitations/ Implications:**
- Depending on the number of correct data and the correlation of data, the correctness of the proposed algorithm should be changed.

**Keywords:** FFT, Time series analysis, Estimation
Dismantling of the inverted U curve

Abstract
The purpose of this study is to address the two following issues.
What are the causes of differences of open innovation effects?
What are the differences of open innovation effects according to the surrounding situations of firms?
Depending on the specific strategy of the firm, the industry where the firm belongs to (i.e., knowledge characteristics of the corresponding industry), and on the time dimension where the corresponding open innovation is in progress, open innovation creates various levels of performance.

Keywords: aircraft industry, open innovation, simulation, game of life, inverted U curve, mathematical modeling
Roadmapping for export of space segment based on portfolio analysis: A case of Korea

Space industry is technology-intensive comprehensive industry. Governments around the world are actively investing into space industry since its high industrial relevance on employment or technology. In Korea, space industry is also evaluated as a power industry for realizing the creative economy and focus on successful acquisition of technical capability. However, most companies in space industry of Korea are small and medium enterprises (SMEs) and they need to reinforce the global capability to export aerospace product. Nevertheless, the link between target country and product is still insufficient. Accordingly, the purpose of this study is to propose an export roadmap of aerospace product for providing SMEs with export opportunities and strategic guidelines. Technology roadmap and portfolio analysis are applied to this purpose. This study is expected to be helpful to SMEs and government agency.

Keywords: Roadmap, Export, Space industry, Portfolio analysis, Open innovation

1. Introduction

Space industry is technology-intensive comprehensive industry. Governments around the world are actively investing into space industry since its high industrial relevance on employment or technology. In Korea, space industry is also evaluated as a power industry for realizing the creative economy and focus on successful acquisition of technical capability. The scale of global space industry is about 30 billion dollars and is growing 4.9% per year within 5 years. Korea government also consider space industry as the power for implementing creative economy and try to acquire the technological capability.

However, most companies in space industry of Korea are small and medium enterprises (SMEs) and they need to reinforce the global capability to export aerospace product. Almost Korean SMEs in space industry has insufficient technological capability and export records. There are several difficulties to export such as policy issue such as national security. Technology roadmapping with considering both internal technological capacity and external market condition is necessary for export of space segment. Nevertheless, the link between target country and product is still insufficient.

Accordingly, the purpose of this study is to propose an export roadmap of aerospace product for providing SMEs with export opportunities and strategic guidelines. The export roadmap is made by considering both technological capacity and marketability of internal space product. Also the export roadmap is customized by considering market situation, technology level, and policy status of each
country. The remainder of this paper is organized as follows: section 2 briefly reviews the previous research; section 3 presents a research methodology; and section 4 presents the conclusions.

2. Literature Review

(Under progressing)

3. Methodology

This study develops a strategic roadmap for the exports of Korean aerospace products (including technologies, components, systems, equipment, and service platforms) to other countries. At first, the promising aerospace product segments of Korea and the target countries for entry are explored. The promising aerospace product segments are selected by experts’ opinion on the competitiveness of Korean aerospace products. The target countries are selected considering their aerospace import markets as well as recent political and diplomatic relations with Korea.

Then, the product segments for each of target countries are analysed in terms of product marketability, technological competitiveness, and policy trends, which are the definitely core factors of aerospace export strategy (Goldstein 2002; Park et al. 2012). Including these factors, the strategic mapping of product segments and countries are derived using portfolio analysis. Specifically, this study plans to assess several key measures for each factor, as shown in Figure 1.

In terms of the marketability of a space product segment for each country, a government’s intention to invest and an import competitiveness are measured. As the space industry is developed by the balanced attempts of the government’s needs and the market’s interest, we measure both sides. The government’s intention to invest is measured from R&D investment budget and the import competitiveness from the import RCA (Revealed Comparative Advantage) index. The RCA index is an index used in international economics for calculating the relative advantage or disadvantage of a certain country in a certain class of goods or services as evidenced by trade flow, which is commonly presented by Balassa (1965). If the import RCA of an aerospace product is high in a certain country, the country is said to have a comparative advantage in the product import and thus to be largely interested in and to need for importing the product.

Likewise, the technological competitiveness of a space product segment for each country is evaluated by a technological capability and an export competitiveness. Since the space industry is a technology-intensive industry, the domestic technology level and the export competitiveness of target countries are important factors in establishing export strategy of Korean products. The domestic technological capability is measured by the number of patent application and the export competitiveness
is measured by the export RCA index that represents the comparative advantage in the product export. The policy trends for a product segment for each country are also collected for roadmapping.

For each product segment, the target countries have heterogeneous marketability and technological capabilities so that basic strategies to entry can be established. For example, if a country has high marketability as well as high technological capability, it is attractive but highly competitive market; in order to foster exports to this market, participating in projects led by that country or finding subcontracting business are appropriate strategies. If a country, on the other hand, has high marketability and low technological capability, it is highly import-dependent since they cannot produce required product; in this case, the export contracts can be activated by governmental collaboration or programs conditional on transferring superior technologies of Korea.

Thus, based on measurements, the detailed roadmapping is implemented in three steps: classifying country type using portfolio map, establishing the strategies for product entry, and developing export roadmap (see Figure 2). First, the portfolio maps are constructed using product marketability and technological capability as an axis of the map and countries as the mapping points; and then countries are classified for defining the basic strategies. Second, detailed strategies for product entry are elaborated using detailed future events according to the countries’ future aerospace plans. The future events such as launching or developing a satellite can be reference points to plan when and what to do.
for the exports. Thus, the product segments (in our lists) related to the future events in particular are identified. Integrating basic strategies, future events and their relevant product segments, the detailed strategies for product entry are established. Lastly, the export roadmaps are developed for each product segment. The layers of roadmap are target countries with categories and three elements of future events, export products, and detailed entry strategies are placed according to their time to action and dependencies.

4. Conclusions

This paper proposes an export roadmap of aerospace product based on portfolio analysis. The roadmapping of exports of aerospace products is extremely complex problem due to the need for associating a variety of products and alternative target countries. Responding to the complexity, this study suggests the comprehensive views of product marketability, technology capability, and governments’ policy plans and provides the systemic roadmapping processes to establish basic and detailed strategies. Subsequently, this paper is expected to help SMEs to identify export opportunities and strategic guidelines.

References


The role of business model in market growth:- The difference between the converted industry and the emerging industry

Research Question
What are role differences of business model between already existing autonomous car industry, and new emerging intelligent robot industry?

Research Method and Scope
We examine 2 different industries to answer to the research questions. They are autonomous car industry and intelligent robot industry. We selected these because these are all new industries, but these are totally different industries. The one is a kind of expanding industry from mechanical car industry to electronic and computational smart car industry. But the other is new emerging industry which is totally different from existing industries including industrial robot industry.

This research used simulation method of System Dynamics(SD) to find of role difference of business model between industries. We simulated each 72 different conditions in 2 target industries, so to say, autonomous car industry, and intelligent robot industry.

Second, we interviewed more than 10 specialists deeply in 2 industries with half structured questionnaires to validate our simulation models and to find out clues to explain simulation results.

Third, we did patent analysis, and set up simulation conditions from technology patents and business model patents in 2 target industries. We used G-Pas(https://gpass.kisti.re.kr) which is a kind of worldwide patent database by the Korea Institute of Science and Technology information(KISTI). The patents of the two industries were extracted by using keywords ‘autonomous car or autonomous vehicle, and intelligent robot or autonomous robot’ from 1960 to 2014. This patent date base coverage is all major countries such as United States, Europe, China, Japan, Korea, Germany, France, Great Britain, and Canada.

Literature review and Simulation model building
1) Literature review
Technologies do not affect markets directly but rather affect the markets through the business, and, a separate positive feedback loop structure exists between the technologies and business model, as well as between the business model and markets(Yun, Won et al. 2016). The business model serves as an intermediate construct that links the technical and economic domains(Chesbrough 2006). Business model as combination between technology and market requires strategies and resource to conquer the miss combinations such as technology overfitting or Icarus paradox. But new business models allows for additional innovation potential on top of product and process innovation(Gassmann, Frankenberger et al. 2014).

What make disruptive innovations? The root of tension is the conflict between the business model established for the existing technology, and that required to exploit the emerging, disruptive technology(Chesbrough 2010). So, according to Chesbrough(2010), following ‘dominant logic’ can lead firms to miss potentially valuable uses of technology which do not fit their current business model. In addition, to offset the trends of rising development costs and shorter product life cycles, companies must experiment with creative ways to open their business models by using outside ideas and technologies in internal product development and by allowing inside intellectual property to be commercialized(Chesbrough 2007).
Meanwhile, we can analyze technology and business model through technology patents, and business model patents (Jaffe and Trajtenberg 2002). The key aspect of the relationship between a patent and its descendants is what we call the overall “importance” of a patent. This measure is designed to capture the technological impact of an invention as reflected in the number and importance of its descendants, and hence corresponds to the most intuitively appealing notion of basic innovations (Jaffe and Trajtenberg 2002).

2) Research Framework

### Simulation

1) simulation Condition

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autonomous car

L,S,R

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intelligent robot

L,S,R

| 0.5 0.5 0.5 | 0.5 0.5 0.9 | 0.5 0.9 0.5 | 0.5 0.9 0.9 | 0.9 0.5 0.5 | 0.9 0.5 0.9 | 0.9 0.9 0.5 | 0.9 0.9 0.9 |
Reference


Innovative Production Scheduling with Customer Satisfaction Based Measurement

Abstract

Purpose/Research Question: In this paper, we focus on the scheduling problem in the ear of the 4th industrial revolution. In terms of the open innovation, the innovative production scheduling can be defined as the one used by using Big data, cyber-physical system problems, internet of things and cloud computing. Under this environment, one of the most important things is to develop efficient and effective scheduling algorithm for the quality, cost, delivery and flexibility. There are various types of workstations according to the physical flows of manufacturing lot or product and one of them is flexible flowshop (also known as hybrid flowshop). In the flexible flowshop, there are serial workstations with multiple machines or equipment which can process multiple lots simultaneously and most manufacturing systems such as semiconductors, glasses, liquid crystal display (LCD), steel, solar cells, paper, aircraft and so on, have flexible flowshops. Therefore, it is very important to schedule jobs/products effectively and efficiently for the quality, cost, delivery and flexibility.

In this paper, flexible flowshop scheduling problem is considered with the property of sequence-dependent setup and different process plans of jobs. Two methodologies for improving production firm are suggested based on the dispatching rules and optimized production technology. A simulation study is conducted for the performance evaluation on the randomly generated problem instances and results show that our proposed methods perform better than existing ones.

Key Literature Reviews (About 3–5 papers): In the field of flexible flowshop scheduling problem, since these kind of problem are known as NP-hard, there have been lots of paper for developing meta-heuristics, such as simulated annealing, genetic algorithms, taboo searches (Gupta and Tunc; 1998, Gelders and Sambandam; 1978, Khouja et al.; 1992). On the other hand, to maximize customer satisfaction like meeting the due dates of customers’ order, usual researches use the tardiness measurement (Guinet and Solomon; 1996, Chen and Gupta; 1989). Also, according to the complexity of the problem, in which can be classified by the number of serial workstations (or stages), several heuristic algorithms are developed to find near optimal solution.

Design/Methodology/Approach: To solve the problem considered here, we need to decide the size of lot or product to process at the shop and the scheduling scheme. In the proposed method, when a machine/equipment becomes idle, a job to be processed is selected according to the its priority, which is determined by the devised method here, and is processed at the machine.
the information about the due dates and processing times as well as setup time, we develop the methodologies based on the combination of dispatching rules, which are used for scheduling jobs, and optimized production technology, which is modified after solving the lot sizing problem for the objective of minimizing total tardiness of jobs. Here, the tardiness is defined as difference between completion time and due date of job.

(Expected) Findings/Results: To evaluate the performance of the suggested methodologies, these are compared with the existing ones which are used in the practical field. For each problem instance, we use the evaluation performance measure, relative deviation index (RDI), which is defined as \((A - B)/(W - B)\), where \(A\), \(B\), \(W\) are the solution values of algorithm A, the best algorithm and the worst algorithm, respectively. Simulation study is conducted on randomly generated instances in which the real production situation can be reflected. The results show that the proposed methods outperform the existing ones.

Research limitations/ Implications: In the era of 4th industrial revolution, sustainability and open innovation is becoming more necessary and important. Especially, in the manufacturing level, they are becoming more important for the mass customization which is one of the important demands. A smart factory, which represents 4th industrial revolution, is one way of the sustainability, and innovative production scheduling with customer satisfaction based measurement is considered here since the quantity, quality, and customer’s satisfaction are affected by scheduling results in the operational level. Therefore, an effective and efficient scheduling is one of critical success factor for the smart factory.

There might be a limitation on this research since this scheduling problem is specified in the lower level of production hierarchy of the manufacturing firms. Therefore, for the higher level such as production strategies and policies of the company, one may need to give an effort to develop production plans. Also, it may need more tests on various range of parameters to obtain more general results.

Keywords: fourth industrial revolution, scheduling, due date based measure, flexible flowshop, heuristics
The influence of institutional voids on the appropriability regime of servitization of manufacturing—comparative study on the role of intermediaries between Taiwan and Korea’s ICT industries

Abstract
Due to the rapid development of digital convergence and service, such as mobile devices and cloud computing, both Taiwan and Korea’s information communication and technology (ICT) manufacturing industries have been upgrading of servitization. The purpose of this paper is to investigate how institutional voids of appropriability regime based on manufacturing-based production influence the industrial upgrading of ICT servitization by comparing the development of Taiwan and Korea’s ICT industries and policies, and what the role of intermediaries deploy to cope with formal or informal institutional voids of appropriability regime. In theoretical contribution, this paper investigates how the concept of institutional voids is understood on the perspective of appropriability regime, and what the role of intermediaries are in place and how intermediaries may work in the voids, and finally what institutional voids challenges may be confronting the servitization of manufacturing in Taiwan and Korea’s ICT industry.

In addition, previous literature has shown different points of view related to the influence of Institutional voids on the development of industries. On one hand, institutional voids may negatively influence innovation moderated by type of networks and systematic failure. On the other hand, institutional voids offer entrepreneurs with the opportunity to create the appropriability of innovative business models. With this, we will employ a qualitative research approach by In-depth interviewing with governmental officials, entrepreneurs, research institutes from both Taiwan and Korea. Finally, we construct the contents of interview by the method of structure analysis developed by Professor Godat for more/further observations in both newly emerging economies. In a word, this paper will contribute the conceptual development of servitization of manufacturing by exploring the role of intermediates, and in turn provides an insightful learning for policy makers for the economic transaction.

Keywords: Servitization of manufacturing, appropriability regime institutional voids, ICT industries, intermediaries

Purpose/ Research Question
The transition economies are used to be characterized as the underdeveloped formal institutions. An uncertainty and risk void in the emerging market are usually used to be filled by informal institutions. For example, Khanna and Palepu’s study (2013) explained how the absence of intermediary organisations, such market research firms and credit card systems, affect the connection with buyers and sellers efficiently which create obstacles for operation in emerging markets. Thus, with the more understanding of the institutional voids, the influence of formal and informal voids on the development of specific industry could be comprehensively understood.

Several studies have shown that the formal institutions that are so supportive for entrepreneurship in developed economies are sorely inadequate in transition economies like Russina and China (Golenkova & Igitkhanian, 2008; Puffer et al, 2010). Institutional voids are regarded as one of sources of market opportunities by refining market architecture or legitimating new market actors when supportive institution or policy are absent or weak (Mair et al., 2013). In the other hand, the formal institutional void may create an environment in which formal institutional voids could be destructive, or if that informal institutional voids supports piratical behaviours, then in turn piratical organizations as the role of intermediary may be involved with new market opportunities.
Similarly, the transition, when countries need to upgrade their industrial development, has shown similar characteristics we could further justify the argument from above perspective of institutional voids. Consequently, while boundaries between ICT’s manufacturing and services have become gradually unclear and the source of appropriability derive from intangible assets and services, leading to the trend towards the servitization of manufacturing.

With the rapid development of digital convergence and service, such as mobile devices and cloud computing, both Taiwan and Korea’s information communication and technology (ICT) manufacturing industries have been upgrading of servitization. For example, Taiwanese ICT producers have shown some characteristics that used to related mainly to their role in global production networks (Chen, 2004), such as Original Equipment Manufacturer (Chu, 2009). Both Taiwan and Korea as newly industrial countries are therefore the best cases while both countries have improved their manufacturing-based innovation system toward servitization. Thus, this study contributes to the literature on the perspective of the institutional void. This study would further highlight how their relationship in Asia countries differs from those in developed economies.

**Current understanding and research questions**

While the formal institutional void has resulted mostly from weak intention to develop institutions, institutional voids may move forward Institutional Interfaces between market institutions and local institutional arrangements (Mair et al., 2013). For example, Khanna and Palepu (2010) explores the unique institutional contexts for the outsiders’ (foreign firms) strategies in an individual emerging market. Due to the institutional arrangement are not easily to change when facing challenges from outboard in the first place, outsiders are required to navigate around or in the market’s voids and look for opportunities elsewhere to fill institutional voids. Since both Taiwanese and Korea have strong ICT infrastructure and formal institutions, Korea has expanded to some of the software sector, particularly in the online game industry. These lead to the main question in this project—why Taiwan ICT industries did not expand their competitiveness into software industry when Korean develop complementary sectors of ICT industries, is there any institutional voids existed in Taiwan?

In addition, previous studies have shown that modern manufacturing are interesting in servitization either adding services to or integrating services into their main products (Lightfoot et al., 2013; Neely, et al., 2011; Vandermerwe & Rada, 1988). In search of manufacturing of servitization, the transformational issues facing with manufacturers are especially acute for delivering advanced service in Information, Communication, and Technology (hereafter as ICT) industries. For example, Ceci and Masini (2011) has demonstrated that balancing specialized and generic capabilities are vital for information technology sector when delivering servitization. This is also true in defence industry when offering effective delivery of integrated product and service (Datta and Roy, 2011). For ICT industry, the operations of the manufacturer in ICT industry, such as Acer in Taiwan, demands different capabilities to those of production in the past model. A transformational failure used to be occurred when related capabilities related to servitization are not in place.

**Research contribution**

This study has set out to investigate how institutional voids influence servitization of manufacturing by comparing Taiwan and Koreas’ Information, Communication and Technology (ICT) industries, and what strategies ICT industries deploy in order to deal with formal or informal institutional voids they encountered. This study investigates how the concept of institutional voids is understood, what the role of intermediary organizations are in place and how they works, and finally what institutional voids challenges may be
confronting the servitization of manufacturing in Taiwan and Korea’s ICT industry through the perspectives of governmental officials, entrepreneurs, research institutes will be interviewed for more and further observations in both newly emerging economy.

The first research question is: "What intermediaries and their interactions have taken place in the transformation of appropriability regime in the ICT industry in Taiwan and Korea?" To answer this, secondary and documentary data analysis will be conducted. These data include legal documents, international trade information, patenting activities information etc. An interview method may be employed before analysing indepth case studies for which longitudinal data is available. Through Interviews the information that is required to develop the case studies and establish more in-depth understanding can be found out.

In addition, the second research question: "What characteristics and nature of policy network in terms of intermediaries involving Taiwanese industries emerge from institutional voids?" is raised. We construct the contents of interview by the method of structure analysis developed by Professor Godat for more/further observations in both newly emerging economies.

This paper employs structural analysis which intends to identify the inter-relationships between considered variables in the process during servitization of manufacturing. These variables may correspond to the attributes of the internal and external environment of innovation system both in Taiwan and Korea, while variables selections are conducted on the basis of their role as key driving forces in ICT servitization.

With those key variables of the system, both internal and external, we can capture the driver of the system’s future states and the ‘influence-dependence’ relationships among a set of selected variables (Stratigea, 2013). In doing so, we employ the MICMAC module developed by Godet (2011) based on structure analysis in order to discover the key variables of the study area/problem in both Taiwan and Korea, and in turn formulates the basic framework in terms of institutional voids as to their future states. Such implication of comparative study between Taiwan and Korea is very insightful for policy-makers in order to define innovation policies that can lead to the successful transformation from manufacturing based ICT industries to manufacturing of servitization.

**Preliminary Findings**

To begin with, the paper draws attention to the role of intermediary organisations in the point of view of institutional voids. For example, with the institutional voids related to Intellectual property rights protection, Taiwanese firms in the ICT sector develop a production strategy that focuses on producing complementary products to Brand within the existing standards. This broad development strategy has been adopted by Korea, to improve their manufacturing and production capabilities in order to export their products to advanced countries.

Secondly, this study highlight the importance of an industries-specific of intermediary organisations in the institutional voids to create appropriability regime. ICT Industries characterised by cumulative technologies utilize the role of patent protection in different ways. In particular when "time to market" in the ICT industries of Taiwan is considered as an important factor for appropriating rent from inventions, the role of appropriability regime has been recognised as a strategic tool or a defensive mechanism in competition. While competing with products from developing countries, the commonly seen “razor-thin profit” situation became worse. Therefore, both Taiwan and Korea faced the issue in terms of how to progress toward the high value added service and innovation-based industrial growth to ensure appropriability. For example, the institutional voids of enforcement mechanisms turn out to be the different appropriability strategies with a major intermediary organisation, Industry
Technology Research Institute (ITRI).

Finally, the institutional voids of the transformation of manufacturing servilization have many surprising outcomes and a large amount of confusion in the appropriability regime. Both Taiwan and Korea in terms of Trade structure of institutional voids are complex issues to analyse due to the mix of technological problems with the misleading use of innovation policy.

Conclusion
The contribution of this study, in general, is related to two strands in the literature. Firstly, the issue examined here extends the scope of the research on the optimal form of appropriability regime in relation to institutional voids. Secondly, the study seeks to extend and integrate the empirical findings from structure analysis and institutionalism in highlighting the role of intermediary organisations in the process of servitization. In particular, this study takes a comparison study between Taiwan and Korea from both newly industrialised countries, to illustrate the influence of the appropriability of intuitional voids in both countries on the development of servitization. This leads to the implication of theoretical framework of the linkage of innovation policy from the transformation of ICT industries servitization.

Reference


Linking Firm Openness and Innovation: The Moderating Role of External Knowledge Search strategy

Abstract
Traditionally, firms are striving to the closed methods for innovation process, but it connection with the market environment is quite limited. In recent year, external knowledge sourcing has become a vital part of firm’s innovation strategies. In order to access external knowledge, firms collaborate with multiple partners for multiple technologies that would lead to the diversification of their technological knowledge. Moreover, the organizational innovation is considered to be highly important for a firm’s competitiveness. The purpose of this study is to examine the relationship between the technology diversity and organizational innovation in terms of how to drive the innovation performance based on the open innovation perspective. The analysis is based on a sample of 2381 Taiwanese firms active in innovation activities taken from the Community Innovation Survey (CIS) 2012, survey by the Taiwan Ministry of Science and Technology. Finally, we use Tobit regression analysis to tests the hypotheses and the relationship among open collaboration diversity, organizational innovation and innovation performance. We found open collaboration has an inverted U-shaped and significant effect on the firm innovation performance, and that this relationship is positively moderated by organizational innovation. In addition, the empirical result also found that the organizational innovation has a positive and significant effect on firm innovation performance.

Keywords: Open innovation; organizational innovation; open collaboration diversity; innovation performance

Purposes
A starting point for the openness strategy is that a single firm cannot produce all knowledge and technologies in isolation. In this view, firms have collaborated with different types of partners to acquire knowledge and capabilities across organizational boundaries (Chesbrough, 2003; Laursen & Salter, 2006). It is relevant to explore how external knowledge resources influence the firm innovation outcomes. The different partners have different knowledge, technologies, and capabilities to complement in-house innovation deploying. In this regard, the collaboration relationships among external actors for accessing of knowledge, technologies, and capabilities have become more and more important because of continuous technological change, shorter product life cycles and increasing speed of the development of products and services. Such external partners increase the available innovation resources to acquire exchange, assimilate, and internalize for internal innovative resources. In the case of open innovation era, firms continuously monitor the external environment and seek external partners in order to determine when to engage in innovation. Therefore, openness strategy perspective is increasingly appearing on strengthening firms’ incentives to increase their reliance on external knowledge for in-house innovation.

In the multiple and open collaboration partners context, open collaboration diversification and its implication for firm performance has recently attracted attention in the literature on innovation activity (e.g., Garcia-Vega, 2006; Laursen, & Salter, 2006; Rodan & Galunic, 2004). As noted Rodan and Galunic (2004), for example, firms access to external heterogeneous knowledge and technology is important for increasing innovation performances. Consequently, under these empirical evidences, it might be expected that firms are more open collaboration diversified can have certain advantage in acquisition from external collaborators. Especially, the increasing competitive pressure in highly innovative markets, technological change, and the rate of imitation are sources of economic obsolescence for the firm’s technology. To overcome these barriers, firms engage in technological diversity may access advanced
technologies in their R&D, because the diversification in their internal innovation deploying tends to reduce the risks inherent in the R&D activity. There is evidence that best performing firms can create more complex and developed products by through wide spectrum of technological capabilities in which possibly allows them to increase competitiveness (Gambardella & Torrisi, 1998).

In addition, previous empirical studies mostly focused on the effect of technological innovation and ignored the importance of non-technological innovation activity, especially, organizational innovation. Organizational innovation refers to implementation of a new organizational method in the firm's operational practice, workplace, management control, and external relationships (OECD, 2005). Since organizational innovation is one of most important and sustainable sources of competitive advantage for the firms (Hamel, 2009). Most studies of organizational innovation focus specifically on the interaction between technological innovation and organizational innovation (Evangelista & Vezzani, 2010; Ganter & Hecker, 2013; Tether & Tajar, 2008), which is relative to get a comprehensive innovation framework. Given the importance of organizational innovation on the innovation, the difficult task for firms is to explore how organizational innovation to drive open collaboration partner in order to capture the benefit from external collaboration partner sources. Importantly, these literatures also highlight the existence of important firm and organization context factors that impact on the innovation of the firms. However, prior literature has still lack of conceptual and methodological contributions to deal with investigating organizational innovation. Drawing on innovation perspective of the firms, the organizational innovation may substantially enhances the potential performance gains through innovation striving. Mol and Birkinshaw (2009), for example, suggested that the previous studies of organizational innovation showed little empirical evidence of the relationship between the deployments of new management practices and firm performance.

While the argument on the effect of organizational innovation on the firms’ innovation is still ongoing, it is worth addressing the open collaboration diversity from open innovation perspective which is nevertheless major way in innovation efforts. This study, therefore, focus on explore the relationship between the open collaboration source diversity and organizational innovation how to drive the performance of the based on the open innovation perspective. First, we introduces the empirical evidences of innovation survey at firms level in Taiwanese that have focused on the innovation activities from large-scale firms survey activities, which was established to facilitate innovation policy across different types of industries. Second, we explored the place the concept of open collaboration diversity in the open alliance context which may directly impact on innovation performance. Third, we examine the organization innovation effects on the firms’ innovation outcomes and further explore its role play between open collaboration diversity and firm performance. This study, adds to our understanding of the open collaboration diversity in open innovation context investigating the adoption of external collaborative partner resources in different industries in emerging Taiwanese region.

2. Theoretical and hypotheses development

Open innovation studies addresses that external partners from different knowledge domains and countries are crucial for in-house innovation. Diverse knowledge strengthens firm creativity and generates new perspectives and insights into a problem solving for innovation outcomes. Along with an open innovation perspective, the primary concern is how firms’ use external knowledge, technologies and ideas of external multiple partners in boosting their internal innovation deployment processes (Chesbrough, 2003). Diverse knowledge can create new opportunities and synergies through multiple knowledge sources of external collaborators, and in turn increase their innovativeness. Diversity in knowledge and technologie resources enhances the firm’s capability for innovation by through external inter-firm alliances. Therefore, diverse knowledge and technological resources can complement firm internal innovation and provide an opportunity to make novel linkages (Cohen and Levinthal 1990). A
broad variety of sources, including competitors, suppliers, customers and universities, and labs may are helpful in the exchange of diverse technological knowledge for rapidly improving innovation outcomes. Prior research emphasizes collaboration partner diversification are very important for firms in the skills, technologies and knowledge incorporating into the possibilities of new combinations of internal knowledge through integration and learning (Inkpen, 1998).

Furthermore, from the knowledge-based view (KBV) of the firms (Grant, 1996; Kogut, and Zander, 1992), the heterogeneous knowledge sources and the values for the firms enhances the probability of rise of innovative ideas through novel combinations, and integration diverse knowledge when engaging in collaboration with diverse types of partners. Focal firms can achieve appropriability benefits obtained from their higher level diversity level of cooperative partner such as accessing more technological opportunities, knowledge sharing and exchange from their open alliance portfolio. When knowledge and technologies exchange share the timely and newly generated knowledge that may facilitate new combination of resources from partners and exploitive possible synergies and then recombines them into new products and services, thus firms can achieve superior innovation performance (Belderbos et al., 2007; Duysters & Lokshin, 2011; Nieto & Santamaria, 2007). In the similar vein, focal firms collaborate with multiple partners may obtain a performance advantage because they provide a firm with an access to valuable knowledge through its interactions with external partners (Grant & Baden-Fuller, 2004).

However, these positive effects may decrease and even become negative effect if collaborative partners are too large to be handled. First, excessive collaborative partners may have unfavorable impact on firm performance in terms of the increasing complexity of partners and management costs. Diverse collaborative partners also raise the potential integrative costs of different knowledge and technologies from various partners when transferring in their innovation. Because greater variance of the technological knowledge being integrated increases the level of complexity, and thus the difficulty and costs of coordinating these technologies in which the integrative cost can be increased (Argyres, 1996). As Jiang and colleagues (2010) indicate, firms engage in diverse their cooperative partners increases managerial complexity and is finally harmful for firm performance.

According to the above discussion of the benefits and risks of open collaborative partner diversity impact on the firms innovation activity, we proposes that there is curvilinear relationship between open collaborative partner diversity and firm innovation performance. As Huang and Chen (2010) found that technological diversification form diverse collaborative partners to firm performance rise up to a threshold, beyond which the cost of coordination, integration, and learning outweighs the benefit of diversity. As a result, both theoretical arguments and empirical study suggest that open collaboration partner diversity of a firm is beneficial for the innovation outcomes but only up to the high point. However, at high levels of open collaboration partner diversity, management and control costs is likely to causing the net benefit to decrease.

Organizational innovation and innovation performance

Traditionally, there is few studies address organizational innovation in terms of how to affect the performance of the firms. To date, there is no widely accepted definition of organization innovation in management and business fields. Some empirical literatures proposed that most studies are only one category of innovation, such as technical innovations (Damanpour & Evan, 1984) to examine its effects on the firm performance. However, there is an agreement that a relatively accepted concept based on the organizational innovation activity in the literature, i.e., Damanpour and Evan (1984). According to the work on organizational innovation (Damanpour & Evan, 1984), innovations at the organizational level may involve the implementation of a new technical idea or a new administrative idea. Considering the
organizational innovation level, an innovation may be considered as having been adopted once the holistic perspective about adoption innovation behavior and activity has been made. Thus, an organizational innovation refers to the implementation of an internally generated or a borrowed idea in which pertaining to a product, device, system, process, policy, program, and service that was new to the organization at the time of adoption. (Damanpour & Evan, 1984).

Of interest in this study is open innovation in the context of organizational innovation. In this study, we link the organizational innovation to openness innovative strategic for acquiring and searching diversity external resources, exploring how organizational innovation in diverse collaboration strategies are among external partners influence their ability to achieve different levels of innovative performance. Accordingly, the open innovation focus helps deepen our understanding of specific facets of organizational innovation. Additionally, by targeting the firm level, we can provide a practical basis on which managers can build comprehensive multi-dimensional frameworks and systems perspectives that would enable open innovation perspective to be embedded on in this study.

Extending on organizational innovation, we propose that generating and implementing new ideas, methods, or behaviors in firm’s business practices and external linkages that may have positive consequences for their innovation performance. That is, organizational innovation constitutes the introduction of a new management system, managerial process, or staff development program (Damanpour et al., 1984). Although, organizational innovation cannot directly provide a new product/service, but it indirectly affects the production of products and services as well as the processes of them (Kimberly & Evanisko, 1981). Accordingly, the introduction of organizational innovations may reduce the administrative expenses and transaction costs, improve workplace satisfaction, gain access to non-tradable assets (such as non-codified external knowledge) or reduce costs of supplies (OECD, 2005).

Empirical studies verified of organizational innovation providing benefits can be found, for example, in Camisón and Villar-López (2014), who demonstrate that the organization innovation does indirectly impact on firm performance if that relationship is mediated by product and process innovation capability. Empirical studies that look at the impact of top management team of firms on the organizational innovation, for example, Qian, Cao and Takeuchi (2013), argue that the impact of top management team functional diversity on organizational innovation depends on the beneficence of a firm’s institutional environment. In essence, top management team diversity enables the organization to differentiate its innovation management and changes what the organization face to the outside world rapidly changing. In addition, Ballot et al. (2015) explores the relationships among product, process and organizational innovation, which found that there is complementarities-in-performance between these forms of innovation, of organizational innovation. Taken together, organizational innovation is more likely to result in concrete innovative outcomes.

In summary, whereas high (vs. low) organizational innovation strengthens the positive effects of open collaboration diversity by further improving the efficiency of innovation resources acquisition, it also enhances the negative impacts of open collaboration diversity by aggravating overemphasize innovation costs issues. Therefore, we predict that organizational innovation strengthens the inverted U-shaped relationship between open collaboration diversity and firms’ innovation performance.

2.2 Data collection
The database used in this paper is the Taiwanese Community Innovation Survey III (CIS III), well-defined dataset with detailed firm-level matching information on firm innovation behavior, alliance and collaboration and other firm characteristics. The survey provides the firm’s innovation information and activities go into detail during the period 2010-2012 throughout different industries that with traditional manufacturing industries, high-tech industries and
knowledge-intensive business service, and service-oriented firms. The CIS III questionnaire survey was developed under the guiding principles of the Oslo Innovation Manual (OECD, 1992), the survey aims to collect data on innovation from a firm perspective, rather than exclusively examining the invention process. The CIS III lists different kinds of information sources of innovation at firm level that includes their external alliance and collaboration partners. The questionnaire has eleven pages that comprise all of the necessary settings in order to minimize the response subjectivity. The raw data consist of a representative sample of 13842 firms based on a combination census and random sampling without subject replacement used for all other firms. In order to disentangle the open collaboration diversity effect of firms across different industries, we screen the original dataset to extract the useful and available sample in which suit the current research purposes.

Empirical Results
Since firms’ insufficient internal knowledge hardly support their R&D activities, firms have changed their strategy from closed to open for grasping more valuable knowledge they need from outside the boundaries. This study explored the relationship between open collaboration diversity and innovation performance. Besides, we considered the moderating effect of organizational innovation on open collaboration diversity and innovation performance. Based on previous researches, we developed the hypotheses about the impacts on innovation performance of open collaboration diversity and organizational innovation. We used the CIS III survey database of Taiwan firms for testing our hypotheses. Despite a growing collaboration diversity literature, a few researches have contributed to the effects of collaboration diversity on both innovation performances (firm novelty and market novelty). The results of firm-level data analyses suggest that the relationship between open collaboration diversity and both firm novelties and market novelties are inverted U-shaped as in previous researches (Duysters & Lokshin, 2011; Laursen & Salter, 2006). Moreover, the results suggest that the moderating effect of organizational innovation would increase the risk from extreme high level of collaboration diversity on both innovation performances and also strengthen the benefits from collaboration diversity. The results also point out the important of firm’s managerial practices and their organizational innovation strategy.

On the whole, this study found some critical outcomes among open collaboration diversity, organizational innovation and innovation performance, and our major findings are discussed as follows. Prior researches argued that firms should collaborate with a wide range of diverse actors that would assist firms to reproduce and redesign their new products and services by combining knowledge from external sources (Escribano, Heimeriks & Lokshin, 2012; Inkpen, 1998; Von Hippel, 2007). However, open collaboration diversity may increase the complexity of knowledge and firms’ cooperative relationship with external partners, and further increase the costs of coordination, monitoring and communication (Bapuji, Loree & Crossan, 2011; Combs & Ketchen, 1999), and would decrease firm’s innovation outcomes. In this study we also found the relationship between open collaboration diversity and innovation performance is an inverted U-shape, which points to further increase the diversity of collaborative partners may lead to overcome the benefits on innovation performance. Open collaboration diversity has enhanced on firm novelty which means products and services are only new to the firm and have other substitutes in market. That is, a focal firm diverse their collaborative partners would reinforce the market shares of their new-to-firm products even if there are other product/service substitutes in market. At the same time, open collaboration diversity also has enhanced on market novelty which means products and services are new-to-market and without substitutes in the market. A focal firm has high level of collaboration diversity would assist them to become the earlier entrant compare to their competitors.

On the other hand, our study also revealed that both innovation performances have presented excess open collaboration diversity may lead to negative effects on innovation performance, and the results of our empirical analysis show that the coefficients of square open
collaboration diversity is negative. Thus, firms have to manage their collaborative portfolios for coordinating the relationship with external actors and organizing the knowledge from external sources, and find the optimal configuration. Therefore, our study considered the moderating effect of organizational innovation on the relationship between open collaboration diversity and innovation performance.

**Conclusion and limitation**

To conclude, the present study is preliminary research on open collaboration diversity and innovation performance, and its relevance to organizational innovation research can also be seen. We derive several contributions.

First, the present findings contribute to the field’s understanding of the various forces acting on the focal firms’ innovation activities. One such force in our study is the impact of open collaboration diversity. The present findings confirm previous evidence that the relationship between various collaborators (e.g. customers, suppliers, universities, research institutions and so on) and innovation performance (firm novelty and market novelty) which presents that can strengthen and improve the focal firm’s products and services not only in firm but also in market. Furthermore, firms should construct their own managerial mechanism for managing their partnership of external actors because a firm’s alliance portfolio on its innovation performance is not set in stagnation but can be changed by conscious managerial actions.

As mentioned, secondly, a related issue concerns the effect of organizational innovation. Organizational innovation means involving the implementation of new technical ideas or new administrative ideas into a firm’s innovation process. We hereby contribute to the organizational innovation literature which often be ignored, and firms engage in administrative actions can turn a negative effect of open collaboration diversity into a positive effect. However, as the scale of a firm’s collaboration enlarges, the firm inclines to depend on more organizational procedures for managing and controlling diverse types of alliance. The overemphasized innovation investment will exacerbate the benefits from organizational innovation practices. Firms have to consider the tradeoff between open innovation and organizational innovation. Our findings would give an insight into future relevant researches and suggest firms should build a complete managerial mechanism for monitoring the partner diversity of their alliance portfolio and conforming external knowledge of different disciplines.

**Reference**


Efficiency Analysis of Retail Chain Stores in Korea

Abstract: In today’s low-growth business environment, efficiency management is becoming more important to improve corporate sustainability. In a chain store, the efficiency of individual stores must be well managed to improve the efficiency of the entire enterprise. To do this, it is important to measure the efficiency of individual stores and to find factors that affect efficiency. The main purpose of this study is to find out the factors affecting the efficiency of the chain store and to analyze the results to find out the implications that contribute to the efficiency improvement. We measured the relative efficiency of individual stores using DEA and analyzed the factors that affect the efficiency with the Tobit regression model. As a result, we found that the number of items and competitive environment influence the efficiency of stores. Excessive number of items may cause efficiency to be lowered. Therefore, it is necessary to manage the lifecycle of the item considering the trade-off between assortment and efficiency. Competition helps to improve efficiency to some extent, but too much competition can reduce efficiency.

Keywords: efficiency analysis; chain stores; data envelopment analysis (DEA); Tobit regression

1. Introduction

The Korean retail market has grown at a slower pace, with growth of 1% in the last two years since 2013. In particular, traditional distribution channels such as department stores, supermarkets, and specialty stores recorded negative growth in 2014. This is due to factors such as the prolonged recession in the domestic market, the maturity of the retail industry, changes in consumer trends, growth of online and mobile shopping, and strengthening government regulations [1]. The slow growth of the Korean retail market is expected to continue for the time being, and it is difficult to expect the high growth rate of the past. In such a business environment, it is difficult to expand sales, so pursuing profitability through cost reduction is a common way to improve the sustainability of a company. Therefore, the importance of efficiency management is emphasized.

In the chain store, one of the representative forms of retailing, it is essential to improve the efficiency of individual stores in order to improve the efficiency of the entire enterprise. To do this, we first measure the efficiency of individual stores, and if there are differences in efficiency between stores, we need to figure out what is the cause. Since chain stores are based on standardized processes, IT systems, and employee training programs, theoretically, there should be little or no difference in efficiency between stores. However, if there is a difference in efficiency between stores, it means that other factors are affecting the efficiency, and understanding these factors will be a starting point for improving efficiency.

Therefore, this study aims to analyze the factors affecting the efficiency of individual retail stores and to provide managerial implications for improvement of efficiency.

The research questions of this study are as follows: (1) What is the efficiency of individual stores in a chain store, taking into account multiple inputs and outputs? (2) Is the efficiency of the store different depending on the local characteristics? (3) What are the factors that affect the efficiency of retail stores?

2. Literature Reviews

In the early stage studies, the efficiency of the retailers was measured using DEA (Data Envelopment Analysis) and the results were analyzed. Donthu and Yoo [2] measured the relative
efficiency of 24 the US restaurant chains. Thomas et al. [3] analyzed the efficiency of 520 retail outlets and examined 16 variables used as input variables to determine the variables affecting efficiency. Keh and Chu [4] compared the efficiency of inputs, intermediate output, and final output for 13 the US grocery chain stores. Barros and Alves [5] measured the relative efficiency of 47 chain stores in Portuguese hypermarkets. There is also an efficiency study for retailers in Spain, the US and India [6-9]. Table 1 shows the efficiency studies for retailers using DEA.

Subsequent studies have been extended to factors affecting efficiency, mainly using the Tobit regression model. Barros [10] measured the efficiency of 22 hypermarkets in Portugal by DEA model, and then analyzed the factors affecting the efficiency by Tobit regression model. The independent variables examined in the Tobit regression model are the market share of the retailers, the number of outlets, ownership, regulation and location. As a result, the efficiency scores are positively related and statistically significant with all variables, with the exception of the regulation variables, signifying that the market share, number of outlets, national ownership and market coverage contribute to the efficiency of retailers. Perrigot and Barros [11] used the DEA model to analyze the efficiency of 11 French retailers and identify the factors that affect their efficiency. As a result of the analysis, the efficiency was higher as the period increased, and the efficiency of stock market-quoted retailers, companies involved in mergers and acquisitions, retailers belonging to an economic group, and retailers with an international expansion strategy were high. Yu and Ramanathan [12] used the DEA model to examine the economic efficiencies of 41 retailer companies in the UK and analyzed the determinants of efficiency. As a result, it was found that the factors influencing the efficiency are the type of ownership, legal form and retail characteristic. Foreign retail companies, private retail companies, and food retail companies seem to be more efficient. Yu and Ramanathan [13], which applied the DEA model to 61 Chinese retailers, also analyzed the determinants as well as the efficiency values, and found that the only factors influencing efficiency were the retail characteristic and the department stores were the most efficient. Uyar et al. [14] assessed operational efficiency of 79 bookshops within a bookshop chain in Turkey and identified efficiency drivers. The results revealed that shop age has positive significant influence on bookshop efficiency, whereas manager experience, staff experience, and education level of the shop manager do not. Gandhi and Shankar [15] studied the determinants of efficiency in 18 Indian retailers. The results shows that number of retail outlets and mergers and acquisitions can be considered as the driving forces influencing efficiency. Table 2 shows prior studies that include an analysis of the determinants of efficiency for retailers.

There have been many studies on efficiency of retailers, however, most of the studies have the unit of analysis as the entire company, so it is still not enough to study individual retail stores.

3. Methodology

This study consists of two stages: measuring the relative efficiency of individual stores and determining the factors that affect the efficiency. First, DEA model, which is widely used in this study, was used to measure relative efficiency. The Tobit regression model was used to analyze the factors affecting the efficiency. This is because the efficiency calculated by DEA has a limited range of values between 0 and 1.
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<th>Studies</th>
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<tr>
<td>Donthu and Yoo (1998)</td>
<td>24 outlets of a USA fast food restaurant chain</td>
<td>Store size, Store manager experience, Store location, Promotion expenses</td>
<td>Sales, Customer satisfaction</td>
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<td>Thomas et al. (1998)</td>
<td>520 outlets of a USA multi-store, multi-market retailer</td>
<td>Full-time employees, Full-to-part-time employees, Salaries, Employee tenure, Store manager tenure, Store age, Occupancy expenses, Population, Household income, Households, Proximity, Inventory, Transactions, Employee turnover, Shrinkage</td>
<td>Sales, Profits</td>
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<tr>
<td>Keh and Chu (2003)</td>
<td>13 outlets of a USA chain of grocery stores</td>
<td>Labor (floor staff and management wages and benefits), Capital (occupancy, utilities, maintenance and general expenses)</td>
<td>Distribution services (accessibility, assortment, assurance of product delivery, availability of information, and ambience), Sales revenue</td>
</tr>
<tr>
<td>Barros and Alves (2003)</td>
<td>47 outlets of a Portuguese hypermarket retail company</td>
<td>Full-time employees, Part-time employees, Cost of labor, Absenteeism, Area of outlets, Number of points of sale (POS), Age of the outlet, Inventory, Other costs</td>
<td>Sales, Operational results</td>
</tr>
<tr>
<td>Sellers-Rubio and Mas-Ruiz (2006)</td>
<td>100 supermarket chains in Spain</td>
<td>Employees, Outlets, Capital</td>
<td>Sales, Profits</td>
</tr>
<tr>
<td>Mostafa (2009)</td>
<td>45 USA retailers</td>
<td>Employees, Assets</td>
<td>Revenues, Market value, Earn share</td>
</tr>
<tr>
<td>Gupta and Mittal (2010)</td>
<td>43 outlets of a Indian grocery retailer</td>
<td>Area of outlets, Number of SKUs, Number of POS machines, Labor cost of employees, Number of employees, Working hours of employees</td>
<td>Sales, Customer conversion ratio</td>
</tr>
<tr>
<td>Sharma and Choudhary (2010)</td>
<td>200 Indian retail stores</td>
<td>Size of retail store, Manager’s experience, Location of retail store</td>
<td>Sales, Customer satisfaction</td>
</tr>
<tr>
<td>Studies</td>
<td>Units</td>
<td>Inputs</td>
<td>Outputs</td>
</tr>
<tr>
<td>--------------------------</td>
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<td>------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>Barros (2006)</td>
<td>22 hypermarket and supermarket firms in Portugal</td>
<td>Labor, Capital&lt;br&gt; <em>Tobit regression model variables:</em>&lt;br&gt; Share, Outlets, Ownership, Regulation, Location</td>
<td>Sales, Operational results</td>
</tr>
<tr>
<td>Yu and Ramanathan (2008)</td>
<td>41 retail companies in the UK</td>
<td>Total assets, Shareholders funds, Employees&lt;br&gt; <em>Tobit regression model variables:</em>&lt;br&gt; Head office location, Types of ownership, Years of incorporation, Legal form, Retail characteristic</td>
<td>Turnover, Profit before taxation</td>
</tr>
<tr>
<td>Yu and Ramanathan (2009)</td>
<td>61 retail firms in China</td>
<td>Total selling floor space, Employees&lt;br&gt; <em>Tobit regression model variables:</em>&lt;br&gt; Head office location, Firm nationality, Years of incorporation, Ownership type, Retail characteristic</td>
<td>Sales, Profit before taxation</td>
</tr>
<tr>
<td>Uyar et al. (2013)</td>
<td>79 bookshops within a bookshop chain in Turkey</td>
<td>Area, Population, Inventory, Employee, Salaries, Other costs&lt;br&gt; <em>Tobit regression model variables:</em>&lt;br&gt; Education of manager, Experience of manager, Experience of staff, Age of bookshop</td>
<td>Sales, Profit</td>
</tr>
<tr>
<td>Gandhi and Shankar (2014)</td>
<td>18 Indian retailers</td>
<td>Cost of labor, Capital employed&lt;br&gt; <em>Tobit regression model variables:</em>&lt;br&gt; Number of outlets, Ownership, Age since incorporation, Mergers and acquisition</td>
<td>Sales, Profit</td>
</tr>
</tbody>
</table>
3.1 DEA

Data Envelopment Analysis (DEA) was developed by Charnes et al. [16] as a methodology primarily used to determine the relative efficiency when there are a large number of input and output factors. DEA uses the distance function concept (Shephard [17]) centered on the efficient DMU among the decision making units (DMUs) to obtain the relative efficiency value of each DMU.

There are several types of models used in DEA, but they can be largely classified into a CRS (Constant Returns to Scale) model and a VRS (Variable Returns to Scale) model depending on the size variability. The CRS model is based on the assumption that the input and output ratios do not change with size, and is called the CCR model after the first letters of Charnes, Cooper, and Rhodes (see equation (1)). The VRS model is a model that applies when the ratio of input and output varies with size, also called the BCC model in the name of Banker et al. [18].

The DEA model can be broadly divided into two models: an input-oriented model and an output-oriented model for the purpose of efficiency improvement. The input-oriented model is aimed at minimizing the input amount in the direction of efficiency improvement, and the output-oriented model tries to maximize the output in order to improve the efficiency.

Equation (1) shows the output-oriented CCR model. Assuming that there are a total of n DMUs, m inputs $x_{ij}(i = 1, \ldots, m)$, and s outputs $y_{rj}(r = 1, \ldots, s)$,

$$
\begin{align*}
\max \phi_k + \epsilon \left( \sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+ \right) \\
\text{s.t.} \sum_{j=1}^{n} x_{ij} \lambda_j + s_i^- = x_{ik}, \quad i = 1, \ldots, m \\
\sum_{j=1}^{n} y_{rj} \lambda_j - s_i^+ = \phi_k y_{ik}, \quad r = 1, \ldots, s \\
\lambda_j, s_i^-, s_i^+ \geq 0, \quad \forall \ i, j, r
\end{align*}
$$

Here, $\phi_k (k = 1, \ldots, n)$ is the efficiency value of the kth DMU, and $s_i^-$ and $s_i^+$ represent input and output slack variables, respectively.

Equation (2) shows the output-oriented BCC model. This equation has a constraint on the sum of $\lambda$ in the CCR model of Equation (1) to have convexity constraints.

$$
\begin{align*}
\max \phi_k + \epsilon \left( \sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+ \right) \\
\text{s.t.} \sum_{j=1}^{n} x_{ij} \lambda_j + s_i^- = x_{ik}, \quad i = 1, \ldots, m \\
\sum_{j=1}^{n} y_{rj} \lambda_j - s_i^+ = \phi_k y_{ik}, \quad r = 1, \ldots, s \\
\sum_{j=1}^{n} \lambda_j = 1 \\
\lambda_j, s_i^-, s_i^+ \geq 0, \quad \forall \ i, j, r
\end{align*}
$$

3.2 Data

In this study, DMU is the individual store of retailers operating the largest household goods retailers in Korea. In DEA, the homogeneity of DMU should be assumed. Therefore, first, it was restricted to stores located in Seoul area. In addition, since new stores require a certain period of time
to stabilize their operations, only those stores with more than one year of operation period are considered. Finally, 32 stores in the Seoul area with a store operation period of more than one year were identified as the DMU of this study.

3.3 Input/output measures

In order to apply DEA successfully, selection of inputs and output variables is important. Input and output variables for DEA should be chosen such that they accurately reflect the retail firm's goals, objectives, and sales situation. The choice of the input and output variables is critical to the successful application of this technique [2]. In this study, the input and output variables were selected in consideration of the variables used in the precedent study and the key performance indicators used by the target company. This is intended to include variables that are commonly used in retailers' efficiency analysis, as well as variables that reflect the target company's strategic goals, sales situation, and performance management system.

Through this process, four variables were selected as the input variables: store size, number of items, number of employees, and rental cost. The store size and the number of employees are used as input variables in most of the previous studies [2,3,5-8,19] and the target company also manages them as management indicators. The store size used in this study was only the area used for sales excluding the warehouse area. The number of employees is the sum of the number of full-time employees and the number of part-time employees. The number of part-time employees was calculated to be 0.7 times the number of full-time employees in the same way as in the target company. The number of items, which are important indicators of the target company, means the total number of items including both products displayed on the store floor and products stored in the warehouse. This was used as an input variable in the study by Gupta and Mittal [8]. The rental cost was used as input variable in the study of Thomas et al. [3]. Since rental cost vary according to the terms of the contract, we used the average rental cost in the area where the store is located.

In our study, we selected sales and number of customers as output variables. Sales is used as an output variable in almost all previous studies [2-10,13-15] and is a key performance indicator for most companies. In this study, daily average sales was used. In addition, the number of customers was selected as the output variable in order to compensate the efficiency result when the number of customers is high even if the sales amount is low.

3.4 DEA Models

The DEA model is divided into the CCR model and the BCC model based on the assumption of economies of scale. In this study, the BCC model was used. In addition, in the selection of input-oriented or output-oriented models, the output-oriented model was applied according to the general criteria proposed by Barros and Alves [5]. They argue that it is desirable to apply the output-oriented DEA model because private firms operating in a competitive market environment maximize output rather than minimizing inputs [5].

3.5 Tobit regression model

To analyze the factors that affect some outcomes, we generally use a regression model. However, the general regression model cannot be used to analyze the factors that affect the efficiency calculated through DEA. Since the efficiency value calculated through DEA has a limited range of values between 0 and 1, the OLS (ordinary least squares) results in biased estimates or invalid inferences. The Tobit regression model proposed by Tobin [20] is suitable for the case where the dependent variable of the regression model is limited to a certain range of values [14]. Equation (3) shows the Tobit regression model used in this study.
\[ y_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \ldots + \beta_5 x_{5i} + \varepsilon_i \]

\[ \text{if } y_i^* \leq 0, \text{then } y_i = 0 \]
\[ \text{if } y_i^* \geq 1, \text{then } y_i = 1 \]
\[ \text{if } 0 < y_i^* < 1, \text{then } y_i = y_i^* \]

Here, \( y_i \) is the efficiency value of DMU; calculated by DEA, and the determinants are the store age (\( x_1 \)), number of items per unit area (\( x_2 \)), number of items per employee (\( x_3 \)), trade area index (\( x_4 \)), and number of competitors (\( x_5 \)) were examined.

The selection of independent variable is the most important process in regression model design. In this study, the variables were selected by combining the results of the previous studies and the opinions of the managers of the target companies, which includes experience and knowledge of stores, operational capability, and external environment factors.

Typical variables that indicate store's experience and knowledge are the store age and the employee's working period. The store age is an indicator of accumulated experience and knowledge of stores, reputation in the area and consumer's awareness. Thomas et al. [3] found that the store age affects efficiency and Uyar et al. [14] also found similar results. Also, in the study of Assaf et al. [21] for supermarket chain stores, age of the firm was found to affect the efficiency. Therefore, this study considers the store age as a factor in order to determine whether the experience and knowledge of stores are influencing on efficiency. Another variable that can represent the experience of a store is the manager's and staff's working period, but this is excluded because the company has job rotation system. In this study, two variables - number of items per unit area and number of items per employee - were defined to compare the operating capabilities of stores. The number of items per unit area represents the ability to display a variety of items in a limited space and effectively display them. In the case of a large number of items to be handled like the target company of this study, the capacity to utilize the store space is considered to have an important effect on the efficiency, so it is included in the independent variable. The number of items per employee represents the ability to manage the appropriate number of items compared to the number of employees. One of the most important operational capabilities is how many items can be managed by the staff in charge of item display and customer response in the store.

External environmental factors are also important factors affecting the efficiency of stores. The environmental variables mainly used in previous studies are demographic variables such as population, population density, number of households, income level, and the location of the store and the distance from other stores. In this study, trade area index and the number of competitors were selected as variables representing external environmental factors. The trade area index is a numerical representation of the distribution of major facilities and buildings affecting sales within a radius of 500 meters from the store. Some examples of facilities and buildings are subway stations, schools, offices, hospitals, hotels, etc. The larger the value of a trade area index, the larger the size of the trade area. We included a trade area index as an independent variable to determine whether the size of a trade area affects efficiency as well. Competition is also an important external environmental variable to consider in terms of store efficiency. Dubelaar et al. [22] found that competition had a significant impact on productivity and that competition-related factors should be included in the assessment of productivity. This study also used the number of competitors located within a radius of 500 meters from the store to consider the competitive strength of stores.

4. Discussion of Results

4.1 Efficiency scores

Mean overall efficiency for all stores is 0.8366 and standard deviation is 0.1569. The efficiency score of the lowest efficient store was 0.5113 and the number of efficient stores with efficiency score 1.0 was 8, which was 25% of the total stores.
4.2 Comparison of efficiency

Is the efficiency of the store different depending on the local characteristics? To answer this question, we compared the efficiency scores of the 4 stores in the residential area and the 27 stores in the residential and commercial area (One store is classified as other areas and excluded from the analysis). Since the efficiency scores obtained using DEA are calculated values, we cannot use a test method that assumes a normal distribution like t-test. Therefore, we used the non-parametric Wilcoxon Rank Sum Test to test the efficiency difference between the two groups. As a result of the test, the p-value was 0.04793, indicating that there was a difference in efficiency between the two groups at significance level 0.05. The average efficiency of the stores located in the residential area is 0.6810. The average efficiency of the stores located in the residential and commercial areas is 0.8639, indicating that the efficiency of the stores located in residential and commercial areas is higher.

4.3 Tobit regression model

The results of the Tobit regression model are shown in Table 3. The number of items per employee and the number of competitors were statistically significant at the significance level of 1%. Also, it was confirmed that the number of items per employee affects the negative direction and the number of competitors affects the positive direction.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Estimate</th>
<th>Std. Error</th>
<th>z value</th>
<th>p-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Store age</td>
<td>0.0011525</td>
<td>0.0015299</td>
<td>0.753</td>
<td>0.45128</td>
</tr>
<tr>
<td>Items per area</td>
<td>0.0014730</td>
<td>0.0007993</td>
<td>1.843</td>
<td>0.06536</td>
</tr>
<tr>
<td>Items per employee</td>
<td>-0.0004210</td>
<td>0.0001429</td>
<td>-2.945</td>
<td>0.00322 **</td>
</tr>
<tr>
<td>Trade area index</td>
<td>-0.3490104</td>
<td>0.3113706</td>
<td>-1.121</td>
<td>0.26234</td>
</tr>
<tr>
<td>Competitors</td>
<td>0.0067086</td>
<td>0.0025178</td>
<td>2.664</td>
<td>0.00771 **</td>
</tr>
</tbody>
</table>

Note: p-values followed by ** are significant at a level of 1%

R-Squared=0.6469811, Adjusted R-Squared=0.5790929

The number of items per employee affects efficiency in the negative direction. It can be understood that managing the appropriate number of items that can be afforded by store staff helps improve efficiency. For customer satisfaction, it is important to have various item assortment. However, efficiency may be deteriorated if item displays or customer service are not performed properly due to excessive items.

The fact that the number of competitors affects efficiency in a positive way means that some competition can have a positive impact on efficiency. It can be understood that the more intense the competitive environment such as the store located in the central commercial district of the big city, the higher the work tensions of the employees, which can improve the efficiency.

4.4 In-depth analysis of significant variables

The analysis of the determinants leads to a more detailed analysis of the two variables found to have a significant effect on efficiency.

4.4.1 Number of items per employee

The stores were divided into two groups based on average of efficiency and average of sales, and the average of items per employee of each group was compared. Regardless of the size of the sales, the more efficient the group has fewer items per employee, and the higher the sales, the lower the number of items per employee. This shows the regression results that the number of items per employee affects the efficiency negatively. It is necessary to pay attention to the difference in the number of items per
employee in the groups with high efficiency and low efficiency. That is, the difference in the number of items per employee between the high efficiency group and the low efficiency group is larger in the low sales group. Similar results can be obtained by using store size instead of sales in the same way. That is, the difference in the number of items per employee between the high efficiency group and the low efficiency group is larger in small stores. Figure 1 shows this relationship.

![Figure 1](image)

**Figure 1.** Changes in the number of items per employee in high-efficiency and low-efficiency groups. (a) Comparison of high-sales stores and low-sales stores; (b) Comparison of large-sized stores and small-sized stores

In sum, it can be deduced that the number of items per employee is high in stores where sales are low and stores are small in size. This is because, even if a small-scale store has a certain number of items assortments, the number of items increases, but the increase in the number of employees is relatively limited. We can derive two important implications from these results. First, in estimating the appropriate number of employees, it is necessary to consider the number of items, not just the size of the store. Currently, this company estimates the number of employees considering the sales and external characteristics of the store. However, there is a need to consider the number of items. The second is the importance of product life cycle management. As the sourcing of new items continues, the number of items will continue to increase and this problem is expected to become more and more intense. Managing the life cycle of an item and discontinuing it at the right time can eventually be a way to improve efficiency.

4.4.2 Number of competitors

Regression analysis shows that the number of competitors has a positive effect on efficiency. If so, does the efficiency continue to improve as the intensity of competition increases? To answer this question, the squared value of the number of competitors was added to the model, and the results of Table 4 were obtained.

<table>
<thead>
<tr>
<th>Table 4. The results of the Tobit regression</th>
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<tr>
<td>Variables</td>
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</tr>
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<td>Items per area</td>
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<td>Items per employee</td>
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<td>Trade area index</td>
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<tr>
<td>Competitors</td>
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<tr>
<td>Square competitors</td>
</tr>
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</table>

R-Squared=0.6916738, Adjusted R-Squared=0.6176755

Note: p-values followed by ** are significant at a level of 1% and those followed by * are significant at a level of 5%
As with the previous results, the number of items per employee and the number of competitors are significant, and the number of items per employee is negative and the number of competitors has a positive effect. In addition, the squared value of the number of competitors was also significant and the sign was negative. In other words, the number of competitors appears as an inverted "U" shape, which means that efficiency increases when the intensity of competition increases to a certain level, but that efficiency decreases if the threshold is exceeded. In the regression equation of this model, the remaining variables excluding the number of competitors are fixed as an average, and the graph is shown in Figure 2 and it can be confirmed that it is an inverted "U" shape.

![Figure 2. Changes in efficiency scores as the number of competitors changes](image)

This result implies that it is necessary to consider the competitive environment of the store when evaluating the performance of the store. It can also be used when evaluating the location to open a new store.

5. Conclusion

In this study, we measured the efficiency of individual stores and found that 75% of the stores are inefficient, which means that there is room for improvement in performance without additional resources. In addition, the efficiency of the lowest-efficient stores is only 0.5113, so it is necessary to analyze what difference these individual stores have under the standardized process and the IT system.

To identify the cause of this difference in efficiency, we used the Tobit regression model. As a result, we found that the number of items and competitive environment influence the efficiency of stores. A variety of items are required for customer satisfaction, but the excessive number of items may lead to lower efficiency. Therefore, it is necessary to manage the lifecycle of the item considering the trade-off between assortment and efficiency. In particular, these issues are clearly seen in low-sales and small-sized stores, so it is necessary to focus on these stores in order to improve the efficiency of the entire enterprise.

Understanding the impact of competitive environment on efficiency is also important. Competition affects efficiency with an inverted "U" shape. In other words, competition helps to improve efficiency to some extent, but too much competition can reduce efficiency. Therefore, it is necessary to consider the influence of this competitive environment in making decisions such as evaluating the performance of a store or opening a new store.

However, this study is limited to one household goods retailer, so the results may not be applied to other industries. In addition, it is the analysis of the data at a specific point in time, so it would be meaningful to conduct a longitudinal study in future studies.
References


Effect of Art Enjoyment on the Perception of Inequality

Recently in Korean society, worsening phenomena of polarization and subjective perception of class have been the subjects of concern as a serious social problem. When phenomenon of polarization is deepening and subjective perception of class is negatively formed in society, discomfort among social classes is created and ultimately will hinder social integration. The government views these deepening polarization and worsening phenomenon of subjective perception of class as serious policy agendas, and is pursuing a variety of social integration policies to solve and overcome them. In addition, in academia, there are a variety of disciplines which are dealing with polarization as a major research topic. Many studies have illuminated polarization from an objective point of view, considering it as a structurally formed phenomenon in society. However, it is difficult to find studies trying to see either perception of polarization of people or subjective perception of the class against objective class level. In this study, an attempt to complement the existing researches by considering the subjective perceptions of polarization and class is made with more expanded view.

On the other hand, previous studies have tried to reveal the main influencing factors of worsening phenomena of polarization and class, and have found that generally economic factors such as income and assets and social factors such as social capital would be important ones on the phenomena of polarization and class. However, studies that examine the relationship between cultural factors and them are relatively difficult to find and discussions on the role of cultural factors have been insufficient. With recognition of these problems, this study focuses on the issues of deepening phenomenon of perception of the polarization and the worsening phenomenon of subjective perception of class against objective class level in Korean society, and tries to empirically elucidate the effects of cultural factors as an alternative to mitigate them.
Analysis data used in this study are ‘2013 Consciousness and Values Survey of Koreans’, conducted by ‘the Ministry of Culture, Sports and Tourism’, and are used for descriptive statistics and multiple regression analysis. In addition, detailed analyses are carried out by separating samples into the sub-groups to discuss the findings.

It is found that cultural factors such as ‘satisfaction with cultural leisure activities’, ‘satisfaction with cultural living conditions’, and ‘cultural and artistic infrastructure’ have different effects on each dependent variable, and they generally not only mitigate the perceptions of social and economic polarization but also play an active role in relaxing subjective perception of class against objective class level. Specifically, ‘satisfaction with cultural leisure activities’ is found to lower the perception of social polarization and make people positively perceive their own classes. On the other hand, ‘satisfaction with cultural living conditions’ is found to mitigate the perception of social polarization but aggravate the perception of economic polarization. In addition to the subjective ‘satisfaction with cultural leisure activities’ and ‘satisfaction with cultural living conditions’, ‘cultural and artistic infrastructure’, which is an objective cultural situation, is found to mitigate the perception of economic polarization and have a positive impact on the perception of the class gap. According to the results of the relevant previous studies, cultural experiences and activities contribute positively to the individual’s subjective thinking and feelings and social attitudes (Galloway, 2006; Jeannotte, 2003; Matarasso, 1997). The results of this study also support the positive role of culture which has been highlighted in previous studies.

Key words: Perception of the Social Polarization, Perception of the Economic Polarization, Perception of the Class Gap, Role of Culture, Cultural Policy, Social Integration Policy
Effect of Distance on Open Innovation: Differences among Institutions according to Patent Citation and Reference

Research Question?
1) Is there any relation among the distance between technology and market, the open innovation network, and innovation performance?
2) What kinds of difference is there in the relation among university, national lab, Fortune 500th firms, Fortune Non 500th firms, and SMEs and Start-ups, if then?

Research Scope and Research Method

1) Research Scope

-all patent which were applied at USTPM in Computer Industry, and Information and Communication Industry in 2007

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2) Research method

(1) Measure of the distance between technology and market

- Number of Citation and Reference

- Closed between technology and market (A > B > C > D)
(2) Measure of open innovation

- Open Innovation in patent application (ROI, IOI)
- Open Innovation network by Sub IPC 7 digit connection

(3) Measure of performance of firms

- Number of Patents application
- Number of Family patent
- Number of Sub IPC in 4 digits

(4) Relation among open innovation, distance, difference of agency

- Overlapping of Network analysis of 7 digit sub IPC, Distance, and 5 agencies. methods

(5) Modulate effects analysis; statistic method

**Literature Review and Research Framework**
1) Literature Review

Regionally asymmetric knowledge capabilities and open innovation: Exploring ‘Globalisation 2’—A new model of industry organisation (Phil Cooke, 2005)

Regional innovation systems: the integration of local ‘sticky’ and global ‘ubiquitous’ knowledge (Asheim & Isaksen, 2002)

Learning at the boundaries in an "Open Regional Innovation System": A focus on firms’ innovation strategies in the Emilia Romagna life science industry (Belussi, Sammarra, & Sedita, 2010)

The industrial dynamics of Open Innovation—Evidence from the transformation of consumer electronics (Christensen, Olesen, & Kjær, 2005)

Regional knowledge capabilities and open innovation: Regional innovation systems and clusters in the asymmetric knowledge economy (Philip Cooke, 2005)

Applying open innovation in business strategies: Evidence from Finnish software firms (Harison & Koski, 2010)

Specialized organizations and ambidextrous clusters in the open innovation paradigm (Ferrary, 2011)

Neither invented nor shared here: The impact and management of attitudes for the adoption of open innovation practices

2) Research Framework
In advance analysis

1) Statistic Conditions

![citations 2007](image1)

![citations 2002-2012](image2)
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2) Network analysis

- Open Innovation Network by Sub IPC 7 digit network which are higher than cosign value 0.8.
- The distance between technology and market

- Open Innovation Network + 5 type agencies
- 5 type agencies

- Open Innovation Network by Components
Open Innovation Network by Modules


Trends of phenological responses to climate change and urbanization in South Korea

Phenological dynamics have been recognized as key attributes of plants and animals that are being affected by a warming climate (Parmesan & Yohe 2003; Root et al. 2003; Cleland et al. 2007). As a result of rising temperatures, many plant species are leafing out and flowering earlier in the spring, many animals are active earlier, and many migratory birds are arriving earlier at points along their migration routes (e.g., Inouye et al. 2000; Fitter & Fitter 2002; Cotton 2003; Miller-Rushing & Primack 2008). However, the changes vary considerably among species; some species are changing dramatically while other are not changing at all (Fitter & Fitter 2002; Lehikoinen et al. 2006; Sherry et al. 2007; Miller-Rushing & Primack 2008). Climate change could, thus, disrupt relationships among some species and their environments, causing ecological mismatches. Even if they were to occur only during a short period of time, mismatches among species in their phenological responses to climate change could potentially lead to the decline and even extinction of species. Current studies are either region-limited, sole species or short researching period so the studies about various species are necessary throughout South Korea. In this study, trends of change the budding and flowering dates of spring plants in South Korea by climate factors such as temperature and precipitation according to the climate change and urbanization. Four species such as *Forsythia koreana* (forsythia), *Rhododendron mucronulatum* (azalea), *Prunus yedoensis* (Yoshino cherry) and *Prunus mume* (Japanese apricot) are focused during the period from 1973 to 2008. Three types of regions were divided by plant species and phenological events. Finally, budding of *Forsythia koreana, Rhododendron mucronulatum, Prunus yedoensis* and flowering of *Prunus mume* are defined as Type I, and flowering of *Forsythia koreana, Rhododendron mucronulatum,* and
Prunus yedoensis were grouped as Type II. Prunus mume budding was different from others so that it defined as Type III. There are no differences cluster 1 of between Type I and II. The region is cold and dry area that affected by Siberian high atmospheric pressure, on the other hand, cluster 2 and 3 are humid and warm coast areas even in winter season due to the southeastern wind.

There were the advancements for 3.1 days of Forsythia koreana, 5.5 days of Rhododendron mucronulatum, and 6.5 days of Prunus yedoensis and 18.6 days of Prunus mume during the research period. These phenological events are due to climate changes. The most changes were occurred in Jan minimum temperature and Feb maximum temperature and precipitation change was not significant. But in cluster 1 of type II, the precipitation significantly impacted on plant flowering events. Precipitation would be the lowest in early spring in South Korea, and especially the flowering of plants were impacted by few amount of precipitation in this region. Also, if precipitations after budding are over 1mm for Forsythia koreana and Rhododendron mucronulatum, 2mm for Prunus yedoensis and 7mm for Prunus mume, flowering was done in over 80% of regions.

South Korea has a small land and high density population in cities so it gets huge influence by global warming as well as urbanization. Seven metropolitan cities and Suwon that has over 1 million populations showed more remarkable phenological events and changes of climate factors than the other regions. Especially in case of shrubs, the phenological events were delayed in urban areas during this research. These phenomena are the evidence to explain the quality of the air and decreasing of the amount of light from buildings were the factors for impacting on shrubs.

Literature Cited


Inouye DW, Barr B, Armitage KB, Inouye BD (2000) Climate change is affecting altitudinal migrants and hibernating species. *Proceedings of the National Academy of Science USA* **97**:1630–1633


Government support and SMEs innovations in the regional industries: Export perspective in South Korea

1. Introduction

Since the world economy evolved into turmoil due to the outbreak of world financial crisis at the end of 1990s, sustainable economic performance has been a central topic of for policy agendas for each countries. Over the years, each government has been put forth to state this issue. In Korea, a variety polices created. In particular, after the Industry-University Collaboration law of 2003 (IUC law) was introduced, most universities in Korea has more been eager to pursue industry-university cooperation (hereafter, IUC). This makes Korean universities has been pursuing research and development with firm’s commercialization by doing the joint research via the technology transfer, and since then, these universities have enacted a number of initiatives to improve industry-university collaboration through technology transfer. Also, numerous direct support programs for SMEs in region were implemented since the end of 1998.

The purpose of this policy in Korea is to enhance the firm’s competitiveness in region. According to the OECD (2000), SMEs account for over 95% of firms, and they generate a large share of job creations in OECD areas. SMEs has been pivotal role in economic performance. In that sense, the performance of SMEs in terms of export growth and productivity thus demands the attention of policy makers. In this paper, we explore the impact of government support policies in the innovation of SMEs in the regional strategic industries at Chongnam province in Korea. Comparing with conglomerates, many of traditional problems facing SMEs, such as “low productivities, constrained managerial capabilities, difficulties in exploiting technology” has become obstacles to grow constantly. Korea has achieved rapid economic growth since 1970s. The significant characteristics of rapid growth was adoption of an outward-looking strategy, so called export-driven policy through labor-intensive manufactured exports. Thus, in order to rapid grow it, central government has been focused on export-oriented development of around of Seoul, capital city of South Korea. As results of this policy, rural area relatively was under-developed. And ever since, income disparity was a serious problem for each local areas. Since the beginning of 2000s, various strategies for balanced
regional development has been implemented.

Regardless of firm size, constant growth is crucial for all firms and consistent with their objectives and enhancement of survival probabilities. Both firm survival and firm growth have been dealt with equally by some authors (Geroski, 1995; Sutton, 1997). For Small and medium enterprises (SMEs), the growth of firms is very critical to ensure survival (Lotti et al., 2009). In addition, SMEs are considered to be the main driving force which pulls economic and employment growth and, therefore should be given a special status and attention in major government economic policies. This is in consideration of the importance of SMEs for economic and employment growth in each country.

In particular, studying the relationship between R&D activities and SMEs growth is especially valuable in the regional economic development context. R&D activities have various facets. R&D activities enable firm to diversifying activities such as forming strategic cooperation network with other firms (Roger, 2004; Han, et al., 2009), absorbing knowledge created from the cooperative relationship formed with agents, as well as the capacity is enhanced to use that knowledge to further increase firm performance (Cohen and Levinthal, 1990; Han et al., 2010). R&D activities vary greatly according to industries. In some industries such as clothing and footwear, fashion design, which is hardly measured in R&D activities may be more important than technical innovation via R&D activities. Moreover, R&D statistics do not measure organizational innovation at all (Freeman, 1991).

Nevertheless in many industries R&D activities give birth to firms and their growth via innovations. In other word, R&D activities may often be a surrogate measure which refl it comes to determinants of firm’s growth, there are numerous factors impacting the outcome. The reason why R&D activities has attracted overwhelmingly consensus is that it is true that empirical research does often confirm the importance of individuals trained variously described as product champions (Schon, 1973). With the basis of those and out own analysis and findings, we also hope to enforce helpful advices for CEO or owner of the firms as well as for policy makers.  

ects the importance of those activities which do contribute to innovative success and growth of firms. From prior empirical literatures that show such evidences (Wooldridge, 1988; Hay and Kamshad, 1994; Geroski, 2005; Han et al., 2008), we acquire evidence of R&D activities and their impacts on growth of firms.
It seems accepted that the answer about questions that what are very critical determinants of firm growth is simply innovation. No one doubts that innovation is essential to this road. To gain high competitive position in the markets, firm growth created by innovative activities is the gateway to further progress (Pagano and Schivaridi, 2003). Growth is dependent on technological innovation in terms of the R&D investment (Rosenberg 2004). This research topic is supported by some empirical evidence in the field. R&D activities lead to new technology development, and pull specific products or goods which can be protected. Thus, it is an embodied innovation process.

The firms can only benefit from R&D by using the goods that result from the R&D activities, which has the effect of bounding the impact on externalities. R&D is also assumed to consist of activities carried out by persons trained for the task. In the regional level, the relationship between R&D activities and firm growth is also very important issue. When

In order to examine the policy support effects on export of firms, we consider a sample of 785 SMEs in manufacturing industries which consist of high-tech firms and non-high-tech firms located at the Chungnam in Korea. All variables are used during 3 years, from 2013 till 2015. The data composed of 785 firms which had not only participated industry-university collaborations but also participated directed support programs. In particular, b because we are concerned firm heterogeneity, we used the dummy. The data set cover the period from 2013 to 2015. Concerning firm size, SMBA definition based on fewer than 350 employees was used. And Multivariate regression analysis is used for estimation using the OLS method with robust standard errors.

Table 1. Least square estimation results for export model, n= 785

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## Parameter Estimates

| Variable   | DF | Parameter Estimate | Standard Error | t Value | Pr > |t| Heteroscedasticity Consistent |
|------------|----|--------------------|----------------|---------|------|-------------------------------|-----------------|-----------------------------|
|            |    |                    |                |         |      | Error                         | Standard Error   | Standard Error              | t Value | Pr > |t|       | Error | Standard Error | t Value | Pr > |t|       |
| Intercept  | 1  | -2.56101           | 0.463          | -5.53   | <.0001 | 0.51078                      | -5.01            | <.0001                      |
| Age        | 1  | 0.02248            | 0.00918        | 2.45    | 0.0145 | 0.01542                      | 1.46             | 0.1452                      |
| RD         | 1  | 1.28393            | 0.22102        | 5.83    | <.0001 | 0.21116                      | 6.11             | <.0001                      |
| lemp1      | 1  | 0.26702            | 0.1051         | 2.54    | 0.0113 | 0.11653                      | 2.29             | 0.0222                      |
| lasset     | 1  | 0.07627            | 0.07026        | 1.09    | 0.278  | 0.08604                      | 0.89             | 0.3757                      |
| lfund      | 1  | 0.35275            | 0.05604        | 6.29 | <.0001 | 0.07275                      | 4.85             | <.0001                      |
| NSupProt   | 1  | -0.02921           | 0.08434        | -0.35   | 0.7292 | 0.07513                      | -0.39            | 0.6975                      |
| NSupMark   | 1  | 0.10338            | 0.05727        | 1.81    | 0.0715 | 0.05265                      | 1.96             | 0.0499                      |
| locat2     | 1  | -0.39687           | 0.25495        | -1.56   | 0.12   | 0.33943                      | -1.17            | 0.2427                      |
| sect2      | 1  | 0.27252            | 0.26519        | 1.03    | 0.3044 | 0.16791                      | 1.62             | 0.105                       |
| sect3      | 1  | -0.01713           | 0.30528        | -0.06   | 0.9553 | 0.24771                      | -0.07            | 0.9449                      |
| sect4      | 1  | 0.59726            | 0.29026        | 2.06    | 0.04   | 0.24154                      | 2.47             | 0.0136                      |
| sect5      | 1  | 0.32076            | 0.31021        | 1.03    | 0.3014 | 0.27005                      | 1.19             | 0.2353                      |
| seduc2     | 1  | 0.21036            | 0.30768        | 0.68    | 0.4944 | 0.22084                      | 0.95             | 0.3411                      |
| seduc3     | 1  | 0.2238             | 0.17543        | 1.28    | 0.2024 | 0.11016                      | 2.03             | 0.0425                      |
| seduc4     | 1  | 0.07038            | 0.52051        | 0.14    | 0.8925 | 0.26241                      | 0.27             | 0.7886                      |
| seduc5     | 1  | 0.32654            | 0.87284        | 0.37    | 0.7084 | 0.50864                      | 0.64             | 0.5211                      |
| grstep2    | 1  | 0.31872            | 0.21469        | 1.48    | 0.1381 | 0.19625                      | 1.62             | 0.1048                      |
| grstep3    | 1  | 1.14717            | 0.34911        | 3.29    | 0.0011 | 0.40169                      | 2.86             | 0.0044                      |

**Conclusion**
Pearson Correlation Coefficients, N = 786

Prob > |r| under H0: Rho=0

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Reference


Do social networks foster innovation? An empirical study of social networks on innovation from knowledge quality perspective.

Abstract

Purpose/ Research Question:

The purpose of this research is to examine the effect of social networks on innovation from the knowledge quality perspective to suggest the importance of knowledge for innovation. This research divides knowledge quality into three dimensions - intrinsic, actionable, contextual - as suggested by Yoo et al. (2011) and further investigates its moderating effect on the relationship between social networks and innovation.

Key Literature Reviews (About 3–5 papers):

- Social Network

Social network theory discusses the connection and relationship in a social structure where a set of actors are connected by a set of social relationships or ties (Brass, 1992). Social network theory turns attention to relationships between actors or individuals that provides knowledge, information and other resources to enhance performance. This social relationship has been analyzed in various disciplines such as entrepreneurship (Kim and Thomas, 2011), psychology, communication and organizational studies. Research on social network focuses on the nature of ties among actors in social network and the types of information shared on the network (Cross and Cummings, 2004; Zhang and Venkatesh, 2013).

- Knowledge based view

Knowledge based view (KBV) suggests that innovation and creativity of a firm are based on the ability to create, manage and utilize knowledge (Grant, 1996). Studies found knowledge exchange and acquisition of knowledge within a firm play important role in developing new products and services as well as fostering creative problem-solving. A number of studies also examined that the knowledge diversity and social linkages influences on innovation (Fichman and Kemerer, 1997; Carlo et al. 2012).

For knowledge to be a competitive asset, it must be transferred and shared through social and interpersonal interaction. As social network theory proposes, new knowledge is created by means of social assets such as human networks and interpersonal relationships, which provide access to valuable
resources (Nahapeit and Ghoshal, 1998).

**Design/ Methodology/ Approach:**

Samples were collected from knowledge workers working in venture companies related to the University-Industry Cooperation Center to examine the impact of social network and knowledge dimensions on task performance. IT industry takes large part of venture companies, which is appropriate to in our study to measure knowledge and performance. The total of 141 samples was collected but after eliminating samples with bias and missing data, 129 useful samples were used for an empirical analysis.

Partial Least Squares (PLS) was used for assessing the measurement and structural models of our research model. PLS has become popular in entrepreneurship and management research (Kautonen et al. 2011; Mitchell et al., 2008). In this study, Smart PLS 2.0 developed by Ringle et al. (2005) was used for the analysis.

**(Expected) Findings/Results:**

As revealed in previous research, weak and sparse network provides diverse and novel information showing a significant relationship between network diversity on knowledge diversity. Knowledge quality is shown to effect both on innovation. This result implies that knowledge quality received from social interaction is important to enhance productivity and creativity and thus people should carefully construct what social interaction is better to assess when search for knowledge to solve a complex problem. (The interaction effect of each dimensions of knowledge quality and social networks on innovation will have conducted in further analysis.)

**Research limitations/ Implications:**

This study focuses on knowledge quality that received from social interaction to explain the impact of social network on performance. Previous research on Knowledge Based View (KBV) has examined the impact of knowledge on performance in general (Grant, 1996; Teece et al., 1997). However, recent studies tend to get interested in examining knowledge base, content and diversity, that a firm holds (Zhou and Li, 2012). For example, diverse and broad knowledge are likely to generate new ideas and innovation while quality and depth of knowledge facilitate the realization of substantial ideas. Knowledge quality, namely accurate, reliable and up-to-date knowledge in this study, is also essential to enhance creative ideas and productive output. That is, knowledge depth and accurate contents facilitate utilizing new ideas and exploitation of novel ideas (Zahra and George, 2002).
**Keywords:** social networks, knowledge quality, intrinsic, actionable, contextual, innovation.
The Effect of Sustainable Entrepreneurship on Entrepreneurial Intention: Focus on the Moderate Effect of Market Orientation

Abstract

Purpose/ Research Question:

The purpose of this research is to examine the relationship between sustainable entrepreneurship and entrepreneurship intention and activity focusing on the moderating effect of market orientation.

Key Literature Reviews (About 3~5 papers):

Sustainable Entrepreneurship is the process of discovering, evaluating, and exploiting economic opportunities that are present in market failures which detract from sustainability, including those are environmentally relevant. (Dean and McMullen, 2007). According to the previous research, the critical issue in sustainable entrepreneurship is to discover and exploit problems accrued from market imperfection and environmental destruction and solve them to sustain environments. Although many researchers pay attention to sustainable entrepreneurship, few research have focused on HOW to find such opportunities in market and to alert market changes from the environmental destruction. The study of entrepreneurship intention for university students by Kuckertz and Wagner (2010) reveals that sustainable orientation has a significant impact on entrepreneurship intention not for business students but for science and engineering students. They explain business experience would have hindered entrepreneurship intention by sustainable entrepreneurship for business students, which brings us the research question such that how potential entrepreneurs capture an opportunities and why the difference occurs by academic subjects.

Drawn from this research issue, we consider the role of market orientation capability along with sustainable entrepreneurship to find out the factor enhancing entrepreneurship intention and actual activity for potential entrepreneurs. Market orientation should be complement to entrepreneurship in identifying market information and generating learning from it (Slater and Narver, 1995). That is, entrepreneurial values and market opportunities become explicit and clear when marketing orientation supports entrepreneurship.

Design/ Methodology/ Approach:

Based on the data from 452 of university students registering Entrepreneurship courses, we analyze
our theoretical model through PLS path modeling using SmarPLS 2. All the survey items are drawn from previous research. (Kuckertz and Wagner, 2010; Van Gelderen et al. 2015, Eggers et al. 2013, Kajalo and Lindblom, 2015).

(Expected) Findings/Results:

We find that sustainable orientation is not directly associated with entrepreneurship intention and entrepreneurial activity. However, market orientation shows a strong moderating effect on the relationship sustainable orientation and entrepreneurship intention and activity. This findings suggest that potential entrepreneurs should possess the capability to understand customer needs and alert market changes in order to acquire opportunities and pursuit sustainable entrepreneurship. (Further analysis by student major and level of business experience are expected in next stage of research).

Research limitations/ Implications:

Our study helps in finding the factor underlying sustainable entrepreneurship and suggesting the way to boost entrepreneurship intention and activity. Further implications for theory and practice are discussed in the paper.

Keywords: sustainable entrepreneurship, market orientation, entrepreneurship intention.
Research on China’s Technology Industrialization based on the Measure of Patent Propensity and Project Cooperation

Abstract
Purpose/ Research Question: Patent industrialization should be the final goal of patent application. However, numerous innovation subjects haven’t put effort into patent application during the process of technical management. There are three main factors contributing to this phenomenon. Firstly, the innovation products such as common software programs are excluded from the scope of the patent protection objects. Secondly, on account of inventors’ concern about the innovation deficiency of his inventions and possibility of rejection, innovations are not worthy of a patent even though the innovation is in principle patentable. Thirdly, for sake of keeping confidential, technical know-how or any other methods are adopted by inventors to carry out legal protection of patent right to obtain economic benefits(Basberg, 1987). The research to innovation economics of strategy in patent application can date back to 1960s(Kuznets,1962; Taylor, Silberston, 1973). Strategic choices in patent application are explained earlier in these researches. Later on, the survey studies by Mansfield(1980) and Levinet et al (1987) during the 1980s highlighted that, in most industries, patent protection was not the typical tool adopted by firms for the extraction of economic returns from innovations and technology industrialization (Cohen et al. 2000). The view that patent is incapable of surely indicating the trend of technical innovation is discussed in various innovation literatures (De Rasenfosse, 2010), nevertheless, technical innovation is still demonstrated in the form of patent which is selected as research object in empirical research. The connection between patent and industrialization has never been interrupted since the foundation of patent system. Promoting the transformation and implementation from patent to industrialization is not only the internal need of patent system, but also one of the key breakthroughs to solve the problem of low patent enforcement rate in contemporary China. This research analyzes the role of China’s patents in technology industrialization and explores the attributes and features of technology industrialization results in various industries based on the theory of innovation ecosystem(Li. 2014), which aims to evaluate the patent propensity in technology industrialization results and propose theories and positive ideas which stimulates the patent industrialization.

Key Literature Reviews: The concept of ‘propensity to patent’ (or ‘patent motivation’) usually defined in the literature as the ratio between patents and R&D expenditures(Scherer, 1983; Hall & Ziedonis, 2001). This definition mainly clarifies the general relationship between patents and innovation expenditures, whereas it doesn’t put forward the subjective and objective factors influencing the patent application of an innovation (eg. the relevance to divers strategies of applicants for patent and features of various industries). The definition of patent propensity has been clarified in numerous following researches,namely the share of patented innovations in the total number of innovations occurring in a given time period(1985, 2012). On closer inspection, there is an operability problem yet based on this definition, which is to calculate how many patentable innovations were actually patented during the specified time period. Moreover, different methods have been implemented in different researches to solve this problem(Meisenzahl&Mokyr, 2011; Nicholas. 2011).
In order to conduct the empirical research, exploring an approach to quantize innovations is of the utmost importance. Primarily, the corresponding relation between innovations and patents should be set up. Scholars has combed and quantized some representative innovations from various industries as samples and found that patent propensity varies with industries and influenced by changeable factors(Fontana, 2013). The final goal of technological achievements is to transform technology into practical productivity, which is creating value profits for obligee through external output of intellectual property(Collan. Heikkilä, 2014) and providing service to the public through the realization of intellectual property value, especially
the use value. As one of the legal existence forms of scientific and technological achievements, patent should be an important carrier of transformation in scientific and technological achievements. Patent industrialization is one of the specific forms of the transformation of scientific and technological achievements, as well as one of the forms of realization of technology industrialization. On account of the uncertainty in the process and results of technological industrialization, legal remedies such as legal right, law enforcement protection, administrative and legal rights protection are used to reduce this uncertainty. The core meaning of industrialization is the scale, that is, the patent industrialization is not limited to the application of the patent. More importance should be attached to the innovation products based on patent technology completing the cataclysm from quantity to quality and forming economies of scale, which will become a crucial part of the national economy according to a specific standard of division and stimulate the self-cycling of R & D investment and industrial development(Yu, 2010). To be sure, path to patent industrialization has been divided into self-industrialization, technology paid transfer of technology, alliance with the third party(Wu, 2012). Furthermore, since the difference of subjects conducting the industrialization, paid transfer of technology and alliance with the third party can be summarized as indirect industrialization while self-industrialization can be summarized as direct industrialization. We should note that indirect industrialization is largely affected by external factors and operated by capital in many cases, which makes it difficult to directly realize the transformation from technology to practical productivity. For this reason, the main viewpoints and conclusions of this research are aimed at direct industrialization of technology.

Reviewing the existing literature, we find that scholars have drawn many meaningful conclusions in different periods varying with their patent propensity regarding the study in industrial diversity of patent propensity(e.g. Acs & Audretsch concluded that the United States in 1982 displayed the highest patent propensity in wood furniture industry while the oil field shared the lowest; Arundel&Kabla found that in 1993, Europe put most patent propensity in the pharmaceutical industry while the textile industry got the lowest; Brouwer&Kleinknecht discovered that the Netherlands in 1992 showed the highest patent propensity to rubber and plastics industry while the metal processing industry got the lowest; Thomson studied US industrial patent propensity in 1853 and found that the electronics industry was the highest and the watch industry the lowest).

Overall, the main result emerging from those literatures is that the industrial diversity of the technology industrialization results should be based on the same patent protection system in the same period. Additionally, the source of the industrial diversity depends on the technological development, competitive situation, technical characteristics, commercial characteristics, innovation model, organization mode and so on.

**Design/ Methodology/ Approach:** This paper select ‘Chinese National Prize for Progress in Science and Technology Award’ as research samples of technology industrialization and dig out effective patents contained in 8270 technology industrialization results. Our source of data is the State Intellectual Property Office of the P.R.C (SIPO). We analyze and summarize the patent propensity of technology industrialization results in different areas in China, and apply the k-means clustering according to the patent propensity of different kinds of industrialization results, taking k = 5, which means that the applicability level of the industry is classified into five (i.e. Industry of high applicability, higher applicability, medium applicability, lower applicability and low applicability ). Apart from that, the patent density and distribution of China’s technology industrialization have been revealed as follows. It is not surprising then that the main cooperative relationship of the technology industrialization has been measured as well based on the innovation ecosystem and the improved triple helix theory.

**Expected Findings/Results:** This paper has found that the cooperation between scientific research institutions and enterprises is of the highest compactness. Furthermore, the high applicability of patent in China is mainly concentrated in the fields of more mature traditional technologies such as mechanical and electrical technology. Overall, due to the fact that there is a certain process cycle in technology industrialization, the tendency to technology industrialization depends on the maturity of technology market in different areas, influenced by several factors(e.g. market demand and value subjects). On closer
inspection and research, it is found that there are potential risks in the implementation of patent transformation concerning emerging technology areas. Another finding should be put forward is that the policy incentives (e.g. ‘National Science and Technology Progress Award’) should aim at promoting the transformation and implementation of patent technology.

Research limitations/ Implications: Although much progress has been achieved in this research, there is no doubt that it still has some shortcomings. We can not deny the fact that this research is restricted by selection rule of awards and there may be some policy orientation in the industrial technology field of the sample, which enables it difficult to fully reflect the real situation of China's technology market. As a consequence of the long periodicity of technology industrialization, it is difficult to reflect the current technological development hotspots. In the following research, we will continue to make up for deficiencies, exploring other factors affecting the patent industrialization and its mechanism of action and accelerating the rational application and effective implementation of China's patent in the industry.

We would like to note that the definition and measurement of patent propensity in technology industrialization are beneficial to clarify the basic trend and distribution of patents in China’s technology industrialization. At the same time, we are ought to guide related subjects to construct consciousness of patent application and overall arrangement, aiming at transformation and implementation and gradually form a sound, scientific motivation for patent application.

Keywords: patent propensity, technology industrialization, triple helix theory, innovation ecosystem, emerging technology

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Incentives and institutions [J]. In: NBER working paper, no. 16993, 2011.


No.23

Nation-wide Eco-System of Academia-Industry Collaborations for Technological Innovations and Industrial Economics: A Case Study of Science Parks

Abstract

National policies for science parks and innovation have been identified as one of the major driving forces for high technology industries, especially for public funded science parks. In addition, technological innovations and R&D have been identified as one of the critical driving factors for high-technology firms to compete and thrive under intensive global competitions. The influence of R&D for business has gained increasing interests in both academia and practice, especially for the high-tech industry. Since the science park and innovation policy are getting acceptance by governmental agencies, a nation-wide macro viewpoint is needed for policy evaluations and high-technology industries should be considered as parts of the national/regional economies. This paper evaluates a nation-wide eco-system of academia-industry collaborations for technological innovations and industrial economics based on the real data from one of the globally recognized high-technology industrial clusters, the national science parks in Taiwan. By taking advantage of robust small and medium-sized enterprise networking, of high quality of human resources, of government support and government-industry-university-institute collaboration, the Taiwan science parks have become globally well-known examples of science parks set up for national prosperity. The policy of facilitating science parks and innovations have been making a tremendously contribution to the development of the high-technology industry clusters, the creation of innovation clusters, and the national economy in Taiwan. This paper utilizes the globally recognized high technology industrial clusters and the case study of science parks in Taiwan to investigate the impacts of nation-wide eco-system of academia-industry collaborations with a holistic viewpoint and nation-wide statistics. First, the economic added values, international trades, and employment in the benchmarked science parks are evaluated. Second, the concepts of academia-industry collaboration and policies to eco-innovation system are introduced, while the measures and performance of innovation and applied R&D in the science parks are addressed. Based on the research results, lessons learned and policy implications for science park developments and academia-industry cooperation innovations are discussed. The innovation of high technology industries in Taiwan has been continuously facilitated by the government policy for strengthening academia-industry links and innovation. Industry-academia cooperative research matches the advanced and practical technologies and knowledge applications
of universities with the needs of private-sector businesses. These projects develop the R&D capabilities of educational and research institutions while encouraging companies to participate in university-based applied research projects. To promote collaboration on highly innovative research projects, MOST defined the scope of research results and established optional models for technology transfer authorization, thus increasing the effectiveness of industry-academia cooperation. In 2014, a total of 813 such projects received government funding, 852 companies participated, NT$328 million was raised in corporate matching funds, and 2095 graduate students received training. To develop the R&D capacity and eco-innovation system of the high technology industries in Taiwan, more innovation policies were promoted as follows:

1. PIONEER Grants for AIC: MOST has been jointly funding the PIONEER Grants for Frontier Technologies Development by Academia-Industry Cooperation with the Ministry of Economic Affairs since 2013 to encourage internationally and regionally leading firms to form alliances and engage in cooperative research with universities.

2. Minor Alliance Projects: Academia-Industry Technological Alliance Projects make use of university researchers’ technological capabilities and encourage professors to establish core technology laboratories as a bridge to industry users. Funded by MOST since 2013, these projects encourage academic organizations to build laboratories centered on their research as a new platform for industry-academia collaboration.

3. From IP to IPO: The purposes of this program are to encourage the establishment of startups by young researchers, promote an innovative, entrepreneurial culture at universities and research organizations, and foster an environment for industrializing R&D results or innovations.

4. Germination Program: The program accelerates technological diffusion by helping scientific research organizations establish mechanisms for the promotion and use of R&D results.

5. Industrial Fundamental Technology Projects: The program brings together academic and industrial resources to reinforce the technical foundations of Taiwan's manufacturing industry.

6. Applied Research Incubation Projects: The program promotes a biotechnology integration and incubation mechanism to evaluate, construct, and connect R&D capabilities along Taiwan's biotech value chain.

To promote science and technology polices and high-technology industrial developments, public policy makers need to continuously evaluate the economic impacts and innovation indicators of science park development. Most importantly, policies for facilitating economic added values and innovations could be the critical driving force from the government side. In this paper, the concept of economic added values, international trades, employment, R&D intensity, patent development are applied to a case study of the economic impacts and innovations of science parks in Taiwan, which is an addition to the theoretical and practical contributions on the development of high-technology industries. Especially for the governmental supported science parks, the proposed
integrated analysis and performance evaluation provides a more comprehensive perspective in supporting the performance evaluation of industrial incubation policies. From a macro standpoint, the integrated economic perspective is worth to be incorporated into the list of those factors used for the construction of nation-wide policies on the industry choices, segmentations, and structural developments. Our research results suggest that the national science parks policy can facilitate successful development of high-technology industries, which bring about both significant economic benefits and R&D performance. While the operations of the science parks in Taiwan have long enjoyed governmental support, the proposed case study provides several policy implications. First, a nation-wide macro viewpoint is needed for the planning of high-technology industrial developments. Second, when high-technology industries are considered as one of the national/regional economies by governmental agencies, appropriate economy index can better represent the contributions of the high-technology industries. Third, a proper industrial clustering mechanism and eco-innovation system can further help high-technology industries to reach the status of an upgraded economy. The proposed policy implications should lead to improved future research for better developments of science parks and high-technology industries. Technically, for other future research, more innovative and practical indices that accommodate the integrated concept between the economic and innovations for specific industrial requirements could be continuously discovered and applied in the future.

**Keywords**: innovation, science park, eco-system, academia-industry collaboration, policy.
A Study on the Energy Performance Evaluation and Economic Analysis of Insulation materials

Abstract

Purpose/ Research Question:

The purpose of this research was to develop a methodology and decision support system which makes it possible to evaluate energy conservation measures for buildings in Korea by using the ECO2 (Building energy efficiency rating program) and establish passive Energy Conservation Measures (ECMs) of insulations which meet the national regulations.

Key Literature Reviews:

Kim et al. remodeled of the insulation for the study of economic evaluation to carry out insulation work to conform to the strengthening of legal insulation standards. Yeom et al. aimed to present and evaluation method of economic feasibility of sustainable technologies using LCC Analysis, in which energy cost and CO2 emission trading cost are considered. In this study it is expected that the result can be used as a decision making tool for selecting sustainable building technologies during the initial building design stage. In residential sector, air conditioning system takes the biggest portion of overall energy consumption to fulfil the thermal comfort need. Aditya et al. aimed to gather recent developments on the building thermal insulations and discuss about the life-cycle analysis and potential emissions reduction by using proper insulation materials to address the issue. Favoino et al. design and control optimizing adaptive insulation for office building by minimizing the total primary energy use and thermal discomfort. Also this study applies this framework to explore the potential of adaptive insulation.

Design/ Methodology/ Approach:

In this study, Energy Conservation Measures (ECMs) were constructed focusing on the construction sector (Passive) of insulation materials as the basis for the domestic situation. An economic efficiency databases for the constructed alternatives was built, the target building was set, and the Passive ECM List for the target building were derived. The energy consumption evaluation and economic efficiency analysis were performed for each of the constructed alternatives, and this research aimed to propose a methodology for guiding energy efficiency decisions, on the basis of the performance evaluation results, and derive the optimal Passive ECM List of insulation materials for the target building.

(Expected) Findings/Results:

Through this study, Energy Conservation Measures (ECMs) and economic evaluation of
construction sector (Passive) of insulation materials were built. Based on this, a methodology for guiding energy efficiency decisions is proposed, and the ECM List of insulation materials for the target building derives on the basis of the performance evaluation results.

**Research limitations/ Implications:**

Since the proposed Energy Conservation Measures were applied only to small business facilities, future studies will need to review the proposed process by evaluating various buildings by region, size, and usage. In addition to adding and complementing passive ECMs, further studies on alternatives to active and renewable systems will be needed.

**Keywords:** Energy Conservation Measure (ECM), Primary Energy Consumption, Economic Analysis, Decision Support Process, Insulation Materials
Transforming Government: A Platform Approach

A series of recent events show that there is malfunction in both proactive and posterior risk management system of Korean government. Such policy vacuum occurred because the current administrative model driven by traditional bureaucracy based on hierarchy cannot provide with appropriate and timely solutions to current complex policy problems. Since administrative environment changes too rapidly and becomes more complex and inter-related, Korean society requires a new type of government model to meet the challenges.

This study proposes ‘platform government’, the administrative application of platform–based business ecosystem with ‘unbundling’ of traditional government functions. Platform Government is a government that enhances flexibility, innovativeness, and responsiveness by dividing the task of government by functions and producing policies collaboratively with public and private entities as platform-based company ecosystem does. This research shows several examples for the application of platform government in areas such as public transportation, education and administrative work and suggests policy recommendation. Platform government is a form of government focusing on data-driven and data-centered administration which accelerate and facilitate the integration of private entities or non-profit organizations in the action of government. It is different from out-sourcing or privatization since it makes the agent as a part of government, not a contractor and government owns the entities as long as it is necessary.

Policy recommendations include setting up of data-based platform, facilitation of ‘contract based cooperation’ between government and private entities, increased investment in the social innovation ecosystem and establishment of M&A system for internalizing social ventures.

Keywords: unbundling, platform government, government innovation, public-private partnership
No. 26

Entrepreneurial Cycling Dynamics of Open Innovation
- The Road to Entrepreneurial State in the 4th industrial revolution

Research Question

In accordance with the development of capitalism, the world is experiencing a new economic trend—business dynamics—along with stagnant economic growth, which has become a general trend that characterizes twenty-first century capitalism. As shown in Figure 1, major economic countries reached a phase of stagnant growth after experiencing consistent decrease in growth rate during the last 40 years in spite taking in consideration that there had been some variations between them.

![Figure 1. Change of Growth Rate of 6 Countries for 40 Years](source: OECD Statistics)

Surprisingly, Korea, Japan, the US, and Germany could not avoid the situation of stagnant economic growth although they have increased the R & D investment in relation to gross domestic product (GDP). Such phenomena drove this research to focus on Schumpeterian Dynamics. It was proposed by Schumpeter that the development of capitalistic economy is not led by technology itself but by entrepreneurs or a conglomerate-oriented combination of technologies and markets through big businesses (Joseph Alois Schumpeter, 1939, p. 15).

By the way, in an evolutionary approach to macroeconomics, the market disequilibrium dynamics
resulting from structural change was properly represented at the aggregate level by Witt and Brunner (2016). If we open the black box of the corresponding flow dynamics that draw attention to variables not usually considered in macroeconomics theorizing, concrete strategy, or policy building from firm level to national innovation, regional innovation, and sectorial innovation system will be possible.

What is the structure and mechanism of modern capital economy system dynamics under the growth limits of a capitalist situation?

This study investigates the structure and mechanism of economic dynamics, which constantly occur at various and unpredictable cycles in a modern capitalistic system generally characterized as the economic situation of stagnant growth. Note that economic dynamics under a period of low economic growth shows an unpredictable pattern of a complex system in various cycles, which deviates from general patterns described by conventional business cycle theories. Thus, this study focuses on analyzing the driving force and functional mechanism of economic dynamics, which this study regard as the model to interpret the unpredictable fluctuation in a period of low economic growth, instead of a conventional business cycle model. However, economic growth can be described at the macro level, but it can never be explained at the micro level (Carlsson & Eliasson, 2002).

In this regard, this study initially established a new Schumpeterian cycling dynamics model (SCDM) by analyzing previous studies on economic dynamics. And in addition to this, mathematical modeling of SCDM is made to generalize this model. Then, the logical validation of the SCDM was...
investigated through causal loop modeling in addition to practical validation for SCDM by analyzing concrete cases. And the conditions and layers of SCDM were subsequently discussed. At the end of this study, conditions and directions of simulation, which can support SCDM were proposed.

This study conducted parallel application of multiple analytic methods. Previous studies on economic dynamics were analyzed through literature reviews. A new model was established based on literature reviews and comprehensive analysis of news and articles from the last five years. The accuracy of the model could be improved by verifying the correspondence and the logical meaning through a causal loop model, which was used to derive SCDM conditions and layers in thought experiments. Finally, a mathematical model of Schumpeterian dynamics was derived to verify SCDM by simulating possible economic phenomena, which is a suggested topic for future research.

**Schumpeterian Cycling Dynamics Model Development**

![Figure 3. Schumpeterian Circling Dynamics](image)

Schumpeterian dynamics is generally initiated from the process of creative destruction through a new combination of entrepreneurial function, which is then finally connected to the socialist blueprint—the civilization of capitalism—through closed season and the vanishing of investment opportunity caused by monopolistic practices. However, the Schumpeterian linear model in Figure 3 appears as a Schumpeterian circling dynamics in the economic reality of the twenty-first century capitalism. This study models the characteristics of the present capitalistic economy as the rotation of Schumpeterian circling dynamics in a multidimensional domain, which consists of a corporate unit and specific sector, industry, or national innovative system units (Jeon, Kim, & Koh, 2015). A specific case related with open innovation through a new combination of the entrepreneur corresponds to the literature on Schumpeterian individual entrepreneur and subsequent opinions.
(Kodama & Shibata, 2015). Closed innovation by big businesses also matches with Schumpeter’s opinion on the conglomerates innovation and close innovation (Patra & Krishna, 2015). Lastly, social innovation by social enterprises is consistent with Schumpeter’s opinion on socialism and Keynes’s opinion on a big government.

Figure 4. The Effects of Active and Passive Schumpeterian Circling Dynamics

The modeling of this study is shown in Figure 4, which demonstrates how the speed of SCD affects the growth of corporations, sectors, industries, and economies. When SCD is active, their growth is accelerated. Meanwhile, when SCD is passively depressed, their growth is stagnated.

The model attributes the consistent acceleration of stagnant economic growth to the depression of economic dynamics, which is affected by the slowing down of the circulation between OI, CI, and SI. In addition, the reason of increased uncertainty in real capitalism or raised economic fluctuation can be verified by the model as increased factors that block efficient circulation between OI, CI, and SI. That is, factors that prevent or foster circling between OI and CI, CI and SI, and SI and CI are aggravating the uncertainty of economic dynamics in modern capitalism.

Modeling of Schumpeterian Cycling Dynamics

1) System Dynamics Modeling of Schumpeterian Cycling Dynamics
When the balance among OI, CI, and SI is medium

When the balance among OI, CI, and SI is high
When the balance among OI, CI, and SI is low

<Reference>


Lee, K. & Lim, C. (2001). Technological regimes, catching-up and leapfrogging: findings from the


The Influence of Perceive Quality on Word of Mouth as Mediated by Perceived Value
(Social, Emotional and Functional)
Study of Zara’s Customers in Surabaya, Indonesia

Abstract— The strict competition in fashion industri require a powerful marketing strategy. The numbers of brands are popping up, business is getting tougher and competitive. In order to survive in the competition, companies are required to do great marketing. The most valuable and powerful tool of marketing is word of mouth. This research aimed to identify the influence of perceived quality on word of mouth as mediated by perceived value, which is divided into social, emotional, and functional as intervening variables. Primary data with population of people ages 18-65, visited Zara at least once a year, and lived in Surabaya. Structural Equation Modeling analysis method was used as the method of analyzing. This research shows that perceived value has positive and significant effect on social value, emotional value, and functional value. On one hand, social and emotional values, both have significant effect on WOM, on the other hand, functional value does not effect WOM significantly.

Keywords— Word of Mouth, Perceived Value, Social Value, Emotional Value, Functional Value, Perceived Quality