# Table of Contents

4-19  *Current Status of CSR in the Japanese MNCS*  
Jaeho Moon

20-48  *The Application of Dynamic Programming Method in Finding Shortest Path for Order Picker with Limited Picking Capacity*  
Noraimi Azlin Mohd Nordin · Mohd Omar · S. Sarifah Radiah Shariff

49-64  *The Effect of the Education and Training on Service Quality, Customer Satisfaction and Loyalty in Airline Industry*  
JiYeon Paek · Chang Won Lee

65-90  *Domains and Trends of Entrepreneurship Research*  
Sunwoo Kim
Current Status of CSR in the Japanese MNCS

Jaeho Moon
Tokoha University
Japan
Email: jhmun@sz.tokoha-u.ac.jp

Received Dec. 6, 2017, Revised May 9, 2018, Accepted Jun. 29, 2018

ABSTRACT

This research is to contribute to understanding the social aspects of the corporate social responsibility (CSR) by analyzing cases of Japanese multinational corporations (MNCs). To achieve the goal, it applies a theoretical framework consisting of an institutional approach. Since the 1990s, in the midst of globalization, ‘supplier code of conduct’ has progressed rapidly as one of CSRs. Here, this article specifically focuses on Japanese MNCs, such as Mizuno, Sony Electronics, Bandai Namco Games, EAON and Shiseido, and examine the strategies of their headquarters which have implemented with the foreign subsidiaries. Especially it highlights how they use the code of conduct, the supply chain management and the registration rate of GRI.

Keywords: Corporate social responsibility, Supply chain management, Supplier code of conduct
INTRODUCTION

Since the 1990s many multinational corporations (MNCs) have increased their outsourcing of manufacturing activities to developing countries. CSR is now confronting different motivational factors, value systems, and commitments to different agendas (Doh & Guay, 2006; Visser et al., 2007). For example, the Western World regards the child labor as completely unethical, while it is not considered so seriously in South Asia (Kumar & Steinmann, 1988). By contrast, many Asian societies see the dismissal of employees during economic downturn, which is not rare in the West, as unethical (Crane & Mattan, 2004). Anglo-American perspectives dominates in understanding of the CSR, which has been largely unaffected by the influence of other institutional contexts, by different pressures in these contexts, or by changes in these pressures over time (Ang & Leong, 2000; Maignan & Ralston, 2002).

Globalization is certainly a strong force in the changing relationship between business and society, and in the rise of the MNCs (Koerber and Fort, 2008). Globalization has boosted the urgent need for the CSR. As a result, the demand for the CSR in supply chains has pressurized brand-name firms especially. Current issues related with the supply chain have been generated from various areas. For instance, the problems that mainly occurred in the suppliers’ side are child labor, racism, excessive working hours, nonunionism and pollution (Perdersen, 2005). Meanwhile, the problems that occurred in the manufacturers’ side are corruption, lack of freedom of association and dangerous working environment and wholesalers’ discrimination. Finally, the problems that are occurred in the distributors’ side often tend to be bribery, lack of fair competition and non-ethical investment. Effective supply chain management requires partners to build and
maintain close long term relationship a successful business (Ellram and Cooper, 1990; Mishra, 2009).

The purpose of this research is to clarify the present conditions of the CSR of Japanese MNCs and the issues on them. To do so, it will apply the institutional approach. This research is to contribute to understanding the social aspects of the corporate social responsibility (CSR) by analyzing cases of Japanese multinational corporations (MNCs).

THEORETICAL DEVELOPMENT

CSR in Japan

In 1991, Japan Business Federation (Nippon Keidanren) established a ‘Corporate Behavior Charter’, and has recently promulgated the CSR guidelines. Since then, Japanese scholars have used the term ‘business ethics’ in order to introduce and describe the situation in the United States. The Japan Society for Business Ethics Study (JABES) was also established in 1993. The year 2003 is often referred to in Japan as ‘CSR gannen’ (the first year of CSR). More Japanese companies have set up a division of the CSR and published CSR reports since 2003. In 2003, Keizai Doyukai, the Japan Association of Corporate Executives, published the 15th Corporate White Paper on “Market Evolution and CSR Management: Toward Building Integrity and Creating Stakeholder Value” (Demise, 2006). In 2004, Nippon Keidanren revised their Charter of Corporate Behavior. Nippon Keidanren recognized that their stakeholders became more interested in corporate social responsibility and they clearly wrote about human rights, communication with their stakeholders and supply chain. Some media, including Nihon Keizaishinbun, published “CSR rankings” on the various valuation bases.
Globalization and Supply Chain Management

It seems that globalization has affected MNCs and has produced both positive and negative consequences in their global operations (Korten, 2001; Strike et al., 2006). Opportunism is either indispensable elements or a serious risk to disrupt the construction of inter-firm relations or the development of a code of conduct in the global supply chain. (O'Donnell, 2000; Das and Rahmann, 2000)

There are also both many benefits (risk reduction, staff recruitment and retention, cost savings, and the development of the relationships with stakeholders) and obstacles (insufficient resources and skills, unawareness of stakeholders’ demands, and inefficient producing techniques) of the CSR in supply chains (Russo and Fouts, 1997; Welford and Frost, 2006).

The translation of responsibility in supply chains into practice is involved in chain management (Kenneth and Osuji and Nndim, 2008). When you build a global supply chain, the supply chain manager is required for three factors: supplier codes of conduct, inspection and audits. (Pedersen and Mette, 2006)

Global Compact Japan Network

In 2012, we happened to have a chance to interview Mr. Miyamoto, the Secretariat of Global Compact Japan Network (GCJN) which was founded in 2000. According to the interview, there are 191 organizations to participate in GCJN: 91 public institution and 100 private enterprise. The numbers of organizations participating in GCJN suddenly increased in 2011 and the participation of Japan JC (Junior Chamber) was known as the big motivation. The JC promoted the participation of companies by the MOU with GCJN. The number of Japanese organizations struck off a list in the companies which joined GCJN is much lower than that of other countries. Enthusiastic activities
of the subcommittees, however, has been characteristic. For the recognition of activities of the subcommittees, its role has shifted from “lesson and dialogue” to “information dissemination and cooperation”. JC currently signed MOU to promote the participation of affiliated corporations. Four Japanese universities are participating: ICU, Doshisya University, Doshisa Woman University and Keiai University.

CASE ANALYSIS

This analysis is performed through the interviews with Mizuno Corporation (Mizuno), Sony Electronic, Bandai, AEON groups and Shiseido. In order to complete this research, interviews were undertaken with CSR managers, various purchase departments’ personnel and other specialists confidentially and anonymously in March 2012. The interviews mainly centered on the existence of the code of ethics, implementation year, management organization, contents of implementation items, continuity of internal ethics audit.

Mizuno

Mizuno established ‘the Mizuno CSR procurement of Conduct’ in 2006. It was designed to let the suppliers understand Mizuno’s philosophy: corporate philosophy, code of conduct, ethical standards, CSR basic philosophy, CSR vision, etc. All the suppliers that are engaged in manufacturing Mizuno products should be complied by it.

These requirements become parts of all new or renewed commercial agreements between Mizuno Corporation and its direct suppliers: especially the Original Equipment Manufacturers (OEM). And Mizuno Corporation and its designated agents (the
third parties) have the rights for the ethical audits in every relevant workplace.

Table 1. CSR Procurement of Mizuno

<table>
<thead>
<tr>
<th>Country</th>
<th>No. of suppliers in 2015</th>
<th>Audited No. of 2012</th>
<th>Audited No. of 2013</th>
<th>Audited Numbers of 2014</th>
<th>Total No.</th>
<th>Accurate rate of Audit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>163</td>
<td>36</td>
<td>10</td>
<td>15</td>
<td>11</td>
<td>36</td>
</tr>
<tr>
<td>China</td>
<td>160</td>
<td>102</td>
<td>26</td>
<td>29</td>
<td>32</td>
<td>87</td>
</tr>
<tr>
<td>Korea</td>
<td>11</td>
<td>10</td>
<td>0</td>
<td>2</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Taiwan</td>
<td>37</td>
<td>17</td>
<td>0</td>
<td>9</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Indonesia</td>
<td>18</td>
<td>15</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>Vietnam</td>
<td>34</td>
<td>26</td>
<td>5</td>
<td>3</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>Thailand</td>
<td>15</td>
<td>9</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Philippines</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Myanmar</td>
<td>5</td>
<td>5</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Cambodia</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Others</td>
<td>14</td>
<td>13</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>463</td>
<td>238</td>
<td>51</td>
<td>70</td>
<td>66</td>
<td>187</td>
</tr>
</tbody>
</table>

Source: Interview with procurement department manager in March, 2015
This is aimed to support fair employment practices, in order to provide a safe working environment with a commitment to basic human rights. And it is following the Universal Declaration of Human Rights, in compliance with all applicable local labor laws about overtime work, compensation, the freedom of association and collective bargaining, working conditions and other workplace practices. Table 1 shows actual achievements of the CSR procurement of Mizuno.

**Aeon**

Aeon launched ‘the Paean supplier CoC (code of conduct)’ in 2003. It is to insure appropriate business practice and working conditions, and to fulfil the social responsibilities among TOPVALUE suppliers. Aeon TOPVALUE suppliers have 13 requirements to achieve: no child labor, no forced labor, health and safety, freedom of association and collective bargain, no discrimination, disciplinary practices, no overtime work, secured wages and welfare system, management responsibility, good environment, fair trade, certification, renewal through auditing and monitoring, and no bribery.

According to the Aeon group, following the Supplier Code of Conduct which was enacted in 2003, about 500 their TOPVALUE suppliers carried out the requirements for compliance with the description of the purpose of its establishment in both domestic and international areas so far. Then, the suppliers of the group shall submit a compliance with the declaration of Aeon. Until now, They have been approved 72 factories in 2005, 211 factories in 2006, 471 factories in 2007, and 732 factories in 2008.

As the figure 1 indicates, Aeon supplier CoC is implemented by five steps altogether. Especially, ethical audit is conducted through three steps. First, suppliers are allowed to put their steps into Aeon supplier groups after making agreements. After that, the third
party audit, which is conducted by external audit agency, plays important roles in the third steps, and then first and second party audit are implemented in order by the professional and external ethics audit institutions. 1,172 OEM factories had been confirmed the three party audits and completed them until February 28, 2011.

Source: Interview with Aeon Group procurement manager March in 2015.

Figure 1. The flow of Aeon supplier CoC

**Bandai Namco Games**

Bandai Namco Games proclaimed ‘the Bandai Code of Conduct Declaration’ in 1998. Since then, they have run the audit system and it has gone through a fair process: for instance, when products are about to be procured, the system examines whether there are any inhumane treatments of employees. Since 2008, the ‘factory
registration audit system’ has been conducted throughout all the registered factories in China and other Asian countries.

Bandai has maintained a good working environment in order to improve the management. They initiated ethical audits in 2004, beginning with 40 major overseas suppliers. Then, since 2007, the ethical audits has been annually performed throughout all the overseas suppliers annually. Furthermore, since 2008, it has been gradually conducted in the domestic suppliers. They are evaluating the adequacy by the scoring system of each audit article, in order to improve the ethical standards of each supplier.

Also, in 2007, Bandai Namco Games has taken steps to confirm the conduct of green audit and CoC (code of conduct) audit to reduce the risk of chemical contamination both in Japan and overseas. In addition to the green audit, they has also confirmed CoC audits for the work environments at overseas OEM manufacturers in 2014.

Table 2. The Implementation of Bandai Namco Games

<table>
<thead>
<tr>
<th>country</th>
<th>number of audits</th>
<th>country</th>
<th>number of audits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>20</td>
<td>Vietnam</td>
<td>1</td>
</tr>
<tr>
<td>China</td>
<td>195</td>
<td>Thailand</td>
<td>3</td>
</tr>
<tr>
<td>Korea</td>
<td>2</td>
<td>Indonesia</td>
<td>3</td>
</tr>
<tr>
<td>Taiwan</td>
<td>3</td>
<td>Malaysia</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: Interview with Bandai Namco Games procurement department manager

The green audit consists of total 80 audit articles in 10 categories, such as fire prevention and emergency countermeasures, health and safety, freedom of association and secured wage.
Sony Electronics

In April 2003, Sony Electronics introduced ‘Sony Supplier Code of Conduct’ based on EICC (Electronic Industry Citizenship Coalition), which is the code of conduct of the US electronics industry, and has procured the parts and the materials for its products from suppliers that were qualified as green suppliers.

Then Sony Electronics requests all the suppliers to completely remove hazardous chemical substances in order to protect the environment. This is a condition for suppliers who wish to either newly make or continue the contracts with Sony Electronics. The suppliers must renew the contract by accepting the condition every two years.

It is the outcome of the painful lesson which Sony Electronics learned from a nightmare called ‘Sony shock.’ In 2001, Dutch government happened to detect the fact that a Sony product violated the European regulations on cadmium. It was the wiring code of the famous Play Station One (PS1). The EU has restricted the level of cadmium (0.1 per cent). The PS1, however, has an excessive level of cadmium (0.5 per cent). This problem occurred on the production process between the second- and third-tier overseas suppliers. As a result, PS1 was banned in the European market. This bitter experience motivated the birth of ‘Sony Supplier Code of Conduct.’

Shiseido

In April 2011, Shiseido presented a new corporate philosophy for the Shiseido Group, called “Our Mission, Values and Way.” As the operational guideline for Shiseido Group employees worldwide this new philosophy has been working toward full compliance. According to it, Shiseido Group must obtain suppliers’ agreements with the ‘Shiseido Group Supplier Code of Conduct’ when initiating contracts, which was based on the Global Compact’s ten principles.
The audit consist of 6 categories, such as human rights, legal compliance, labor practices, protection of intellectual property and maintenance of confidentiality, protection of the environment, and fair operating practices.

In 1999, Shiseido formulated the ‘Green Supplier Code of Conduct’ in order to improve the environment. It was issued to the domestic suppliers. Since then, through questionnaire surveys to the suppliers, they have tried to bring up the ideas on environmental protection. As a result, since 2001, they have been promoting the recycling of used cosmetic bottles, together with both the bottle manufacturers and the cosmetic dealers.

In 2005, Shiseido conducted a questionnaire survey of 500 suppliers both in Japan and overseas, based on the 10 principles of the Global Compact. In September 2004, they proclaimed the participation of the Global Compact as a corporate citizen in the international community. Then, they briefed the suppliers on about it March 22, 2006. It was mainly focused on the raw materials procurement of the factories. Table 2 shows the current state of the Supplier Code of Conduct which are performed by five of Japan's leading MNCs.

Table 2. Current state of the Supplier Code of Conduct by five of Japan's leading MNCs

<table>
<thead>
<tr>
<th>Company name</th>
<th>The existence of SCC</th>
<th>Implementation year</th>
<th>Contents of implementation items</th>
<th>Management organization</th>
<th>Continuity of ethics audit</th>
</tr>
</thead>
</table>
CONCLUSION

This research shows the fact that the major Japanese MNCs have developed the CSR procurements since the 2000s. Meanwhile, they have also provided the institutional basement for supplier
code of conduct since 2003 (the first year of the CSR). Furthermore, this research found out the following points.

First, it turns out that all the companies which are surveyed here have Supplier Code of Conduct. Second, it is examined that Japanese MNCs have been introduced intensively since the mid-2000s. Finally, for contents of implementation items, external ethics audit for domestic suppliers by a third party is a characteristic. As it is mentioned, Japanese MNCs were interviewed for this research.

However, it is mainly on the CSR policies and is limited to the primary suppliers of the head offices. Thus many areas have been left for the further studies. For example, since the comparison between the companies of a same industry is not possible here, providing the number of samples of the target companies are relatively less, so it has been left incomplete.

REFERENCES


The Application of Dynamic Programming Method in Finding Shortest Path for Order Picker with Limited Picking Capacity

Noraimi Azlin Mohd Nordin
Institute of Mathematical Sciences, Faculty of Science
University of Malaya
50603 Kuala Lumpur
Email: noraimi@ns.uitm.edu.my

Mohd Omar
Institute of Mathematical Sciences, Faculty of Science
University of Malaya
50603 Kuala Lumpur
Email: mohd@um.edu.my

S. Sarifah Radiah Shariff
Malaysia Institute of Transport (MITRANS)
UniversitiTeknologi MARA, 40450 Shah Alam.
Department of Statistical & Decision Sciences
Faculty of Computer & Mathematical Sciences
UniversitiTeknologi MARA, 40450 Shah Alam.
Email: radiah@tmsk.uitm.edu.my

Received  May 25, 2017, Revised Jun. 25, 2018, Accepted Jun. 29, 2018

ABSTRACT

Companies are looking forward to improve their productivity within their warehouse operations and distribution centres. In a
typical warehouse operation, order picking contributes more than half percentage of the operating costs. Order picking is a benchmark in measuring the performance and productivity improvement of any warehouse management. Smooth and fast order picking can help to reduce waiting time at the customers end and may increase customers’ satisfaction. Hence, it is crucial to reduce order picking time and one of the ways is by considering the proper routing for picking an order in the warehouse. In this study, the Dynamic Programming (DP) method and Dijkstra’s algorithm are applied to find the shortest distance for order picking in an automotive manufacturing company’s warehouse. The results show that the DP method is a simple yet competent approach compared to Dijkstra’s algorithm in finding the shortest distance to pick an order. DP is then adopted to determine the shortest distance for each order picker considering the limited volume he can picked at a time. The results show a reduced of shortest time by 12% using this method. The shortest distance for each OP with items are also discussed thoroughly in this paper.

**Keywords:** Shortest path model, Order picker, Warehouse cost management.

**INTRODUCTION**

Normally, manufacturing companies are looking forward to cut costs and at the same time try to improve productivity within their daily operations using many management tools such as Total Quality Management (TQM) (Pradhan, 2017). This is to ensure the main objective, which is to meet 100% of the customers’ demand is fulfilled. On one hand, this is due to the strong competition in the industry and increase in the operating cost (Tuya, 2017).
For example, even when companies develop new products and processes, and build new factories, the largest part of the manufacturing cost is often still determined by customers’ satisfaction, and therefore attempts to reduce manufacturing cost will exert pressure on suppliers to improve, develop and restructure their resources especially the manpower (Kato, 2016). There are many contributing factors to this achievement. For a warehouse management, there is a need to have proper handling process in order picking, storage assignment, resource allocation, work force handling, tasking allocation and so on.

On top of all the factors mentioned, it is stated that 55% of all operating costs in a typical warehouse can be attributed to order picking. Trojanowska et al. (2018) stated that manufacturing productivity can be improved through increasing operational efficiency in the warehouse. As part of warehouse operations, order picking is defined as the operation of retrieving goods from specified storage locations based on the customer orders (Dharmapriya & Katalunga, 2011; Roodbergen & de Koster, 2001). In spite of many studies done in order to improve the order picking operation, managing it efficiently has become more complex (Beker et al. (2012). They stated that complexity in handling order and operating them respectively arise in both the demand and supply side. Dharmapriya & Katalunga (2011) also stated that across many other operations in a warehouse, the most time consuming operation in general is in order picking. Any underperformance in order picking leads to unsatisfactory service and an increase in operational cost. Therefore, order picking is a benchmark and the highest priority in measuring the performance and productivity improvement of any warehouse management (de Koster et al. (2007). Due to all these facts, solving order picking problem is part of the solution in inner transportation optimization to help reduce
the waiting time and response time of a customer in order to receive their demands. Humans are at the heart of crucial processes in warehouses. Besides the common economic goal of minimising cycle times, we consider the human effect (in terms of order picker movement) as an effort in minimising the total operation cost (Larco et al., 2017; Elbert et al. 2017).

Optimization, in this situation refers to an act of transportation process, design, system or decision to make it as effective as possible in achieving minimum cost (maximum profit). In a warehouse, transportation can simply be defined as forklifts, trucks, and lorries which are needed to transport their items, material or finished goods to depot. A manufacturing company with a big warehouse usually have their own transportations. Sometimes, the capacity of the transport is not fully utilized. As mentioned in (Beker et al. (2012), the transportation capacity is normally empty in one way of the trip and resulting to only 50% utilization of the capacity. Hence, this leads to wasting of optimal usage of transportation.

On a whole, there is a continuous problem in managing the inner warehouse transportation such as congestion and response time that still results in the used for future research. This may due to improper communication between departments, incompatible transportation plan versus the layout plan, not focusing on the right items, unsuitable storage assignment and underutilisation of resource, which include order picking problem, manpower, and many more. These types of problem are very specific to individual companies. Order picking in warehouse system is known to be a crucial part in supply-chain. Any underperformance or unreliable system may lead to dissatisfaction in customers. The layout of warehouse can affect the management of orders in fulfilling the demand. This can due to long duration of time taken to pick an order requested by customers, hence, affect
the delivery time, and increase the response time. Response time in this case refers to the moment an order is placed until the order is successfully collected at the packaging point before it is delivered to a customer. This also shows that the response time is influenced by the strategic location and routing of the transportation. According to Djukic et al. (2010), with proper routing methods in order picking efficiently helps to reduce between 17% and 34% in travelling distance.

Due to this problem, it is vital to always ensure that the order arrives on time. On top of that, any late arrival of an order leads to stop in production, which can translate to profit loss, wastage, rusty materials, and if it involves with hazardous materials this could be dangerous. Additional costs might incur since the company needs to provide extra working hours, extra labour costs and additional transportation costs to send for emergency items. Thus, this study will offer an approach on finding the shortest path for the order pickers (OP) in a manufacturing company. This can be done by applying Dijkstra’s algorithm and Dynamic Programming (DP) method for one block used in routing decision.

**METHODOLOGY**

**Shortest Path Model**

The shortest path problem (SPP) is defined as an undirected graph, $G=(N,E)$ where $|N|=n$ nodes that are connected by edges (arcs), $|E|=m$ from a specified node S, called the source. Each arc is numbered sequentially and is given a cost function $c: \mathbb{R}$. In general, this $c$ can be in terms of time, distance or currency. Say, $c$ represent distance, thus one may find distances and shortest path that starts from a given node S. The main objective of SPP is to find minimum cost of all paths from S to all nodes in N.
This procedure is used to solve any SPP using various type of algorithm. In this study the Dijkstra’s algorithm is taken into account and discussed in the next section. Dijkstra’s algorithm is applicable when all the weights are nonnegative.

The Dijkstra’s algorithm

In this study, the Dijkstra’s algorithm is used to determine the shortest path from an order list collection point, $O$, to end node $X$, which is the packaging point.

Say there are $n$ number of items in the order list, and the OP needs to stop at each $n$ stored location to pick up all the items in the warehouse. At each iteration, the algorithm computes the distance of the path to every $n$ and make sure all stored location are visited. Dijkstra’s algorithm uses a set $S$ for all the visited items. This set also includes the nodes for which the shortest path has already been determined at the current moment. The set $S$ is updated by extending the shortest path by clearly visiting stored location (node) at every iteration. For each iteration, the edge $(i, j)$, where $i \in S$ and $j \in (N-S)$ is found by:

$$
dist(O,i)+\text{weight}(i,j) = \min \{ \dist(O,i') + \text{weight}(i',j) \}
$$

in which $dist$ denotes the shortest distance from $O$ to $i$ and $E$ is the set of all possible edges from $i$. The edge $(i, j)$ is then added to the shortest path, whose origin is at $O$.

In this study, the weight is the distance between two respective items stored location. The algorithm can also be explained as in the given pseudo code in Figure 1 where we have a set of nodes, $n$ where $i$ is the starting node and $j$ is the destination (ending) node. Let $s_i$ be the starting time at node $i$ and $d_j$ be the distance from node $i$ to $j$. There exist a nonnegative weight between the node $i$ and node $j$. An additional weight, $c$, is presented to show the
distance of lifting and disembarking the items taken from the shelves. Thus, the total distance can be calculated by summation of starting value at the order list collection point until the picker reach the packaging point. If the summation of \( s_i + d_y \) is less than the current \( d_y \), then \( s_i + d_y \) is chosen as the next shortest path with total distance of \( T_y \).

<table>
<thead>
<tr>
<th>Given,</th>
</tr>
</thead>
<tbody>
<tr>
<td>( i ) = starting node (order list collection point)</td>
</tr>
<tr>
<td>( j ) = end node (packaging point)</td>
</tr>
<tr>
<td>( s_i ) = starting time at node ( i )</td>
</tr>
<tr>
<td>( T_y ) = Total distance from node ( i ) to node ( j )</td>
</tr>
<tr>
<td>( c ) = weight of lifting and disembarking items from shelves</td>
</tr>
</tbody>
</table>

The total distance \( T_y \) can be calculated as follow:

If \( s_i + d_y \leq d_y \),

Then, \( T_y = s_i + d_y + c \)

Else, \( T_y = \infty \)

Figure 1. The Pseudo Code of Dijkstra’s Algorithm

The \( T_y \) value will then be added with the distance of lifting/disembarking to compare which routes give the minimum distance value. Otherwise, infinity means other nodes with the smallest value is chosen. The same procedure will be repeated until all nodes have been processed and the minimum total distance from node \( O \) to \( X \) is obtained. In this study, only the small parts or one zone is considered for the application of Dijkstra’s
algorithm. This is to show how the algorithm works and the calculation procedure can be seen in the method.

**Dynamic Programming Method for One Block**

The other method used in this study is Dynamic Programming (DP). In DP method, we define the following variables:

Let $k$ be the number of blocks, where an OP starts through block $i$ $(i=1,...,k)$. The route starts at the left-most subaisle that contains items ($l$) and ends at the right most subaisle that contains items ($r$). Denote that $a_{ij}$ is the back end of subaisle $j$ in block $i$ and $b_{ij}$ is the front end of subaisle $j$ in block $i$ for every $j$, $j=1,...,n$. Let $L_j$ be defined as partial route visiting all pick locations in subaisles $l$ through $j$ and we distinguish to equivalence classes of partial routes:

- $L_{ja}$ is a partial route that ends at the back of subaisle $j$
- $L_{jb}$ is a partial route that ends at the front of subaisle $j$

From subaisle $j-1$ to $j$ we distinguish two ways from here where

- $t_a$ goes along the back of the block
- $t_b$ goes along the front of the block

Refer Figure 2:

![Figure 2](image-url)

**Figure 2. Transitions used in Routing Heuristic**
From here, we distinguish four ways to pick items in subaisle $j$. These four transitions are also stated in Figure 2, where:

- $t_1$ traverse the entire subaisle
- $t_2$ do not enter the subaisle at all
- $t_3$ enter and leave the subaisle from the front of the block
- $t_4$ enter and leave the subaisle from the back of the block

Transition $t_2$ is allowed if the subaisle contains no item to be picked. $L_j + t_w$ is a summation of the partial route $L_j$ and transition $t_w$, where $w$ is a series of transition in Figure 3 where $(w=1,2,3,4,a,b)$ and $c(.)$ denotes the travel time associated with $L_j + t_w$. i.e, for instance, $c(L_j^b + t_1)$ gives the time needed to walk to partial route $L_j^b$ plus the time needed to walk to transition $t_1$. Note that the transitions only involved on how to enter and leave the subaisles.

The dynamic programming method described in Figure 3 where the resulting partial route $L_j^b$ will be used to form the complete order picking route. In step 3, the $L_r^a$ is not needed since all items have been picked in a block and we need to go to the front of the block to be able to go to the next block. The dynamic programming method for one block from (Roodbergen, 2001) can be described in the following procedure:

**Step 1**

Let the block under consideration be block $i$, $l$ be the subaisle from the left and $r$ be the subaisle from the right.

If block $i$ to be the block farthest from depot and contain item(s), we start the algorithm by using two partial routes:

- $L_l^a$ which starts at node $b_{il}$, ends at node $a_{il}$ and consists of transition $t_1$
which starts and ends at node $b_d$ and consists of transition $t_3$

Else, the block is near to the depot and we start with two partial routes:

$L^a_d$ which starts and ends at node $a_d$ and consists of transition $t_4$

$L^b_d$ which starts at node $a_d$, ends at node $b_d$, and consists of transition $t_1$

Step 2
For each consecutive subaisle $j(l<j<r)$ we determine $L^a_j$ and $L^b_j$ as follows:

If subaisle $j$ contains item, then:

$$L^a_j = \begin{cases} L^a_{j-1} + t_a + t_4 & \text{if } c(L^a_{j-1} + t_a + t_4) < c(L^b_{j-1} + t_1) \\ L^b_{j-1} + t_b + t_1 & \text{otherwise} \end{cases}$$

$$L^b_j = \begin{cases} L^b_{j-1} + t_b + t_3 & \text{if } c(L^b_{j-1} + t_b + t_3) < c(L^a_{j-1} + t_a + t_1) \\ L^a_{j-1} + t_a + t_4 & \text{otherwise} \end{cases}$$

If subaisle $j$ does not contain any item(s), then:

$L^a_j = L^a_{j-1} + t_b$

$L^b_j = L^b_{j-1} + t_b$

Step 3
For the last subaisle of the block (subaisle to the right of the depot, $r$), we determine

$$L^b_r = \begin{cases} L^b_{r-1} + t_b + t_3 & \text{if } c(L^b_{r-1} + t_b + t_3) < c(L^a_{r-1} + t_a + t_1) \\ L^a_{r-1} + t_a + t_4 & \text{otherwise} \end{cases}$$

Figure 3. Procedures of DPM
The last partial route $L^n$ will be used to form the complete order picking route. In this step, the $L^n$ is no longer needed since all the items have been picked in a block. We only need to go to the front of the block to be able to complete the routing parts. These two methods will be used in the study to determine which will give a better and accurate result for finding the shortest path. The results will be discussed deliberately under the Result and Discussion section. From the findings, it is hoped to bring contribution in academic literature as well as the manufacturing company with similar procedure in achieving their objective of minimum total distance and shortest path in picking order.

**STUDY SETTING**

**A Case Study of An Automotive Manufacturing**

The data is obtained from an automotive manufacturing company. The floor plan as given in Figure 4 is the current layout of the warehouse in 2016. In finding the shortest path for the OP to collect all the orders made in time, proper routing is vital.

In the company, there are mainly two floors in the warehouse. On the ground floor is where all the big parts are placed on shelves. Should any order is made by a customer, an OP will use a forklift to deliver the big parts onto a pallet. Then from the pallet into the delivery truck. There are 10 forklifts available in the company. This is to reduce waiting time for retrieving the order. All the collected orders will be arranged in a pallet and each pallet can be filled to seven equal parts and ready to be delivered to the customer. Normally for one delivery truck, eight to ten pallets can be filled to complete one trip or depending on the size of the parts. The
number of trips in a day depends on the number of order made by the customers. Zone 2 and zone 3 are in this ground floor.

On the other hand, in the first floor which holds Zone 1 is where all the small parts are placed. Order retrieved will be picked manually by the OP. There are 18 OP all together. The procedure starts with collecting order forms from customers. Next, the OP will print the order form and collect the needed item accordingly. The OP will standby at their particular shelf and they are familiar with the area. This helps to save time when picking the order and thus, the response time can be reduced. Once the order is completed, the items are placed in the ‘Standby for Delivery’ area to be finalized, wrapped and tagged before they are handed to the delivering units.

![Floor Plan of an Automotive Manufacturing Company](image)

Figure 4. Floor Plan of an Automotive Manufacturing Company

In the process of developing the shortest path for the order picking in the warehouse, proper representation of the routes
involved in the network is a main concern. Generally, this network refers to a path with fixed nodes or vertices and intersected with edges or arcs. Under the purpose of this study, nodes are defined as an item placed in the warehouse, while edge is an aisle of item stored location that serves as the directional link between them. Each edge is associated with a particular weight, which is the distance length between two adjacent nodes (items). The weight must be nonnegative since the travel time or distance, by definition, must be nonnegative.

Once the network is completed, an algorithm to find shortest path is applied to determine the shortest path through the network.

**Data Preparation**

Our study involves developing the routing network for the OP in this automotive manufacturing company. Mainly, the floor plan layout of the warehouse is given in Figure 4. The floor plan consists of three zones. Zone 1 in the first floor, where all the small parts are placed. Zone 2 is in the ground floor and stores big parts. Zone 3 is the container loading bay and space where all the packing goods and order are ready to be delivered to the customer. In this study, we will only focus on finding the shortest route for the OP to pick orders in zone 1.

Layout plan for zone 1 is shown in Figure 5. There are four shelves with four front subaisles, (A, B, C, D) and four end subaisles (E, F, G, H). Each aisle are open ended route. Each shelves are loaded with items ready to be picked. In this case, an OP is free to go any side of the shelves and may return to the same point. However, the objective is to find the shortest route to help minimize the order picking time for the OP. Basically, OP starts their working operation with collecting information on the number of orders from customer. They will gather at the main platform in each zone to receive a delivery order (DO). DO form is based on
order made online by the customers. Once the form is received, the parts are identified. Next, the OP starts from the platform to their respected item area.

![Figure 5. Layout Plan for Zone 1](image)

In order to find the shortest route for the OP, few assumptions are made based on the study area. Basically, we assumed that all the OP are well known of their routes and picking area, the conveyor is well maintained and in a good condition, the OP will follow the S-shape routing method. S-shape method means that any aisle containing at least one pick is traversed entirely (except potentially the last visited aisle). The S-shape seems to be the simplest heuristics for routing order and the aisles are equal and at the same length. On top of that, the data collected will only include shift of normal working hours. Any overtime or late working hours will not be included in this study and each transport is provided with accurate information of supplies need to be taken from shelves. Each transport is depot from the main entrance of the warehouse and also a clear diagram of the warehouse is important in identifying the routes of the transports.
RESULTS AND DISCUSSION

Dijkstra’s Algorithm
In order to apply the algorithm, a random order is picked. This order has 9 items and the location of the items are located at 9 different nodes as depicted in Figure 6. Say, the OP starts at A and there are 9 items to be collected from item 1 to item 9 before he can exit to the packaging point. The distance for each nodes from 1 to 9 and A to H are written as in Figure 5. Now, the floor plan has been transformed into a network which represent the respective nodes and distances.

![Network routing for Zone 1](image)

To see how the algorithm works, say, the OP starts at A and he needs to go from node 1 to node 9 to collect all the parts ordered by customer. The Dijkstra’s algorithm starts to find the shortest path from node A until all nodes has been processed (Mohd Nordin, 2010). The path starts at A where node 1 is the immediate neighbour of node A with the distance of 179.35cm. Thenode that
has not been visited and with the least distance from A is selected as next node to be visited. From node 1, there are four possible nodes to be visited which are node 2, node 3, node 4 and node 5. The total distance travelled from A to each immediate neighbour of 1, which are 2, 3, 4 and 5 are then listed.

Table 1. Shortest Path using Excel Solver

<table>
<thead>
<tr>
<th>Stored location</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>102</td>
<td>555.13</td>
<td>652.14</td>
<td>850.24</td>
<td>741.2</td>
<td>1124.3</td>
<td>768.8</td>
<td>994.69</td>
</tr>
<tr>
<td>2</td>
<td>1032</td>
<td>0</td>
<td>594.48</td>
<td>409</td>
<td>224.72</td>
<td>626.51</td>
<td>446</td>
<td>840.62</td>
<td>665.17</td>
</tr>
<tr>
<td>3</td>
<td>555.13</td>
<td>594.48</td>
<td>0</td>
<td>99</td>
<td>300</td>
<td>329.81</td>
<td>388.54</td>
<td>502.73</td>
<td>559.58</td>
</tr>
<tr>
<td>4</td>
<td>652.14</td>
<td>409</td>
<td>99</td>
<td>0</td>
<td>201</td>
<td>329.86</td>
<td>509.07</td>
<td>527.99</td>
<td>515.33</td>
</tr>
<tr>
<td>5</td>
<td>850.24</td>
<td>224.72</td>
<td>300</td>
<td>201</td>
<td>0</td>
<td>410.82</td>
<td>377.33</td>
<td>626.05</td>
<td>499.74</td>
</tr>
<tr>
<td>6</td>
<td>741.2</td>
<td>626.51</td>
<td>329.81</td>
<td>329.66</td>
<td>410.82</td>
<td>0</td>
<td>440</td>
<td>215.23</td>
<td>254.21</td>
</tr>
<tr>
<td>7</td>
<td>1124.3</td>
<td>446</td>
<td>588.54</td>
<td>509.07</td>
<td>377.33</td>
<td>440</td>
<td>0</td>
<td>596.73</td>
<td>303.15</td>
</tr>
<tr>
<td>8</td>
<td>768.8</td>
<td>840.62</td>
<td>502.73</td>
<td>527.99</td>
<td>626.05</td>
<td>215.23</td>
<td>596.73</td>
<td>0</td>
<td>321</td>
</tr>
<tr>
<td>9</td>
<td>994.69</td>
<td>665.17</td>
<td>350.53</td>
<td>515.33</td>
<td>499.74</td>
<td>254.21</td>
<td>303.15</td>
<td>321</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Starting point</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>2</th>
<th>1</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>99</td>
<td>201</td>
<td>377.33</td>
<td>446</td>
<td>1032</td>
<td>741.2</td>
<td>215.23</td>
<td>321</td>
<td>599.58</td>
<td>5983.94cm</td>
</tr>
</tbody>
</table>

Total distance from A → 1 → 2 is 1211.35cm while A → 1 → 3 is 734.48cm, A → 1 → 4 is 831.49cm and A → 1 → 5 is 1029.86cm. Out of the four values, route A → 1 → 3 provide the shortest route and thus this route is selected as the next best path. Similar procedure is repeated at each iteration. The total distance at each
node is updated only when the new distance via new path is less than the current one. Table 1 shows that the shortest distance from A to 9 is achieved via the path A → 3 → 4 → 5 → 7 → 2 → 1 → 6 → 8→9 (coloured boxes) with the total distance of 3983.34cm. The result is obtained using an Excel solver that carries out the steps in Dijkstra’s algorithm. Note that in the earlier explanation using manual calculation, the route start at A → 1 → 3 however as the calculation goes until all the nodes has been processed, it turns out that other route gives better solution for the OP to follow. The simplicity of this algorithm is reflected through the straightforward approach and simple calculation performed in Table 1.

The DP Method for One Block

For DP method for one block, we consider four subaisles based on the layout plan. The layout plan is the same as shown in Figure 6. Figure 7 shows the stored locations for the item stated in the order list. In total, 9 items need to be collected from this block starting from the order list station and stop until the picker arrive at the packaging point. The length of each block is mentioned in centimetres. The length of each block is 1310cm. The distance between two neighbouring subaisles is 360cm. In this case, \( l=1 \) and \( r=4 \). In this occasion, \( A=b_1 \) is denoted as the starting point, and \( D=b_3 \) is the ending point. The route starts at the left-most subaisles \( \delta \) which is \( b_1 \), and ends at the right-most subaisles, \( b_3 \). All the values and distance is transformed to a possible nodes and edges. \( b_1,b_2,b_3 \) and \( b_4 \) are the nodes from the front of the block while \( a_1,a_2,a_3 \) and \( a_4 \) are the nodes from the back of the block. Nodes 1 to 9 denotes the location of the item needed.
The process starts with identifying the node that is assumed to be the block farthest from the depot (packaging point), that is $b_{i_1}$, thus we start with two partial routes $L^a_i$ and $L^b_i$. $L^a_i$ starts at node $b_{i_1}$ and ends at node $a_{i_1}$. This process involved transition $t_i$ with total distance of 1310cm. This can also be written as $c(t_i)=1310$. On the other hand, $L^b_i$ means we start and ends at the same node $b_{i_1}$ and consists of transition $t_i$. In this case, the total distance or $c(t_i)=2422.70$.

![Routing network using Dynamic Programming for Zone 1](image)

Figure 7. Routing network using Dynamic Programming for Zone 1

Next, there are two possibilities of creating $L^a_2$, namely $L^a_2 + t_2 + t_3 = 1310 + 3.6 + [201 + 99 + 504.48] \times 2$ and $L^b_2 + t_2 + t_1 = 2422.70 + 3.6 + 1310$ which result in 2922.56cm and 3735.6cm respectively. The shortest value between the two will be chosen as the next possible shortest path. In this case, the current $c(t_i)=2922.56$. The same procedure need to be repeated to find $L^a_2$. The possible path for $L^b_2$
can be achieved via $L^b_2 = L^a_4 + t_a + t_1$ and $L^b_2 = L^b_4 + t_b + t_3$. The calculation can be seen clearer using the diagram below:

\[
\begin{align*}
L^b_2 &= L^a_3 + t_a + t_1 \\
    &= 1310 + 3.6 + 1310 \\
    &= 2623.6 \\
L^b_2 &= L^b_3 + t_b + t_3 \\
    &= 2422.70 + 3.6 + [201 + 99 + 504.48] \times 2 \\
    &= 4035.26
\end{align*}
\]

Thus, from the findings, $c(t_3) = 2623.60$ is chosen as the next shortest distance. The same process is repeated to find $L^a_3$ and $L^b_3$. The end result for $L^a_3$ is $L^b_2 + t_b + t_1 = 3937.2$ and $L^b_3$ is $L^a_2 + t_a + t_1 = 5049.20$ respectively.

For the last subaisle $r$, we determine $L^b_r$ by comparing the previous shortest value of $L^a_3$ and $L^b_3$. In this step there is no need to find $L^a_r$ since all the items have been picked in a block and we just need to continue to end the picking point $b_3$. The value of $r = 4$ represents the right most aisle in the layout. Thus, $L^b_4$ can be calculated as:

\[
\begin{align*}
L^b_4 &= L^b_3 + t_a + t_1 \\
    &= 5049.2 + 3.6 + 1310 \\
    &= 6362.80 \\
L^b_4 &= L^a_3 + t_b + t_3 \\
    &= 3937.2 + 3.6 + [321 + 596.73] \times 2 \\
    &= 5776.26
\end{align*}
\]

Based on the value obtained, it is clearly shown that $L^b_4$ can be achieved via $L^a_3 + t_b + t_3$. The total distance from $b_{i_1}$ to $b_{i_3}$ can be
achieved via route \( b_{i4} \rightarrow a_{i4} \rightarrow a_{i3} \rightarrow b_{i3} \rightarrow a_{i3} \rightarrow a_{i2} \rightarrow b_{i2} \rightarrow a_{i1} \rightarrow b_{i1} \) with the total distance of 5776.36cm.

![Figure 8. Shortest path using Dijkstra’s Algorithm](image1)

![Figure 9. Shortest path using DP method](image2)
Though the value is bigger than using the Dijkstra’s algorithm, is more accurate since it caters the value to the end of each of the aisle. In Dijkstra’s algorithm we only calculate the value from one node to another without considering the front and back of the aisle. Furthermore, the Dijkstra’s algorithm stops once the shortest path from starting point to end point is obtained. In this case, Dijkstra’s algorithm is not applicable since many other nodes is omitted due to obtaining the shortest path. The shortest path comparison between Dijkstra’s algorithms is depicted in Figure 8 and for DP method is shown in Figure 9.

**Shortest Path with Limited Picking Capacity**

In reality, there are limitations on how much an OP can pick at one time. For instance, in an order, item needed is 100 pieces, however at a time an OP can only pick 25 pieces. Using DP, this limitation is considered and shortest path is redetermined. In this situation, we use the same area of study and the same order note. The OP need to collect all items based on the order node and the shortest path is obtained by making sure that every node with items are collected and visited.

In this company, there are two types of car parts need to be collected based on order. There are seven OPs involved in picking a car parts. Each OP has the maximum of only 25 quantities of item to be picked at a time and they are free to use any routes as long as all the items are fully collected. Thus, using DP method, we are trying to figure out the best path for each OP in picking an order with the minimum distance. Not only that, the customer need is also satisfied.

As for this study, the order note from the company on 28th October 2015 is used. Overall, there is total number of 1600 items to be picked. Each OP will need to collect maximum of 229 items to complete the whole order. Table 2 shows there are 13 orders
made by customer need to be fulfilled. There are nine parts to be collected and each parts are located as in Figure 6. The total daily order for each items are listed as in Table 2. The objective is to make sure every OP to complete every requested items based on the Delivery Order and arrive at the packaging point in the fastest way.

Table 2. Order request by customer

<table>
<thead>
<tr>
<th>No</th>
<th>PDIO Number</th>
<th>PNL Number</th>
<th>Sequence Number</th>
<th>Delivery Trip</th>
<th>Order Type</th>
<th>Part Number</th>
<th>FJ D97</th>
<th>FJ D98</th>
<th>FJ D49</th>
<th>FJ D73</th>
<th>FJ D74</th>
<th>FJ D75</th>
<th>FJ D76</th>
<th>FJ D95</th>
<th>FJ D96</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>KS353348</td>
<td></td>
<td></td>
<td></td>
<td>81037-8208-00</td>
<td>ABK</td>
<td>30</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>KS353349</td>
<td></td>
<td></td>
<td></td>
<td>81038-8207-00</td>
<td>ABK</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>KS353350</td>
<td></td>
<td></td>
<td></td>
<td>58711-8206-00</td>
<td>ABK</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>KS353351</td>
<td></td>
<td></td>
<td></td>
<td>57112-8201-00</td>
<td>ABK</td>
<td>45</td>
<td>45</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>KS353352</td>
<td></td>
<td></td>
<td></td>
<td>57113-8202-00</td>
<td>ABK</td>
<td></td>
<td></td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>6</td>
<td>KS353353</td>
<td></td>
<td></td>
<td></td>
<td>82006-8208-00</td>
<td>ABK</td>
<td></td>
<td></td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>7</td>
<td>KS353354</td>
<td></td>
<td></td>
<td></td>
<td>57116-8202-00</td>
<td>ABK</td>
<td></td>
<td></td>
<td>45</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>KS353355</td>
<td></td>
<td></td>
<td></td>
<td>57115-8202-00</td>
<td>ABK</td>
<td></td>
<td></td>
<td>45</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>KS353356</td>
<td></td>
<td></td>
<td></td>
<td>57112-8201-00</td>
<td>ABK</td>
<td></td>
<td></td>
<td>60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>KS353357</td>
<td></td>
<td></td>
<td></td>
<td>57113-8202-00</td>
<td>ABK</td>
<td></td>
<td></td>
<td>60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>KS353358</td>
<td></td>
<td></td>
<td></td>
<td>57114-8203-00</td>
<td>ABK</td>
<td></td>
<td></td>
<td>150</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>KS353359</td>
<td></td>
<td></td>
<td></td>
<td>57115-8202-00</td>
<td>ABK</td>
<td></td>
<td></td>
<td>150</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>KS353360</td>
<td></td>
<td></td>
<td></td>
<td>57116-8202-00</td>
<td>ABK</td>
<td></td>
<td></td>
<td>150</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In Table 3, the Euclidean distance from one node to another is recorded. As for node 1 to node 2 the distance is 1032cm and so on. Using DP, we need to consider the turning point at each end of subaisles. Additional values of 360cm are added for each turning involves of different aisles. This is different than using DA since DA only calculates straight line distance from one node to the other. Another table is built with empty cells for determining the number of item to be picked by each OP. This table is later on will be filled with the optimal value of items to be picked by each OP as in Table
4. At the bottom of Table 4 we set the maximum limit for each OP to collect items. Every OP is required to collect at most 229 items for this Delivery Order. The number of items for each OP differs for each order note. On the right most column, we set the limit for each items at each nodes. The constraint here is, we need to make sure all items are collected by OP. After the result is obtained, the number of item collected should be equal to the number of orders. At first, all values is set to zero.

<table>
<thead>
<tr>
<th>From \ To</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>1032.0</td>
<td>555.1</td>
<td>652.1</td>
<td>850.5</td>
<td>741.2</td>
<td>1124.3</td>
<td>768.8</td>
<td>994.7</td>
</tr>
<tr>
<td>2</td>
<td>1032.0</td>
<td>0</td>
<td>504.5</td>
<td>409.0</td>
<td>224.7</td>
<td>626.5</td>
<td>446.0</td>
<td>840.6</td>
<td>665.2</td>
</tr>
<tr>
<td>3</td>
<td>555.1</td>
<td>504.5</td>
<td>0</td>
<td>99.0</td>
<td>300.0</td>
<td>329.8</td>
<td>588.5</td>
<td>502.7</td>
<td>550.6</td>
</tr>
<tr>
<td>4</td>
<td>652.1</td>
<td>409.0</td>
<td>99.0</td>
<td>0</td>
<td>201.0</td>
<td>329.7</td>
<td>509.1</td>
<td>528.0</td>
<td>515.4</td>
</tr>
<tr>
<td>5</td>
<td>850.5</td>
<td>224.7</td>
<td>300.0</td>
<td>201.0</td>
<td>0</td>
<td>410.8</td>
<td>377.3</td>
<td>626.1</td>
<td>499.7</td>
</tr>
<tr>
<td>6</td>
<td>741.2</td>
<td>626.5</td>
<td>329.8</td>
<td>329.7</td>
<td>410.8</td>
<td>0</td>
<td>440.0</td>
<td>215.2</td>
<td>254.2</td>
</tr>
<tr>
<td>7</td>
<td>1124.3</td>
<td>446.0</td>
<td>588.5</td>
<td>507.1</td>
<td>377.3</td>
<td>440.0</td>
<td>0</td>
<td>596.7</td>
<td>303.2</td>
</tr>
<tr>
<td>8</td>
<td>768.8</td>
<td>840.6</td>
<td>502.7</td>
<td>528.0</td>
<td>626.1</td>
<td>215.2</td>
<td>596.7</td>
<td>0</td>
<td>321.0</td>
</tr>
<tr>
<td>9</td>
<td>994.7</td>
<td>665.2</td>
<td>550.6</td>
<td>515.4</td>
<td>499.7</td>
<td>254.2</td>
<td>303.2</td>
<td>321.0</td>
<td>0</td>
</tr>
</tbody>
</table>

The optimal shortest distance is determined using Excel solver. The objective value gives the total distance obtained for the total of seven OP. However in our case, we set to find for each OP. Thus, different table is built later to identify the shortest distance and total items picked by each OP. The first constraint is, we need to make sure the items collected by each OP must not exceed 229 items. Next, the second constraint determines that all items collected in the end must be equal to the number of items stated in the Delivery Order. The variable cells in Table 4 where the optimum numbers to be picked by each OP and the suggested route with the shortest path value. Once all the rules is set, click Solve and the computer will run down the program to give us the minimum value.
For Simplex LP, all constraints and conditions need to be satisfied in order to achieve for optimal solution. Unlike other methods, this method only stop once the optimal solution is found. Figure 12 depicts the result of the optimal volume for each OP to pick. Based on the result obtained, with nine nodes (item stationed), and seven OP, the OP starts at node 1 and node 2. Node 1 and node 2 are the starting points and each OP will continue to pick at the balance of seven nodes. In the end, all the items collected will be gathered at the packaging point (destination point). For instance, in Table 4, the first OP (in blue colour) is expected to collect 49 items from node 1 and 180 items from node 3. The total item picked by OP 1 is 229 items. To collect all the items the OP will have to travel the same route back and forth for almost 9 trips. The shortest path for OP 1 is $1 \rightarrow 3$ with the total distance of 555.13cm.

<table>
<thead>
<tr>
<th>From</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>49</td>
<td>49</td>
<td>0</td>
<td>49</td>
<td>0</td>
<td>29</td>
<td>4</td>
<td>180</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>79</td>
<td>0</td>
<td>79</td>
<td>0</td>
<td>22</td>
<td>180</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>180</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>180</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>180</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>180</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>150</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>150</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>180</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>180</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>150</td>
<td>0</td>
<td>0</td>
<td>150</td>
</tr>
<tr>
<td>8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>200</td>
<td>0</td>
<td>200</td>
</tr>
<tr>
<td>9</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>200</td>
<td>200</td>
</tr>
</tbody>
</table>

Table 4. Total Items to be Picked by Seven OP

<table>
<thead>
<tr>
<th>Limit</th>
<th>229</th>
<th>229</th>
<th>229</th>
<th>229</th>
<th>229</th>
<th>229</th>
<th>229</th>
<th>229</th>
</tr>
</thead>
</table>

| Limit | 229 | 229 | 229 | 229 | 229 | 229 | 229 | 229 |

| Limit | 229 | 229 | 229 | 229 | 229 | 229 | 229 | 229 |
The sequence follow until all items collected by every OP. For OP 7 (grey colour), he needs to go to 1 $\rightarrow$ 2 $\rightarrow$ 9 to finish collecting all order. But this time, the number of items to be picked is only 226 items with the total distance of 1697.2 cm. Full results of total items to be picked and shortest distance for all OP is depicted in Table 4 and Table 5 respectively.

On the whole, the total distance for each of the pickers is different when we look at the three situations. In the first and second method, we only find the total distance without considering the capacity volume. As a result, though using DA seems to have total distance of 3983.34cm, which is shorter distance compared to DP method, however, this is not relevant in the real life situations. DA assumes that the picker will move only on the stored locations without considering the location of the aisles in the warehouse.

Table 5. Total Items to be Picked by Seven OP in One Trip

<table>
<thead>
<tr>
<th>OP</th>
<th>Route</th>
<th>Total distance (cm)</th>
<th>Number of item</th>
<th>Total item</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 $\rightarrow$ 3</td>
<td>555.13</td>
<td>49 + 180</td>
<td>229</td>
</tr>
<tr>
<td>2</td>
<td>1 $\rightarrow$ 4</td>
<td>652.14</td>
<td>49 + 180</td>
<td>229</td>
</tr>
<tr>
<td>3</td>
<td>1 $\rightarrow$ 6</td>
<td>741.2</td>
<td>49 + 180</td>
<td>229</td>
</tr>
<tr>
<td>4</td>
<td>1 $\rightarrow$ 8</td>
<td>768.8</td>
<td>29 + 200</td>
<td>229</td>
</tr>
<tr>
<td>5</td>
<td>2 $\rightarrow$ 5</td>
<td>224.72</td>
<td>79 + 150</td>
<td>229</td>
</tr>
<tr>
<td>6</td>
<td>2 $\rightarrow$ 7</td>
<td>446</td>
<td>79 + 150</td>
<td>229</td>
</tr>
<tr>
<td>7</td>
<td>1 $\rightarrow$ 2 $\rightarrow$ 9</td>
<td>1697.17</td>
<td>4 + 22 + 200</td>
<td>226</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>5085.16</td>
<td></td>
<td>1600</td>
</tr>
</tbody>
</table>

On the opposite, DP gives shortest path by considering every turns (penalties) the pickers need to go through in obtaining shortest path. The total distance obtained using DP is 5776.26cm. Due to this reason, DP is then adopted into the study by considering the limited picking capacity. When the capacity
constraint is added in the study, the total distance for the pickers is reduced to 5085.16cm. This results in a reduction in the total distance by almost 12%. The analysis is represented in Table 6. As a conclusion, this reduction may help to reduce waiting time at the customers end and may increase customers’ satisfaction.

Table 6. Comparison between Using DA, DP and DP with Capacity Constraint

<table>
<thead>
<tr>
<th></th>
<th>Shortest Path using DA (in cm)</th>
<th>Shortest Path using DP (in cm)</th>
<th>Shortest path + capacity constraint using DP (in cm)</th>
<th>Percentage of change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>3983.34</td>
<td>5776.26</td>
<td>5085.16</td>
<td>11.96 ~12</td>
</tr>
</tbody>
</table>

These calculations and procedure can be applied for the whole warehouse and any other warehouse.

CONCLUSION

The goal of manufacturing companies mainly is to cut costs and at the same time trying to improve their productivity within their warehouses and distribution centres. This is to ensure the warehouse operation meets the customers’ demand. Major factor that may contributes to this achievement is the handling process in order picking. Since order picking is crucial in supply chain part, any underperformance that leads to customer dissatisfaction is unacceptable. Thus, in this study, the Dijkstra’s algorithm and the DP method are applied to find the shortest path for movement in the warehouse of an automotive manufacturing company. The result carried out from the two approach is compared to identify which is more suitable in finding the shortest path and hence help to improve the order picking process.
On the whole, the DP method did produce better results compared to the Dijkstra's algorithm. This may be due to the inflexibility of choosing path in the Dijkstra's algorithm. Under the algorithm, it is assumed that the picker moves only on the stored location to pick an item which is not rational in a real situation. On the other hand, DP did provide shortest path by considering all possible path. In DP, the picker will follow the path that has already organized in the warehouse. In this case, all impossible solution can be eliminated. Furthermore, the problem is solved stage by stage. From here, the DP is then tested again but this time, we include the number of items to be picked. The result obtained gives the optimum value to be picked for each OP. Not only that, the shortest path and distance for each OP are determined, the item to be picked vary for every order but the number of OP and maximum number to be picked for each trip is fixed. The model and algorithm modified will be discussed in the next paper which will also consider penalty for turning. On top of that, this study only considers a random order. In reality, there will be more than one order and the items stored locations might have different structure. This network can also be represented with different settings and the layout may be reduced to three subaisles altogether depending on how the items are organized in the manufacturing company.

ACKNOWLEDGEMENT

We acknowledge the automotive company for their support in providing data and information in making this study possible.
REFERENCES


The Effect of Education and Training on Service Quality, Customer Satisfaction and Loyalty in Airline Industry

JiYeon Paek, PhD
Hanyang University Business School Center for Technology Entrepreneurial Studies
Seoul 04763, South Korea
Email: svc100@hanyang.ac.kr

Chang Won Lee, PhD
Corresponding author
Hanyang University Business School
Seoul 04763, South Korea
Email: leecw@hanyang.ac.kr

Received Apr. 25, 2018, Revised Jun. 24, 2018, Accepted Jun. 29, 2018

ABSTRACT

This study examines on the education and training of an airlines’ ground staff. Also it studies on employees’ perceived service quality that can make an influence on customer satisfaction and loyalty. After searching the education and training and service quality through the literature reviews related to the subject, established is a framework of an empirical study about the subject of study. In order to achieve the purpose of this study, the survey method is conducted to the airlines’ ground staff members and the time frame and the target subjects are set. Collected data is used for frequency analysis, reliability analysis, factor analysis, regression analysis and with the SPSS 21.0 for a statistical package program. The
study results are shown as follows: first, education and training have a positive influence on the five factors of the service quality. Second, employees’ perceived service quality show positive impacts on customer satisfaction and loyalty. The majority of studies on airline employee training have focused on the cabin crew. As a result, the number of studies involving ground staff is lacking. This study therefore aims to empirically verify the relationship between training of ground staff, service quality, and customer satisfaction. Given the difficulties in accessing customers for their feedback, few studies have been conducted on the effects of employee training on customer satisfaction. This empirical study used questionnaires, which are administered to airline employees and customers via one-to-one interviews, to provide theoretical and practical implications of the findings.

Keywords: Education and training, Service quality, Customer satisfaction, Customer loyalty

INTRODUCTION

As economic units of service production systems, airline systems face the problem of service quality, customer satisfaction, and loyalty along with planning, controlling, and evaluating education and training that consists of conflicting decisions in an organization. Business activities that want to satisfy customers are related to profitability and can eventually gain a competitive advantage within the market (Bienstock et al., 2003; Hapsari et al., 2017). Especially in the service industry, the service contact staff is important because the customer frequently contacts the service staff during the service delivery process and this affects the selection of the service contact point. The importance of education
and training for customer contact staff is becoming more important in service companies (Ahmed et al., 2016; Mahoney, 1984; Migacz et al., 2018). Service training and service quality of service companies are insufficient, and the necessity of empirical research on education and training, service quality and customer satisfaction is raised (Brown et al., 2003; Oliver, 1980; Saleem et al., 2017).

This study examine on the Education and Training of the Airlines’ Ground Staff. Also it studies on employees’ perceived service quality that can make an influence on customer Satisfaction and Loyalty. This study aimed to promote further improvement in the service quality of employees through systematic training to realize high-quality customer service.

This study is composed as follows. The next section presents a study background and its necessary hypotheses developed based on the previous literatures and provides the main constructs. The third section suggests the study methodology with data measurement and data collection. The fourth section presents study results with reliability and validity analysis and tests of hypotheses. The final section provides study discussion and conclusion.

**BACKGROUND AND HYPOTHESES**

Since Nadler (1970) first defined training and development of human resources in academic terms, many researchers have used these terms in different ways depending on circumstances and the context in which they were dealt with, rather than taking the comprehensive and integrated perspectives approach. Since its first use in the 1980s, the term service training has been defined as corporate management training programs that encompass workplace training and human resource development (Carrillat et
al., 2007; Sherman et al., 1998). In other words, training is intended to develop the knowledge, technical skills, and behaviors needed to improve job performance, the abilities of employees, and for career development (Cascio & Award, 1981). In this study, service training is defined as an approach to fostering organizational competence by improving the individual abilities of employees and offering high-quality services by enabling employees to acquire the knowledge and skills necessary to perform their tasks confidently and to deal with customers (Gomez-Mejia et al, 1995; Hensher, 2014; Suki, 2014; ). In view of that, following hypotheses are proposed:

Hypothesis 1: Education and Training influence on service quality.

H1.1: Education and training will have a positive effect on the Tangibles of service quality.

H1.2: Education and training will have a positive effect on the Reliability of service quality.

H1.3: Education and training will have a positive effect on the Responsiveness of service quality.

H1.4: Education and training will have a positive effect on the certainty of service quality.

H1.5: Education and training will have a positive effect on the empathy of service quality.

Hypothesis 2: Education and Training influence on customer loyalty.

Research on service quality has long been studied, but the concept is defined in various ways depending on the researcher or situation (Babakus and Boller, 1992; Jemmasi et al., 2011). Gronroos (1984) defined service quality as a result of a comparative
evaluation of the customer’s perceived and expected services. Cronin and Taylor (1992) say that perceived service quality should be conceptualized and measured as an attitude that means long-term and overall evaluation of a particular service. Also, they argued that service was a precursor to customer satisfaction. Parasurman et al. (1985) defines service quality as 'the overall judgment or attitude of an individual related to the excellence of a particular service', and this concept is generally quoted. Preliminary studies on service quality have used the SERVQUAL scales developed by Parasurman et al (1988) to measure perceived service quality. The items of SERVQUAL are the type of like scale that responds to service attributes. They have been applied to the service industry by dividing them into five dimensions of Tangibles, reliability, responsiveness, certainty, and empathy. This study constitutes a question to measure only the perception of performance based on the SERVQUAL scale and Service quality is defined as employee's perception of service attitude and quality toward contact customers in airline service and applied to research. Parasurann et al. (1988) saw service quality as a precursor to customer satisfaction and also in Cronin & Taylor (1992), the perceived quality of service was a prerequisite for consumer satisfaction. On the basis of several results, we suggest the following hypothesis.

Hypothesis 3: Service quality influence on Customer Satisfaction.

Given that customer satisfaction is a key factor for business activities, numerous studies have provided notable results. However, the findings of these studies vary according to methodological and perspective characteristics.) Customer satisfaction is defined as the overall evaluation of goods and
services based on transactions and experiences that customers have had over time while interacting with a company (Cronin & Taylor, 1992; Upadhyaya et al., 2013). Among previous studies on service quality and customer satisfaction, a study by Lewis & Klein (1987) claimed that service quality has an effect on customer satisfaction. Some studies also reported that service quality is a precursor of customer satisfaction (Cronin & Taylor, 1992). The relationship between service quality, perceived value, customer satisfaction, and repurchase intention is examined by conducting an empirical analysis and reported positive influences of expected service on perceived service as well as some empowerment (Chen, 2008; Hamed, 2010). However, no effects were found for customer satisfaction and perceived value. In addition, perceived service quality had an indirect influence on customer satisfaction through perceived value. Based on previous studies, customer satisfaction is defined herein as customers’ overall perception of service quality after experiences of services offered by the airline (Gursoy, 2005; Liou et al., 2011). Thus, the following hypothesis is proposed:

Hypothesis 4: Customer Satisfaction influence on customer loyalty.

STUDY METHODOLOGY

Measurement and Data

In this study, different types of literature reviews and interviews with professionals and working-level employees were conducted to construct survey questions, and the relevance of the selected questionnaire items were verified through a preliminary survey. The participants in this study included service employees in a Korean airline who had completed workplace service training. A total of 160 self-administered questionnaires were distributed to
measure training and development, service quality, customer satisfaction, and loyalty following the service training. Of those, 156 completed questionnaires were collected. A valid sample of 150 questionnaires was used for statistical analysis after excluding those with missing values such as nonresponses.

The service training and development comprised items asking about the extent to which employees were satisfied with the service training. The service quality items were designed to measure the quality of customer service provided by the participants. The customer satisfaction items were designed to measure the level of customer satisfaction with services offered by the airline, while customer loyalty items measured the level of customer intention to reuse and recommend the airline. All items were measured on a 7-point Likert scale with 0 being “Not at all important” and 7 being “Extremely important.” In order to achieve the purpose of this study, the survey method was conducted to the airlines’ ground staff members and the frame and the target subjects were set. Collected data was used for frequency analysis, reliability analysis, factor analysis, regression analysis and with the SPSS 21.0 for a statistical package program.

**STUDY RESULTS**

**Reliability and Validity Analysis**

The results of validity and reliability test for each variable are as follows: first, for reliability test, Cronbach’s alpha was used for testing internal consistency of the factors, in which the factor with Cronbach’s α above .7 is regarded reliable (Nunnally, 1978). < Table 1 > shows the result of reliability Analysis.
As a result of the primary exploratory factor analysis associated with service quality, a total of five factors that may explain the service quality are derived. The factors are named as Factor_1 of reliability, Factor_2 of empathy, Factor_3 of responsiveness, Factor_4 of certainty and Factor_5 of tangibles. Factor loading are all 0.6 or more. The results are shown in Table 2.

**Test of Hypothesis**

On the basis of hypothesis, first we examined the effects of education and training on service quality. we put service quality as a dependent variable, the education and training as an independent variable. Then we analyzed the relationship between dependent variable and independent variable by using regression analysis. The test can be used to predict the value of the dependent variable given values for the independent variables. The result of

<table>
<thead>
<tr>
<th>Variables</th>
<th>Cronbach’s α</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education and Training</td>
<td>.971</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Service quality</td>
<td></td>
</tr>
<tr>
<td>Tangibles</td>
<td>.860</td>
</tr>
<tr>
<td>Reliability</td>
<td>.939</td>
</tr>
<tr>
<td>assurance</td>
<td>.953</td>
</tr>
<tr>
<td>Responsiveness</td>
<td>.939</td>
</tr>
<tr>
<td>empathy</td>
<td>.927</td>
</tr>
<tr>
<td>Customer satisfaction</td>
<td>.972</td>
</tr>
<tr>
<td>Customer loyalty</td>
<td>.909</td>
</tr>
</tbody>
</table>
regression analysis showed the education and training has a significant and positive relationship with service quality.

Table 2. Results of Factor Analysis of Service Quality

<table>
<thead>
<tr>
<th>variable</th>
<th>Reliability</th>
<th>empathy</th>
<th>Responsiveness</th>
<th>assurance</th>
<th>Tangibles</th>
<th>Commonality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Providing care and attention to customers</td>
<td>.790</td>
<td>.143</td>
<td>.307</td>
<td>.208</td>
<td>.206</td>
<td>.825</td>
</tr>
<tr>
<td>Maintaining records on daily tasks</td>
<td>.789</td>
<td>.245</td>
<td>.197</td>
<td>.237</td>
<td>.150</td>
<td>.800</td>
</tr>
<tr>
<td>Completing work as agreed</td>
<td>.689</td>
<td>.278</td>
<td>.357</td>
<td>.397</td>
<td>.115</td>
<td>.851</td>
</tr>
<tr>
<td>Performing tasks in a timely manner</td>
<td>.640</td>
<td>.352</td>
<td>.324</td>
<td>.376</td>
<td>.187</td>
<td>.814</td>
</tr>
<tr>
<td>Using working hours convenient for customers</td>
<td>.147</td>
<td>.793</td>
<td>.280</td>
<td>.264</td>
<td>.234</td>
<td>.853</td>
</tr>
<tr>
<td>Considering customer interests</td>
<td>.414</td>
<td>.748</td>
<td>.203</td>
<td>.081</td>
<td>.288</td>
<td>.862</td>
</tr>
<tr>
<td>Trying to understand customers</td>
<td>.196</td>
<td>.745</td>
<td>.311</td>
<td>.347</td>
<td>.189</td>
<td>.847</td>
</tr>
<tr>
<td>Paying individual attention to customers</td>
<td>.322</td>
<td>.689</td>
<td>.204</td>
<td>.326</td>
<td>.296</td>
<td>.813</td>
</tr>
<tr>
<td>Responding promptly to customers</td>
<td>.351</td>
<td>.242</td>
<td>.748</td>
<td>.316</td>
<td>.236</td>
<td>.897</td>
</tr>
<tr>
<td>Voluntarily identifying customer needs</td>
<td>.421</td>
<td>.276</td>
<td>.741</td>
<td>.228</td>
<td>.162</td>
<td>.881</td>
</tr>
<tr>
<td>Providing spontaneous customer service</td>
<td>.364</td>
<td>.276</td>
<td>.727</td>
<td>.350</td>
<td>.192</td>
<td>.896</td>
</tr>
</tbody>
</table>
The final results are shown in Table 3A (Tangibles), Table 3B (Reliability), Table 3C (assurance), Table 3D (responsiveness) and Table 3E (empathy). Concerning regression analysis on impact of Education and Training and Tangibles of R2 explains 56.1% of the total variance and value of F is 189.504. Reliability (B=.735, p<.001) showed positive (+) relationship with Education and Training. Further, responsiveness (B=.901, p<.001) showed positive (+) relationship with Education and Training. Likewise, assurance (B=.905, p <0.001) showed positive (+) relationship with
Education and Training. Lastly, empathy (B=.906, p<.001) showed positive (+) relationship with Education and Training. In the model, all five measures were statistically significant. Thus H1-1, H1-2, H1-3, H1-4 and H1-5 are accepted.

Table 3. Results for Education and Training on Service Quality

<table>
<thead>
<tr>
<th>Independent</th>
<th>Dependent</th>
<th>Std. β</th>
<th>T</th>
<th>Sig.</th>
<th>R²</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education and Training</td>
<td>tangibles</td>
<td>0.749</td>
<td>13.766</td>
<td>0.000</td>
<td>0.561</td>
<td>189.504</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>reliability</td>
<td>0.735</td>
<td>13.766</td>
<td>0.000</td>
<td>0.541</td>
<td>189.504</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>assurance</td>
<td>0.905</td>
<td>25.876</td>
<td>0.000</td>
<td>0.819</td>
<td>669.578</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>responsiveness</td>
<td>0.901</td>
<td>25.250</td>
<td>0.000</td>
<td>0.812</td>
<td>637.553</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>empathy</td>
<td>0.906</td>
<td>25.983</td>
<td>0.000</td>
<td>0.820</td>
<td>675.126</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Regarding to the effects of customer satisfaction on service quality, the model were able to explain 44.3% of the observed variations in service quality (R² change = 44.3, F¬ change = 117.945, p<0.01). There is an effect of service quality on customer satisfaction significantly. Thus, H3 was accepted.

Table 4. Result of Influence of Service Quality on Customer Satisfaction

<table>
<thead>
<tr>
<th>dependent</th>
<th>independent</th>
<th>Std. β</th>
<th>T</th>
<th>significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>customer</td>
<td>constant</td>
<td>0.666</td>
<td>5.866</td>
<td>.000</td>
</tr>
<tr>
<td>satisfaction</td>
<td>service quality</td>
<td>10.860</td>
<td>.000***</td>
<td></td>
</tr>
</tbody>
</table>

R² = 0.443, F = 117.945, p=.000

Note: *** p<.001

Regarding to the effects of customer satisfaction on customer loyalty, the model were able to explain 26.3% of the observed
variations in customer loyalty (R² change = 26.3, F¬change = 52.828, p<0.01). Thus, H4 was supported.

Table 5. Result of Influence of Customer Satisfaction on Customer Loyalty

<table>
<thead>
<tr>
<th>dependent</th>
<th>independent</th>
<th>Std. β</th>
<th>T</th>
<th>significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>customer loyalty</td>
<td>constant</td>
<td>0.513</td>
<td>4.723</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>customer satisfaction</td>
<td>7.268</td>
<td></td>
<td>.000***</td>
</tr>
<tr>
<td>R² = 0.263, F = 52.828, p= 0.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: *** p<.001

DISCUSSION AND CONCLUSION

The study explores the five factors of the service quality such as tangibles, reliability, responsiveness, assurance, empathy that can make an influence on customer satisfaction and loyalty. Also it studies on employees’ perceived service quality that can make an influence on customer satisfaction and loyalty. The implications of the study are as follows. This study has attempted a detailed analysis of the relationship between service employee training and each dimension of service quality. It also verified the relationship between service quality perceived by service employees and customer satisfaction, which was directly verified by actual users of airline services, while also providing practical implications for improving customer satisfaction. However, this study has limitations. Its sample size is limited to certain departments within an airline, making it difficult to generalize the results of
this empirical study to the overall organization. The service quality items were designed to measure the quality of customer service provided by the participants. The customer satisfaction items were designed to measure the level of customer satisfaction with services offered by the airline, while customer loyalty items measured the level of customer intention to reuse and recommend the airline. All items were measured on a 7-point Likert scale with 0 being “Not at all important” and 7 being “Extremely important.” In order to achieve the purpose of this study, the survey method was conducted to the airlines' ground staff members and the frame and the target subjects were set. Collected data was used for frequency analysis, reliability analysis, factor analysis, regression analysis and with the SPSS 21.0 for a statistical package program.

REFERENCES


Domains and Trends of Entrepreneurship Research

Sunwoo Kim, Ph.D.
Office of Entrepreneurship and Innovation Studies
Science & Technology and Policy Institute
Korea
Email: kims@stepi.re.kr

Received May 9, 2018, Revised Jun. 26, 2018, Accepted Jun. 29, 2018

ABSTRACT

The Schumpeterian model emphases entrepreneurship as the central axis of economic growth. Growth in the managed economy comes from stability, specialization, and scale, but in the entrepreneurial economy, growth comes from entrepreneurship based on flexibility, creativity and connectivity. So, it is necessary to monitor entrepreneurship more academically. This study analyzed the articles related to entrepreneurship provided by the Web of Science. The representative bibliometric analysis of entrepreneurship were Meyer et al.(2014) and Teixeira(2011). Using this methodology as references, the Database was established. The analysis targets are 15,284 articles. Domain of entrepreneurship research consists of 7: entrepreneurship by target, social institutional entrepreneurship, entrepreneurship education and entrepreneurship intention, corporate governance, technology-based entrepreneurship, firm performance and entrepreneurial orientation, and global entrepreneurship. We analyzed emergence of entrepreneurship research in 2002~2017, but articles not cited in the WOS DB and published before 2002 were not considered.
Keywords: Innovation, Entrepreneurship, Entrepreneurial economy, Bibliometric analysis, Co-word mapping methodology

INTRODUCTION

Schumpeter's theory that capitalism evolves with entrepreneurship as a driving force has recently attracted more attention (Aghion & Akcigit, 2015). The Schumpeterian model presents entrepreneurship and enterprise as the central axis of economic growth. Because the creative destruction that occurs between the obsolescence of existing technologies and new technologies to enter the market and the resulting reallocation of resources within the marketplace. Schumpeter means that enterprise is a big company that has the capacity of R&D and can achieve economies of scale within the industry (Malerba & Orsenigo, 1995). However, the merits of large corporations are disappearing because of increasing competition due to globalization, increasing uncertainty in the economy, and the economies of scale within the organization due to the introduction of flexible production methods.

As the 1990s, innovative small businesses such as Microsoft, Apple, and Cisco entered the market, grew into big companies, SMEs became the mainstream of economic growth. SMEs became a mainstay of economic growth. Growth in the managed economy comes from stability, specialization, homogeneity, scale, and certainty, but growth in the entrepreneurial economy is the power of flexibility, turbulence, pluralism, creativity and novelty, and connectivity. Thurik (2009) presents an entrepreneurial economy that distinguishes existing economic growth model. In the entrepreneurial economy, flexibility is more important than size, so small businesses stimulate innovation and create jobs.
Entrepreneurship in the managed economy negatively affects economic growth, but entrepreneurship in the entrepreneurial economy is the driving force of growth (Fölster, 2000; Acs and Armington, 2004). The failure of an enterprise in the managed economy is considered negative and perceived as wasting social capital. Therefore, investing in venture capital is shrinking. On the other hand, failure in the entrepreneurial economy is perceived as a result of experimental activity. This is part of the overall social learning because it is a consequence of the high risk external environment, and is one of the factors involved in finding and implementing new ideas. Failure in the entrepreneurial economy is perceived as a result of experimental activity and social learning.

Innovation in the transition period is basically dangerous and must be done with failure. Therefore, it is not important to support a successful project, but rather to pursue 'experimental innovation' (Kim, 2018). Experimental innovation, however, comes from entrepreneurship. There must be an entrepreneurial innovator to drive innovation, and these are key. So, it is necessary to make research about entrepreneurship more academically and politically.

The center of the entrepreneurial economy is entrepreneurship. Research on entrepreneurship should become active at the age of digital transition. Samyukta B. et al. (2014) found important differences between the fields. Science and Technology Studies cumulated trajectory that develops in a more or less linear fashion over time. Innovation Studies shift attention of the main trajectory, from macroeconomic issues to business-oriented research. Research on Entrepreneurship develops relatively late, and shows a trajectory that is still in its infancy.

The aim of this study was to set up policy direction for entrepreneurship promotion and to activate research direction on domestic entrepreneurship. To achieve this, this study analyzed entrepreneurship research since 2002.
LITERATUR REVIEW

Until now, the representative bibliometric analysis of entrepreneurship were Meyer et al. (2014) and Teixeira (2011). Teixeira (2011) analyzed key journals on entrepreneurship. The core journals are Entrepreneurship and Regional Development (ERD), Entrepreneurship Theory and Practice (ETP), Family Business Review (FBR), International Small Business Journal (ISBJ), Journal of Business Venturing (JBV), Journal of Small Business Management (JSBM), Small Business Economics (SBE). He found that entrepreneurship is an autonomous, legitimate and cohesive (in)visible college. Moreover, the rather dense formal links that characterize the entrepreneurship (in)visible college are accompanied by a reasonably solid network of informal relations maintained and sustained by the mobility of ‘stars’ and highly influential scholars.

Meyer et al. (2014) constructed an analysis DB using Journal of Business Venturing and journals containing ‘entrepren’, and keyword search. This paper seeks to map out the emergence and evolution of entrepreneurship as an independent field in the social science literature from the early 1990s to 2009. The results from structural analysis, which is based on a core document approach, point to five large knowledge clusters. The first cluster is the cognitive aspects of entrepreneurship. The second cluster is demographic and personality-related determinants of entrepreneurship. The third cluster is the origins, processes and impacts of entrepreneurship. The fourth cluster deals with entrepreneurial finance and governance arrangements in new ventures. The final cluster contains papers that investigate topics ranging from networks and alliances.

Lowell et al. (2014) conducted a bibliometric study involving articles from the 2000–2009 era building on 1985–1999 data to
study entrepreneurship research published in the major management journals. They suggested the area of entrepreneurial opportunities and nascent ventures is showing signs of growth.

Manuel et al. (2015) conducted a large scale survey of the literature of 1,777 articles published in 17 top ranked journals, between 1981 and 2010 published entrepreneurship research. They analysed citations, co-citations and co-occurrences to examine the most central works, themes and how they intertwine. They suggested main research themes of entrepreneurship are ‘entrepreneurial process’, ‘environmental and external determinants of entrepreneurship’, and ‘value creation and performance’.

Also, there are qualitative studies of entrepreneurship research. Joseph & Wayne (2008) focused on an entrepreneur in the marine piloting industry who wanted to make changes and illustrated how professional associations working with and through the government can inhibit individual members from being innovative. Shin (2013) studied to examine the process of organizational change into new entrepreneurship such as corporate spin-offs or intrapreneurship.

**METHODOLOGY**

**Establishment Database**

In order to analyze the latest trends and domains of research in entrepreneurship, this study analyzed the papers provided by the Web of Science. Using this methodology as references like to Meyer et al. (2014) and Teixeira (2011), the Database (DB) was established in the following three steps. In step 1, this study included all of the theses (4,610 documents) published in the five journals that studied about ‘entrepreneurship’ in the existing research, but did not have ‘entrepreneurship’ in the journal titles.
In step 2, all of the theses (2,016 documents) published in the journals with 'entrepreneurship' in its titles were included. In step 3, all of the theses (13,647 documents) with 'entrepreneurship' in the title, summary and keyword of the thesis were included target DB, target period and search formula are shown in TABLE 1.

Table 1. Bibliometrics methodology of Entrepreneurship as a research field

<table>
<thead>
<tr>
<th>Date</th>
<th>Date: 8 December 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source</td>
<td>Source: Web of Science (SSCI, A&amp;HCI)</td>
</tr>
<tr>
<td>Query</td>
<td>Query:</td>
</tr>
<tr>
<td>① Including 5 journals that cover 'entrepreneurship' in the previous studies but do not include 'entrepreneurship' in journal names</td>
<td></td>
</tr>
<tr>
<td>SO=(JOURNAL OF BUSINESS VENTURING OR FAMILY BUSINESS REVIEW OR INTERNATIONAL SMALL BUSINESS JOURNAL OR JOURNAL OF SMALL BUSINESS MANAGEMENT OR SMALL BUSINESS ECONOMICS)</td>
<td></td>
</tr>
<tr>
<td>② Including all the articles in the journals with ‘entrepreneurship’ on the titles</td>
<td></td>
</tr>
<tr>
<td>SO=(ASIA PACIFIC JOURNAL OF INNOVATION &quot;AND&quot; ENTREPRENEURSHIP OR ENTREPRENEURSHIP &quot;AND&quot; REGIONAL DEVELOPMENT OR ENTREPRENEURSHIP &quot;AND&quot; SUSTAINABILITY ISSUES OR ENTREPRENEURSHIP RESEARCH JOURNAL OR ENTREPRENEURSHIP THEORY &quot;AND&quot; PRACTICE OR FOUNDATIONS &quot;AND&quot; TRENDS IN ENTREPRENEURSHIP OR INNOVATION &quot;AND&quot; ENTREPRENEURSHIP IN HEALTH OR INTERNATIONAL ENTREPRENEURSHIP &quot;AND&quot; MANAGEMENT JOURNAL OR INTERNATIONAL JOURNAL OF ENTREPRENEURSHIP &quot;AND&quot; INNOVATION OR INTERNATIONAL JOURNAL OF GENDER &quot;AND&quot; ENTREPRENEURSHIP OR INTERNATIONAL REVIEW OF ENTREPRENEURSHIP OR INTERNATIONAL SMALL BUSINESS JOURNAL RESEARCHING ENTREPRENEURSHIP OR JOURNAL OF DEVELOPMENTAL ENTREPRENEURSHIP OR JOURNAL OF ENTREPRENEURSHIP &quot;AND&quot; PUBLIC POLICY OR JOURNAL OF ENTREPRENEURSHIP IN EMERGING ECONOMIES OR JOURNAL OF INTERNATIONAL ENTREPRENEURSHIP OR JOURNAL OF RESEARCH IN MARKETING &quot;AND&quot; ENTREPRENEURSHIP OR JOURNAL OF SOCIAL ENTREPRENEURSHIP OR STRATEGIC ENTREPRENEURSHIP</td>
<td></td>
</tr>
</tbody>
</table>
The analysis target of this study covers 15,284 documents of theses. This figure was decided through the following two stages. First, the 17,496 documents of theses were included, excluding the overlapping ones. Second, only the article, letter, review and note were selected and analyzed out of them that totaled to 15,284 documents, excluding literatures like book reviews and errors.

This study analyzed 222 keywords, which was decided through the following three stages. First, the keywords of the analysis target were extracted from the author keyword categories in the Web of Science DB. Secondly, the author initially extracted a total sum of 19,002 keywords and going through the filtering process, such as integrating the singular/plural and synonym, this study came up with a total of 18,069 final keywords. Based on the outcome of the review by experts, this study selected a total of 222 keywords that appeared more than 25 times over the whole period as the final analysis target.

**Co-word mapping methodology**

Generally, the methods of analyzing the relationship between words include: 1) the co-word mapping through social network analysis; 2) the co-word mapping based on the latent semantic analysis; and 3) the topic modeling (Leydesdorff, 2014; Leydesdorff and Nerges, 2016). There is not standard set on which is the optimal method according to the document properties and the extraction method of words. However, this study used the co-word...
mapping methodology based on the frequency of co-occurrence, which is generally used in the analysis of theses and patent keywords.

The mapping and cluster analysis were conducted through the VOSviewer. The mapping and clustering were done according to the VOSviewer algorithm. If we look into the details, the similarity between two words in the VOSviewer gets higher for higher frequencies of two words occurring at the same time. On the other hand, the similarity gets lower when the total number of times the occurrence of two words increases. The VOSviewer uses both mapping and clustering at the same time. First, the coordinate of the individual word in the two-dimensional domain is set so that the sum of multiplying the weight of the distance between all two words and the weight of the similarity between two words is minimized. In other words, the two words with high similarity with each other in the VOSviewer mapping are located closely, while those with low similarity are located far away from each other.

Meanwhile, the clustering algorithm of the VOSviewer is a type of the modularity-based clustering mainly used in the weighted network, which is reported to have high accuracy of clustering.

In addition to the general network view that shows the relationship between nodes, the VOSviewer also provides the density view function, which is a type of heat map. The density of certain words reflect the number of neighboring words and the importance of neighboring items (properties of node), so that they are designated as the properties of node. Therefore, the density view is useful in summarizing the structure of the overall map, and it is possible to determine which area is the most important area.

If the distribution of the cluster according to the statistical clustering algorithm can be found in the network view, the density view has the advantage of intuitively confirming the important areas in the overall map. In other words, if the statistical
clustering algorithm includes words that are not important to classify the sub topics, the density view has the advantage of intuitively confirming the sets of important words.

View
In addition to the general network view that shows the relationship between nodes, the VOSviewer also provides the density view function, which is a type of heat map. The density of certain words reflect the number of neighboring words and the importance of neighboring items (properties of node), so that they are designated as the properties of node. Therefore, the density view is useful in summarizing the structure of the overall map, and it is possible to determine which area is the most important area.

The mapping and cluster analysis were conducted through the VOSviewer. The similarity between two words gets higher when the two words presented at the same time. In the network view, we can see the distribution of the cluster according to the statistical clustering algorithm.

Also, there are qualitative studies of entrepreneurship research. Joseph, Terry & Wayne (2008) focused on an entrepreneur in the marine piloting industry who wanted to make changes and illustrated how professional associations working with and through the government can inhibit individual members from being innovative. Shin (2013) studied to examine the process of organizational change into new entrepreneurship such as corporate spin-offs or intrapreneurship.

RESULTS

Trends of entrepreneurship research
The analysis target of this study covers 15,284 articles. From the late 1980s to the early 2000s, articles has been steadily increasing. Since 2002, it has been rapidly rising. Since 2010, more than 1,000 papers have been published every year. This study examined changes in the core keywords including 3 sections (2002~2006, 2007~2011, 2012~2017) for every 5 years after 2002, which can be considered as a starting point of the increasing trends of entrepreneurship.

![Figure 1. Rate of increase (node size) of keyword](image)
In terms of keyword growth, ‘social entrepreneurship’, 'innovation', 'entrepreneurial intention' and 'entrepreneurial orientation' are rapidly growing keywords in 2002~2017.

In 2002~2006, keywords such as 'venture capital' and 'small business' are strong. In 2007~2011, keywords such as 'social capital' and 'women and gender' are getting stronger. In 2012~2017, keywords such as 'social entrepreneurship' and 'self-employment' were active in compared to the whole map.

Table 2. Changes in the frequency of keywords (> 100 times)

<table>
<thead>
<tr>
<th>Keywords</th>
<th>2002-2006</th>
<th>2007-2011</th>
<th>2012-2017</th>
<th>Whole time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovation</td>
<td>65</td>
<td>252</td>
<td>386</td>
<td>715</td>
</tr>
<tr>
<td>SMEs</td>
<td>56</td>
<td>181</td>
<td>233</td>
<td>477</td>
</tr>
<tr>
<td>Firm Performance/Firm Growth</td>
<td>39</td>
<td>114</td>
<td>194</td>
<td>354</td>
</tr>
<tr>
<td>Family Business/Family Enterprise</td>
<td>24</td>
<td>138</td>
<td>181</td>
<td>343</td>
</tr>
<tr>
<td>Self-employment</td>
<td>29</td>
<td>107</td>
<td>149</td>
<td>292</td>
</tr>
<tr>
<td>Social Entrepreneurship</td>
<td>3</td>
<td>75</td>
<td>205</td>
<td>284</td>
</tr>
<tr>
<td>Small Business/Small Firms</td>
<td>52</td>
<td>101</td>
<td>100</td>
<td>268</td>
</tr>
<tr>
<td>Entrepreneurs</td>
<td>31</td>
<td>112</td>
<td>113</td>
<td>266</td>
</tr>
<tr>
<td>Venture Capital</td>
<td>39</td>
<td>90</td>
<td>112</td>
<td>246</td>
</tr>
<tr>
<td>Gender/Women</td>
<td>21</td>
<td>78</td>
<td>146</td>
<td>245</td>
</tr>
<tr>
<td>Networks/Networking</td>
<td>37</td>
<td>90</td>
<td>109</td>
<td>241</td>
</tr>
<tr>
<td>Social Capital</td>
<td>18</td>
<td>90</td>
<td>118</td>
<td>230</td>
</tr>
<tr>
<td>Entrepreneurship Education</td>
<td>9</td>
<td>81</td>
<td>134</td>
<td>228</td>
</tr>
<tr>
<td>New Firms/New Ventures</td>
<td>25</td>
<td>101</td>
<td>93</td>
<td>226</td>
</tr>
<tr>
<td>Technology/Knowledge Transfer</td>
<td>20</td>
<td>70</td>
<td>117</td>
<td>210</td>
</tr>
<tr>
<td>China</td>
<td>16</td>
<td>66</td>
<td>116</td>
<td>200</td>
</tr>
<tr>
<td>EO(Entrepreneurial Orientation)</td>
<td>10</td>
<td>62</td>
<td>125</td>
<td>197</td>
</tr>
<tr>
<td>Institutions</td>
<td>9</td>
<td>49</td>
<td>112</td>
<td>170</td>
</tr>
<tr>
<td>Human Capital</td>
<td>22</td>
<td>61</td>
<td>86</td>
<td>169</td>
</tr>
<tr>
<td>Start-ups</td>
<td>14</td>
<td>51</td>
<td>100</td>
<td>167</td>
</tr>
<tr>
<td>Sustainability/Sustainable Develop</td>
<td>5</td>
<td>40</td>
<td>119</td>
<td>165</td>
</tr>
<tr>
<td>Domains of entrepreneurship research</td>
<td>7</td>
<td>62</td>
<td>90</td>
<td>161</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>---</td>
<td>----</td>
<td>----</td>
<td>-----</td>
</tr>
<tr>
<td>Institutional Theory</td>
<td>1</td>
<td>33</td>
<td>122</td>
<td>156</td>
</tr>
<tr>
<td>Entrepreneurial Intention</td>
<td>19</td>
<td>55</td>
<td>66</td>
<td>146</td>
</tr>
<tr>
<td>Culture</td>
<td>6</td>
<td>46</td>
<td>84</td>
<td>142</td>
</tr>
<tr>
<td>Entrepreneurship Policy</td>
<td>6</td>
<td>32</td>
<td>95</td>
<td>136</td>
</tr>
<tr>
<td>Corporate Entrepreneurship</td>
<td>8</td>
<td>44</td>
<td>77</td>
<td>135</td>
</tr>
<tr>
<td>Academic Entrepreneurship</td>
<td>7</td>
<td>52</td>
<td>75</td>
<td>134</td>
</tr>
<tr>
<td>University/Higher Education</td>
<td>10</td>
<td>49</td>
<td>73</td>
<td>133</td>
</tr>
<tr>
<td>Economic Development</td>
<td>13</td>
<td>51</td>
<td>61</td>
<td>132</td>
</tr>
<tr>
<td>Internationalization</td>
<td>12</td>
<td>53</td>
<td>61</td>
<td>130</td>
</tr>
<tr>
<td>International Entrepreneurship</td>
<td>15</td>
<td>58</td>
<td>56</td>
<td>129</td>
</tr>
<tr>
<td>Regional Development</td>
<td>9</td>
<td>45</td>
<td>67</td>
<td>124</td>
</tr>
<tr>
<td>Emerging Markets/Countries/Economies</td>
<td>5</td>
<td>36</td>
<td>79</td>
<td>120</td>
</tr>
<tr>
<td>Spin-offs</td>
<td>10</td>
<td>42</td>
<td>59</td>
<td>111</td>
</tr>
<tr>
<td>Strategy</td>
<td>14</td>
<td>37</td>
<td>53</td>
<td>110</td>
</tr>
<tr>
<td>Knowledge</td>
<td>15</td>
<td>43</td>
<td>48</td>
<td>107</td>
</tr>
<tr>
<td>Institutional Entrepreneurship</td>
<td>5</td>
<td>38</td>
<td>62</td>
<td>105</td>
</tr>
<tr>
<td>Entrepreneurialism</td>
<td>6</td>
<td>65</td>
<td>30</td>
<td>104</td>
</tr>
<tr>
<td>Opportunity</td>
<td>6</td>
<td>40</td>
<td>58</td>
<td>104</td>
</tr>
<tr>
<td>Total number of articles</td>
<td>1,791</td>
<td>4,724</td>
<td>6,700</td>
<td>-</td>
</tr>
</tbody>
</table>

According to the results of conducting keyword clustering on the whole analysis period, the entrepreneurship research can be largely divided into seven detailed areas as shown in Figure 2. If a keyword map is set up on each of the seven clusters to conduct the detailed clustering analysis, we can confirm the details of 13 sub-areas (no details of sub-areas for 6 and 7).
Figure 2. Domains of entrepreneurship research

In the subdomain of the cluster for ‘entrepreneurship by target’ from number 1 of Figure 3, keywords like ‘woman entrepreneurship’, ‘self-employment and entrepreneurship’, and ‘entrepreneurship of immigrants’ were major fields of research on entrepreneurship traditionally. However, they are included in the topics of recent researches that are actively conducted. The keywords like ‘social capital’ and ‘human capital’ acts as the core link in this cluster.
In the subdomain of the cluster for ‘Social Institutional Entrepreneurship’ from number 2 of Figure 4, the topics like ‘social entrepreneurship’ and ‘emerging economy and systematic entrepreneurship’ are included. Detailed keywords related to seeking alternatives for the market economy like social innovation and sustainability act as the core link, including ‘sustainability/sustainable development’, ‘corporate responsibility’, and ‘social innovation’, showing that related researches have increased recently.
Figure 4. Sub-domains of ‘Social Institutional Entrepreneurship’

In the subdomain of the cluster for ‘Entrepreneurship Education’ and ‘Entrepreneurial Intention’ in number 3 of Figure 5, the topics like ‘cultural/cognitive aspects of the manifestation of entrepreneurship’ and ‘learning/education of start-up’ are included. It can be confirmed that the keyword with high increase rate ‘entrepreneurial intention’ is included under this theme.
In the subdomain of the cluster for ‘Corporate Governance’ from number 4 of Figure 6, the topics like ‘venture capital and financing’ and ‘family company and reliability/governance’ are included. discussion on corporate governance acts as the link of the two detailed topics.
Figure 6. Sub-domains of ‘Corporate Governance’

In the subdomain of the cluster for ‘Technology-based Entrepreneurship’ from number 5 of Figure 7, the topics ‘innovation system and technology-based entrepreneurship’ and ‘university start-up and spin-off’ are included. The start-up based on technological innovation is a traditional research field, which is considered as the field that led the research on entrepreneurship in the initial stage.
In the cluster for ‘Firm Performance and Entrepreneurial Orientation (EO)’ from number 6 of FIGURE 8, various topics are included to connect EO with the creation and management of corporate performance.

In the cluster for ‘Global Entrepreneurship’ from number 7 of Figure 9, the topics related to globalization are included such as ‘foreign direct investment’ and ‘establishment of international networking’.
Figure 8. Sub-domains of ‘Firm Performance and Entrepreneurial Orientation’

Table 3 shows the number of theses by period and by cluster and the proportion accounted for in the total theses during the applicable period. Similar to the analysis by period shown before, we can confirm that the number of theses and the proportion in the overall researches continued to increase in the field of ‘entrepreneurship by target’, ‘entrepreneurship education and entrepreneurial intention’, and ‘social institutional entrepreneurship’ compared to other research topics on entrepreneurship.
In particular, the number of theses on ‘social institutional entrepreneurship’ showed a big growth rate. On the other hand, the traditional research fields like ‘technology-based entrepreneurship’ and ‘firm performance and entrepreneurial orientation’ showed a steady increase in the number of theses, but remained stagnant in the proportion accounted for in the total theses.

Figure 9. Sub-domains of ‘Global Entrepreneurship’
<table>
<thead>
<tr>
<th>Table 3. Domains of entrepreneurship research</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 entrepreneurship by target</td>
</tr>
<tr>
<td>1 woman entrepreneurship</td>
</tr>
<tr>
<td>2 self-employment and entrepreneurship</td>
</tr>
<tr>
<td>3 entrepreneurship of immigrants</td>
</tr>
<tr>
<td>2 social institutional entrepreneurship</td>
</tr>
<tr>
<td>1 institutional entrepreneurship</td>
</tr>
<tr>
<td>2 social entrepreneurship</td>
</tr>
<tr>
<td>3 entrepreneurship education and entrepreneurial intention</td>
</tr>
<tr>
<td>1 entrepreneurial intention</td>
</tr>
<tr>
<td>2 entrepreneurship education</td>
</tr>
<tr>
<td>4 corporate governance</td>
</tr>
<tr>
<td>1 financing</td>
</tr>
<tr>
<td>2 family business</td>
</tr>
<tr>
<td>5 technology-based entrepreneurship</td>
</tr>
<tr>
<td>1 technology innovation &amp; collaboration</td>
</tr>
<tr>
<td>2 university and technology transfer</td>
</tr>
<tr>
<td>6 firm performance and entrepreneurial orientation</td>
</tr>
</tbody>
</table>
IMPLICATION AND CONCLUSION

This paper provides a brief but extensive rear view of the field useful to develop research agendas. In order to analyze the latest trends and domains of researches on entrepreneurship, this article conducted on 222 keywords of the 15,284 articles provided by the Web of Science. The number of articles related to entrepreneurship from 2002 to 2017 is growing. From the perspective of keyword increase rate, 'social entrepreneurship', 'innovation', 'entrepreneurial intention' and 'entrepreneurial orientation' are rapidly growing keywords in 2002~2017.

The keywords were clustered and analyzed as the following 7 clusters, including 1) entrepreneurship by target, 2) social institutional entrepreneurship, 3) entrepreneurship education and entrepreneurial intention, 4) corporate governance, 5) technology-based entrepreneurship, 6) firm performance and entrepreneurial orientation, and 7) global entrepreneurship. If the topics are divided into subtopics, there are 13 clusters including 1) woman entrepreneurship, 2) self-employment and entrepreneurship woman entrepreneurship, 3) self-employment and entrepreneurship, 4) entrepreneurship of immigrants, 5) institutional entrepreneurship, 6) social entrepreneurship, 7) entrepreneurial intention, 8) entrepreneurship education, 9) financing, 10) family business, 11) technology innovation & collaboration, 12) university and technology transfer, 13) firm performance and entrepreneurial orientation, and 14) global entrepreneurship.
We analyzed emergence of entrepreneurship research, but articles not cited in the WOS DB and published before 2002 were not considered.

REFERENCES


Teixeira, A. A. (2011). Mapping the (in) visible college(s) in the field of entrepreneurship. Scientometrics, 89(1), 1-36.
Appendix 1 – Cognitive Style Indicator Questionnaire

Please indicate to what extent the following statements specify you.

1- Strongly Disagree
2- Disagree
3- Neutral
4- Agree
5- Strongly Agree

1. I like much variety in my life.
2. I study each problem until I have understood the underlying logic.
3. I prefer well-prepared meetings with a clear agenda and strict time management.
4. I like to contribute to innovative solutions.
5. New ideas attract me more than existing solutions.
6. I make definite engagements which I follow-up meticulously.
7. I try to avoid routine.
8. I want to have a full understanding of all problems.

9. Developing a clear planning is very important to me.

10. A good task is a well-prepared task.

11. I prefer to look for creative solutions.

12. I always want to know what should be done when.

13. I like to analyse problems.

14. I like to extend the boundaries.

15. I make detailed analyses.

16. I prefer clear structures to do my job.

17. I am motivated by ongoing innovation.

18. I like detailed action plans.
Objectives

Business management is a primary area of market competitiveness and sustainability in all types of industries. Managerial insights in the global and/or local business are major drivers of organizational innovation, business dynamics and business value chain. Managerial review will be an integral player in the 21st knowledge industry and economy.

Nevertheless, how to foster managerial review and insights have not been appropriately explored in terms of global or local business perspectives. In fulfilling of this urgent and timely theme, business management need more sustainable profitability, better operational excellence, higher goods and services quality, more proper market promotion, stronger leaderships, and more accurate financial planning in order that business organizations are more competitive.

This journal’s main objective is to establish an outlet for executives, managers, educators, and researchers interested in a variety of topics in business management and insights in terms of global or local perspectives. Thus, papers will focus on the global or local implications of managerial review and insights in business settings.

Subject Coverage

Examples of topics appropriate to the theme of management review include:

- Case studies of business management
- Business decisions and insights
● Business science research
● Business service research and policy
● Engineering management
● Entrepreneurial study and venture business
● Ethical issues in business and social responsibility
● Financing and investment
● Green, energy, environment, social business management
● Information management
● Leadership and organizations
● Market life management
● Management theory and philosophy development
● New business creation and strategy management
● Operational excellence with customer intimacy
● Pedagogy to foster business management
● Planning for profit and non-profit business
● Quality issues in business
● Resource allocation in local and global business
● Sustainability and profitability
● System and cybernetics management
● Technology and innovation management
● Tutorials in management
● Other related topics

Notes for Prospective Authors

Submitted papers must original manuscripts that have neither been previously published, nor currently reviewing for publication elsewhere. Full author guideline, academic research ethics and copyright agreement policies are available upon requests. All submitted manuscripts are refereed through a double blinded peer review process. KINFORMS, a subdivision of INFORMS, USA, has published the Journal twice a year, June 30 and December 31, respectively.
Management Review: An International Journal

Editorial Policy
Management Review: An International Journal (MRIJ) publishes intellectual findings to academies and practitioners in profit and non-profit organizations as well as local and global institutions on all aspects of managerial issues. MRIJ promotes the findings of sharing knowledge, exchanging experience and creating new ideas between academies and practitioners. MRIJ encourages all manuscripts of multi-disciplinary and cross-functional approaches with theoretical and empirical, technical and non-technical, and cases studies related to managerial issues in certain individual organizations, societies, countries. The journal is a double-blind referred journal.

Manuscript Submission
Your manuscript should be original contents that are not copyrighted, published, accepted for publication by any other journal, or being reviewed to any other journal while being reviewed by the Journal. Your manuscripts should be formatted with Century 12 points, double-spaced, left-aligned, 2.5 inches of top, 1.5 left and right, and 2 bottom margins on international standard (letter) size. The manuscript size may be between seven and fifteen pages. Manuscripts should follow generally accepted manuscripts printing guidelines. All manuscripts should be electronically submitted to the managing editor at leecw@hanyang.ac.kr with a copy of mrij.office@gmail.com. More details are at http://www.kinforms.net.